Three Essays on Natural Resource Exploitations and Negative Social Externalities

A thesis submitted to The University of Manchester for the degree of

Doctor of Philosophy

in the Faculty of Humanities

2019

Jubril Olayinka Animashaun

School of Social Sciences

Economics

Contents

Final Word Count: 69,638

List of Tables

List of Figures

Abstract

This three-essay thesis provides a critical analysis of the resource curse in oil-rich countries. We provide insights on the resource curse in oil-rich countries by drawing on historical legacies of colonisation and information asymmetry with citizens' ability to ascertain resource-rich governments' revenue allocation priorities to understand the resource curse. These approaches help to identify and address some gaps in the empirical and theoretical literature on the resource curse and to specify policy interventions that can enhance the potential benefits from oil and gas endowments for socio-economic development.

In the first essay, our central hypothesis relates the resource curse to the inherited institutional framework that goes back to the 16th-19th century European-organised mercantilism. We test the conditional institution-resource curse hypothesis using an IV-GMM model and examine how the experience of European colonisation indirectly reinforces resource curse in 69 (40 colonised and 29 non-colonised) oil-rich countries with at least one discovery of giant oil reserves from 1960-2015. We instrument the unweighted institutional index (drawn from averages of executive constraints, protection against expropriation risk and government effectiveness) with a dummy for colonial experience, and the giant oil and gas abundance with the log of the depth and depth (squared) of oil and gas fields to account for the endogeneities in oil and gas exploration activities. We measure the European colonial experience with a dummy variable and define colonial experience with evidence of data on settlers' mortality and/or the persistence of any European language as the official language in non-European oil-rich countries. This approach helps to reduce measurement error with identifying the colonisation experience and for categorising oil-rich countries based on experience of economically exploitative colonialism. Our findings show that oil-countries without the experience of European colonisation have better institutional quality and can reverse resource curse, whereas, countries with exploitative colonial experience cannot. Given the plausible abuses associated with 16th-19th century colonial heritage and the festering effect it has on the institution-resource curse theory, to reverse resource curse, we propose investing rents on the identified inherited structures from colonialisation that make institutional reforms and good governance challenging in colonised countries. Such involves prioritising investment on human capital development, quality education and building social trust and civic responsibilities across ethnic groups and between citizens and the government.

In the second essay, we explore the resource curse by focusing on how shocks to income translate to improvement in child health in oil-rich countries with oil and gas discoveries. We condition income per capita on shocks from time-series variation in global oil-prices interacted with longitudinal variation in oil discoveries and a dummy to capture if a country was a European colony during the 16th to 19th-century European colonialism. Child health is a robust marker of socioeconomic status, and an improved understanding in oil-rich countries could prove useful for understanding another channel of the resource curse. If the positive shock to income (oil-price shocks given oil discoveries) is compromised by the inefficiency with revenue allocation and management (e.g., the resource curse and/or the enduring impact of the 16th to 19th-century European colonialism), the effect of positive shocks on income might not translate to an improvement in health outcomes especially, those aimed at reducing child mortality. We use a 2-stage Fixed Effect (FE) Instrumental variable (IV) strategy to estimate the causal effect of aggregate GDP per capita on child mortality per 1,000 births in 99 oil-rich countries from 1960 to 2010. Conditional on the instrumental variables, we find a statistically insignificant impact of income on child mortality. Our findings document an aspect of the resource curse; in many resource-rich countries, the expected benefits from resource-wealth hardly translate to significant improvement in child health through income. However, we find that child mortality reduces with female labour market participation. We suggest that

empowering women and ensuring their engagement in economically productive activities could be a way of reducing child mortality.

Our third essay complements the existing literature on the political resource curse with theory and data. Our theory of the resource curse builds on the information asymmetry in the electoral market that leads to agency loss and the unaccountability of political agents. The theory is premised on the observation that governments in resource rich countries want to appear as not plundering resource wealth, so they have a higher incentive to give an incomplete report on economic performance that does not reflect budgetary allocations. If citizens cannot independently verify the economic performance associated with allocation priorities of the incumbent, this information asymmetry will leave room for abuse of power and expropriation of revenue for private benefits. Furthermore, we analyse the role of democracy and dynamics of human rights protection as forms of political institutions that could hold government more accountable in the allocation of benefits associated with giant oil discovery. Our sample is drawn from 157 countries with yearly observations from 1992 to 2008. Because of the known limitation of GDP statistics provided by resource-rich and autocratic governments, we use variation in night-time lights intensity to overcome the identification constraint. Our panel strategy controls for country and time fixed effects. We find that countries with at least a discovery of giant oil field and with more dependence on non-resource tax revenue have less intense night-time lights than countries without a discovery. We conclude that investing in structures that improve human rights conditions, industrialisation, and increasing non-resource tax contribution to government revenue can be useful channels for holding political agents more accountable for resource management, and ultimately, for reducing the resource curse.

Declaration

I declare that no portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institutes of learning.

Copyright Statement

Preface

This PhD thesis is about the resource curse. By the "resource curse" we mean the less economic growth, more corruption and worse development outcomes observed in countries with significant oil and natural gas endowments from countries with less or countries without.

As we write the preface of this thesis, many resource-rich countries in the Middle East, Sub-Sahara Africa, Latin America and South-Asia are embroiled in socio-economic and political crisis. Venezuela, probably with more oil reserves than anywhere else in the world, is on the brink of financial collapse, and Nigeria, Angola and Brazil are all embroiled in allegations of corruption scandals involving public officials, national oil firms and some foreign-owned oil firms. Oil-rich and rentier countries, e.g., Russia, Trinidad and Tobago and Saudi Arabia, facing plummeting oil prices, are experiencing economic contractions with drastic cuts in the funding of some social programs. Moreover, the effect of competition for rent-grabbing among political agents on the political process could be observed in the quality of the political process and the post-election disputes and crises that followed the recently conducted democratic elections in Nigeria, Venezuela, Russia and the Democratic Republic of Congo.

Many works on the resource curse exist, the phenomenon has been analysed and examined from a disciplinary (e.g. economics, political science and sociology) and multi and inter-disciplinary perspectives.

Our purpose is to examine the resource curse, not as isolated speculations, but as an integral part of an economic, social and political outcome; one that builds on and reflects an underlying character of institutions. This raises a great many points; particularly, one that demands a more general account of historical antecedents and the understanding of the quality of existing socio-political and economic institutional structures that help in shaping how countries manage resource wealth.

In the following pages, we give empirical evidence to these highlighted problems and propose suitable recommendations for the management of resource revenues for socio-economic development.

Acknowledgement

I thank all of those who have given so freely of their time, resources, knowledge and expertise for the completion of this thesis. Their detailed and unbounded passion for excellence, often in the face of enormous obstacles, have been inspirational and of great value for the completion of this thesis.

Foremost in this regard, are my supervisors; Prof Ada Wossink and Dr Ron Chan for their positive and constructive guidance, and the support and encouragement provided, especially in the early days of my PhD, and up till the process of completing this thesis. Most importantly, I appreciate and thank Prof Wossink for her encouragement and support which proved really helpful for completing this PhD. Also I thank the panel of examiners, Prof Alastair Hall (chairman), Dr Abhishek Chakravarty (internal) and Prof Steven Poelhekke (external), for their insightful comments and suggestions. I am grateful to the Islamic Development Bank (IsDB), Jeddah Saudi Arabia, University of Ilorin, Nigeria and the Economics Discipline Area (University of Manchester), UK for providing funding for this PhD programme.

I thank Brothers Lakdhar Kadkadi, Dr Nazar Mubarak El-Hilali, Mahmud Aman, Dr Bello Abdulateef and Dr Hayat Sindi all of the IsDB, for their collective and individual role in advising, facilitating and ensuring the timely and prompt disbursement of my fund from the IsDB scholarship. Also, I thank the past, immediate past and current Vice-chancellors of the University of Ilorin, Prof Ishaq Oloyede, Prof AbdulGaniy Amballi and Prof Sulayman Age AbdulKareem respectively for approving me for the University of Ilorin Staff Development Award. I equally thank my supervisors and the PhD coordinator, Dr Michele Berardi, for the funding I received from the Economics Discipline to supplement my PhD scholarship. I have had the opportunity to present my research at the Economics Discipline Area's in-house PhD conference, the UK's Northwest Doctoral Training Conferences (NWDTC) (Liverpool and Lancaster), The Centre for the Study of African Economies (CSAE), University of Oxford, and the Annual Conference of the European Association of Environmental and Resource Economists in Manchester. I acknowledge the support and comments I received on my research from all participants of these conferences and the conference funding I received from the University of Manchester.

My profound gratitude goes to friends and senior colleagues in Nigeria and Manchester. Special thanks to Prof Mathew Adewumi who is the HOD of the Agricultural Economics University of Ilorin and I warmly acknowledge Prof Olubunmi Omotesho for being a wonderful inspiration and a blessing to the department. Other colleagues in the department are all highly appreciated. My special thanks to Dr (Mrs) Toyin Ajibade, Dr Afolabi Toye, and staffs and members of the faculty of Agriculture and University of Ilorin community. My gratitude goes to my friends in Manchester, Drs Ibrahim Adebisi Tajudeen, Ali Raza, Chisom Ubabukoh, Waseem Toraubally, Chuku Chuku, and Minh Tung Le. Also, my gratitude goes to Selma Godinjak, Nico Ochmann, Lois Simanjuntak, Manuel Mosquera, Lin Lang, Camilla Knudsen, Uzoma Iloanugo and Lotanna Emediegwu.

My special tribute and heartfelt thanks go to my late father AbdulAzeez Animashaun (Justice of the Peace), for inspiring the art of critical thinking and I thank my mother, Alhaja Ramat Aduke Animashaun for her prayers, investment and support in my education. I thank my siblings; Mrs Ganiyah Okon, Mr Saheed Animashaun, Mrs Ruqqayyah Musa and Alhaja (Mrs) Rofeah Badamosi, each in their varying capacity that is too big to mention. My special thanks to my nephews and nieces. I am very grateful to Arc (Dr) Bashir Adams for the moral support provided before and during my PhD programme.

I am thankful to my lovely wife Hajia Asmau Titilayo and my boys, Jamaaldeen and AbdulAzeez and give thanks to the Almighty Allah, the merciful, compassionate, and the source and custodian of all knowledge, inspiration and wisdom. I thank Him for granting me with the health and حكمة, *ḥikma* (understanding and wisdom) to pursue this program to a completion.

Chapter 1

1 General Introduction

1.1 Background of the thesis

Suppose a region or a country discovers a huge natural resource of significant value either as a market commodity or as a production input, how can this resource translate into an improvement in socio-economic and political outcomes? This question, which at first sight might not seem difficult, is one of the most challenging research questions in the fields of economics and political science (Van der Ploeg 2011, Havranek et al. 2016). Addressing this problem is as important as it is challenging. The importance lies in the immense value that natural resource portends for setting countries on the path of socio-economic and political progress necessary for sustainable development (Arezki et al. 2017). The challenge, as it is shown in the extant literature, is with the understanding of the impact of resource endowment and with singling it out from other factors that confound the relationship. Without resolving this challenge, formulating an appropriate policy that will help to tap the potentials of resource endowment for sustainable development will remain elusive.

Benefits from oil and natural gas exploration and extraction are a major driver of industrial development (Auty and Warhust 1993) and socio-economic activities. Historical evidence suggests that natural resource endowment was instrumental in triggering the mid-nineteenth to the mid-twentieth century industrial revolution in much of Europe and the US (Habakkuk 1962, David and Wright 1997). The technological progress, which has been identified as important contributing factors to these early industrialisations, could not have happened without the transition to the more efficient energy source used in production activities (Auty and Warhust 1993, Bowen and Gleeson 2019 pp. 201-224).

For instance, when compared to the other primitive energy sources (e.g. muscle power, water, and steam), the energy density of fossil fuels is much greater. With the use of fossil fuels as inputs in the production process, naturally, the costs of production declined, and amounts of outputs increases. In another dimension, use of fossil fuels enables the ability to mass-produce steel and other raw materials; diversification of economic activities, and the transportation and linkage to broader markets other regions thereby facilitating trade and commodity exchanges. These developments ultimately lead to an increase in wealth and income and the improvement in the production of foods, the growth of cities and diversification into other economic activities.

However, in recent times, the relationship between natural resource endowments, especially, fossil fuels, has not always been that clear cut (Havranek et al. 2016). Although not completely new[1], Richard Auty described a situation where countries endowed with natural resources are observed to grow slowly than countries without, a situation he termed as the resource curse paradox (Auty 2002). In a follow-up study, Sachs and Warner (1995) find a strong correlation between natural resource abundance and poor economic growth at the country level. In these arguments on the resource curse paradox, the specific case of oil endowment in developing countries has received prominent focus (Ross 2015).

Oil as a source of energy and as a market commodity has an intrinsic and significant value which influences the dynamics of global political and economic power (Figure 1). Its extraction

[1] The observation that countries of the "greatest plenty" often have the highest number of the poorest was first raised by Steele in the 1711 edition of the Spectator.

requires specific technical skills and a capital-intensive investment structure, which makes it an attractive investment option for foreign firms and giant corporations (Venables 2016). Furthermore, oil exploitation generates a well-above-average profit margin that accrues over time which could induce local politicians to perpetuate their stay in elective positions, discourage entrepreneurship and reward a socially inefficient rent-seeking system (Van der Ploeg 2011). Also, because of the uncertainty that surrounds commodity prices, policy-makers may base budgetary planning on high prices following a boom. However, if such booms are short-lived, a specialised and non-diversified economy that depends on oil rents would feel the shock from the economic contraction introduced by the fall in revenue of government (Frankel 2010).

The relationship between oil and gas abundance/dependence/wealth and several development outcomes (e.g. economic growth, income levels and employment, democracy and autocracy, happiness, conflict, environmental quality, institutions/social capital, trade, debt and human rights) has been the subject of numerous and highly cited studies. These studies have taken different perspectives; from a multi-disciplinary context, to employing different methodological approaches and across diverse geographical foci (Latin America, sub-Saharan Africa, global).

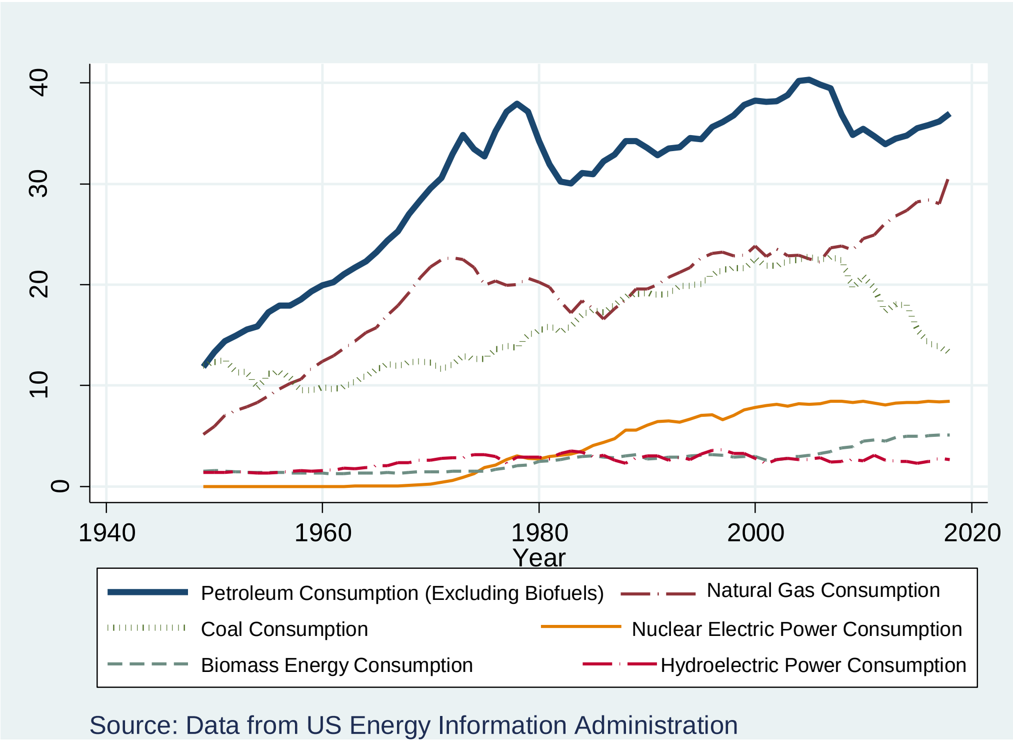

Figure 1.1: Primary Energy Consumption by Source (Quadrillion Btu)

Most empirical research relies heavily on cross-country data to test for the causality between resource endowment and economic development. As described in Van der Ploeg (2011) and Van der Ploeg and Poelhekke (2017), relying on cross-country data on the existence of the natural resource curse is fraught with econometric limitations. For one, there could be many confounding factors (e.g., institutional, cultural, and policy) that play a significant role in explaining the relationship; thus limiting the ability to make causal inference on the resource curse hypothesis. Also, there could be bidirectional causality between resource wealth and the development outcome. For example, where higher levels of natural resources cause less development, and/or, because of fewer alternative sources of revenue, developing countries could become dependent more on resource rents.

The bias will be large if both resource wealth and economic development are affected by a third, omitted, factor such as country-specific heterogeneities (e.g. geographies, ethnic fractionalisation and institutions). In the category of studies that address this issue, Hodler (2006) shows that natural resources endowment can lead to lowers outcomes in ethnically fractionalized societies than in higher incomes and homogeneous societies. Robinson et al.'s (2006) findings implicate natural resources by showing that it can lead to inefficiency and high public sector employment without strong political institutions. Bhattacharyya and Hodler (2010) hypothesise a mediating influence of political institutions in determining how natural resource revenues affect economic policy choices and corruption.

Another complication arises with the measurement of resource endowment or dependence. For instance, the endowment is often treated as 'dependence' and in the case of oil and gas, proxied with the share of fuel exports in a country's GDP. Fuel rents or an export figure per GDP, however, is a noisy measure of natural resource abundance as it is an endogenous variable. Fuel export or production also understates the oil rents when producers produce below their full capacity (Tsui 2010).

To circumvent the challenge imposed by econometric endogeneity, researchers often employ Instrumental Variables (IV) estimation when analysing the resource curse. A valid instrument induces changes in the explanatory variable but has no independent effect on the dependent variable. To achieve this, the researcher must find a variable that is related to the economic development variable only through its impact on resource measurement, and such variable must be uncorrelated with the error term in the regression equation (e.g. Cotet and Tsui 2013). The availability of data for such an instrument often makes the implementation of the IV a challenge.

Another method that is used to verify the resource curse hypothesis in a quasi-experimental setting is by mimicking "natural experiments". For example, Vicente (2010) examines how increased oil rents raise the value of being in office through vote inducement and sharp practices by government and more significant corruption in public services. The identification strategy was to utilise a natural experiment by comparing the difference-in-difference for Sao Tome and Principe (STP) and Cape Verde, two countries that share very similar recent and colonial political histories. The case of STP and Cape Verde is unique, given that they share similar colonial and post-colonial experiences; however, outside of these two countries, it would be challenging to find such natural experiments. STP's anticipated oil windfall accounts for an increase of 237% of her GDP and Cape Verde did not have such oil windfall, which makes it an ideal control.

Other experimental approaches have employed the Regression Discontinuity Designs (RDD) by using within-country evidence for the impact of natural resources. Brollo et al. (2013) utilised the exogenous change in federal transfers to municipal governments given population thresholds in Brazil to implement a regression discontinuity design. The empirical evidence shows that larger transfers increase observed corruption. In another example, Caselli and Michaels (2013) use the within-district variation in oil output among Brazilian municipalities to investigate if municipalities with more variation in resource windfalls have more revenue and if this corresponds to an increase in government's spending on public goods and services. In the study, the findings show that while oil-rich municipalities experience increases in revenues and a corresponding increase in spending on public goods and services, however, survey data and administrative records indicate that social transfers, public good provision, infrastructure, and household income increase less (if at all) than one might expect given the higher reported spending (Caselli and Michaels 2013).

While RDD designs are widely used and hold promise as a means of obtaining causal effects, there are potential threats to its validity. The central assumption that underlies RDD is that members of the treatment and control groups are equal in expectation in all ways other than exposure to the exogenous treatment, which in this case is the shock from oil discoveries and the corresponding windfall. If, however, there is an underlying relationship between the outcome and the assignment variable, then the small differences in the assignment variable between those on either side of the treatment 'cut-off' could lead to differences in outcomes and bias the inference. For example, non-oil municipalities that are close to oil-rich municipalities might also attract economic impact (spillover from the "Boomtown" phenomenon) when such municipalities experience an increase in population, employment and business activity. Such spillover might also stem from negative social and economic consequences of increased crime rates, housing rental costs, and air pollution that affect boomtown municipalities (Muehlenbachs et al. 2013).

Another approach used is built on a quasi-experimental approach generated by the random outcomes of exploratory oil drilling. In Cavalcanti et al. (2019), the authors investigate the causal effect of natural resource discoveries on local development in Brazil. The approach allowed to compare economic outcomes in municipalities where the national oil company, Petrobras, drilled for oil but did not find any, to outcomes in municipalities where oil drilling for oil was successful. The "treatment assignment" is related to the success of drilling attempts and places with oil were assigned to treatment, while places with drilling but no oil were assigned to the control group. The experiment design resembles a "randomization", since (conditional on drilling taking place) a discovery depends mainly on luck. Therefore, places with oil discoveries are the "winners" of the "geological lottery." The results show that oil discoveries significantly increase local production and have positive spillovers.

The question of the resource curse has largely been carried out in countries where the market is imperfect and inefficient. If markets are efficient, then standard trade models predict that resource-abundant regions benefit from an increase in resource prices with no deleterious effects. This was the main premise in Allcott and Keniston's (2017) influential paper. In the paper, Allcott and Keniston (2017) asked whether oil and gas booms within the U.S. over the past half century h*ave* benefited the local economies and people who live in resource-abundant areas. The identification strategy is inspired by Bartik's (1991) "shift-share" approach where the key independent variable interacts time series variation in national oil and gas employment with cross-sectional variation in counties' initial oil and gas endowment. By extending the analysis back to the 1960s, the study was able to exploit dramatic time series variation of oil and gas jobs are created and destroyed during the 1970s and early 1980s boom. The study finds evidence against the hypothesized Dutch Disease and deindustrialisation effect as manufacturing plants in resource-abundant counties benefit a surprising amount from local demand growth, manufacturing productivity does not decrease, and oil and gas abundance increases cumulative local wages and welfare (Allcott and Keniston 2017).

Although, the within-country strategy poses several identification advantages relative to cross-national studies; however, their generalisability is weak, and in contrast to the conclusion from cross-national analyses, could limit their general applicability (Cassidy 2019). The question of the political resource curse in oil-rich countries holds global relevance that goes beyond conclusion reached within the limited institutional context afforded by subnational analysis.

Another approach used in the identification is to provide evidence using big oil discovery data to identify the impact of oil on macroeconomic outcomes (Smith 2015, Arezki et al. 2017, Van der Ploeg and Poelhekke 2017). Because news shocks on total factor productivity are hard to observe, the central idea is that discoveries of oil fields which are quite uncommon might lead to large and observable anticipation effects that could make such events plausibly exogenous to the economic outcome (Arezki et al. 2017).

According to Arezki et al. (2017), giant oil discoveries possess unique features; the relatively significant size, the production lag, and the plausibly exogenous timing of discoveries make them an ideal candidate to casually identify the macroeconomic impact of resource wealth on economic outcomes. Giant oil discoveries represent a significant amount of oil revenue for a typical country of a modest size, which would ordinarily translate into significant output in measurable economic units and macro-relevant news shocks. The time lag between giant oil discoveries and production makes it useful for exogenously observing the effect on economic outcomes capturing socio-economic development. The timing of giant oil discoveries is plausibly exogenous and unpredictable due to the uncertain nature of oil exploration. With these, it is possible to exploit the variation in the timing of giant oil discoveries and the geographical features of such discoveries to identify the resource curse (Arezki et al. 2017).

1.2 Objectives of the Thesis

From a scientific point of view, it is important to dissociate the effect of natural resource endowment from the underlying cause of development to be able to proffer solutions for the design of relevant policies that can achieve tangible improvements in socio-economic wellbeing of people in oil-rich countries. In the light of these observations, the primary objective of this thesis is to use a carefully designed scientific approach that relies on reliable identification techniques and statistical inferences to understand the resource curse in countries with giant oil (and gas) discoveries.

The specific objectives of this thesis are to:

1. provide a better understanding of the cause of the resource curse by exploring the indirect and long-lasting effects of colonial rule and resource exploitation practices during colonization,
2. examine the resource curse by observing how the positive shock to income, conditional on time series variation in global oil prices and cross-sectional variation in the oil discoveries and experience of colonization, affects under-five child mortality, and
3. use theory and evidence to explain how natural resources introduce information asymmetry that supports poor governmental accountability in oil-rich countries.

1.3 Outline of the thesis

In this concluding part of Chapter 1, we elaborate on our objectives and outline the remaining components of the chapters that constitute this thesis.

Chapter 2 entitled: ***Colonialism, Institutional Quality and the Resource Curse*** achieves the first objective as highlighted in Section 1.2 above. Essentially, the hypothesis outlined in Chapter 2 is to test is if European-organised mercantilism and resource exploitation practices during the colonisation era can have an enduring effect, manifesting as inherited socio-political institutional extractive structures that moderate the benefits from oil endowment.

Colonial investment in structures of extractive institutions could manifest later in the way countries manage wealth from oil endowment and cause resource curse. To consolidate foreign rule and encouraged low-cost extraction of resources using local population’s labour, colonial authorities often modified apparatuses of governance and designated authority to selected individuals creating a gap in social structure by creating an elitist group (Dell 2010, Aldrich and McCreery 2016). If this gap in the social structure becomes intergenerational, the post-colonial elite group might favour a rent distribution structure that is not socially rewarding, exclusive and discourages institutional reforms supportive of inclusive shared prosperity (Acemoglu et al. 2004, Angeles and Neanidisy 2010).

We build on these stylised observations, and, as a main contribution to the resource curse literature, hypothesise that European-organised mercantilism, with specific reference to direct colonialism either through exploitation or settlement colonialism, has an enduring effect, manifesting as the inherited institutional structures that moderate how countries relate oil windfalls to economic prosperity. Exploring the long-term impact of colonial bequeath as a channel for resource curse in petroleum endowed countries is useful for devising a useful institutional framework that could reverse the resource curse. For instance, if the inequality in the allocation of privileges during colonial era created an imbalance in the social structure that amplifies resource curse (van Leeuwen and Földvári 2016), then, the curse can be reversed by strengthening human capital, access to education for all citizens and investment in programs that enhance social mobility.

We test the conditional resource curse hypothesis by exploring the long-run change in GDP per capita associated with giant oil discoveries arising indirectly from colonial experience and geographic attributes of oil formation in 69 (40 colonised and 29 non-colonised) oil-rich countries from 1960-2015. We instrument the variables of oil and gas abundance and institutions with a dummy for colonial experience and the log of the depth of oil and gas fields and depth (squared) to account for the exogeneity in geographies of oil and gas formation.

Chapter 3, ***Income and Child Mortality in Oil-Rich Countries: Evidence from Oil Price Shocks and European-Colonial Legacy*** addresses the second objective we set forth to achieve in Section 1.2. We investigate the income-child-public health nexus in oil-rich countries. If the effect of a positive shock to income (oil-price shocks given oil discoveries) is compromised by the inefficiency with revenue allocation and management (e.g., the resource curse and/or the enduring impact of the 16th to 19th-century European colonialism), the effect on income might not translate to an improvement in health outcomes especially, those aimed at reducing child mortality (Jorgenson 2004, Shandra 2004). An improved understanding of the income-public health nexus in oil-rich countries using child mortality channel is useful for broadening the scope of the resource curse and for guiding the design of a socially-efficient rent allocation system that improves maternal, perinatal and paediatric healthcare. We use a 2-stage Fixed

Effect (FE) Instrumental variable (IV) strategy to estimate the causal effect of aggregate GDP per capita on child mortality per 1,000 births in 99 oil-rich countries from 1960 to 2010.

Our empirical framework in Chapter 3 contributes to the extant literature in four ways. First, previous studies have mainly focused on negative economic shocks arising from macroeconomic crises or droughts, and they fail to distinguish between positive and negative shocks. We contend that this distinction is important. News shocks from oil discoveries are a source of positive, permanent shocks on the current account and other key macroeconomic variables (Arezki et al. 2017). However, such positive shocks on income may not be evident at reducing child mortality, either because of the inefficiency arising from the resource curse and/or because of the enduring impact of European colonialism that aggravates the corruption in colonised countries (Angeles and Neanidis 2015). Second, by using child mortality as the measure of public-health outcome, we extend the resource curse debate and link how natural resource endowment can influence health outcomes (Ross 2015). Apart from Wigley (2017), the limited resource curse literature that specifically links oil endowment to health outcomes has focused mainly on HIV and tuberculosis. However, in contrast to HIV and tuberculosis outcomes, infant mortality does not involve controlling for the long-run impact of prevention and treatment associated with adults' disease and health outcomes (Currie and Neidell 2005). Our third contribution is with the identification of aggregate national income per capita with time series variation in global oil prices interacted with the longitudinal variation in the oil discoveries and a dummy to capture if a country was a former colony under European colonisation. The income per capita and child health co-vary at the national level for a variety of reasons; therefore, simple correlations would reveal inconsistent estimates (Summers and Pritchett 1996, Acemoglu et al. 2013). Finally, our sample comprises of heterogeneous countries with oil discoveries (not giant), with and without colonial experience, and across different ecological zones. This allows us to test for the heterogeneous effect of aggregate income shocks on health in a variety of country with historical and ecological settings.

Chapter 4, ***Political Accountability, Information Asymmetry and the Resource Curse*** addresses the third objective we outlined in Section 1.2. We complement the existing literature on the political resource curse with theory and data. Our theory of the resource curse builds on the premise that governments in resource rich countries want to appear as not plundering resource wealth, so they have a higher incentive to give an incomplete report on economic performance that does not reflect budgetary allocations. If citizens cannot independently verify the economic performance, this information asymmetry will leave room for abuse of power and expropriation of revenue for private benefits.

As empirical contributions, we use data on the government's protection of human rights as an indication of political accountability and good governance that could help in reducing the curse. Also, because of the constraints with the use of GDP statistics in resource-rich and authoritarian governments, we use variation in night-time lights intensity to overcome the identification constraints. We use cross-sectional variations in giant oil discovery as a dichotomous variable and conceptualise changes in human rights abuse as a latent variable captured by the extent of the government's protection of citizens' human right (Fariss 2014).

Our panel strategy controls for country and time fixed effects and the confounding effect of GDP on night-time lights. Improvement in human right protection is correlated with institutional change, and a plausible advantage is that the measurement is not associated with the endogenous entry of politicians, the main feature of democratic institutions in many rentier states (Brollo et al. 2013, Carreri and Dube 2017). Our finding is useful in the context of the evaluation of a variety of policies, such as the human rights regime and the role of international institutions, states, and non-state actors at strengthening state's accountability and the management of the windfall from resource discoveries.

In Chapter 5, we offer a general discussion followed by a discussion of theoretical, methodological and empirical issues with the thesis. From these, we spell out the implications for further research and conclude and offer general recommendations.

References

Acemoglu D. Johnson S, and Robinson, J.A. (2001). The colonial origins of comparative development: an empirical investigation. *American Economic Review*. 91:1369–401

Acemoglu, D., Finkelstein, A., & Notowidigdo, MJ. (2013). Income and health spending: Evidence from oil price shocks. *Review of Economics and Statistics,* 95(4).

Acemoglu, D., Verdier, T., & Robinson, J. A. (2004). Kleptocracy And Divide-and-Rule: A Model Of Personal Rule. *Journal of the European Economic Association*, *2*(2-3), 162-192

Albouy, D. Y. (2012). The colonial origins of comparative development: an empirical investigation: comment. *American Economic Review*, *102*(6), 3059-76.

Aldrich, R., & McCreery, C. (2016). *European Sovereigns and their Empires beyond the Seas*. In: Aldrich, R., & McCreery, C. (Eds.), *Crowns and Colonies* (pp 9-11). Manchester: Manchester University Press

Allcott, H., & Keniston, D. (2017). Dutch disease or agglomeration? The local economic effects of natural resource booms in modern America. *The Review of Economic Studies*, *85*(2), 695-731.

Angeles, L., & Neanidisy, K. C. (2010). Colonialism, Elite Formation and Corruption (No. 2010-51). *Scottish Institute for Research in Economics* (SIRE).

Arezki, R., Ramey, V. A., & Sheng, L. (2017). News shocks in open economies: Evidence from giant oil discoveries. *The Quarterly Journal of Economics*, *132*(1), 103-155.

Auty, R. (2002). *Sustaining development in mineral economies: the resource curse thesis*. Routledge.

Auty, R., & Warhurst, A. (1993). Sustainable development in mineral exporting economies. *Resources Policy*, *19*(1), 14-29.

Bartik, T. J. (1991). Who Benefits from State and Local Economic Development Policies?. *Books from Upjohn Press*.

Bowen, W. M., & Gleeson, R. E. (2019). The Industrial Revolution and Its Effects. In *The Evolution of Human Settlements* (pp. 201-224). Palgrave Macmillan, Cham.

Brollo, F., Nannicini, T., Perotti, R., & Tabellini, G. (2013). The political resource curse. *American Economic Review*, *103*(5), 1759-96.

Carreri, M., & Dube, O. (2017). Do natural resources influence who comes to power, and how?. *The Journal of Politics*, *79*(2), 502-518

Caselli, F., & Michaels, G. (2013). Do oil windfalls improve living standards? Evidence from Brazil. *American Economic Journal: Applied Economics*, *5*(1), 208-38.

Cassidy, T. (2019). The long-run effects of oil wealth on development: Evidence from petroleum geology. *The Economic Journal*, *129*(10), 2745-2778.

Cavalcanti, T., Da Mata, D., & Toscani, F. (2019). Winning the oil lottery: The impact of natural resource extraction on growth. *Journal of Economic Growth*, *24*(1), 79-115.

Cotet, A. M., & Tsui, K. K. (2013). Oil and conflict: What does the cross country evidence really show?. *American Economic Journal: Macroeconomics*, 5(1), 49-80.

Currie, J., & Neidell, M. (2005). Air pollution and infant health: what can we learn from California's recent experience? *The Quarterly Journal of Econom*ics, 120(3), 1003-1030.

David, A. P., & Wright, G. (1997). Increasing returns and the genesis of American resource abundance. *Industrial and Corporate Change*, *6*(2), 203-245.

Dell, M. (2010). The persistent effects of Peru's mining mita. *Econometrica; Journal of the Econometric Society*, *78*(6), 1863-1903.

Fariss, C. J. (2014). Respect for human rights has improved over time: Modeling the changing standard of accountability. *American Political Science Review*, 108(2), 297-318.

Frankel, J. A. (2010). *The natural resource curse: a survey* (No. w15836). National Bureau of Economic Research.

Habakkuk, H. J. 1962. *American and British Technology in the Nineteenth Century: The Search for Labour-Saving Inventions*. Cambridge and New York: Cambridge University Press
Havranek, T., Horvath, R., & Zeynalov, A. (2016). Natural resources and economic growth: a meta-analysis. *World Development*, *88,* 134-151.
Hodler, R. (2006). The curse of natural resources in fractionalized countries. *European Economic Review*, *50*(6), 1367-1386.
Jorgenson, A. K. (2004). Global inequality, water pollution, and infant mortality. *The Social Science Journal*, 41 (2): 279–288.
Muehlenbachs, L., Spiller, E., & Timmins, C. (2015). The housing market impacts of shale gas development. *American Economic Review*, *105*(12), 3633-59.
Robinson, J. A., Torvik, R., & Verdier, T. (2006). Political foundations of the resource curse. *Journal of Development Economics*, *79*(2), 447-468.
Ross, M. L. (2015). What have we learned about the resource curse?. *Annual Review of Political Science*, *18*, 239-259.
Sachs, J. D., & Warner, A. M. (1995). *Natural resource abundance and economic growth* (No. w5398). National Bureau of Economic Research.
Shandra, J.M. (2004). Dependency, democracy, and infant mortality: a quantitative, cross-national analysis of less developed countries. *Soc Sci Med*. 59 (2): 321–333.
Smith, B. (2015). The resource curse exorcised: Evidence from a panel of countries. *Journal of Development Economics*, *116*, 57-73.
Steele (1711). *The Spectator*. pp. Number 200, October 19th 1711
Summers, L.H., & Pritchett, L. (1996). Wealthier is healthier. *Journal of Human Resources*, 841-868.
Tsui, K. K. (2010). More oil, less democracy: evidence from worldwide crude oil discoveries. *The Economic Journal*, 121(551), 89-115.
Van der Ploeg, F. (2011). Natural resources: curse or blessing?. *Journal of Economic Literature*, *49*(2), 366-420.
Van der Ploeg, F., & Poelhekke, S. (2017). The impact of natural resources: Survey of recent quantitative evidence. *The Journal of Development Studies*, *53*(2), 205-216.
Van Leeuwen, B., & Földvári, P. (2016). Economic Mobility in a Colonial and Postcolonial Economy: Indonesia. *Journal of Interdisciplinary History*, 47(2), 171-191.
Venables, A. J. (2016). Using natural resources for development: why has it proven so difficult?. *Journal of Economic Perspectives*, *30*(1), 161-84.
Vicente, P. C. (2010). Does oil corrupt? Evidence from a natural experiment in West Africa. *Journal of Development Economics*, *92*(1), 28-38.
Wigley, S. (2017). The resource curse and child mortality, 1961–2011. *Social Science & Medicine*, *176*, 142-148.

Chapter 2

Colonialism, Institutional Quality and the Resource Curse

Abstract

We examine the enduring impact of the 16th to 19th-century European colonial practises of resource exploitation on the inherited institutional quality to explain the resource curse in oil-rich countries. A primary objective of European colonialism was to expand the economic base of the metropole through the imposition of institutions that favoured rent-seeking. If inherited, such structures can constitute a significant reason for the resource curse and why post-colonial institutional reform is hard. We also condition the oil abundance estimates on geologic features associated with depth and depth (squared) of oil fields. We estimate a 2-Step GMM model using data for 69 countries with at least a discovery of giant oil reserves from 1960-2015. Our results show that oil-rich countries without the experience of European colonisation have better institutions and more oil discoveries. Second, conditional on the colonial heritage, moments of lagged income and geologic features of oil formation, institutional quality helps to reverse the resource curse. Because giant oil discoveries did not drive the 16th to 19th-century European colonialism, our findings offer an in-depth understanding of the resource curse and suggest promising ways for reforms that undo some colonial legacies on education and social trust.

Keyword: Resource Curse, Colonialism, Institutions, Petroleum-resources

JEL-Codes: F54, E02, O43, Q35

2.1 Background and motivation

Why are many oil-rich countries characterised by slow economic growth and corruption? Cursed by the resource endowment and/or cursed by weak institutions that nurture the mismanagement of oil wealth? For many developing countries where a significant percentage of the future oil production will come, ensuring a socially efficient oil-rents management that translates to sustainable development is an important policy objective[2]. To a large extent, the general economic literature acknowledges that economic and political institutions matter (North 1990, Hall and Jones 1999, Acemoglu et al. 2001, 2012), but is divided on the role institutions play in the context of the resource curse[3]. Nevertheless, most policy recommendations centre on institutional reforms: encouraging democratisation, seeking for a global partnership to promote good governance, and supporting calls for open access to information along the oil industry value chain.

---

[2] Oil and gas are valuable natural resources capable of stimulating broad-based economic growth, productivity spillover and development (Allcott and Keniston 2017, Arezki et al. 2017, Pelzl and Poelhekke 2018). But many oil-rich countries have corrupt governments, are politically fragile, and are home to some of the world's poorest people (Sachs and Warner 1999, Ross 2003, Brollo et al. 2013). Productivity benefits do not last for long, tend to operate as enclaves and are followed by depressed local incomes (Jacobsen and Parker 2016). These observations, called the resource curse, are impossible to exaggerate as they reflect in every observable measure of development in resource-rich countries.

[3] On the one hand, institutions matter if they enable governments to utilise rents for inclusive shared prosperity (Mehlum et al. 2006) and if they help attract foreign investment in oil exploration activities by influencing the location priorities of oil exploration companies (Bohn and Deacon 2000, Cust and Harding 2014). On the other hand, while oil can negatively impact government accountability, increase corruption, and create political instability; however, it might not necessarily lead to noticeably worse economic outcomes (Alexeev and Conrad 2009, Ross 2012, Cassidy 2019).

However, there is limited evidence on how institutions work to support the decline of the resource curse. When resource-rich states are compared with non-resource rich states, the evidence of slow growth and state corruption persists (Dunning 2008, Ross 2015). Evaluating the effect of institutions is complicated by the lack of exogenous variation in institutions and by the complexities introduced from the multifaceted aspects of institutions (Casey et al. 2012). Importantly, these initiatives suffer a setback when governments decide to withhold information as most transparency initiatives cannot impose sanctions (Nissen 2019). How institutions emerged and work to reduce the resource curse are likely path-dependent on the historical, long-standing, deep-rooted, political and social changes that evolved with state capacity (Acemoglu et al. 2001, Besley and Persson 2009). If weak structures that determine state capacity and institutions evolved before nationhood, nothing causal could be read into the institutional channel used in explaining the resource curse and external pressure will hardly make governments more committed to transparency.

In this study, we offer three perspectives that provide an in-depth analysis and understanding of the resource curse. First, the effectiveness of institutions and governments' commitment for implementing reforms should not be seen in isolation; but rather as one that builds on and reflects the formation of institutions associated with the enduring impact of the 16th to 19th-century European colonial practises of resource exploitation. A primary objective of European colonialism was to expand the economic and power base of the metropole through the exploitation of labour and natural resources in the colonies (Bertocchi and Canova 2002). Therefore, it was not uncommon for some of the colonial practises to disrupt and impose institutions that restricted political inclusion, widened the social gap and favoured rent-seeking elites[4] (Acemoglu et al. 2001, Dell 2010, Aldrich and McCreery 2016). If such structures are inherited, they could constitute a significant reason why the resource curse persists and explains why initiating an internally-driven institutional reform is challenging.

Second, political ambitions for colonies acquisition that caused the forced partitioning of diverse pre-colonial ethnic groups into a single nation-state weaken social trusts and make post-colonial engagement in political discourses hard to sustain[5] (Alessina et al. 2011, Nunn and Wantchekon 2011, Michalopoulos and Papaioannou 2016). Where social trust is not strong, social and economic inequality will be high and institutional reforms will be challenging as there will be less incentive for citizens to act honestly and overcome the collective action constraints (Uslaner and Rothstein 2012). Successful institutional reforms can be carried with an improvement in education that creates social trust for overcoming problems of collective action (Glaeser et al. 2007).

Third, country-level institutions and oil endowments are endogenous to other country-level correlates of growth; therefore, conclusions emanating from cross-country regression will be inconsistent (Bohn and Deacon 2000, Acemoglu et al. 2001, Cust and Harding 2014). Recent analyses emphasis subnational analysis using household and firm-level data (Brollo et al. 2013, Cust and Poelhekke 2015). States may have more in common outside of institutions that drive the difference in economic outcomes; therefore, analysis at the subnational level may also lack

[4] The problem with the empowerment of a sub-group with political power is well captured in Acemoglu and Robinson (2012) as: "those who are further empowered politically will use this to gain a greater economic advantage by stacking the cards in their favour and increasing economic inequality".

[5] For instance, Alessina et al. (2011) introduced the concept of "artificial states" to describe states whose borders were defined artificially (unnatural) borders and create ethnically fragmented countries or, conversely, separate the same people into bordering countries as the root of economic tragedy in many colonised countries.

external validity[6] (e.g., Brollo et al. 2013). Besides, centralised authority is the main feature of many oil-rich countries; therefore, subnational analysis cannot isolate the share of the costs and benefits from the "boom-town" effect associated with regions close to oil-regions (Muehlenbachs et al. 2015).

We examine the impact of giant oil discoveries and institutional quality on the change in GDP per capita and corruption conditional on colonial experience and the geology of oil fields in 69 oil-rich countries (40 colonised and 29 non-colonised) from 1960-2015. We isolate the effect of institutions and size of resource endowment by using a 2-Step GMM regression. Our first contribution instrument the institutional quality index with a colonial dummy, observed if an oil-rich country had European colonial settlement (e.g., settler mortality estimates from Acemoglu et al. 2001), and/or if any of the colonial European language (e.g. English, French, Spanish, etc.) persist as official post-independence language. We define institutions as the score of the unweighted averages of executive constraints, expropriation risk and government effectiveness (institutional quality index). By measuring colonialism with a dummy measurement, we aim to reduce the measurement error with estimates of the settler mortality data identified in Albouy (2012). Also, by observing colonialism with the persistence of the colonial language, we can distinguish colonies based on the depth of economic engagement that has a persistent effect[7].

Our second contribution isolates the effect of the size of discoveries by exploiting the geological features of depth associated with oil formation and accumulation. Richer countries may have the means to build better institutions and attract greater investment and efforts in resource exploration (Cust and Harding 2014, Cassidy 2019). We identify the size of giant oil discoveries with geological features that are important for the formation of oil that correlates with the depth of the oil fields (Philippi 1965, Saftić et al. 2001). Because such geological features are unobservable at the time of oil exploration, they are plausibly uncorrelated with institutions and capital making them ideal instrumental variables.

Our third contribution is to measure corruption with individual surveys that ask questions on what people think of corruption and the extent of the cost they are willing to pay to reduce corruption. Corruption is perceived as one of the main reason why resource-rich countries perform poorly (Ades and Tella 1999, Kolstad and Søreide 2009). Corruption activities are clandestine, hidden and highly collusive, which makes it challenging to measure (Chabova 2017, Wysmułek 2019). Existing measurements rely on composite indices that rely on experts' opinion. Such composite indices raise concerns because they tell us little about corruption at the micro-level and how it reflects on the way society accepts corrupt behaviours. On the other hand, surveys are built on representative samples of the adult population;

[6] For instance, oil-rich countries of similar in culture and oil endowment found in the Middle East and North Africa region differs in terms of economic outcomes and level of development. Countries like Qatar, Kuwait and UAE in this region without the experience of economically exploitative colonialism but with weak democracies have some of the highest per capita income in the region. In contrast, countries like Libya, Iraq and Egypt with the experience of European colonialism have troubled political transitions and corruption which present significant obstacles for economic activities (Yousef 2004).

[7] Language imperialism was essential for successful colonisation (Phillipson 1992, Migge and Léglise 2008). It was important in European settlers' colony countries (e.g., Australia, Canada) and for fostering economic partnership in exploitative-colony countries (Nigeria and Angola). It was not important in non-economically important colonies (e.g. many Arab nations in the Gulf) as there was no effort to supplant the language of Arabic-speaking peoples with the European language (Weber 2011).

therefore, they facilitate generalisation that give voice to perceptions and experiences of different social groups to corruption (Richards 2016, Wysmułek 2019).

Because giant oil discoveries did not drive the status of being a European colony, our findings offer an in-depth understanding of the resource curse and suggest promising ways for institutional reforms. Our results show that non-colonised countries, via a positive net effect on institutions, can reverse the adverse impact of oil abundance on economic growth and corruption, whereas, countries with colonial experience cannot. Our findings are unchanged after controlling for countries that got independent after 1960, the year of the start of our analysis (many former Portuguese colonies fall under this category). We relate to previous studies that link good quality institutions as a condition for resource curse. However, we causally identify the conditional resource curse and link the inequality in access to education and mistrust as some of the European colonial legacies that plausible hinder institutional reform. We find a significant gap in illiteracy level between colonised and non-colonised countries and find that countries with colonial heritage have less trust. To reverse the resource curse, higher priorities should be placed on investment in human capital and education. These will boost citizens' ability to demand accountability and good governance from elected officials and improve the quality of discourse on civic engagement on institutional reforms.

The validity of our claims rest on the reliability of our instrumental variables, this, in turn, depends on two conditions. First, the instruments are correlated with the endogenous regressor once the other exogenous explanatory variables from the structural equation have been accounted for, and; second, the instruments are excludable as direct causes of current economic development (Angrist and Krueger 2001). For the first assumption, the first-stage results and the diagnostics show that the instruments are statistically correlated to the endogenous regressors. Validating the second assumption requires more profound intuition that reflects theoretical and statistical criteria. For instance, places with sophisticated technologies could have resisted colonial occupation, and such historical technologies may have a persistent long-term effect (Comin et al. 2010). On the contrary, socio-political competitions among European superpowers drove colonisation (Findlay 1992, Hoffman 2012), and as evidenced by many former superpowers who were unable to resist being colonised, the early adoption and use of sophisticated technology plausibly had no direct effect colonisation. We run a reduced form regression of colonial instruments on the historical 1500AD technology adoption using the data from Comin et al. (2010) to validate this argument.

Also colonised countries might be more fractionalised (Alesina et al. 2011) which can cause more in-fighting over resource ownership and reduce productive activities (Hodler 2006). We treat this backdoor channel hypothesis as serious. We show in a reduced-form regression that fractionalisation is unlikely to constitute outside channels to institutions since our sampled countries were selected based on giant oil discoveries that is plausibly exogenous to European colonisation. Finally, we also employed a reduced-form regression of the instruments and other exogenous variables on the dependent variable to show that being a former colony or having deeper oil fields are not directly correlated to current economic performance (Angrist and Krueger 2001, Murray 2006, French and Popovici 2011).

2.2 Estimation Strategy and Data Description

2.2.1. Institutional Quality and the gap in income per capita of oil rich countries

Formal models on the conditional resource curse model suggest that institutions mediate the impact of natural-resource endowment on development outcomes. Following Mehlum et al. (2006), we motivate our thesis of the moderating effect of institutional quality and oil abundance on the log of the ratio of income per capita five years after the discovery of giant oil reserves in oil rich countries in equation (2.1).

$$Y_{i,t} = \beta_0 + \beta_1 Disc_{i,t} + \beta_2 IQ_i + \beta_3 \left(Dis_{i,t} \times IQ_i\right) + \sum_{k=4}^{10} \beta_k R_{k,t} + \sum_{j=11}^{15} \beta_j F_j + \varphi_t + \varepsilon_{it} \quad (2.1)$$

In Eqn. (2.1), $Y_{i,t}$ takes two values: first, it is the log of the long-run change in GDP per capita in country i $\left(\Delta Y_{i,t} = \frac{GDP\ per\ capita_{\ t+5}}{GDP\ per\ capita_{\ t-4}}\right)$. We expect the effect of giant oil discovery not to be immediate but to materialise after a period given that it takes time for oil production and processing to take place after discovery (Arezki et al. 2017). A typical lag between oil discovery and oil production of five years is discussed in Arezki et al. (2017).

Second, $Y_{i,t}$ is the country-level measure of corruption obtained through standardised surveys. We measure corruption with country-level survey that asks the following questions: Corruption Perception among Government Officials: Most (% respondents), Corruption Perceptions Index, is it socially acceptable to report corruption: agree (% respondents), and would you spend a whole day in court to give evidence: agree (% respondents). Corruption is a social problem; people in a systemically corrupt setting see corruption as the preferred strategy, and everyone is also likely to take bribes or abuse state resources for personal gain. Because of this, measuring corruption with individual surveys that ask question on what people think of corruption and the extent of the cost they are willing to pay to reduce corruption may be a useful measure corruption.

The variable $Disc$ is the size and magnitude of the amount of ultimately recoverable oil or gas equivalent discovery in country *i* time *t*. A giant oil and gas discovery is defined as a discovery of an oil and/or gas field that contains at least 500 million barrels of ultimately recoverable oil equivalent (Arezki et al. (2017). These giant oil discoveries are a significant source of wealth with a directly observable measure on current account and other macroeconomic variables (Arezki et al. 2017). Recent critical reviews suggest that they are plausibly more exogenous than the previous measure of resource abundance that uses rents per GDP, production per capita and reserves levels (Arezki et al. 2017, Van der Ploeg and Poelhekke 2017).

IQ_i is the unweighted institutional quality index which is the unweighted averages of Executive constraints (Jaggers and Marshall 2000), Average protection against expropriation risk (Acemoglu et al. 2001) and Government effectiveness (Kaufman et al. 2003). $Dis_{it} \times IQ_i$ captures the interaction term, which is the moderating effect of institutional quality on oil abundance or the deteriorating influence of oil discovery on institutional quality in country *i* period *t*. The coefficient of the interaction term $Disc_{it} \times IQ_i$, has an important connotation. It represents the conditioning influence of institutional quality on the log of ratio of change in the GDP per capita five years after oil discovery. Alternatively, if institutional quality is weak, sudden oil discovery could further weaken it by encouraging dictatorships and favouring a socially inefficient rent-seeking system that exchanges rents benefits for political patronage (Ross 2012). Therefore, given the same amount of oil discoveries; countries with better institutional quality and political accountability are expected to have an improvement in income per capita in response to the wide multiplier effect on the overall economy (Figure 2.1).

Countries could perform better just because of the prior level of growth in the year of oil discoveries. Countries' previous growth is likely to influence the subsequent path of growth independent of the amount of discovery of oil. Equation (1) adds additional controls (R), including control for prior income change in GDP per-capita for country i in the year of discovery t and a year before discovery t-$_1$ $Log\left(\frac{GDP\ per\ capita_{\,t}}{GDP\ per\ capita_{\,t-1}}\right)$, 1900s discovery of coal to control for early industrialisation, a dummy to control if oil-rich country borders were drawn before major oil discoveries and a dummy that controls for the sovereignty status of the country as at 1960, control for latitude and absolute latitude and log of population growth. A dummy for sovereignty status as at 1960 is important because some countries included in our sample got independence after 1960, which is the year our analysis takes effect. Also, as part of robustness, we exclude these countries in the Instrumental Variable estimation. 1900s coal controls for our the divergence associated with the Industrial Revolution affect the long-run economic performance and prior income change captures how income change in the year of oil discovery affects long term income change five years after discovery. Latitude and latitude (squared) control for how differences in economic growth are attributable to the differences in the physical environment (Mellinger et al. 2000, Nunn and Puga, 2012). Indeed, as noted by Gallup et al. (1999) and Easterly and Levine (2003), as latitude increases relative to the equator, levels of real GDP per capita also increase[8]. $F_{\,i}$ controls for 4 regional dummies of country location in sub-Saharan (SSA), Latin America, Middle East and North Africa and $South\ Asia$ geographical regions based on World bank classification and φ_t controls for time dummies.

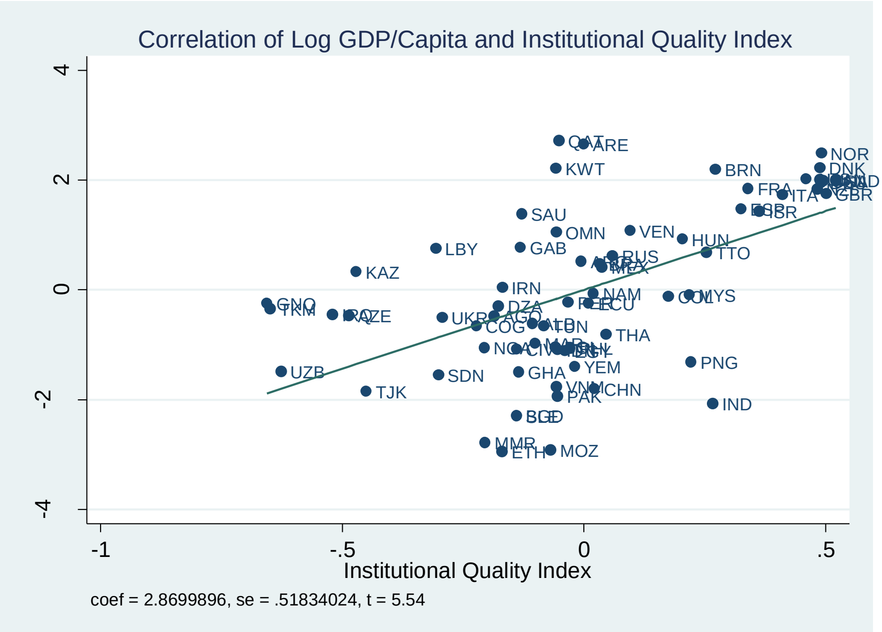

Figure 2.1: Partial regression plot of Log GDP/Capita on Institutional quality index

[8] The inverse relationship between closeness to the latitude and economic performance could be due to the correlation areas closer to the latitudes has with productivity and ecological conditions that favour infectious diseases and food security.

2.2.2 Endogeneity bias and economic growth in oil rich countries

An equilibrium relation may exist in equation (2.1) implying a bi-directional relationship between the dependent and the independent variables; if this is the case, then this would render our estimates biased (Figure 2.2). Rich oil-endowed countries can be able to afford better institutions and/or have the financial and technical capacity to engage in oil prospecting, which would lead to more and early discoveries than less rich ones. In essence, equation (2.1) can yield a set of structural equations (Eqns 2.2, 2.3, and 2.4) since it has, *ceteris paribus*, causal interpretations from the equilibrium relationship (Figure 2).

$$Log\ Disc_{i,t} = \delta_0 + \delta_1 Log\ GDP/capita_{it} + \delta_t(Year) + \varepsilon_{it} \quad (2.2)$$

$$IQ_i = \xi_0 + \xi_1 Log\ GDP/capita_{it} + \xi_t(Year) + \varepsilon_{it} \quad (2.3)$$

$$Log\ Disc_{it} \times IQ_i = \theta_0 + \theta_1 Log\ GDP/capita_{it} + \theta_t(Year) + \varepsilon_{it} \quad (2.4)$$

Where $Log\ Disc_{it}$ measures the size of oil and gas discovery in country *i* time *t*. IQ_i is the unweighted institutional quality index for each country and $Log\ Disc_{it} \times IQ_i$ captures the moderating effect of institutional quality on oil abundance in country *i* period *t*. In essence, these three main variables could be endogenous and performing the regression with just equation (2.1) would lead to a biased OLS estimator arising from simultaneity bias. By obscuring the direction of causality, the endogeneity bias will lead to a wrong diagnosis of the resource curse and could make policy recommendation ineffective. These ultimately make further discussion and understanding of the resource curse to merit more attention.

In addition to this bias, equation (2.1) misses out the important, much more long-run dimension of colonialism to economic development. For instance, it cannot verify our hypothesis of the enduring impact of the legacy of European colonialism on the economic performance in oil rich countries since we assume that the effect of colonial instruments over a hundred years ago does not have a direct influence on current income except through the indirect impact on institutional quality.

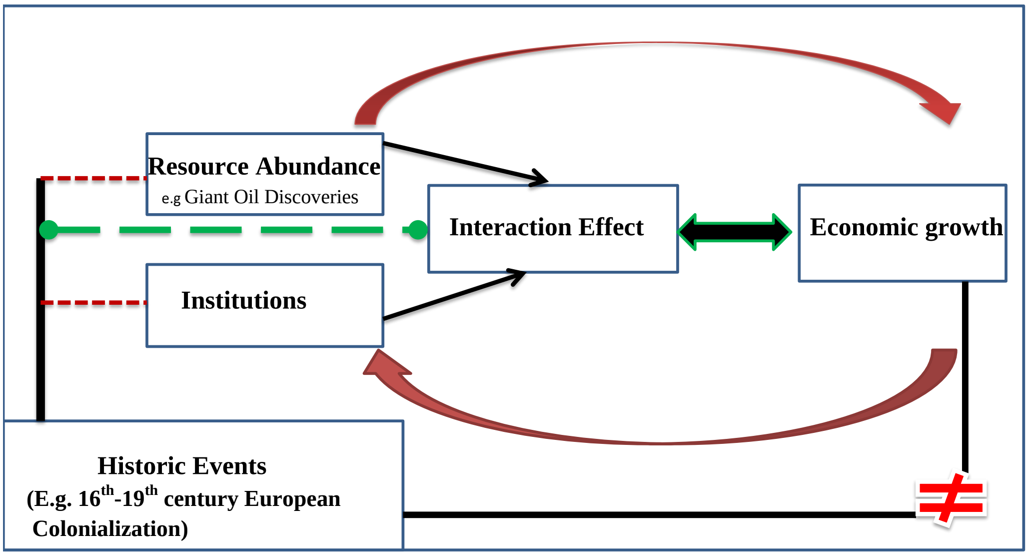

Figure 2.2: Bidirectional causality of economic growth with institutions and resource abundance

In this study, we correct this bias by employing the Instrumental variable (IV) method, which allows for the consistent estimation of our variables. Using the IV estimator, it is possible to recover unbiased estimates of the variables of interests. To consistently use this estimator, we need new variables that satisfy properties of non-correlation with under-development and are not directly correlated with economic performance (Imbens and Angrist 1994, Angrist et al. 1996, Angrist and Krueger 2001, Wooldridge 2001, pp. 101-2, Nichols 2006).

2.2.3 Institutions, Historical Antecedents, Institutions and the Resource Curse

In so many ways, socio-political institutions of governance influence economic policy; but they are not randomly assigned (Aghion et al. 2004). An important aspect of institutional quality is to understand how institutions were formed and the structural incentives that encourage the "optimal" design of favourable institutions. Institutional theories suggest that post-independence institutional quality in former colonial countries is endogenous, and determined by colonial legacy, inherited law systems and culture (Acemoglu et al. 2001, Banerjee and Iyer 2005, Engerman and Sokoloff 2005, La Porta et al. 1998, Du 2010, Bruhn and Gallego 2012).

On the one hand, scholars emphasise that positive development can be attributed to some of the colonial investment in local economies and instruments of modernisation that could have a countervailing effect on poor development (Feyrer and Sacerdote 2009, Eynde 2015, Cappelli and Baten 2017, Dell and Olken 2017, Michalopoulos and Papaioannou *in press*). However, there are reasons to suspect that some of the colonial practices during colonisation have broader negative long-term implications[9]. Indeed, the literature on the historical 16th and 19th-century colonial practises suggests that today's development can be explained through the colonial bequeath of weak institutions, e.g., property rights institutions (Acemoglu et al. 2001, Banerjee and Iyer 2005, Engerman and Sokoloff 2005), and the legal systems practised (La Porta et al. 1998). Inheriting such dysfunctional institutions could constitute a major cause for the resource curse by reducing the accountability of the new indigenous elites who have fewer concerns for a socially efficient rent allocation system with giant oil discoveries.

Acemoglu et al. (2001) in a seminal contribution illustrates how colonisation strategy created different sets of property rights institutions which persisted after independence and accounted for the differences in the post-independence economic and political outcomes in resource-rich countries. For the first case, the authors cite instances where colonisers from Europe merely set up "extractive states" in their colonies, exemplified by many colonies in Africa and Asia. The sole objective of the colonisers in these colonies was to facilitate the regular supply of raw materials for use in the empire. In such cases, no effort was made to building institutions nor did they introduce much protection for private property, or provide checks and balances against government expropriation. Former colonial countries in Africa, especially Congo and Nigeria, are the typical cases. What is observed is that many of such former colonies in this category have weak institutions that persist and have documented evidence of the resource curse. In Acemoglu et al.'s (2001, 2013) second case, many Europeans migrated and settled in the specific colonies. Here, the settlers tried to replicate European institutions with an emphasis on strong private property protection and checks against government power. Primary examples of this include Australia, New Zealand, Canada, and the United States (Acemoglu et al. 2001).

[9] For instance, Dell (2010) attributes the deplorable social and economic conditions of some regions in Peru and Bolivia to the exploitative colonial practice of *mita*, an extensive forced mining labour system in colonial Peru and Bolivia between 1573 and 1812. Acemoglu et al. (2001) examine how the log of settlers' mortality associated with latitude influence colonisation patterns and causes differences in current per capita income level in many countries.

Therefore, it is arguable that colonial history and legacy could be a factor in accounting for the post-independence economic and political outcomes in these countries.

In Acemoglu et al. (2001), the authors instrumented for average protection against exploitation risk using the log of settler mortality. It is quite useful to think that places with higher mortality of settlers will be unfavourable for long-term residence (Acemoglu et al. 2001). Furthermore, if such locations are also well-endowed with raw materials of economic benefits, the immediate pecuniary gain from the low-cost extraction of resources and the exploitation of the local population's labour might introduce the long-term poverty trap in these places (Dell 2010) (Figure 2.3).

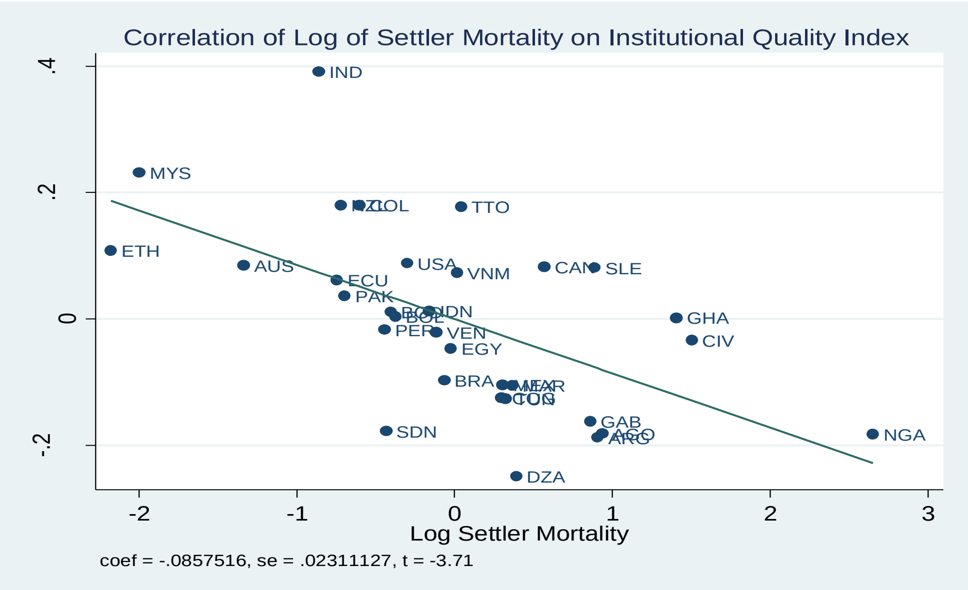

Figure 2.3: Plot of Regression of Log of Settler Mortality on Institutional quality in Oil and gas-rich countries that were former European colonies.

Other studies have explored other avenues to test the impact of colonialism. Feyrer and Sacerdote (2009) for example, document a positive relationship between the number of years as a European colony among islands in the Atlantic, Pacific, and Indian Oceans and current GDP per capita. Dell and Olken (2017) showed that locations close to Colonial Dutch established sugar factories are today more industrialised and richer than nearby counterfactual locations. However, a major limitation of this approach is that we cannot completely rule out the that such islands do not retain a constitutional link to the motherland as such jurisdictions are likely to receive a wide range of post-independence location-related opportunities (see Bertram 2007).

2.2.4 Constructing an Instrumental Variable for Institutions

A major limitation of the use of historical data on colonialism is that it is often unverifiable as the colonial events happened long way past. For instance, Albouy (2008) and (2012) believe that the estimated mortality rates of early European settlers in 36 of the 64 countries in the Acemoglu et al. (2001, 2005) sample are assigned "based on mistaken or conflicting evidence" (Albouy 2012). Controlling for these data issues, the studies argued to make the relationship between mortality and expropriation risk to lack robustness, and instrumental-variable estimates become unreliable (Albouy 2008, 2012).

Another limitation with studying the effect of colonialism using settler mortality data is how to form a basis for comparison to non-colonised or colonies. Since not all the colonised countries are reported in Acemoglu et al. (2001), it gets difficult on how to ascertain the settler mortality and colonialism records for countries not included. Also, because not all countries were colonised "equally", another challenge is to distinguish between countries that were colonised purely for economic exploitation from non-economic purposes. For instance, many countries in the Middle East were under the one form of European protectorate and could not be classified as a pure colony in the sense of economic exploitation that involved the imposition and disruption of existing institutions. In our particular case, we have oil rich countries in the Gulf region, which in addition to not having data on settler mortality also only saw their countries used only as a trading post and without resource exploitation practises that characterised most resource-rich colonies. If by the enduring impact of exploitative colonialism we mean the tendency for European countries, wanting to expand their economic base, to exploit and impose foreign structures on the colonies, then, in that case, it is hard to categorise such countries as colonised.

Given the limitations with the measurement of colonialism, we construct the colonial instrument by categorising countries based on whether they had European colonial experience and used this as an instrument for institutional quality. We define a country as a former colony if: first, data on settler mortality exists for such a country and second if the official language used in such countries is European (Figure 2.4). There is a consensus that settler mortality is an indication of European interest and economic exploitation (Acemoglu et al. 2001). However, the point of departure is the estimates and values ascribed to the settler mortality in some countries. By defining colonialism with a dummy measurement, we aim to reduce the measurement error with estimates of the settler mortality data identified in Albouy (2012).

Language played a key role in fostering economic partnership and was an instrument used in the subjugation of the indigenous members in the colonies. The use of European languages as the official medium of communication reflects a critical dimension of colonialism in colonies where Europeans have significant economic interest (Phillipson 1992, Migge and Léglise 2008). Imposing a standard language was crucial for the effective administration of colonies, and an effective way of recognising countries with substantial colonial influence was the post-colonial dominance of the European language as an official language used as a medium of communication.

Our hypothesis leverages on the 16th to 19th century prevailing socio-political and economic conditions in Europe and the level of non-oil resource abundance of economic value in the colonies, both of which encouraged European-organised mercantilism and the colonial management and institution bequeath (Acemoglu et al. 2001, Hoffman 2012). These factors subsequently have no direct impact on current income in oil-rich states except through the inherited socio-political institutional legacy that moderates how oil wealth translates into economic growth prevailing that socio-political conditions in Europe drove colonial occupation of the territory as at the time (Hoffman 2012).

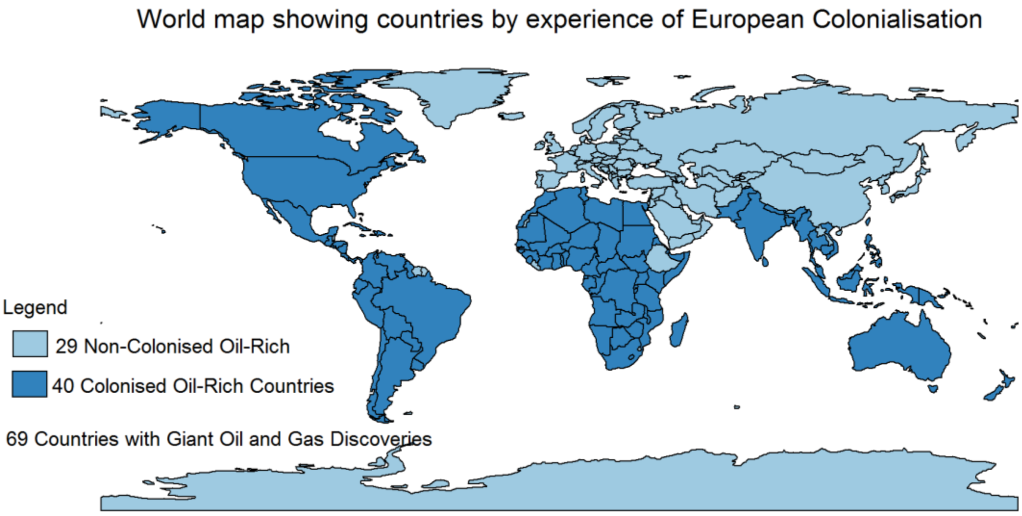

Figure 2.4: Map indicating colonised countries based on our coding using settler mortality data and the official use of European language in the non-European country

2.2.5 Geological characteristics of oil formation

In addition to institutional quality, we hypothesis that log of oil discoveries is plausibly endogenous. In a recent study, Cust and Harding (2014) used the institutional setting to explain the location of oil and gas exploration. Cust and Harding (2014) argue that because exploration activities require sizeable up-front capital, a potential investor will consider the returns to investment on operational costs and risks. Higher risks are more likely to be associated with weak institutions; therefore, countries with weak institutions will have less investment, less the exploration efforts and fewer discoveries (Cust and Harding 2014). Additionally, richer countries may have the means to build better institutions and attract greater investment in resource exploration (Van der Ploeg and Poelhekke 2010). On the other hand, countries with weak regulations and institutions may attract more exploration because of the general lax regulatory framework that oil exploring firms have to face. Because oil exploration comes with significant environmental negative externalities, oil firms may find countries that are lax in the implementation of policies concerning gas flaring, oil spillage and the protection of ecosystem favourable for re-allocation. Also, prospects of discoveries can raise the value of political offices and cause the incumbent politicians to over discount future benefits and increase efforts on extraction rates (Robinson et al. 2006).

We identify the size of giant oil discoveries with the geologic features associated with oil and gas formation, migration and accumulation. In an early influential study, Philippi (1965) explains that petroleum generation is a temperature-dependent chemical process; therefore, higher hydrocarbon/noncarbonate carbon ratio occurs at greater depths where the temperature is higher (Philippi 1965). Subsequent studies have identified some important geologic process that determines the size of petroleum in a reservoir (Norman 2001, Tissot and Welte 2013). In all these processes, the depth of the structure is critical for the subsequent volume of petroleum that is formed and accumulated (Tissot et al. 1971, Tissot et al. 1974, Saftić et al. 2001). Petroleum is initially formed in the source rock which contains sufficient organic matter in the form of kerogen that can only be transformed into hydrocarbon at great depth and when heated at high temperature at about 65°C. Then, a migration pathway and trap must exist that allows the expelled petroleum and water to move buoyantly in response to pressure gradient from the source rock into a reservoir rock. For petroleum to become concentrated in an economic oil or gas field, suitable rocks called the reservoir rocks must be charged with petroleum fluids. The oil that accumulated at reservoir rock that is shallow and that is located at or near the surface may be affected by excessive "inspissation" (evaporation) and chemical oxidation; therefore, less oil will be recovered over time (Milner et al. 1977). The deeper the formation, the more likely the reservoir rock will be compacted as the grains are finer and consolidated than shallow reservoirs that are likely to consist of coarser materials and are likely to be unconsolidated.

In a typical sedimentary basin that served as the source rock, the oil window where the light oil is formed occur around 7000 to 18,000 ft (2100 to 5500m) deep and at about 150°F (65°C) and ends at about 300°F (150°C). Above this temperature range and depth, less oil will be formed, and the relationship between depth and quantity of oil in fields may no longer be linear. Depth also implies a gradation in permeability and porosity of the reservoir rocks; implying that at excessively deeper oil reservoirs, less oil will be formed. In essence, the relationship between Deeper reservoirs is far less permeable than shallow reservoirs.

Previous attempts at identifying the size of oil discoveries use the distribution of sedimentary basin (Cassidy 2019) and the use of subsoil assets and oil-initially-in place (Tsui 2011). The potential weakness of sedimentary basin is that the location could influence the definition of national borders; countries that are more developed could have an advantage if it can influence how the inclusion of large sedimentary basins within her national boundary and the use of existing oil stock could be correlated with economic factors that determine exploration efforts (Cassidy 2019). Because depth cannot be observed before discoveries, it is plausibly uncorrelated with economic and institutional drivers of exploration efforts and this is not a concern for our identification strategy. Our approach improves on previous instruments used to identify oil discoveries.

Under the assumption that colonial experience and geographic variation in oil endowment affect income per capita change five years after the discovery of giant oil and gas institutional quality and magnitude/amount of oil discoveries, we can estimate the conditional resource curse hypothesis using an instrumental variables approach. Specifically, we re-estimate equation (2.1) after the first stage regression in eqn. (2.5).

$$X_{i,t} = \lambda_1 Dpt_{it} + \lambda_2 {Dpt_{it}}^2 + \lambda_3 Coly_i + \lambda_4 Y_{i,t-3} + \lambda_5 Y_{i,t-4} + \sum_{j=n}^{k} \beta_j M_{i,t} + \varepsilon_{it} \quad 2.5$$

Here, X_{it} stands for the endogenous regressor respectively: (a) log of size of oil discovery in country *i*, year *t* (b) unweighted index of institutional quality in country *i* (c) the interaction of oil abundance and institutional quality in country *i*, year *t*, and (d) the log of income per capita change prior in year of oil discovery in country *i*, year *t*.

The instruments comprise of :

1. Dpt is the Log of depth of oil reserves and it is used as an instrument for oil abundance.
2. ${Dpt_{it}}^2$ is the log of depth(squared) to account for the possible non-linearities between oil abundance and depth; i.e. deeper wells could be more expensive to drill
3. *Coly* is a dummy variable that measures a country's experience of colonial occupation. *Coly* =1 if a country has data on settler mortality and/or if despite being a non-European country, it adopts any other European languages of major colonial masters as an official language. *Coly* is used as an instrumental variable for a measure of institutional quality and to identify the indirect effect of the heritage of European colonialism relative to non-colonised countries.

4. The variables, $Y_{i,t-3}$, and
5. $Y_{i,t-4}$ are the lagged levels of GDP per capita and are used to instrument for the log of ratio of change in prior GDP per capita in the year of oil discovery.

M is a vector of other exogenous covariates as in Equation 2.1.

Estimating the 2-stage equations 2.1 and 2.5 become challenging, and the standard two-stage least squares are no longer consistent. First, we have nine over-identifying restrictions and second; there is a serial correlation between the dynamic model (additional lagged moments). In this case, using the 2-stage GMM estimator instead of the 2-stage SLS can provide more precise estimates of the parameters (Hayashi 2000, pg. 206-227; Baum et al. 2003).

2.2.6 Validity of the instruments

A necessary condition for the reliability of instrumental variables rests on two conditions. First, the instruments are correlated with the endogenous regressor once the other exogenous explanatory variables from the structural equation have been partialled out, and; second, that the instruments are excludable as direct causes of current economic development (Angrist and Krueger 2001). In essence, the instruments do not directly enter the equation (Eqn. 2.1) except through institutions. For the first assumption, we can show that the instruments are statistically correlated to the endogenous regressors through the first stage (Eqn. 2.5) regression. Also, we can show that incentives of the post-colonial elite to reform the inherited institutions weakens as more giant oil reserves with significant oil-wealth are discovered[10].

However, validating the second assumption, i.e., direct excludability and the correlation of the instruments with the error term requires deeper intuition. In essence, the question is to know how the instrument's independence from an unobservable error process can be ascertained. There are no straight forward answers to this question but we can deduce if this condition is fulfilled by carrying out some tests. First, we use the commonly employed J statistic of Hansen (1982) as described by (Baum et al. 2003) to test for over-identification—i.e., whether the instruments are uncorrelated with the error process. Because our model is overidentified; i.e., we have more excluded instruments than included endogenous variables, the Hansen j statistics tests whether the excluded instruments are appropriately independent of the error process by regressing the residuals from the 2SLS regression on all instruments in Eqn. 2.7 (Baum et al. 2003).

Second, we estimate a reduced form model to get the direction of causality from the correlation and to test if current economic performance is significantly influenced colonisation and the depth of oil fields. Strict exogeneity of the instruments implies that the causal effect in the conditional model should operate entirely through the endogenous regressors (Engle et al. 1983). Still, we can get the underlying background knowledge on the relationship between the instruments and the dependent variable with the reduced-form regression (Cartwright 1989, Pearl 2000, Bazinas and Nielsen 2015). Also, by employing reduced-form regressions of the instruments and other exogenous variables on the dependent variable (Angrist and Krueger 2001), we can test if the instruments are significantly correlated with the income growth in Eqn. 2.6. The absence of statistical significance could imply that the instruments do not affect

[10] This might probably explain why non-resource rich former colonies (e.g. Singapore) have been able to emerge from poverty and accumulate human capital. The lack of oil windfall endowment could have created a strong government that worked at creating reforms that are conducive for growth and entrepreneurship.

the outcome (Murray 2006, French and Popovici 2011). We implement Eqn. 2.6 to verify this test

$$Y_{i,t} = \lambda_1 Dpt_{it} + \lambda_2 {Dpt_{it}}^2 + \lambda_3 Coly_i + \lambda_4 Y_{i,t-1} + \lambda_5 Y_{i,t-2} + \sum_{j=n}^{k} \beta_j M_{i,t} + \varepsilon_{it} \qquad 2.6$$

Where $Y_{i,t}$ is the measure of the log of the long-run change in GDP per capita in country *i* $\left(\frac{GDP\ per\ capita_{t+5}}{GDP\ per\ capita_{t-4}}\right)$ and corruption measurements as discussed in Eqn. 2.1.

Third, we use data from Comin et al. (2010) that documents the historic technology adoption to validate the colonial dummy instrument as not correlated with long term development arising from pre-colonial technology adoption by running a separate regression to show that being a technologically advanced nation prior to colonisation was not correlated with whether a country was colonised or not. Countries with early discoveries, adoption and use of military, agricultural, transportation, communication technologies could have avoided being colonised. Because these technologies can have an enduring impact on current economic activities (Cormin 2010), the validity of the colonial instruments could be invalidated. An alternative hypothesis upon which we validate our instrument is that while historical technology adoption matters for current development; however, it has no direct effect on the decision to colonise. To illustrate this position, consider the invention of gun powder and shipbuilding technologies which were well developed in ancient China and the Middle East. Yet, these countries did not colonise other countries, nor were they able to successfully resist the invasion from countries in Europe that developed such technology at a later period. In essence, the colonisation was driven mainly driven by the socio-political competitions among European superpowers, which made them innovate and improve upon existing technologies, and able to colonise others. In essence, we argue that being a colony is not associated with the residual effect arising from historical technology adoption.

In Eqn. 2.7, we estimate the partial effect of pre-colonial agricultural, communication, military transportation and industry technology adoption (circa 1500AD-2000AD) adjusted for international migration on the probability of being a European colony. We also include additional controls for 1500AD urbanisation index, log population, a dummy for landlocked nations, latitude and absolute latitude and pre-1900 coal discoveries. The absence of statistical significance between colonial experience and these early (1500AD to 2000AD) technology adoption could plausibly validate our assumption.

$$Coly_i = \lambda_1 Tech_{i,t\geq 1500AD} + \lambda_2 \log Pop_{i,t\geq 1500AD} + \lambda_3 L_i + \lambda_4 U_i \sum_{j=5}^{7} \lambda_j M_i + \varepsilon_{it} \qquad 2.7$$

Where $Coly_i$is a binary variable T_i is the index of technology adoption for agricultural, communication, military transportation and industry and urbanisation in country *i* circa 1500AD using data from Comin et al. (2010).

Fourth, to rule out other possible channels like ethnic, religious and language fractionalisation outside of institutions that can cause differences in the resource curse between places that were colonised and places that were not, we estimate a reduced-form regression to see if there is any correlation between these in Eqn. 2.8.

$$Fract_i = \lambda_1 Dpt_{it} + \lambda_2 {Dpt_{it}}^2 + \lambda_3 Coly_i + \lambda_4 Y_{i,t-3} + \lambda_5 Y_{i,t-4} + \sum_{j=n}^{k} \beta_j M_{i,t} + \varepsilon_{it} \qquad 2.8$$

Where $Fract_i$ is the degree of ethnic, language and religious fractionalisation in the country *i* respectively.

Finally, we validate the use of depth as instruments for the size of discoveries and show using reduced-form models that deeper wells are not found in richer countries and that depth is not correlated with the initial level of endowment (oil initially in-place). In contrast to geological features that rely on Fraction of country area covered by sedimentary basins (Cassidy 2019), we show that the geologic features are relatively uncorrelated with GDP and may plausible provide a better approach to isolating the effect of size of oil discoveries.

2.3. Data description

Log GDP/capita GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars, and it is sourced from the World Bank national accounts data, and OECD National Accounts data files. We estimated log of change in income per capita as the ratio of GDP/capita five years after and four years before oil discovery $Log\ \left(\frac{GDP\ \ per\ capita_{t+5}}{GDP\ \ per\ capita_{t-4}}\right)$.

Colonial Experience[11]: To define the colonial experience, we considered countries described in Acemoglu et al.'s (2001) with settlement or exploitation colonisation. Also, we use countries with evidence of substantial colonial direct rule during the 16th-19th European colonisation as evidenced by the official use of European language as the post-colonial medium of communication. In this regards, countries with only protectorate status and not with any direct control of the internal governance structures are not considered strictly as European colonies.

Estimated Ultimate Recovery of Oil Equivalence in MMBOE (EUR) is the sum of the proven reserves at a specific time. Data on oil reserves discoveries include a column for the depth of oil fields. Data covers the period from 1960-2010, and it is sourced from Horn (2014), Giant Oil and Gas Fields of the World. As an alternative specification, we use the value of the oil discoveries in USD. Information on oil prices was sourced from British petroleum (USD 2015), and we multiplied oil price with the magnitude of oil discoveries between 1960 and 2010 to get the oil wealth.

Institutional quality is a measure of the quality of institutions which is the index of an unweighted aggregate of Executive Constraints (1960-2000), average protection against Expropriation Risk (1982-1997) and Government Effectiveness (1998-2000). It takes the value of zero to one with 1 being the maximum value and 0 being the country with the lowest

[11] List of 40 countries with giant oil discovery between 1960-2010 and colonial experience are: Algeria, Angola, Argentina, Australia, Bangladesh, Bolivia, Brazil, Brunei, Canada, Colombia, Congo, Rep, Cote d'Ivoire, Ecuador, Egypt, Equatorial Guinea, Ethiopia, Gabon, Ghana, India, Indonesia, Libya, Malaysia, Mexico, Morocco, Mozambique, Myanmar, Namibia, New Zealand, Nigeria, Pakistan, Papua new guinea, Peru, Philippines, Sierra Leone, Sudan, Trinidad and Tobago, Tunisia, United states of America, Venezuela, and Vietnam.
The 29 countries with giant oil discovery between 1960-2010 that were not considered with direct European colonial experience are: Albania, Azerbaijan, China, Denmark, France, Germany, Hungary, Iran, Iraq, Israel, Italy, Kazakhstan, Kuwait, Netherlands, Norway, Oman, Qatar, Romania, Russian, Saudi Arabia, Spain, Tajikistan, Thailand, Turkmenistan, Ukraine, United Arab Emirate, United Kingdom, Uzbekistan, and Yemen.

protection against expropriation risk, government effectiveness and of constraint on the absoluteness of the authority of the executives.

$$Institutional\ Quality_i = \frac{((X_i) - \text{Min}\ (X_i))}{(\text{Max}(X_i) - \text{Min}(X_i))}$$

Where X_i is the average of the scores of Protection against the risk of expropriation, executive constraint and government effectiveness for each country, Min (X_i) is the value for the country with the lowest aggregate score and Max(X_i) is for the country with the highest aggregate score.

The executive constraint is the extent of institutionalised constraints on the decision-making powers of chief executives of the government. It ranges from one to seven where higher values equalled a greater extent of institutionalised constraints on the power of chief executives and calculated as the average from 1960 through 2000, or for specific years (Jaggers and Marshall 2000).

Protection against Expropriation Risk is defined as the protection against "outright confiscation and forced nationalisation" of property. This variable ranges from zero to ten, where higher values equal a lower probability of expropriation. This variable is calculated as the average from 1982 through 1997, or for specific years as needed in the tables. The source is from the International Country Risk Guide at http://www.countrydata.com/datasets/.

Government effectiveness is defined as the measure of the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies. The primary focus of this index is on "inputs" required for the government to be able to produce and implement good policies and deliver public goods. This variable ranges from -2.5 to 2.5, where higher values equal higher government effectiveness. This variable is measured as the average from 1998 through 2000 (Kaufman et al. 2003). Because of the difference in the years of availability of these data, we consider a robustness analysis where the institutional quality is disaggregated.

Log Annual Population Growth Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. The population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship and the data from the World Bank database.

1900's Coal Discoveries: The success of the Industrial Revolution was based on the availability of coal to power steam engines, which made international trade to expand (Fernihough and O'Rourke 2014). Being a cheaper and more efficient source of energy, countries that developed techniques to extract it and make use of it were able to grow further. The abundance of coal can have a long term impact of subsequent economic performance. Our main data is taken from recorded data on coal reserve in the 1900s using data from Bauerman (1911), and we also supplement the data with official gazettes and coal-producing countries official statistics on the coal production in the 1900s.
Table 2 in the Appendix I presents the summary statistics of the variables.

2.4 Results and Discussion

2.4.1 Main results: Giant oil discoveries, institutional quality and economic growth

Table 2.1 reports the main findings of our estimation. In Model I, we use the Ordinary Least Squares (OLS) regressions to test for the correlation between oil discovery, institutional quality and their interaction on the log of change in GDP/capita in oil rich countries with giant oil discoveries 1960-2015. Model I does not control for the plausible endogeneity and did not account for the indirect impact of colonialism on the resource curse via institutional quality. In Model I, we show that institutional quality is statistically correlated with the variation in the log of the ratio of change in GDP/capita. However, the log of oil discoveries and the interaction with institutional quality are not significant. Also, the underlying economic performance of oil rich countries measured as the log of change in GDP/capita in the year is positively correlated to the GDP growth. The literature suggests that political and economic institutions are fundamental to explaining the economic performance of a country. Institutional quality and economic development reinforce each other over the longer term (North 1990, Hall and Jones 1999, Knack and Keefer 1995, Glaeser et al. 2004). Improving the institutional quality unlocks growth potential, and this does not intrinsically suffer from diminishing returns.

Our first concern with the results in Model I is the negative sign of the coefficient on institutional quality, which suggests a bias and the plausibility of endogeneity. First, institutional quality may be bi-directionally correlated with our measure of economic prosperity (income/capita) (Hall and Jones 1999, Acemoglu et al. 2001), and the negative bias might imply an under-estimation of the coefficient arising from the reversed measure (Tu et al. 2008). Second, oil prospecting is capital intensive. Therefore, developing countries might not have the human and financial capital to embark on oil prospecting. Also, in the absence of strong institutional frameworks that offer protection for investment, foreign investors may be reluctant to divert capital into exploration activities in developing countries (Cust and Harding 2014).

Additionally, we cannot rule out the possibility of omission of variables that could likely be correlated with some measure of underdevelopment not included in our analysis. For instance, underdevelopment could be associated with poor quality policies that discourage investment in the non-oil sectors. With the collapse of the manufacturing sector arising from short-sighted policies, the oil sector which remains as the main source of economic activities is insufficient to spur growth, and it is correlated with the unobservable component from weak policies and a source of bias to the estimates in Model I (Brunnschweiler and Bulte 2008). Consequently, we extend our regression and conduct IV GMM estimation in Models II to IV to account for the endogeneity with Model I.

In the extended regression (Models II to IV), we can identify the direction of causality and the conditional resource curse theory with experience of colonialism and depth of oil fields. In Model II, we do not control if the country border was defined before oil discoveries, and if the country was independent before 1960. In Model III, we control for the sovereign status of the country as at 1960 and if the border was drawn before major oil discoveries by including a dummy. In Model IV, we exclude countries that were not fully independent and sovereign states by 1960.

Our results in Model II and III show a significant improvement in contrast to the OLS results and support our hypothesis. We document a negative impact of oil discoveries on the change in income growth per capita, and we show that the effect is moderated by the institutional quality drawn from the unweighted index of executive constraints, average protection against expropriation risk, and government effectiveness. The estimates in Models II and in III (where we control for the border before discovery and if country is independent as at 1960) indicate that when oil abundance (mmboe) increases by 10%, there is a 0.60% decline in growth in GDP per capita five years after the discovery of giant oil fields. In Model IV, we exclude countries that were not fully independent and sovereign by 1960, and the estimates imply a 40% drop in GDP growth five years after giant oil discovery.

The results in Models II, III and IV show that the resource curse is not absolute. Countries with an above-average quality of institutions (defined as an institutional quality index higher than 0.46) can reverse the curse. Good institution matters for determining how the government manages windfall and its re-investment in capital accumulation for inclusive shared prosperity (Robinson and Torvik 2005, Mehlum et al. 2006, Robinson et al. 2006). Specifically, in Model II where we do not control for if the country border was defined before oil discoveries and if country was independent before 1960 and in Model III where we control for these, an increase in institutional quality by 10 unit relative to the mean reverses the resource curse and leads to 11% and increase GDP growth by 0.5% holding all other variables constant (Models II and III). In essence, given two countries (A and B) with the same amount of oil discoveries but different quality of institutional quality, country A with an institutional quality that is 10% above the average index will have 0.5% increase in growth in GDP per capita relative to country B that has an average institutional index. The result suggests that conditional on the experience of European colonisation and the geology of oil formation (depth), strengthening the quality of executive constraints, protection and expropriation risk and government effectiveness in oil rich countries will help to transform the resource curse into economic benefits. In Model IV, we exclude 17 countries that were not fully sovereign states by 1960. We find that similar conclusion of the important institutions conditional on European colonial experience for reversing the resource curse in countries with giant oil discoveries.

Another important contribution of the results is that we account for the plausible long-term impact of early industrialisation on oil rich countries by including an indicator of the 1900s discovery of coal; we show that early industrialisation matters for subsequent economic growth in resource-rich countries and not accounting for this variable may overstate the estimate on the resource curse. Historical evidence shows that the mid-nineteenth to the mid-twentieth century the discoveries of coal were vital in explaining the take-off and the broader economic success of the industrial revolution in the US and Europe (Wright 1990, David and Wright 1997, Wright and Czelusta 2002). It is possible that oil-rich countries with early industrialisation which we represent by the discovery to coal and subsequent capital formation, which perhaps aid such countries in growth. Coal, above any other resource, was at the centre of the Industrial Revolution (Fernihough and O'Rourke 2014). Additional controls include the log of population, latitude and the regional and time dummies to account for regional differences economic growth in oil-rich countries.

Table 2.1: Giant Oil Discoveries, Institutional quality and the Resource Curse

Dependent Variable **Log ΔGDP=** $\left(\frac{GDP\ per\ capita_{t+5}}{GDP\ per\ capita_{t-4}}\right)$.	**Log ΔGDP** **i,t+5**	**Log ΔGDP** **i,t+5**	**Log ΔGDP** **i,t+5**	**Log ΔGDP** **i,t+5**
	Model I	**Model II**	**Model III**	**Model IV**
Log Oil Discovery (mmboe)	0.002	-0.06***	-0.06***	-0.04***
	(0.005)	(0.02)	(0.02)	(0.02)
Institutional Quality (IQ)	-0.24**	0.35	0.35	0.09
	(0.10)	(0.44)	(0.44)	(0.3)
Interaction Term (Log Oil Disc × IQ)	0.001	0.11***	0.11***	0.07***
	(0.007)	(0.04)	(0.04)	(0.03)
Prior change in GDP/Capita $Log\left(\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$	0.73***	2.62***	2.5***	3.83***
	(0.33)	(0.97)	(0.99)	(1.74)
1900s Coal Discoveries	0.02	0.09***	0.09***	0.06***
	(0.05)	(0.02)	(0.02)	(0.02)
Border before First discovery (Dummy =1)	-0.03		-0.004	
	(0.03)		(0.02)	
Country Independence after 1960 (Dummy =1)	-0.04		-0.04	
	(0.06)		(0.03)	
Net marginal effect of Oil Discovery	0.003	0.05***	0.05***	0.03***
Estimator	OLS	IV GMM	IV GMM	IV GMM
Number of instruments	None	5	5	9
All colonised countries since 1960 included?	Yes	Yes	Yes	No
Hansen J test (Over-identification test of all instruments)		1.76	1.63	3.9
Under-identification test (Kleibergen-Paap rk LM statistic)		35.1***	29.5***	10.9*
Weak-instrument-robust inference (Anderson-Rubin Wald F-stat)		75.31	73.32	27.62

Notes: Data covers 69 countries with the discovery of at least a giant oil field during 1960-2015. Years with no significant discoveries were given the least value of 0.01 to be able to take the log. All models report robust standard errors (in parenthesis) clustered at the country level.

*, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively. The dependent variable is the Log ΔGDP= $\left(\frac{GDP\ per\ capita_{t+5}}{GDP\ per\ capita_{t-4}}\right)$ and we allow for a five-year lag between discoveries and growth

In Model I, we used OLS estimator and did not account for the plausible endogeneity concerns.

Models II to IV use Instrumental Variable (IV) GMM estimator to control for the endogenous bias.

Model I, II and III include all colonised countries with giant oil discoveries.

Model IV Excludes 17 Countries. These are countries with ongoing colonization as at 1960 (mostly Portugal colonies in Africa), and countries that split from mother countries (constituent countries that formed the USSR). All models control for Latitude, Latitude (squared), a log of population growth, absolute latitude and time and regional dummies of Sub-sahara Africa (SSA), South America, Middle East and North Africa (MENA) and South Asia.

2.4.2 First stage estimation: European colonialism and institutional quality

According to our hypothesis, institutional quality is influenced by some historical events that have no direct bearing on current economic prosperity in these countries except through the inherited extractive institutions. In essence, colonialisation could improve or deteriorate countries' institutional quality relative to non-colonised countries in oil rich countries (Acemoglu et al. 2001, Banerjee and Iyer 2005, Engerman and Sokoloff 2005, La Porta et al. 1998).

Our story essentially builds on the established relations between the long-term consequence of colonial experience and the quality of institutions (Acemoglu et al. 2001, Banerjee and Iyer 2005, Engerman and Sokoloff 2005, La Porta et al. 1998). What we propose here is that the resource curse in oil-rich countries is conditionally related to having a colonial origin because of the inherited weak institutions. The inherited weak institutions can lead to resource curse by making government less accountable in the use of oil wealth and by lowering investment and exploration activities in colonised countries in contrast to non-colonised countries.

Because the decision to colonise a country was plausibly uncorrelated with whether such country has giant oil discoveries, it is possible to isolate the effect of institutions on the resource curse using colonial experience dummy. Also, we cannot observe the direct effect of colonialism on resource curse (growth and corruption), but we can show that the main results in Table 2.1 are conditional on the instrumental variables (colonial experience and geology of depth of oil fields) through the first-stage results (Table 2.2). We define whether a country was colonised as a dummy variable, observed if a country had a colonial heritage either as having data on settler mortality taken from Acemoglu et al. (2001, 2012) and/or by using the adopted European language as the post-independence official language of teaching and communication. Other instruments include the depth of oil fields and two years lagged moments of levels of GDP per capita.

Table 2.2 contains the instrumental variable estimates for our main results in Model II of Table 2.1. The endogenous regressors are Log of Oil Discoveries, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of and the year before the discovery of giant oil$\left(Log\,\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$. As shown in the Table (2.2), colonised countries have less amount of oil discoveries 0.94 (Columns A and C) and less institutional quality 0.76 (Columns B and C) than non-colonised. In essence, the quality of institutions in colonised oil-rich countries is lower than non-colonised oil-rich countries. Also, plausibly arising from the weak institutions, we find that colonised countries have fewer oil discoveries (Column C) than non-colonised countries. The results for the first-stage for Models III and IV are presented in Appendix 2.1.

An important result we find here is that the negative impact of colonial activities on institutions is not absolute but also conditional on the presence of expected oil wealth. The incentive by the post-colonial local elite to maintain extractive institutions is likely premised on the further discovery of additional resource with significant wealth value which might further strengthen the extractive sector and the colonial apparatus used for resource extraction. In such a situation, countries with fewer discoveries could develop institutional structures and strong post-colonial leadership systems that enabled institutional reforms that are conducive to growth and entrepreneurship. Countries with more resources might neglect the need for such reform and continue with the colonial practise of unsustainable resource exploitation. This might probably explain why colonised countries without post-colonial access to a windfall from oil and gas or natural resource (e.g. Singapore) have been able to emerge from poverty and accumulate human capital.

Countries will fail to reform inherited extractive institutions in the presence of exploitable resources. In this case, oil windfall in the hands of the post-colonial elite will probably work at discouraging institutional reforms that would favour entrepreneurship and inclusive growth. In essence, as oil abundance increases (log depth increases), colonised countries have deteriorating institutions compared to non-colonised (an estimate on the interaction term) suggesting the inability to reverse economic curse associated with giant oil endowment. There is a higher tendency for post-colonial leaders in countries used as former extractive colonies to continue with the expropriation of resources and not creating governance structures that would bring about an equally distributed welfare among the citizens. Our first stage findings contrast several findings that rely on the unconditional bad influence of colonial heritage on institutions (Acemoglu et al. 2001, 2002; Dell 2010). Also, we find that depth of oil field is correlated with the amount of estimates of recoverable oil and the change in prior GDP per capita is influenced by the lagged values in the levels of GDP per capita respectively.

In addition to institutional quality, we hypothesise that a log of oil discoveries is plausibly endogenous. Oil prospecting requires human and financial capital, and low-income countries might not be able to afford these. Subsequently, we treat the log of oil discoveries (mmboe) as endogenous and instrument it with the logs of the depth and depth (squared). We also find that depth and depth (squared) both have a significant correlation with the amount of oil discoveries (Column A) of Table 2.2. The formation and accumulation of petroleum in oil fields mainly depend on; a source rock, which possessed the right conditions that favoured the accumulation of oil and hydrocarbon from the buried and baked organic and single-celled aquatic life called kerogen. For a typical source, rock to contain significant oil, the depth range of 7000 to 18,000 ft (2100 to 5500m) and temperature of about 150°F (65°C) and 300°F (150°C) (Philippi 1965, Norman 2001, Tissot and Welte 2013) are important. Second, the hydrocarbon in the source rocks must be able to migrate into a reservoir rock from which oil is drilled and extracted (Norman 2001, Tissot and Welte 2013). If the reservoir is not deep enough, buoyancy and other forces will cause it to move uncontrolled toward the surface, and much of the oil would have passed through the reservoir rock to the surface, and nothing will be left. However, above a specific temperature range, less oil is formed in the source rock (Tissot and Welte 2013). Also, if the reservoir rock is too deep, it would be highly compacted to allow for permeability and porosity and reduce migration to the reservoir rocks. Therefore, the depth (squared) as an additional instrument is to identify the non-linear relationship between the size of giant oil discoveries and depth.

Table 2.2: First stage Estimates of Model II[12]

	First Stage for IV (GMM) estimates (Model II)			
	A	B	C	D
	Log Oil (mmboe)	Institutional Quality	Interaction term	Log Prior change in GDP/Capita
Colonised (Dummy = 1)	-0.05**	0.13***	-0.89***	-0.001
	(0.3)	(0.01)	(0.14)	(0.004)
Log depth	2.66***	-0.01***	1.67***	0.001
	(0.05)	(0.004)	(0.09)	(0.002)
Log depth (squared)	-0.70***	-0.005	-0.28***	-0.0002
	(0.04)	(0.004)	(0.08)	(0.002)
Log GDP/Capita $t-3$	0.16	0.11	-1.69	0.13***
	(0.11)	(0.1)	(1.15)	(0.04)
Log GDP/Capita $t-4$	0.13	-0.01	0.66	-0.14***
	(0.11)	(0.09)	(1.14)	(0.03)
F-Statistics of Excluded instruments	6414	176.9	492.07	7.48
Under ID (SW)	52.57***	46.84***	52.30***	19.98***
Weak ID (SW F-test of Excluded Instruments)	25.59	22.8	25.46	9.72

Notes: Data covers countries with the discovery of at least a giant oil field during 1960-2015 and the dependent variables are the endogenous regressors of Log Oil, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of discovery $\left(Log\,\frac{GDP\ per\ capita_{\ t}}{GDP\ per\ capita_{\ t-1}}\right)$. Variables on the left column are the instruments used. Robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

2.5 Corruption Mechanism

The result in Tables 2.1 and 2.2 are useful in their rights. Still, it is also essential to understand the mechanism through which oil discovery conditional on the long term impact of colonial heritage on institutional quality lead to the resource curse. The literature is replete with several plausible channels; the Dutch disease (Corden and Neary 1982), the decline in terms of trade, macroeconomic volatility (Van der Ploeg and Poelhekke 2009), and bad decision-making (Ross 2013). Oil-wealth bonanza will make the government weak at collecting taxes and exploring other ways of improving internally generated revenue and building on human capital (Van der Ploeg 2011). Oil rents can impede economic growth through corruption (Ades and Di Tella 1999). Countries with more corruption will grow less, making corruption a plausible mechanism that explains the negative growth and associated with the resource curse. Institutions offer incentives for decision-makers to overcome the “social dilemmas” arising from placing personal priorities (corrupt practices) above public interest (Ostroam 2009). Although there is an extensive literature explaining how corruption lowers investments and therefore economic growth (Mauro 1995, Aghion et al. 2016, d'Agostino et al. 2016), for the most part, the explanation ignores the role of colonialism (Angeles and Neanidis 2015). Given the colonial heritage, perhaps another important mechanism is that oil wealth strengthens the economic foundation for corruption through the inherited weak institutions. Weak structures

[12] The first stages for Models III and IV of Table 2.1 are presented in Appendix III

of accountability make it impossible to monitor corrupt leaders stolen funds and help in making the resource curse to fester.

How to measure and quantify a problem like corruption in resource-rich countries where corruption is endemic is potentially challenging (Donchev and Ujhelyi 2014). There are two main approaches: one that relies on experts' opinion and the extent to which the legal-institutional framework for anticorruption laws is improving and the other that rely on answers to surveys that ask adult citizens about their acceptance of corruption and the extent they are willing to prevent it. A large number of corruption measurements, e.g., the Corruption Perceptions Index (CPI), rely on the first approach and collect expert views on corruption for many resource-rich countries to understand the reality of corruption in these countries. These expert views on corruption suggest that the legal-institutional framework for anticorruption laws is improving. But in reality, corruption is not declining and if anything is more rampant. Oil revenue from the oil-sector is usually targeted at building public projects (*white elephants*) that are poorly planned, managed and purposely used as a source of fund embezzlement by public office holders[13] (Robinson and Torvik 2005).

In a systemically corrupt setting when corruption is endemic and widespread, the collective action theory of corruption suggests that everyone, especially those that stand to gain more (experts) will see corruption as the preferred strategy and many corruption measures like the Transparency International's Corruption Perceptions Index (CPI) will not reflect the progress made towards anti-corruption per se (Uslaner and Rothstein 2012, Persson et al. 2013). If corruption is collectively perceived as the preferred strategy, it becomes a social trap that can best be measured by using respondents' answers to survey asking them how they perceive corruption and the extent of costs they would pay to reduce corruption. More importantly, such survey questions is an evaluation of the standard of society in terms of corruption and how supportive they are corrupt practises (Uslaner 2002, 68-75).

Results in Model V in Table 2.3 shows that when respondents with giant oil size are asked about agreeableness to government officials being corrupt, most of the respondents agree (Model V). Because the ordinary people are usually at the receiving end of corruption in the society, asking for their experience could be useful for diagnosing corruption and making inferences regarding the state of corruption in a country. However, if we use the Corruption perception index from transparency international, oil rich countries with more oil are seen as more transparent (Model VI). The result in Models V and VI suggests that public opinion surveys play a vital role in corruption research. Surveys on the general public provide vital information that can improve our understanding of the causes and consequences of corruption at the micro-level. Results from Model V and VI show that measurement of corruption in oil-rich countries is sensitive to reliance on "perceived expert opinions" and why mischaracterisation of corruption could lead to the impression of success with the anti-corruption crusade whereas, more still need to be done on the context of strengthening laws that hold public officials more accountable. In both Models, conditional institutional quality makes countries with more oil discoveries more transparent. Specifically, strengthening the quality of executive constraints, protection and expropriation risk and government

[13] Examples of a positive connection between rents, colonial heritage and corruption abound. Corruption is a documented characteristic feature in many colonised oil-rich countries; Venezuela, Angola, Nigeria and Equatorial Guinea, are noted the case of a corruption scandal in many documented evidence.

effectiveness in oil rich countries will help to reduce the corruption and may help the government to allocate rents into activities that favour growth optimally.

Table 2.3: Giant Oil Discoveries, Institutional quality and Corruption Indicators[14]

Dependent Variables	**Corruption Perception Gov Officials Most corrupt (% respondents)**	**Corruption Perceptions Index**	**Is it socially acceptable to report corruption: agree (% respondents)**	**Would spend a whole day in court to give evidence: agree (% respondents)**
	Model V	**Model VI**	**Model VII**	**Model VIII**
Log Oil Discovery (mmboe)	0.09***	8.62***	-0.04**	-0.12***
	(0.03)	(1.95)	(0.02)	(0.04)
Institutional Quality (IQ)	-1.39***	-64*	0.61**	2.11***
	(0.43)	(35.9)	(0.27)	(0.53)
Interaction Term (Log Oil Disc × IQ)	-0.15***	-14.6***	0.07**	0.18***
	(0.04)	(3.4)	(0.03)	(0.05)
Prior change in GDP/Capita $Log\left(\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$	-1.32	0.81	0.77**	0.87
	(14.13)	(53.5)	(0.35)	(0.53)
1900s Coal Discoveries	-0.04***	-5.51***	0.12***	0.05***
	(0.01)	(1.29)	(0.011)	(0.02)
Border before First discovery (Dummy =1)	-0.01	-2.89**	0.005	0.07***
	(0.01)	(1.01)	(0.10)	(0.02)
Country Independence after 1960 (Dummy =1)	0.01	5.39***	-0.21***	-0.29***
	(0.01)	(1.43)	(0.02)	(0.03)
Net marginal effect of size of Oil Discovery	-0.06***	-5.98**	0.03**	0.06**
Number of instruments	5	5	5	5
Hansen J test (Over-identification test of all instruments)	3.1	0.146	0.57	0.448
Under-identification test (Kleibergen-Paap rk LM statistic)	20***	22.1***	19.8***	19.8***
Weak-instrument-robust inference (Anderson-Rubin Wald F-stat)	14.5***	326.59***	4.32***	54.71***

Notes: Data covers 69 countries with the discovery of at least a giant oil field during 1960-2015. Years with no significant discoveries were given the least value of 0.01 to be able to take the log.

[14] The corresponding first-stages regressions for Models V to VIII are presented in the Appendix III.

Models V to VIII use Instrumental Variable (IV) GMM estimator to control for the endogenous bias of Oil discovery, Institutional Quality (IQ), the interaction term (Log Oil Disc × IQ) and Prior change in GDP $\left(\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$.
The dependent variables in Models V, VI and VII are taken from the Global Corruption Barometer (GCB) of Hardoon and Heinrich (2013)
All models control for Latitude, Latitude (squared) log of population growth, absolute latitude and time and regional dummies of Sub-sahara Africa (SSA), South America, Middle East and North Africa (MENA) and South Asia.
All models report robust standard errors (in parenthesis) clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

In Models VII and VIII, our dependent variables represent a public survey that seeks citizens' opinion about how supportive they are corrupt practises and how willing they are to fight against corruption. In line with the logic of collection action theory (Persson et al. 2013), if corruption is seen as the expected norm, the short-term benefits of corruption are likely to outweigh the costs and agents (public officials), and the principal (citizens) will see no incentive to enforce anti-corruption laws that condemn and people will be less inclined to incur a cost to reduce corruption. In Model VII, we find that citizens with more size of oil agree less that corruption is a social problem but having improved institutions help to reduce the number of respondents who agree. In Model VIII, we find that respondents in countries with more oil size are less likely to stay up in court to give evidence against corruption. The fight against corruption is a costly endeavour and information is needed to uphold social trust. In a recent study, Lee et al. (2019) find that if there is distrust in institutions, people will be less optimistic about engaging in cooperative interactions that resolves corruption. The estimates in Model VII and VIII suggest that citizens in countries with more oil discoveries are less likely to be optimistic in the fight against corruption as it is seen as a collective action problem. Appendix III contains the corresponding first-stage regressions for Models V to VIII.

2.6 Colonialism, post-colonial education enrolment and social trust in oil-rich countries

So far, we have examined the conditional resource curses using the slower growth GDP and corruption as possible channels. We have shown that accounting for the endogeneity bias makes our estimates better. Since we cannot time-travel to undo colonialism, we may wish to understand what colonial structures prevent oil-rich countries from undoing the colonial impact on institutions and how these structures make institutional reform challenging. More specifically, given that good quality institutions are worth having, how could the experience of colonialism impose structural barrier that makes oil-endowed countries hard to reform institutions to the ones that are growth-enhancing and that ensure accountability. In this section, we explore the impact of the colonial experience on level of illiteracy, defined as the percentage of adult (people ages 15 and above), who can read and write.

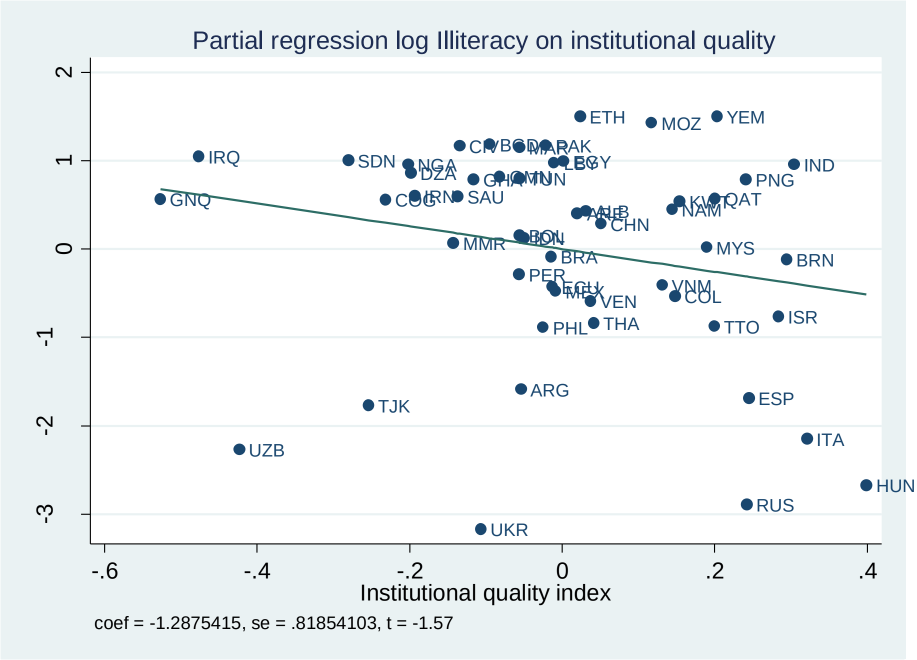

Figure 2.5: Partial regression log illiteracy and institutional quality in Oil-Rich Countries with control for Log GDP

The colonial educational system could have introduced theories that supported colonialism, insensitive to indigenous culture, and the language of teaching might not have been positively viewed in many quarters (Bolt and Bezemer 2009). This may have denied a substantial part of the population access and introduced some inequality which put the pro-colonial group who eventually become the postcolonial indigenous elite at a better advantage than the anti-colonial group who eventually becomes the non-elite (Figures 2.5 and 2.6). Also, individuals belonging to groups that were opposed to colonialism could have been denied access to schools and less investment made in regions which were less tolerant of colonial practices. The wide gap in educational inequality could have caused unequal distribution of post-colonial investment in education and technologies. The persistence of the inequality in education introduces significant constraints on the quality of civic participation; including voting and participation in support of an inclusive system of governance rather than a narrow-based regime (Glaeser et al. 2007). Ultimately, the colonial inequality in education leads to major differences in the post-colonial education enrolment; groups that were denied access could have limited advantage for social and economic mobility.

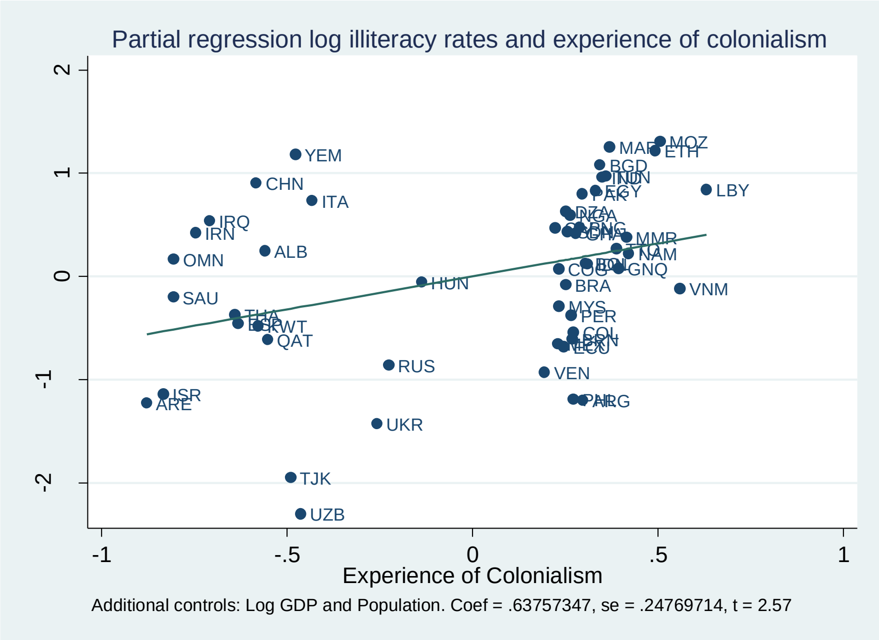

Figure 2.6: Partial regression log illiteracy and Experience of Colonialism in Oil-Rich Countries with control for Log GDP and population

Education and trust in others and the government plays an important role in civic participation and how citizens effectively demand institutional reforms (Uslaner and Brown 2005). However, the breakdown in social trust among citizens associated with colonialism could have made it challenging for building trust that encourages civic participation (Figure 2.7). For instance, the European colonial masters encouraged the ethnic partitioning of precolonial rival factions (Michalopoulos and Papaioannou 2016) and the disruption of existing institutions without due consideration to the precolonial understanding among the ethnic groups. The groups in the newly formed entity are "strange bedfellows and may find it challenging to build trust. Subsequently, colonisation made norms of mistrust towards others more beneficial than norms of trust, and if these beliefs and norms persist (Nunn and Wantchekon 2011), it may effectively influence how citizens engage among themselves and with their leaders on how they request for institutional reform.

While there is no *silver bullet* for reversing inherited institutions, however, a good way of reversing given the impact of colonialism on institutional reform is by advising oil-rich countries particularly those with experience of colonialism to prioritise investment in education and building of trust. Education is a great leveller that enables social mobility across social stratum. By investing in education and basic training, the barriers from inequity and access to opportunities introduced by colonial heritage can be reduced. Also, educating the population reduces the complexity of governance by making both the ruler and ruled more likely to have constructive debates; by being able to learn continually, effectively communicate and collaborate, and strategise how to relate rent to socio-economic improvement. In contrast to investing in public infrastructures that require constant maintenance, investment in social capital like building a shared sense of identity, understanding, norms, values, and cooperation would improve social trust. It could effectively make citizens more engaging in their civic duties that demand institutional reforms.

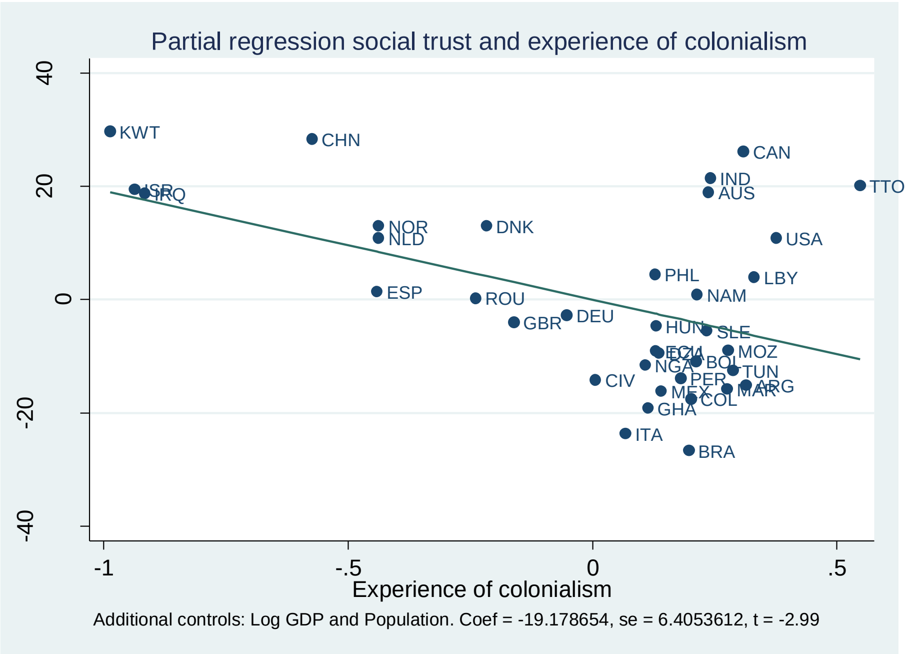

Figure 2.7: Social Trust Index and the Experience of Colonialism

We examine how if colonised countries have lower literacy levels (Model IX) and if the effect of colonialism on literacy operates through bequeath of weak quality of institutions (Model XI). Good institutions make it promising to invest in education that enables citizens and the government from reaching a consensus on how to improve the allocation of benefits from rents.

We test this hypothesis in Table 2.4. We show in Models IX that colonised have a higher number of adults who could not read and write. We show in Model XI that channel for the low number of literate is through bequeathing of weak institutions conditional on the colonial experience. Perhaps a prerequisite for disrupting and imposing weak institutions in the colonies would be first to design a system of education that directly supported colonialism through constituted ideological strategies that rationalised, naturalised, and legitimised colonialism as a natural order (Martin, 2002, p. 210). Another way is being selective in the category of people that would benefit from education. Inequality in access to education could have enabled the formation of elitist governance structures that empowers selected individuals (Angeles 2007). If this bias becomes intergenerational, it could undermine how inequality in education could make it hard for citizens to demand reform in the inherited political structure (Acemoglu et al. 2012). The differences in education enrolment and literacy could make it hard for citizens to demand accountability and the reform institutions from the government.

Education matters for building and trust and trustworthiness are important for a successful institutional reform (Heinemann and Tanz 2008, Bjørnskov and Méon 2013). Trust has always been considered as a measure of social cohesion in diverse societies and a necessary condition for the successful reform of institutions that favours accountability and a keystone for successful economic development (Tilly 1990, Algan and Cahuc 2010). Trust and the confidence among groups facilitated social cohesion in the pre-colonial times and contributed to the legitimacy and survival of the administrative autonomy of the local state/kingdoms. A necessary step for the colonial imposition of weak institutions would be to break-up traditions that favoured social trust, social cohesion and administrative autonomy.

Table 2.4: Long term Impact of Colonialism on Current Education enrolment and Social trusts

Dependent Variables:	Log Illiteracy rate, adult total (% of people ages 15 and above)	Log Illiteracy rate, adult total (% of people ages 15 and above)	Log Illiteracy rate, adult total (% of people ages 15 and above)
	Model IX	**Model X**	**Model XI**
Colonised (Dummy = 1)	0.62***		
	(0.16)		
Institutional Quality (IQ)		0.049	-6.5***
		(0.66)	(0.78)
Log Depth	0.02	0.007	
	(0.03)	(0.04)	
Log depth (squared)	-0.016	-0.01	
	(0.02)	(0.03)	
Prior change in GDP/Capita	0.62	0.63	0.13
	(0.63)	(0.60)	(0.80)
Border before First discovery (Dummy =1)	-0.11	0.03	0.58***
	(0.16)	(0.18)	(0.10)
Country Independence after 1960 (Dummy =1)	-0.22	-0.27	-0.40**
	(0.21)	(0.21)	(0.12)
Pre 1900 Coal discovery	0.19	0.21	0.88***
		(0.20)	(0.12)
F-Statistics	28.47	23.25	26.27
First-stage F-stat			50.69
Under identification test			48.93
Weak identification test			29.58
Anderson-Rubin Wald test			257.13

Notes: Data covers 50 countries with the discovery of at least a giant oil field during 1960-2015. Years with no significant discoveries were given the least value of 0.01 for the depth to be able to take the log. Colonised dummy is defined for countries with settler mortality and non-European countries with European language as an official language. All models control for Latitude, Latitude (squared) log of population growth, absolute latitude and time and regional dummies of Sub-sahara Africa (SSA), South America, Middle East and North Africa (MENA) and South Asia.
Model IX is the reduced-form regression of illiteracy on the colonial experience. Model X regresses illiteracy on institutions and Model XI show that the effect of the colonial experience on illiteracy level works through the institutional quality.
All models report robust standard errors (in parenthesis) clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

2.7 Assessing the Validity of the Colonial Dummy as an Instrument

In addition to the first-stage regression results, additional validity of the identification strategy rests on the assumption that the instruments are uncorrelated with the residual error term and directly uncorrelated to today's growth except through the effect it has on the quality of institutions. In other words, if certain factors influence long-term outcomes and such factors also influenced the decision to annex a country as a colony, or if historically, colonies systematically differ in some way to non-colonised areas, then the instrumental variable estimates are no longer consistent.

In this section, we consider various arguments that might affect the validity of our instrument. To test that being a colony and that the other instruments of depth and lag GDP do not directly affect current economic growth and current level of corruption, we run a reduced form specification in Table 2.5, and the result confirms that the relationship between the instruments on the outcomes (main model) are uninformative (Angrist and Krueger 2001, Murray 2006, French and Popovici 2011). Table 2.5 gives us two possible reasoning to justify the choice of our instruments. First, the instruments are not significantly correlated with the outcome measure of income growth and second, the estimates tell us of the direction of causality of colonial experience and log of the depth of oil fields on income per capita growth in oil rich countries. Second, we can deduce from the signs on the instruments, the plausible causal ordering of our instrumental variable on the observed outcome (Cartwright 1989, Pearl 2000, Bazinas and Nielsen 2015).

Table 2.5: Reduced-form regressions for the test of the validity of instruments on economic and corruption outcomes

Dependent Variables	Log $\Delta GDP_{i,t+5}$	Corruption Perception Govt Officials Most (% respondents)	Corruption Perceptions Index	Would spend a whole day in court to give evidence: agree (% respondents)
	Model XII	**Model XIII**	**Model XIV**	**Model XV**
Colonised (Dummy = 1)	-0.04	-0. 09	5.36	0.13
	(0.04)	(0.09)	(3)	(0.11)
Log Depth	0.006	0.006	-0.56	-0.004
	(0.014)	(0.008)	(0.50)	(0.009)
Log depth (squared)	-0.009	0.006	-0.45	-0.004
	(0.01)	(0.006)	(0. 36)	(0.005)
Log GDP 3 − year lagged	0.19	-0.06	-2.49	0.006
	(0.21)	(0.09)	(6.10)	(0.08)
Log GDP 4 − year lagged	-0.28	0.08	11.59	0.04
	(0.22)	(0.09)	(5.91)	(0.09)
F-stat	82.47			
Root MSE	0.26	0.11	10.54	0.11

Notes: Data covers 69 countries with the discovery of at least a giant oil field during 1960-2015. All models control for two years lagged levels of GDP per capita, Latitude, Latitude (squared) log of population growth, absolute latitude and time and regional dummies of Sub-sahara Africa (SSA), South America, Middle East and North Africa (MENA) and South Asia.
All models report robust standard errors (in parenthesis) clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

Because colonised countries are likely to be artificial states that are more fractionated in terms of ethnic, language or religious than non-colonised states (Alesina et al. 2011), this can constitute additional channels outside of institutions that affect how the resource curse (Hodler 2006). But our sampled countries were selected based on giant oil discoveries; we expect this selection to be exogenous to European colonialisation and other recognised residual effects of colonisation that can constitute channels on development. In Table 2.6, we show that regression of the instruments on the ethnic, religious and language fractionalisation is not significant and adds no additional information.

Table 2.6: Reduced-form regressions for the test of the validity of instruments on ethnic, religious and language fractionalisation

Dependent Variables	**Ethnic fractionalisation**	**Language fractionalisation**	**Religious fractionalisation**
	Model XVI	**Model XVII**	**Model XVIII**
Colonised (Dummy = 1)	0.03	-0. 03	0.02
	(0.09)	(0.09)	(0.07)
Log Depth	-0.008	-0.009	0.002
	(0.01)	(0.01)	(0. 009)
Log depth (squared)	-0.004	-0.003	-0.006
	(0.007)	(0.007)	(0. 007)
Log GDP 3 − year lagged	-0.19	-0.17	-0.06
	(0. 13)	(0.12)	(0.18)
Log GDP 4 − year lagged	0.2	0.15	0.09
	(0.13)	(0.12)	(0.17)
Root MSE	0.16	0.18	0.18

Notes: Data covers 69 countries with the discovery of at least a giant oil field during 1960-2015. All models control for the year of independence dummy, Latitude, Latitude (squared) log of population growth, absolute latitude and time and regional dummies of Sub-sahara Africa (SSA), South America, Middle East and North Africa (MENA) and South Asia. All models report robust standard errors (in parenthesis) clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

Consistent estimation of the long-run effects of oil discoveries requires the use of depth as instruments for the size of discoveries is orthogonal to institutional quality and other important country characteristics. Previous cross-country studies have relied on initial subsoil assets (e.g., Van der Ploeg and Poelhekke 2010, Tsui 2011) and the use of geological features like the proportion of sedimentation basin as instruments. These could be problematic if initial endowments and the distribution of oil basins respond to economic or political factors (Cassidy 2019). In Table 2.7, we show that the use of depth as instruments for the size of discoveries are not found in richer countries. In contrast to geological features that rely on Fraction of country area covered by sedimentary basins (Cassidy 2019) and initial level of endowment (oil initially in-place) (Cotet and Tsui 2013), we show that the geologic features of depth are relatively uncorrelated with GDP and may plausible provide a better approach to isolating the effect of size of oil discoveries.

Table 2.7: Reduced-form regressions for the test of the validity of instruments on economic and corruption outcomes

Dependent Variables	Log Depth of oil fields	Log Depth of oil fields (squared)	Total oil-initially-in-place (ln) (Cotet & Tsui, 2013)	Fraction of country area covered by sedimentary basins (Cassidy 2019)
	Model XIX	**Model XX**	**Model XXI**	**Model XXII**
Log GDP	0.06	-0. 03	0.44**	0.04*
	(0.04)	(0.05)	(0.2)	(0.02)
Institutional index	-0.18	0.08	-1.28	-0.09
	(0.18)	(0.17)	(0.82)	(0.13)
F-stat	42.47	36.55	62.16	232.75
Root MSE	0.95	1.03	1.26	0.19

Notes: Data covers 69 countries with the discovery of at least a giant oil field during 1960-2015. All models control for Latitude, Latitude (squared) log of population growth, absolute latitude and time and regional dummies of Sub-sahara Africa (SSA), South America, Middle East and North Africa (MENA) and South Asia.
All models report robust standard errors (in parenthesis) clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

Historical technology adoption may affect subsequent economic development by facilitating the adoption of pre and post-industrial revolution technologies (Comin et al. 2010). It is also possible that places with significant technology adoption may be difficult to colonise, and because of the sophisticated military technology usage, may resist the attempt to colonisation. Finally, we wish to verify that early technology adoption and urbanisation *circa* 1000BC, both of which could have a persistent long-term effect, are uncorrelated to being a colony, we run a reduced-form regression of the status of being a colony on each of the technology adoption in agricultural, military, industry and the sectoral indexes in period 1500 AD while also controlling for other covariates in Table 2.8.

We show in our results in Table 2.8 that the colony dummy is uncorrelated to historical technology adoption. Early access and use of technology (military, agriculture, communication, transportation and industry) around 1500AD which could also have an enduring impact on subsequent economic performance (Comin et al. 2010) are uncorrelated to what made a location a colony (Table 2.8).

While historical technology adoption matters, however, it has no direct effect on the decision to colonise which we hypothesis to be mainly driven by the socio-political competitions among European superpowers which made them politically divided. The intense and relentless political competition among the "outward-looking" maritime European states (e.g., the Italy, Portugal, Holland, and Britain), the more "inward-looking" land-based states (e.g., the Hapsburg Empire, Prussia, France) and the agrarian states (e.g. Russia) helped to develop an expanding network that unified against the "gunpowder empires" (e.g., the Ottoman Turks, Safavid Persia, Mughal India, and the Ming and Manchu dynasties).

The question of what made Europe, despite the more advancement of many societies in Asia and the Middle East, to establish a colony of other countries is a complex issue that is not easy to answer. The question has been the focus of scholarly debates, which is beyond the scope of this study (see, e.g., Jared 1997, Findlay 1992, Andrade 2010, Wilcox 2010, and Hoffman 2017). However, to briefly annotate some important reasons; Jared (1997) suggests that colonisation were mainly 'accidents' of history and not created out of "superior intelligence", but is the result of a chain of developments, each made possible by certain preconditions. Other discourses provide similar arguments. For example, Hoffman (2017) suggests that economic, political, and historical changes in Europe gave rise to competition among European states and which played a pivotal role in the story. In other words, it is arguable that such "accidents" or "circumstances" were random and uncorrelated to the conditions that cause economic development in the 21st century. Findlay (1992) added that incentives enabled the European to colonise even more sophisticated empires.

Table 2.8: Reduced-form regressions for correlation between instruments and historical (1500AD) technology adoption and urbanisation

	Independent Variables			
	Average technology adoption in agriculture in 1500AD	Average Military technology adoption in 1500AD	Average technology adoption in industry 1500AD	Average of the sectoral technology adoption indexes in 1500AD
Dependent variable	**Model XXIII**	**Model XXIV**	**Model XXV**	**Model XXVI**
Colonised (Dummy = 1)	-0.19	-0.009	-0.12	-0.16
	(0.26)	(0.16)	(0.17)	(0.21)
R(Squared)	0.71	0.72	0.7	0.71
F-stat	28	29.5	30	29.08

Notes: Data covers 47 countries with the discovery of at least a giant oil field. The technology adoption variables in Models XXIII, XXIV, XXV and XXVI are taken from Comin et al. 2010 https://www.aeaweb.org/aej/mac/app/2008-0131_app.pdf and are adjusted for 1500AD international migration.

All models control for log population (1500AD), urbanizaton index (1000BC to 1AD), landlock country dummy, pre 1900 coal disocverydummy, absolute latitude and regional dummies of Sub-sahara Africa (SSA), South America, the Middle East and North Africa (MENA) and South Asia.

All models report robust standard errors (in parenthesis) clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

2.8 Additional Robustness: Oil wealth and Disaggregated Institutional Index components

In this section, we examine specific issues with measurements employed and examine if considering alternative measurement options would change the results. First, the measure of oil abundance used is the magnitude of the number of oil discoveries. This measurement does not take into account the monetary value of the discoveries. As shown by Brunnschweiler and Bulte (2008) and Van der Ploeg and Poelhekke (2009), using the value of resource wealth (the value of the subsoil resources) is a better measure of resource abundance. Oil discoveries could transmit the shock to the economy is via the potential contribution on government finances and accounting for the monetary value of the oil abundance might be a better way to check the robustness of impact of oil discoveries on the income per capita. Low prices of oil reserves may not be as stimulating as when the prices of reserves per barrel are high. In Table 2.9 (Model XXVII), using the value of oil wealth does not change our result.

Also, we disaggregate institutional quality and consider each component on its own to access its relative impact on reducing the change in income per capita (Models XXVIII, XXIX and XXX). From practical perspective, it is important to identify which institution matters as the aggregated institutional quality tells us very little about specific governance reforms that will reliably improve poverty and development outcomes (Acemoglu and Johnson 2005). Importantly, it may be impossible from a political and social perspective to change the entire institutional regime, whereas by identifying which aspects of institutions are beneficial, efforts can be intensified in that respect.

Also, from a measurement perspective, our measure of institutional quality is the unweighted average component of three institutional quality indicators of unequal years; it is possible to have introduced a measurement bias in the unit of institutional quality used. For instance, a country might have a higher risk of expropriation but be low in government effectiveness. Besides, a country can have limited observations for a particular component in years where it performed better and more when it performed poorly.

We unbundled the institutional quality indicators and run separate regressions for the disaggregated indicators of average risk against expropriation, executive constraints and government effectiveness in oil-rich countries (Table 2.9). Taken independently, the components of the institutional quality are not as important and offer limited information in terms of translating the impact of oil discoveries on growth. Nevertheless, we find that countries with higher constraints on the executive's accountability (Model XXVIII) can significantly reduce the lower growth associated with oil discovery.

This result is surprising because it contrasts previous evidence that points to property rights that guarantee private and domestic ownership as the most important institution (Luong and Weinthal 2010). Changing property rights only tinkers institutions at the economic margins, whereas, imposing restraint that improves the level of accountability facilitates an almost infinite variety of interactions that allows more efficient and transparent utilisation of the available resources.

If the restraints placed on the chief executive’s scope for unilateral action increase, due either to “answerability”, “liability”, or the expectation of account-giving, fewer rents will be less incentive for "the misuse or the abuse of public office for private gains". Importantly, if constraints are imposed on the executive, there will be a limit to corrupt practices, misappropriation of public funds, and less exposure of private investments to executive predation.

Table 2.9: Measures of Oil wealth, Oil Discoveries and Disaggregated Institutional quality

Dependent Variables	**Log ΔGDP i,t+5**	**Log ΔGDP i,t+5**	**Log ΔGDP i,t+5**	**Log ΔGDP i,t+5**
	Model XXVII	**Model XXVIII**	**Model XXIX**	**Model XXX**
Log Oil-Wealth (US$/barrel)	-0.06**			
	(0.02)			
Log Oil Discovery (mmboe)		-0.06**	-0.05	0.0002
		(0.02)	(0.08)	(0.004)
Institutional Quality (IQ)	0.19			
	(0.38)			
Executive constraints		0.05		
		(0.05)		
Expropriation risk			-0.01	
			(0.17)	
Government effectiveness				-0.21
				(0.13)
Interaction Term (Log Oil ×IQ)	0.10**	0.02***	0.007	0.002
	(0.04)	(0.005)	(0.01)	(0.01)
Prior change in GDP/Capita $Log\left(\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$	2.6***	1.96**	6.43	2.91***
	(0. 98)	(0.98)	(5.92)	(0.96)
1900s Coal Discoveries	0.09***	0.04**	0.08	0.10***
	(0.02)	(0.02)	(0.08)	(0.02)
Border before First discovery (Dummy =1)	-0.006	-0.05***	-0.04	0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Country Independence after 1960 (Dummy =1)	-0.04	0.06**	0.01	-0.05
	(0.03)	(0.03)	(0.04)	(0.03)
Net marginal effect of Oil Discovery	0.04**	-0.04**		
Estimator	IV (GMM)	IV (GMM)	IV (GMM)	IV (GMM)
Hansen J test (Over-identification test of all instruments)	1.90	0.923	1.095	2.088
Under-identification test (Kleibergen-Paap rk LM statistic)	28.443	14.949	1.624	18.164
Weak-instrument-robust inference (Anderson-Rubin Wald F-stat)	73.32	63.07	64.78	73.32

Notes: Data covers 69 countries with the discovery of at least a giant oil field during 1960-2015. Years with no significant discoveries were given the least value of 0.01 to be able to take the log.
All models control for Latitude, Latitude (squared) log of population growth, absolute latitude and time and regional dummies.
All Models use Instrumental Variable (IV) GMM estimator to control for the endogenous bias of Oil discovery, Institutional Quality (IQ) (both in aggregates Model XX) and disaggregated (Models XXI, XXII and XXIII), the interaction term (Log Oil Disc×IQ) and Prior change in GDP $\left(\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$. The instruments are Colony (Ci) dummy, log depth of oil field, log depth field(squared) and 2-year lagged levels of GDP respectively

Model XXVII measures oil abundance with the monetary value of the discovery in terms of US$ per barrel.
Models XXVIII to XXX measure the disaggregated institutional index individually
All models report robust standard errors (in parenthesis) clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

2.9 Conclusion

The global increase in the demand for hydrocarbon fuel is driving oil exploration activities in many developing countries where a significant percentage of the future oil production is estimated to occur[15] (Finer et al. 2008, Abas et al. 2015). But in many middle and low income petroleum-endowed countries, there is an inverse relationship between petroleum endowment and development outcomes; a condition often called the resource curse. While there is no consensus on the cause of the curse, popular explanation conditions resource curse on the quality of institutions. Although this is a logical conclusion, however, insights from another strand of the literature suggest that the channel of causality of resource curse could have arisen from historical colonial legacies of resource exploitation during the 16th-19th colonisation era. In this paper, we contribute by exploring the colonial heritage channel to explain the resource curse. We hypothesise that European-organised mercantilism and exploitative resource management during colonialism could have an enduring effect on the structures and types of governance that provide effective checks and balance and encourage sustainable resource management.

Our hypothesis is conditioned on the 16th to 19th century prevailing socio-political and economic conditions in Europe and by the level of non-oil resource abundance of economic value to European colonisers in the colonies, both of which encouraged European-organised mercantilism and the differences in colonial management patterns (Acemoglu et al. 2001, Hoffman 2012). These factors subsequently have no direct impact on current income in oil-rich states except through the inherited socio-political institutional legacy that moderates how oil wealth translates into economic growth prevailing that socio-political conditions in Europe drove colonial occupation of the territory as at the time (Hoffman 2012).

We test this hypothesis using a two-stage IV-GMM model and examine how European colonisation indirectly reinforces the resource curse in 69 oil-rich countries with at least a discovery of giant oil reserves from 1960-2015. We validate the colonial instruments by showing that they are not significantly correlated with current economic growth and also are not significantly correlated with residual of economic growth from the historical 1000BC to 0AD technology adoption. In the first stage, we show that colonised countries have poorer institutional quality than non-colonised countries. We also find that log of the depth of oil fields correlates with the magnitude of oil abundance and that the log of oil abundance negatively impacts income per capita after accounting for the initial level of economic performance and institutional quality. In the second stage, we find that countries with more oil abundance have negative growth, but the institutional quality has a strong moderating impact on the resource curse. Given the same oil abundance, oil-countries that were not colonised have better institutional quality and can reverse the adverse effect of oil abundance, whereas colonised

[15] A large amount of oil-reserves has already been discovered in developed countries, and as they are becoming depleted, emphasis is placed on the untapped reserves in developing countries (Collier 2010). For instance, OECD countries have discovered 130 thousand USD worth of subsoil natural resources per square km compared to 25 thousand in Africa (Collier 2010).

countries cannot. Our analysis is robust to alternative oil abundance measurements and the disaggregated components of institutional quality.

Conditional on colonial heritage, we examine the plausible mechanism through which institutions and the resource abundance lead to negative growth. We examine the channel of corruption. Corruption is a documented characteristic feature in many colonised oil-rich countries where are documented evidence cases of corruption scandals. If there are large sums of money in countries with bequeath of weak institutions, the temptation among decision-makers to engage in corruption will inevitably increase. Good institutions offer incentives for decision-makers to overcome "social dilemmas" arising from placing personal priorities (corrupt practices) above public interest (Ostroam 2009). We find that an increase in oil abundance is associated with an increase in the Corruption Index, and after conditioning this relationship on institutional quality, the estimate suggests that corruption index fall. Inherited weak institutions aid corruption and reduce the incentives for government agents to be accountable and effective in the management of resource rents. The result also suggests that strengthening the quality of executive constraints, protection and expropriation risk and government effectiveness in oil rich countries will help to reduce the measurement of corruption and may help the government to allocate rents into activities that favour growth optimally.

We also test, conditional on colonial heritage, what structures prevent oil-rich countries from reforming institutions and specifically, understand the possible barrier imposed by colonisation that makes oil-endowed countries hard to reform institutions to the ones that are growth-enhancing and that ensure accountability. On this, we explore the correlation between colonialism, education and social trust. The persistence of the inequality in education on school enrolment introduces significant constraints on the quality of civic participation, call for institutional reforms and participation in support of an inclusive system of governance rather than a narrow-based regime (Glaeser et al. 2007). Also, the breakdown in social trust among citizens associated with colonial subjugation could make it hard for effective civic participation and how citizens effectively demand institutional reforms. We find a big gap between student enrolment in primary and secondary education in colonised and non-colonised countries and countries with colonial heritage have less trust.

These new empirical insights on the enduring impact of colonialism suggest oil-rich countries wishing to reverse the resource curse should have structures put in place that undoes some of the negative implication of colonial experience on the quality of institutions. Notably, we suggest that empowering citizens' right to demand accountability and transparency from governments in oil-rich countries with experience of European colonialism could reverse the resource curse. To achieve citizens' empowerment, we recommend that oil windfall should be invested in strengthening human capital. For instance, by investing in education, social mobility would be enhanced, and the barriers from inequity introduced by colonial heritage can be reduced. Institutions are likely to improve from educated and constructive debates; making both leaders and subjects able to learn, effectively communicate and meaningfully collaborate continually, and strategies on how to relate rent to socio-economic improvement. The effects of an investment in human capital development would, therefore, create a critical mass of enlightened citizens who can demand transparency and institutional reform that constrains political leaders' scope for unilateral actions, and ultimately, reverse resource curse.

References

Abas, N., Kalair, A., & Khan, N. (2015). Review of fossil fuels and future energy technologies. *Futures*, *69*, 31-49.

Acemoglu D. Johnson S, and Robinson, J.A. (2001). The colonial origins of comparative development: an empirical investigation. *American Economic Review*. 91:1369–401

Acemoglu, D. and Robinson, J.A. (11 March 2012). "The Problem With U.S. Inequality". HuffPost.

Acemoglu, D., & Johnson, S. (2005). Unbundling institutions. *Journal of Political Economy*, *113*(5), 949-995.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2012). The colonial origins of comparative development: An empirical investigation: Reply. *American Economic Review*, *102*(6), 3077-3110.

Acemoglu, D., Johnson, S., & Robinson, J.A. (2005). A response to Albouy's. *A Reexamination Based on Improved Settler Mortality Data" MIT Department of Economics Working Paper*

Ades, A., & Di Tella, R. (1999). Rents, competition, and corruption. *American economic review*, *89*(4), 982-993.

Aghion, P., Akcigit, U., Cagé, J., & Kerr, W. R. (2016). Taxation, corruption, and growth. *European Economic Review*,*86*, 24-51.

Aghion, P., Alesina, A., & Trebbi, F. (2004). Endogenous political institutions. *The Quarterly Journal of Economics*,*119*(2), 565-611.

Albouy, D. Y. (2008). The colonial origins of comparative development: an investigation of the settler mortality data (No. w14130). National Bureau of Economic Research.

Albouy, D. Y. (2012). The colonial origins of comparative development: an empirical investigation: comment. *American Economic Review*, *102*(6), 3059-76.

Aldrich, R., & McCreery, C. (2016). *European Sovereigns and their Empires beyond the Seas*. In: Aldrich, R., & McCreery, C. (Eds.), *Crowns and Colonies* (pp 9-11). Manchester: Manchester University Press

Alesina, A., Easterly, W., & Matuszeski, J. (2011). Artificial states. *Journal of the European Economic Association*, *9*(2), 246-277.

Alexeev, M., & Conrad, R. (2009). The elusive curse of oil. *The Review of Economics and Statistics*, *91*(3), 586-598.

Algan, Y., & Cahuc, P. (2010). Inherited trust and growth. *American Economic Review*, *100*(5), 2060-92.

Allcott, H., & Keniston, D. (2017). Dutch disease or agglomeration? The local economic effects of natural resource booms in modern America. *The Review of Economic Studies*, *85*(2), 695-731.

Andrade, T. (2010). Beyond Guns, Germs, and Steel: European Expansion and Maritime Asia, 1400-1750. *Journal of Early Modern History*, *14*(1-2), 165-186.

Angeles, L. (2007). Income inequality and colonialism. *European Economic Review*, 51(5), 1155-1176.

Angeles, L., & Neanidis, K. C. (2015). The persistent effect of colonialism on corruption. *Economica*, *82*(326), 319-349.

Angrist, J. D., & Krueger, A. B. (2001). Instrumental variables and the search for identification: From supply and demand to natural experiments. *Journal of Economic Perspectives*, *15*(4), 69-85.

Angrist, J. D., Imbens, G. W., & Rubin, D. B. (1996). Identification of causal effects using instrumental variables. *Journal of the American Statistical Association*, *91*(434), 444-455.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277-297.

Arezki, R., Ramey V.A. and Sheng L. (2017). News Shocks in Open Economies: Evidence from Giant Oil Discoveries. *The Quarterly Journal of Economics*, 103–155.

Banerjee, A., & Iyer, L. (2005). History, institutions, and economic performance: The legacy of colonial land tenure systems in India. *American Economic Review*, *95*(4), 1190-1213.

Bauerman, H. (1911). *Coal*. In Chisholm, Hugh (ed.). *Encyclopædia Britannica*. **6** (11th ed.).Cambridge University Press. p. 579.

Baum, C. F., Schaffer, M. E., & Stillman, S. (2003). Instrumental variables and GMM: Estimation and testing. *The Stata Journal*, *3*(1), 1-31

Bazinas, V., & Nielsen, B. (2015). *Causal transmission in reduced-form models* (No. 2015-W07). Economics Group, Nuffield College, University of Oxford.

Bertocchi, G., & Canova, F. (2002). Did colonization matter for growth?: An empirical exploration into the historical causes of Africa's underdevelopment. *European Economic Review*, *46*(10), 1851-1871.

Bertram, G. (2007). Reappraising the legacy of colonialism: a response to Feyrer and Sacerdote. *Island Studies Journal*,*2*(2), 239-254.

Besley, T., & Persson, T. (2009). The origins of state capacity: Property rights, taxation, and politics. *American Economic Review*, *99*(4), 1218-44.

Bjørnskov, C., & Méon, P. G. (2013). Is trust the missing root of institutions, education, and development?. *Public Choice*,*157*(3-4), 641-669.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115-143.

Bohn, H., & Deacon, R. T. (2000). Ownership risk, investment, and the use of natural resources. *American Economic Review*, *90*(3), 526-549

Bolt, J., & Bezemer, D. (2009). Understanding long-run African growth: colonial institutions or colonial education?. *The Journal of Development Studies*, *45*(1), 24-54.

Brollo, F., Nannicini, T., Perotti, R., & Tabellini, G. (2013). The political resource curse. *American Economic Review*, *103*(5), 1759-96.

Bruhn, M., & Gallego, F. A. (2012). Good, bad, and ugly colonial activities: do they matter for economic development?. *Review of Economics and Statistics*, *94*(2), 433-461.

Brunnschweiler, C. N., & Bulte, E. H. (2008). The resource curse revisited and revised: A tale of paradoxes and red herrings. *Journal of Environmental Economics and Management*, 55(3): 248-264

Cappelli, G., & Baten, J. (2017). European Trade, Colonialism, and Human Capital Accumulation in Senegal, Gambia and Western Mali, 1770–1900. *The Journal of Economic History, 77(3),* 920-951.

Cartwright, N. (1989). *Nature's Capacities and their Measurement.* Clarendon Press Oxford

Casey, K., Glennerster, R., & Miguel, E. (2012). Reshaping institutions: Evidence on aid impacts using a preanalysis plan. *The Quarterly Journal of Economics*, *127*(4), 1755-1812.

Cassidy, T. (2019). The long-run effects of oil wealth on development: Evidence from petroleum geology. *The Economic Journal*, *129*(10), 2745-2778.

Chabova, K. (2017). Measuring corruption in Europe: public opinion surveys and composite indices. *Quality & Quantity*, *51*(4), 1877-1900.

Collier, P. (2010). *The Plundered Planet*. Oxford University Press

Comin, D., Easterly, W., & Gong, E. (2010). Was the wealth of nations determined in 1000 BC?. *American Economic Journal: Macroeconomics*, *2*(3), 65-97.

Corden, W. M. (1984). Booming sector and Dutch disease economics: survey and consolidation. O*xford Economic Papers*, *36*(3), 359-380.

Corden, W. M., & Neary, J. P. (1982). Booming sector and de-industrialisation in a small open economy. *The Economic Journal*, *92*(368), 825-848.

Cust, J., & Harding, T. (2014). Institutions and the location of oil exploration. *Journal of the European Economic Association*.

d'Agostino, G., Dunne, J. P., & Pieroni, L. (2016). Corruption and growth in Africa. *European Journal of Political Economy*,*43*, 71-88.

David, A. P., & Wright, G. (1997). Increasing returns and the genesis of American resource abundance. *Industrial and Corporate Change*, *6*(2), 203-245

Dell, M. (2010). The persistent effects of Peru's mining mita. *Econometrica; Journal of the Econometric Society*, *78*(6), 1863-1903.

Dell, M., & Olken, B. A. (2017). The Development Effects of the Extractive Colonial Economy: The Dutch Cultivation System in Java (No. w24009). National Bureau of Economic Research.

Donchev, D., & Ujhelyi, G. (2014). What do corruption indices measure?. *Economics & Politics*, *26*(2), 309-331.

Du, J. (2010). Institutional quality and economic crises: legal origin theory versus colonial strategy theory. *The Review of Economics and Statistics*, *92*(1), 173-179.

Dunning, T. (2008). *Crude democracy: Natural resource wealth and political regimes* (Vol. 7). Cambridge: Cambridge University Press.

Easterly, W., & Levine, R. (2003). Tropics, germs, and crops: how endowments influence economic development. *Journal of Monetary Economics*, *50*(1), 3-39.

Engerman, S. L., & Sokoloff, K. L. (2005). *Colonialism, inequality, and long-run paths of development* (No. w11057). National Bureau of Economic Research.

Engle, R. F., Hendry, D. F., & Richard, J. F. (1983). Exogeneity. *Econometrica: Journal of the Econometric Society*, 277-304.

Eynde, O. V. (2016). Military service and human capital accumulation: Evidence from Colonial Punjab. *Journal of Human Resources*, 51(4), 1003-1035

Fernihough, A., & O'Rourke, K. H. (2014). *Coal and the European industrial revolution* (No. w19802). National Bureau of Economic Research.

Feyrer, J. and Sacerdote, B. (2009). Colonialism and modern income: islands as natural experiments. *The Review of Economics and Statistics*, *91*(2), 245-262

Findlay, R. (1992). The roots of divergence: Western economic history in comparative perspective. *The American economic review*, *82*(2), 158-161.

Finer, M., Jenkins, C. N., Pimm, S. L., Keane, B., & Ross, C. (2008). Oil and gas projects in the western Amazon: threats to wilderness, biodiversity, and indigenous peoples. *PloS one*,*3*(8), e2932.

French, M. T., & Popovici, I. (2011). That instrument is lousy! In search of agreement when using instrumental variables estimation in substance use research. *Health Economics*,*20*(2), 127-146.

Gallup, J. L., Sachs, J. D., & Mellinger, A. D. (1999). Geography and economic development. *International Regional Science Review*, *22*(2), 179-232

Glaeser, E. L., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004). Do institutions cause growth?. *Journal of Economic Growth*, *9*(3), 271-303.

Glaeser, E. L., Ponzetto, G. A., & Shleifer, A. (2007). Why does democracy need education?. *Journal of Economic Growth*, *12*(2), 77-99.

Hall, A. R. (2005). *Generalized method of moments*. Oxford University Press.

Hall, R. E., & Jones, C. I. (1999). Why do some countries produce so much more output per worker than others?. *The Quarterly Journal of Economics*, *114*(1), 83-116.

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica: Journal of the Econometric Society*, 1029-1054.

Hardoon, D., & Heinrich, F. (2013). *Global corruption barometer 2013*. Transparency International.

Hayashi, F. (2000). Econometrics. 2000. *Princeton University Press. Section, 1*, 60-69.

Heinemann, F., & Tanz, B. (2008). The impact of trust on reforms. *Journal of Economic Policy Reform*, *11*(3), 173-185.
Hodler, R. (2006). The curse of natural resources in fractionalized countries. *European Economic Review*, *50*(6), 1367-1386.
Hoffman, P. T. (2012). Why was it Europeans who conquered the world?. *The Journal of Economic History*, *72*(3), 601-633.
Hoffman, P. T. (2017). *Why did Europe conquer the world?* (Vol. 54). Princeton University Press.
Horn, Myron, K. (2014). "Giant Oil and Gas Fields of the World," http://www.datapages.com/AssociatedWebsites/GISOpenFiles/HornGiantFields.aspx, 2014
Imbens, G. and Angrist, J. (1994), "Identification and Estimation of Local Average Treatment Effects", *Econometrica*, 62, 467-476.
Iyer, L. (2010). Direct versus indirect colonial rule in India: Long-term consequences. *The Review of Economics and Statistics*, *92*(4), 693-713.
Jacobsen, G. D., & Parker, D. P. (2016). The economic aftermath of resource booms: evidence from boomtowns in the American West. *The Economic Journal*, *126*(593), 1092-1128.
Jaggers, K. Marshall, M.G. (2000). *Polity IV Project*. Center for International Development and Conflict Management. University of Maryland
Jared, D. (1997). Guns, germs, and steel: the fates of human societies. *NY: WW Norton & Company*, *14*.
Kaufmann, D., Kraay, A., & Pablo, Z. L. (2002). *Governance matters II-updated indicators for 2000-01* (No. 2772). The World Bank.
King, S. J. (2007). Sustaining Authoritarianism in the Middle East and North Africa. *Political Science Quarterly*, *122*(3), 433-459.
Knack, S., & Keefer, P. (1995). Institutions and economic performance: cross-country tests using alternative institutional measures. *Economics & Politics*, *7*(3), 207-227
Kolstad, I., & Søreide, T. (2009). Corruption in natural resource management: Implications for policy makers. *Resources Policy*, *34*(4), 214-226.
La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R. (1998). Law and finance. *J. Polit. Econ*. *106*:1113–55
Lee, J. H., Iwasa, Y., Dieckmann, U., & Sigmund, K. (2019). Social evolution leads to persistent corruption. *Proceedings of the National Academy of Sciences*, 201900078.
Luong, P. J., & Weinthal, E. (2010). *Oil is not a curse: ownership structure and institutions in Soviet successor states*. Cambridge University Press.
Martin, I. P. (2002). Canon and pedagogy: The role of American colonial education in defining standards for Philippine literature. In A. Kirkpatrick (Ed.), *Englishes in Asia: Communication, identity, power and education* (pp. 201– 11). Melbourne, Australia: Language Australia.
Mauro, P. (1995). Corruption and growth. *The quarterly journal of economics*, *110*(3), 681-712.
Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. *The Economic Journal*, *116*(508), 1-20.
Mellinger, A. D., Sachs, J. D., & Gallup, J. L. (2000). *Climate, Water Navigability, and Economic Development*. Chicago-Graduate School of Business.
Michalopoulos, S., & Papaioannou, E. (2016). The long-run effects of the scramble for Africa. *American Economic Review,106*(7), 1802-48.
Michalopoulos, S., & Papaioannou, E. (*in press*) Historical Legacies and African Development. *Journal of Economic Literature (Forthcoming)*.
Migge, B., & Léglise, I. (2008). Language and colonialism: Applied linguistics in the context of creole communities. In *Hellinger, A. and Pauwels, P.(eds.). Handbook of Language and Communication: Diversity and Change*. De Gruyter.
Milner, C. W. D., Rogers, M. A., & Evans, C. R. (1977). Petroleum transformations in reservoirs. *Journal of Geochemical Exploration*, *7*, 101-153.

Muehlenbachs, L., Spiller, E., & Timmins, C. (2015). The housing market impacts of shale gas development. *American Economic Review*, *105*(12), 3633-59.
Murray, M. P. (2006). Avoiding invalid instruments and coping with weak instruments. *Journal of Economic Perspectives*,*20*(4), 111-132.
Nichols, A. (2006, July). Weak instruments: An overview and new techniques. In *Stata 5th North American Meeting Presentation*
Nissen, A. (2019). The European Union as a Manager of Global 'Business and Human Rights' Regulation: Country-By-Country Reporting Rules. *UCL Journal of Law and Jurisprudence*, *8*(2), 141-163.
Norman, J. H. (2001). Non-technical Guide to Petroleum Geology Exploration. *Drilling and Production. 2nd edition, printed in USA*, 1-15.
North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.
Nunn, N., & Puga, D. (2012). Ruggedness: The blessing of bad geography in Africa. *Review of Economics and Statistics*, *94*(1), 20-36.
Nunn, N., & Wantchekon, L. (2011). The slave trade and the origins of mistrust in Africa. *American Economic Review*,*101*(7), 3221-52.
Ostrom, E. (2009). *Understanding institutional diversity*. Princeton university press.
Pelzl, P., & Poelhekke, S. (2018). *Good mine, bad mine: Natural resource heterogeneity and Dutch disease in Indonesia* (No. TI 2018-073/VIII). Tinbergen Institute Discussion Paper.
Persson, A., Rothstein, B., & Teorell, J. (2013). Why anticorruption reforms fail—systemic corruption as a collective action problem. *Governance*, *26*(3), 449-471.
Philippi, G. T. (1965). On the depth, time and mechanism of petroleum generation. *Geochimica et Cosmochimica Acta*, *29*(9), 1021-1049.
Phillipson, R. (1992). Linguistic imperialism. *The Encyclopedia of Applied Linguistics*, 1-7.
Richards, L. (2016). Using survey methods to research corruption. *How to research corruption,* 4-12.
Robinson, J. A., & Torvik, R. (2005). White elephants. *Journal of Public Economics*, *89*(2), 197-210.
Robinson, J. A., Torvik, R., & Verdier, T. (2006). Political foundations of the resource curse. *Journal of Development Economics*, *79*(2), 447-468
Ross, M. (2012). *The oil curse: How petroleum wealth shapes the development of nations*. Princeton University Press.
Ross, M. L. (2015). What have we learned about the resource curse?. *Annual Review of Political Science*, *18*, 239-259.
Sachs, J. D., & Warner, A. M. (1999). The big push, natural resource booms and growth. *Journal of Development Economics*, *59*(1), 43-76.
Saftić, B., Peh, Z., Velić, J., & Jüttner, I. (2001). Interdependence of petrophysical properties and depth: Some implications of multivariate solution on distinction between the Lower Pontian hydrocarbon-bearing sandstone units in the western part of the Sava Depression. *Geologia Croatica*, *54*(2), 259-277.
Teorell, J., Dahlberg, S., Holmberg, S., Rothstein, B., Khomenko, A., & Svensson, R. (2015). The quality of government standard dataset, version jan15. *University of Gothenburg: The Quality of Government Institute*.
Tilly, C. (1990). *Coercion, capital, and European states, AD 990*. Cambridge: Basil Blackwell.
Tissot, B. P., & Welte, D. H. (2013). *Petroleum formation and occurrence*. Springer Science & Business Media.
Tissot, B., Durand, B., Espitalie, J., & Combaz, A. (1974). Influence of nature and diagenesis of organic matter in formation of petroleum. *AAPG Bulletin*, *58*(3), 499-506.

Tissot, B., Y. Califet-Debyser, G. Deroo, and J. L. Oudin, (1971). Origin and evolution of hydrocarbons in early Toarcian shales, Paris basin, France: Am. Assoc. Petroleum Geologists Bull., v. 55, p. 2177-2193

Uslaner, E. M. (2002). *The moral foundations of trust*. Cambridge University Press.

Uslaner, E. M., & Brown, M. (2005). Inequality, trust, and civic engagement. *American Politics Research*, *33*(6), 868-894.

Uslaner, E. M., & Rothstein, B. (2012). Mass education, state-building and equality. *QoG Working Paper Series*, *2012*(5), 5.

Van der Ploeg F. (2011). Natural resources: curse or blessing? *Journal of Economic Literature 49*(2), 366–420.

Van der Ploeg, F., & Poelhekke, S. (2009). Volatility and the natural resource curse. *Oxford economic papers*, *61*(4), 727-760.

Van der Ploeg, F., & Poelhekke, S. (2017). The impact of natural resources: Survey of recent quantitative evidence. *The Journal of Development Studies*, 1-12

Weber, A. S. (2011). Politics of English in the Arabian Gulf. *FLTAL 2011 proceedings*, 60-66.

Wilcox, M. (2010). Marketing conquest and the vanishing Indian: An indigenous response to Jared Diamond's Guns, germs, and steel and Collapse. *Journal of Social Archaeology*,*10*(1), 92-117.

Wooldridge, J. (2001). *Econometric Analysis of Cross-Section and Panel Data*. MIT Press, 2001.

Wright, G. (1990). The Origins of American Industrial Success, 1879-1940. *The American Economic Review*, *80*(4), 651-668.

Wright, G., & Czelusta, J. (2002). Exorcizing the resource curse: minerals as a knowledge industry, past and present.*Available online at http://www-econ. Stanford. edu/faculty/workp/swp02008. pdf*.

Wysmułek, I. (2019). Using public opinion surveys to evaluate corruption in Europe: trends in the corruption items of 21 international survey projects, 1989–2017. *Quality & Quantity*, 1-22.

Yousef, T. M. (2004). Development, growth and policy reform in the Middle East and North Africa since 1950. *Journal of Economic Perspectives*, *18*(3), 91-115.

Appendix I: Summary and descriptive statistics of Variables

	All Countries					Non-Colonised Oil-Rich Countries					Colonised Oil-Rich Countries				
Variable	Obs	Mean	Std.dev	Min	Max	Obs	Mean	Std.Dev	Min	Max	Obs	Mean	Std.Dev	Min	Max
log GDP/capita	3,215	8.40	1.55	4.87	11.65	1,527	8.83	1.65	4.87	11.65	1,688	8.01	1.34	5.10	10.91
Oil Discoveries (mmboe)	3,865	0.46	4.00	0.00	176.06	2,073	0.70	5.37	0.00	176.06	1,792	0.19	1.03	0.00	21.22
Institutional quality	3,809	0.48	0.30	-0.18	0.99	2,017	0.46	0.35	-0.18	0.99	1,792	0.49	0.22	0.17	0.97
Protection against Expropriation Risk (1982-1997)	3,417	7.34	1.66	2.40	9.98	1,625	7.77	1.83	2.40	9.98	1,792	6.96	1.37	4.01	9.97
Government Effectiveness (1998-2000)	3,809	0.03	1.02	-1.63	2.17	2,017	0.13	1.11	-1.63	2.17	1,792	-0.08	0.89	-1.47	1.89
Executive Constraints (1960-2000)	3,753	3.76	2.02	1.00	7.00	1,961	3.64	2.14	1.00	7.00	1,792	3.89	1.86	1.45	7
Depth of Oil fields	3,865	-3880	21713	-300000	17.42	2,073	-4292	22954	-300000	14.02	1,792	-3403	20178	-300000	17
Log Population Density	3,676	0.53	0.86	-6.44	2.87	1,892	0.41	1.10	-6.44	2.87	1,784	0.66	0.45	-3.44	1.6
Absolute Latitude	3,809	26.15	16.82	0.23	61.52	2,017	33.67	15.72	1.65	61.52	1,792	17.69	13.72	0.23	56.13

Appendix II

First stage Estimates of Model III of Table 2.1

	First Stage for IV (GMM) estimates (Model III)			
	A	B	C	D
	Log Oil (mmboe)	Institutional Quality	Interaction term	Log Prior change in GDP/Capita
Colonised (Dummy = 1)	-0.07**	0.12***	-0.81***	-0.002
	(0.3)	(0.01)	(0.13)	(0.004)
Log depth	2.66***	-0.01***	1.67***	0.001
	(0.05)	(0.004)	(0.09)	(0.002)
Log depth (squared)	-0.70***	-0.004	-0.30***	-0.0002
	(0.04)	(0.004)	(0.08)	(0.002)
Log GDP/Capita $t-3$	0.15	0.09	-1.5	0.13***
	(0.11)	(0.09)	(1.12)	(0.04)
Log GDP/Capita $t-4$	0.13	0.004	0.52	-0.14***
	(0.11)	(0.09)	(1.11)	(0.03)
F-Statistics of Excluded instruments	6537.18	173.65	483.61	7.74
Under ID (SW)	50.05***	42.98***	49.77***	18.77***
Weak ID (SW F-test of Excluded Instruments)	24.32	20.89	24.19	9.12

Notes: Data covers countries with the discovery of at least a giant oil field during 1960-2015 and the dependent variables are the endogenous regressors of Log Oil, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of discovery $\left(Log\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$. Variables on the left column are the instruments used. Robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

First stage Estimates of Model IV of Table 2.1

	First Stage for IV (GMM) estimates (Model IV)			
	A	B	C	D
	Log Oil (mmboe)	Institutional Quality	Interaction term	Log Prior change in GDP/Capita
Colonised (Dummy = 1)	-0.40	0.37***	-3.99***	-0.07**
	(0.33)	(0.07)	(0.83)	(0.03)
Log depth	2.73***	-0.035***	1.70***	0.0002
	(0.06)	(0.008)	(0.15)	(0.003)
Log depth (squared)	-0.68***	-0.02***	-0.25*	-0.0009
	(0.06)	(0.008)	(0.14)	(0.003)
Colonised × log Depth	-0.10	0.04**	0.09	-0.001
	(0.09)	(0.01)	(0.19)	(0.004)
Colonised × log Depth (squared)	-0.04	0.02**	-0.001	0.002
	(0.09)	(0.008)	(0.17)	(0.004)
Log GDP/Capita $t-3$	-0.20	0.34***	-4.26***	0.04
	(0.20)	(0.11)	(1.44)	(0.04)
Log GDP/Capita $t-4$	0.16	-0.21*	2.9**	-0.05
	(0.20)	(0.11)	(1.42)	(0.04)
Colonised × Log GDP/Capita $t-3$	0.09	-0.35**	4.33***	-0.03
	(0.25)	(0.13)	(1.67)	(0.06)
Colonised × Log GDP/Capita $t-4$	-0.05	0.32**	-3.91***	0.04
	(0.25)	(0.13)	(1.67)	(0.06)
F-Statistics of Excluded instruments	4245.08	123.27	247.38	2.56
Under ID (SW)	67.93	34.48	64.77	11.74
Weak ID (SW F-test of Excluded Instruments)	10.92	5.54	10.41	1.89

Notes: Data covers countries with the discovery of at least a giant oil field during 1960-2015 and the dependent variables are the endogenous regressors of Log Oil, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of discovery $\left(Log\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$. Variables on the left column are the instruments used. Robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

Appendix III

First stage Estimates of Model V in Table 2.2

	First Stage for IV (GMM) estimates (Model V)			
	A	B	C	D
	Log Oil (mmboe)	Institutional Quality	Interaction term	Log Prior change in GDP/Capita
Colonised (Dummy = 1)	-0.027	0.03**	0.16	0.004
	(0.03)	(0.01)	(0.16)	(0.005)
Log depth	2.56***	-0.006	1.71***	-0.001
	(0.06)	(0.007)	(0.10)	(0.003)
Log depth (squared)	-0.76***	-0.004	-0.30***	-0.001
	(0.05)	(0.005)	(0.08)	(0.003)
Log GDP/Capita $t-3$	-0.20*	0.16	-2.2*	0.13***
	(0.11)	(0.10)	(1.16)	(0.04)
Log GDP/Capita $t-4$	0.19*	-0.06	1.24	-0.14***
	(0.11)	(0.1)	(1.15)	(0.03)
F-Statistics of Excluded instruments	6872.72	131.35	382.79	9.58
Under ID (SW)	40.94***	33.13***	41.03***	16.29***
Weak ID (SW F-test of Excluded Instruments)	19.70	15.95	19.75	7.84

Notes: Data covers countries with the discovery of at least a giant oil field during 1960-2015 and the dependent variables are the endogenous regressors of Log Oil, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of discovery $\left(Log\,\frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$. Variables on the left column are the instruments used. Robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

First stage Estimates of Model VI in Table 2.2

	First Stage for IV (GMM) estimates (Model VI)			
	A	B	C	D
	Log Oil (mmboe)	Institutional Quality	Interaction term	Log Prior change in GDP/Capita
Colonised (Dummy = 1)	-0.03	0.12***	-0.9***	-0.006
	(0.02)	(0.01)	(0.13)	(0.005)
Log depth	2.64***	-0.02**	1.71***	-0.001
	(0.05)	(0.01)	(0.10)	(0.002)
Log depth (squared)	-0.70***	-0.006	-0.31***	-0.002
	(0.05)	(0.005)	(0.1)	(0.002)
Log GDP/Capita t − 3	-0.16*	-0.06	0.37	0.16***
	(0.09)	(0.10)	(1.13)	(0.04)
Log GDP/Capita t − 4	0.14	0.17*	1.5	-0.17***
	(0.09)	(0.1)	(1.12)	(0.04)
F-Statistics of Excluded instruments	6376.21	140.18	329.99	12.80
Under ID (SW)	35.25***	32.02***	35.14***	23.43***
Weak ID (SW F-test of Excluded Instruments)	17.09	15.52	17.03	11.36

Notes: Data covers countries with the discovery of at least a giant oil field during 1960-2015 and the dependent variables are the endogenous regressors of Log Oil, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of discovery $\left(Log \frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$. Variables on the left column are the instruments used. Robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

First stage Estimates of Model VII in Table 2.2

	First Stage for IV (GMM) estimates (Model VII)			
	A	B	C	D
	Log Oil (mmboe)	Institutional Quality	Interaction term	Log Prior change in GDP/Capita
Colonised (Dummy = 1)	-0.03	0.11***	-0.63***	0.003
	(0.04)	(0.01)	(0.17)	(0.005)
Log depth	2.57***	-0.01	1.9***	0.001
	(0.06)	(0.006)	(0.10)	(0.002)
Log depth (squared)	-0.75***	-0.001	-0.43***	0.0004
	(0.06)	(0.005)	(0.09)	(0.002)
Log GDP/Capita $t-3$	-0.19	0.17	-2.87**	0.26***
	(0.14)	(0.12)	(1.45)	(0.04)
Log GDP/Capita $t-4$	0.17	-0.01	1.34	-0.27***
	(0.14)	(0.1)	(1.44)	(0.04)
F-Statistics of Excluded instruments	4753.50	356.08	507.39	12.09
Under ID (SW)	29.75***	27.36***	29.67***	38.13 ***
Weak ID (SW F-test of Excluded Instruments)	14.06	12.93	14.02	18.01

Notes: Data covers countries with the discovery of at least a giant oil field during 1960-2015 and the dependent variables are the endogenous regressors of Log Oil, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of discovery $\left(Log \frac{GDP\ per\ capita_{t}}{GDP\ per\ capita_{t-1}}\right)$. Variables on the left column are the instruments used. Robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

First stage Estimates of Model VIII in Table 2.2

	First Stage for IV (GMM) estimates (Model VIII)			
	A	B	C	D
	Log Oil (mmboe)	Institutional Quality	Interaction term	Log Prior change in GDP/Capita
Colonised (Dummy = 1)	-0.03	0.14***	-0.93***	0.003
	(0.04)	(0.01)	(0.17)	(0.005)
Log depth	2.59***	-0.01**	1.9***	0.0001
	(0.06)	(0.006)	(0.10)	(0.002)
Log depth (squared)	-0.73***	-0.003	-0.40***	-0.001
	(0.06)	(0.004)	(0.09)	(0.001)
Log GDP/Capita $t-3$	-0.19	0.04	-1.74	0.28***
	(0.14)	(0.15)	(1.73)	(0.05)
Log GDP/Capita $t-4$	0.16	0.15	-0.13	-0.28***
	(0.14)	(0.15)	(1.73)	(0.04)
F-Statistics of Excluded instruments	4598.30	494.11	458.35	10.18
Under ID (SW)	30.28***	27.97***	30.21***	35.71***
Weak ID (SW F-test of Excluded Instruments)	14.17	13.09	14.14	16.72

Notes: Data covers countries with the discovery of at least a giant oil field during 1960-2015 and the dependent variables are the endogenous regressors of Log Oil, Institutional Quality, the Interaction term of Institutional Quality and Log of oil abundance and are the log of change in GDP per capita in the year of discovery $\left(Log \frac{GDP\ per\ capita_t}{GDP\ per\ capita_{t-1}}\right)$. Variables on the left column are the instruments used. Robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

Chapter 3

Income and Child Mortality in Oil-Rich Countries: Evidence from Oil-Price shock and European Colonial Experience

Abstract

In this study, we investigate the impact of changes in income on child mortality in oil-rich countries. The health-economics literature does not accept a direct causal effect from income to child health. Therefore, we condition income per capita to shocks from time-series variation in global oil-prices interacted with the longitudinal variation in oil discoveries and a dummy to capture if a country was a European colony during the 16th to 19th-century European colonialism. This strategy helps to isolate a potentially exogenous source of variation in incomes and to broaden the scope of the resource curse while accounting for the enduring effect of European colonial experience. We estimate the causal effect of aggregate GDP per capita on child mortality in 99 heterogeneous, oil-rich countries from 1960 to 2010 with a Fixed Effect (FE) Instrumental variable (IV) estimator. In the first stage, we find a significant correlation between oil-price shock and income, but the experience of colonialism reduces the magnitude. In the second stage and across all specifications, we find a statistically insignificant impact of income on child mortality. Our findings document an aspect of the resource curse; in many resource-rich countries, the expected benefits from resource-wealth hardly translate to significant improvement in child mortality through income. Nevertheless, improving female labour participation helps in reducing child mortality. We suggest improving investments that economically engaged women and improving rent allocation that directly target child welfare as ways of reducing child mortality.

Keywords: Oil-Price Shocks, Resource Curse, Child Mortality, Colonial legacies
JEL Codes: F54, I15, I38, J13, Q32, Q33

3.1 Introduction and Motivation

In this study, we investigate the income-public health nexus in oil-rich countries. Specifically, we investigate the impact of income per capita, conditional on shocks from oil-price given oil discoveries and the enduring impact of European colonial experience, on child mortality in oil-rich countries. If the positive shock to income (oil-price shocks given oil discoveries) is compromised by the inefficiency in its management, the conditional income shocks might not reduce child mortality. Child health is a robust marker of socioeconomic status, and an improved understanding in oil-rich countries is particularly useful for understanding another channel of the resource curse and for improving maternal, perinatal and paediatric healthcare in resource rich countries[16].

Our work is motivated by the extensive empirical literature in demographics and economics that document mixed findings on the impact of economic shocks on child mortality. In developed countries, evidence suggests that aggregate income shocks and child health outcomes are counter-cyclical: that is, child health improves during economic recessions and deteriorates when the economy improves (Chay and Greenstone 2003, Dehejia and Lleras-

[16] Data on 2018 estimates of child mortality indicate that all the top 20 countries with the highest child mortality are all European colonised countries and many of them derive substantial revenue from resource rents (UNICEF 2018).

Muney 2004). Negative economic shocks could cause a reduction in some health-damaging activities like smoking and unhealthy food eating habits (Ruhm 2000) and lowers the opportunity cost of childcare by making the unemployed parents invest more time for child caring tasks that improve child health (Baird 2011). Another strand of studies shows that in low-income and developing countries, the effect of income shocks is negatively pronounced on child health (Pritchett and Summers 1996, Ferreira and Schady 2009, Baird 2011). Negative income shocks have been shown to have significant implication for child mortality (Cutler et al. 2002, Paxson and Schady 2005, Bhalotra 2010), children's anthropometrics (Rabassa et al. 2012), child investment (Jensen 2000), and child school enrolment (Grimm 2011).

However, these studies have mainly focused on negative economic shocks and they fail to distinguish between positive and negative shocks. We contend that making this distinction is essential. For instance, consumption (Christelis et al. 2019), mental health (Apouey and Clark 2015) and child care (González 2013) respond differently to positive and negative income changes. At the macro level, positive income shocks may lead to wealth redistribution and reduce income inequality as opposed to negative income shocks that increase inequality (Doepke and Schneider 2006, Mumtaz and Theophilopoulou 2017, Furceri et al. 2018). Making this distinction is especially important in resource-rich countries where resource wealth is a source of positive shocks on government spending (Arezki et al. 2017, Emami and Adibpour 2012, Van der Ploeg and Poelhekke 2017). If positive income shocks reduce inequality, then we should expect a reduction in child mortality as child mortality is concentrated among the poor (Flegg 1982, *Waldmann 1992*, *Rodgers 2002*). But positive shocks from oil discoveries may not be evident at reducing child mortality, either because of the inefficiency arising from the resource curse and/or because of corruption bequeath from the enduring colonial experience that aggravates rents allocation in resource-rich countries (Ades and Di Tella 1999, Wigley 2017).

The second motivation follows from the mixed evidence on the implication of the enduring legacies of some colonial structures on economic development (Acemoglu et al. 2001, Feyrer and Sacredote 2009). For instance, while the colonial influence on institutional quality and corruption could make government weak at resource allocation (Acemoglu et al. 2001, Angeles 2007, Angeles and Neanidis 2015), the colonial experience could exert countervailing effects through the colonial investment in structures of modernisation that raise post-colonial income per capita (Feyrer and Sacredote 2009). For example, the colonial investment in the human capital (Eynde 2015, Ayesu et al. 2016), the industrial expansion of local processing facilities (Cappelli and Baten 2017, Dell and Olken 2017), and the provision of transportation (railroad, roads) infrastructures (Michalopoulos and Papaioannou, in press) could be useful for raising post-colonial income per capita given oil discoveries that translate to improvements in child and maternal health.

Perhaps a closely related work that motivates this study is Wigley[17] (2017). Wigley (2017) examined whether the so-called resource curse extends to the health of children, as measured by under-five mortality. To analyse the relationship between oil wealth and child mortality, the study uses a measure of oil wealth as the total oil income per capita calculated by deducting extraction costs from the total value of a country's oil and natural gas production. While this

[17] Other studies that link oil endowment to health outcomes have focused mainly on adult diseases and have found mixed results (*de Soya and Gizelis 2013, Sterck 2016*). Child mortality can be considered a more appropriate indicator for studying the effects of the resource curse because it does not involve controlling for the long-run impact of prevention and treatment associated with adults' disease and health outcomes (Currie and Neidell 2005).

measurement represents a better measure of oil rents than oil exports divided by GDP, because it depends on extraction costs, it is also a noisy indicator of resource wealth. Poorer countries with weak institutions and poorly developed financial sector tend to have higher extraction costs than wealthier countries (Bohn and Deacon 2000, Cust and Harding 2014). The health-economics literature does not accept that a direct causal effect runs from income to health (Deaton 2003); therefore, oil rents per capita, income per capita and child health will covary for a variety of reasons and simple correlations would reveal inconsistent estimates (Caldwell 1986, Cutler et al. 2006, Acemoglu et al. 2013).

Our approach is to focus on one specific channel of causation of windfall from oil discoveries on under-five child mortality: the one operating through shocks to income per capita from the stock value of natural resources. We relate our approach to Acemoglu et al. (2013) where the stock value of the natural resource is employed as an instrumental variable to obtain a consistent estimate of the impact of income on health care spending in an OECD country. Income is good for health (Pritchett and Summers 1996), but in many developing countries, healthcare financing is shaped not necessarily through income but by overseas assistance through development assistance. Our contribution to Acemoglu et al. (2013) utilises *c*hild mortality indicator and not health care spending as it more likely reflects the nutritional status, access and quality of healthcare, immunisation status, and level of education of women and children. Child mortality does not involve controlling for the long-run impact of prevention and treatment (Currie and Neidell 2005) and conditions attached to development aids.

Specifically, we identify income per capita with the time series variation in global oil prices given the longitudinal variation in the discovery of oil and gas at country level and a dummy to capture if a country was a European colony during the 16th to 19th-century European colonialism. This strategy helps to isolate a potentially exogenous source of variation in income (Acemoglu et al. 2013), and broadens the scope of the resource curse through the enduring implication of colonial legacies that complicate the resource curse (Angeles and Neanidis 2015). Although these discoveries are not exclusively giant oil fields, they also represent a potential source of shocks on the government's current account and other key macroeconomic variables. At a reasonable global oil price, the effects could plausibly be directly observable national income and government spending (Arezki et al. 2017). We use a 2-stage Fixed Effect (FE) Instrumental variable (IV) strategy to estimate the causal effect of aggregate GDP per capita on child mortality per 1,000 births in 99 oil-rich countries from 1960 to 2010.

Despite the intuitive appeal, this strategy also implies a limitation: there remains the possibility of unobserved components of health that are correlated with colonialism and shocks from oil discoveries. We show that because colonial investments were made a long time ago, they are part of the fixed components of the residual term that explains child mortality and have been plausibly removed from the error term with the fixed effect estimator. Also, we show that because the main source of variation in the value of the log of oil discoveries instrument comes from the time series variation in the global oil price, the value of discoveries per capita is not correlated with another non-income channel. Besides, while countries can choose efforts and investment on exploration, they cannot choose the amount of discoveries they get which is mainly function geography of oil formation that is independent of countries' efforts and investment.

We find a statistically insignificant relationship between conditional income shocks and child mortality. A limited analysis where we restrict our analysis to oil-rich countries in the tropics and colonised countries, we also find similar results. Also, income per capita does not appear to reduce other potential child mortality mechanisms like the reduction of maternal mortality, investment in hospital facilities, basic sanitations and per cent of low birth weights. Our findings document an aspect of the resource curse; in many resource-rich countries, the expected benefits from resource-wealth hardly translate to significant improvement in child mortality through income.

The rest of the paper proceeds as follows. Section 3.2 formalises the analytical and identification strategy adopted and Section 3.3 describes the data. Section 3.4 contains the main results of the first and second stage regressions. It also offers a discussion of the main findings and provides additional robustness. We conduct a series of validity test to confirm the strength of our identification strategy in Section 3.5 and Section 3.6 considers the heterogeneous impact of income shocks and child mortality with respect to ecological zones and experience of colonialism. Section 3.7 explores other non-income potential mechanisms of child mortality. We conclude in Section 3.8.

3.2 Analytical strategy

In Appendix I, we discuss the conceptual framework that underlies our study and our analytical strategy. In a simple household income-health model, the effect of income on child mortality is reflected by the marginal elasticity of household income on the probability of the child's survival. However, income shocks at this level could hardly explain the variation in child mortality. Investment and interventions aimed at improving the child's survival and health, e.g. the provision of vaccinations and immunisation against infectious disease, are usually done by the government at the macro-level. Also, the government provides subsidies that cater to the health needs of pregnant women and children, especially in many developing countries where out-of-pocket medical expenses are usually low. So a more-informed analysis will focus on analysing the effects of income shocks on child mortality (CMR) at the macro-level (k).

For the general equilibrium, we take the national averages by countries and estimate the income-child mortality model by specifying eqn (3.1).

$$CMR_{\ k,t+1} = \delta_0 + \delta_1\left(Log\ GDP_{k,t}\right) + \delta_2\left(F_{k,t}\right) + \delta_3\left(R_{k,t}\right) + \lambda_k + \Omega_t + \varepsilon_{k,t} \quad (3.1)$$

In Eqn. (3.1), $CMR_{\ k,t+1}$ represents the child mortality rate per 1,000 live births before reaching age five in country k and a year ahead of the income shock. $Log\ GDP_{k,t}$ is the income per capita is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. $F_{k,t}$ is the percentage of female of the total work force and $R_{k,t}$ is the percentage of the population within the active age range of 15 to 64 years. The country (λ) and time (Ω) fixed effects measure any other time-invariant differences across the different oil rich countries and the year fixed effects capture any common changes in disease outcomes each year.

Fixed Effects (FE) estimates in Eqn (3.1) are likely to be biased. Income per capita and child health co-vary at the national level for a variety of reasons; therefore, simple correlations would unlikely reveal the causal effect of income on health (Acemoglu et al. 2013). First, economic growth itself might not be solely responsible for improvement in life expectancy, instead, public policy on health initiatives and new knowledge of disease prevention and control may be more important (Easterlin 1999). Second, improvements in health are a consequence of the efficient use of public health technology, improvements in the education of women, maternal and child health services, and changes in genetic diversity all of which may be correlated with higher income (Caldwell 1986, Venter et al. 2001, Cutler et al. 2006). Third, income is inconsistently measured. The fact that GDP is a poor measure of well-being in countries with poor national income accounts and countries with poor institutions are well documented (Henderson et al. 2012).

To consistently estimate the income elasticity on child mortality, first; we relate our approach to the one used in Acemoglu et al. (2013), Michael (2007) and Black et al. (2005) where the stock value of the natural resource is employed as an instrumental variable to obtain a consistent estimate of the impact of income on health outcomes. Specifically, we identify income per capita with the time series variation in global oil prices given the longitudinal variation in the discovery of oil and gas at country level. We call this instrumental variable the log of the value of discoveries. This variable is sourced from the replication dataset of Cotet and Tsui (2013). Although these discoveries are not exclusively giant oil fields, they also represent a potential source of shocks on the government's current account and other key macroeconomic variables. At a reasonable global oil price, the effects could plausibly be directly observable national income and government spending (Arezki et al. 2017).

As our second instrumental variable, we interact with the values of the discoveries a dummy variable that represents the experience of European colonialism. The intuition for this is to understand how specific institutional barriers constitute inefficiencies that reduce the shocks from the discoveries on income. The extent to which oil-price shocks given discoveries will translate to improvement in income per capita that will reduce child mortality depends on the presence of a socially efficient rent allocation mechanism that makes the government accountable in revenue allocation. For instance, if corruption and clientelism are high, the government will be less concerned at having an efficient allocation (Ades and Di Tella 1999), and such positive price shocks may not translate into an improvement in child mortality. The interaction of these two variables will give the true value of the income shocks and can aid in providing a true impact of income shocks on child mortality.

Corruption has been shown to have a deep historical origin associated with the enduring legacies of some of the 16^{th} -19^{th} European colonisation practises (Mulinge and Lesetedi 1998, Treisman 2000, Angeles and Neanidis 2015). In several ways, colonial could have inadvertently birthed corruption that makes the benefits from oil price shocks to not translate into a significant economic improvement in many oil-rich countries. For instance, to consolidate foreign rule and encouraged low-cost extraction of resources in many colonies, colonial authorities often modified apparatuses of governance and designated authority to selected individuals which created a gap in access to privilege and created an elitist group (Igbafe 1979, Dell 2010, Aldrich and McCreery 2016). These elites were not directly responsible to the people, and the position created limited accountability, an increase in the abuse of offices and the use of the position to divert public resources for private use (Leonard 1991, Mulinge and Lesetedi 1998). If this abuse of office and poor accountability associated with colonial experience is passed on and inherited, it could inform the decision of the indigenous post-colonial elite on how to allocate rent that would be socially efficient and supportive of inclusive shared prosperity.

Building on these insights, we instrument the log of income per capita in Eqn(3.1) with the time series variation in global oil prices given discoveries and a colonial dummy that represent the enduring impact of the colonial legacy. Equation (3.2) is the first-stage regression:

First Stage Regression:

$$Log\ Y_{k,t} = \varphi_0 + \varphi_1 (Price \times Discoveries_{\ k,t}) + \varphi_2 (Price \times Discoveries_{\ k,t} \times Colony_k) + \sum_{j=3}^{4} \varphi_j X_{\ k,t} + \lambda_k + \Omega_t + \mu_{k,t} \qquad (3.2)$$

where $Log\ Y_{k,t}$ is the endogenous regressor (income per capita). $Price \times Discoveries$ measures the log of the value of the new oil discoveries in terms of millions of barrels per capita multiplied by the price of crude oil per barrel expressed on 1990 USD (variation in oil discoveries and time-series variation in global oil-price). Because a significant variation comes from the time series variation in global oil price, the value of the new discoveries is plausibly exogenous to income shocks. $Colony$ is a dummy variable equal to 1 if country k is a former European colony (with available data on settlers' mortality and the use of European colonial language as official language) and 0 otherwise. Other time-varying variables ($X_{\ k,t}$) in eqn 3.1 are controlled for by accounting for the country's socio-demographics by including a female participation in labour and the proportion of the population within the active working age 15-64 ages.

Our approach leverages on the assumption that changes in global oil price, discoveries and European colonial history have no direct effect on aggregate child mortality except through the income per capita. However, areas with different amount of oil discoveries and colonial experience may differ in other ways that could affect health outcomes. For example, the overseas investment in modernisation via industrial expansion (Dell and Olken 2017), the human capital (Eynde 2015, Ayesu et al. 2016), and the provision of transportation infrastructures (Michalopoulos and Papaioannou, in press) could help in raising current income per capita and reducing child mortality. However, since these investments are likely to be fixed, therefore time-invariant, they have been absorbed by the country fixed effects. Furthermore, exogenous changes in government policy and global innovation in the treatment and care of children and pregnant mothers are all likely to be accounted for by the time fixed effects (Acemoglu et al. 2013). We conduct a series of validity test to confirm the strength of our identification strategy in Section 3.5. The schematic framework for the analytical strategy is illustrated in Figure 3.1.

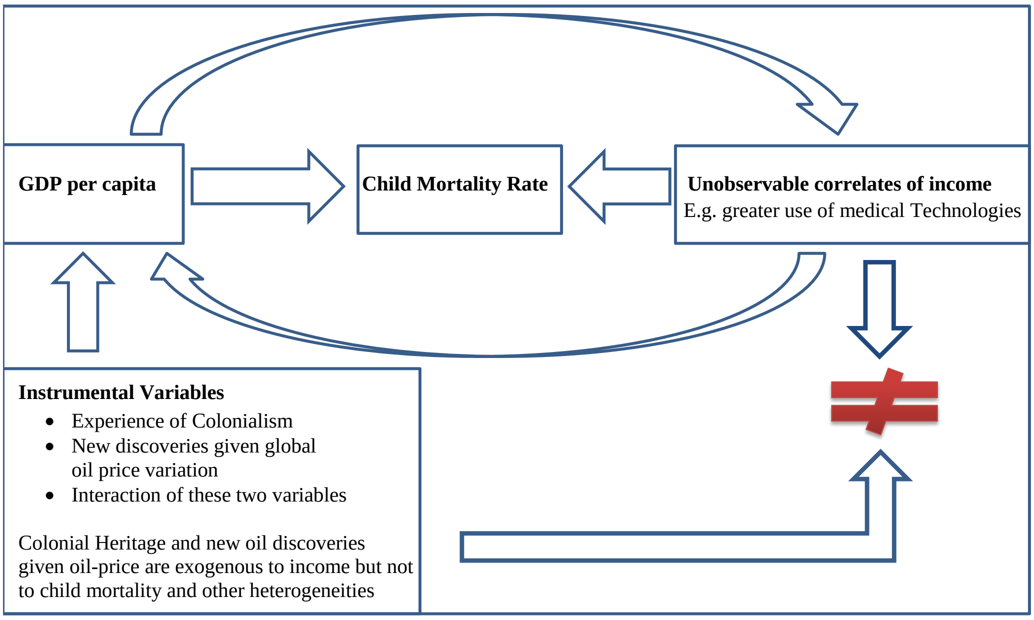

Figure 3.1: Schematic Illustration of the Conceptual and Analytical Strategy

3.3 Data and Variable Description

GDP per capita (constant 2010 US$). GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Log of GDP per capita in 2000 constant dollars (multiplied by a 100).

Child mortality rate child (per 1,000 live births and multiplied by a 100) Child mortality rate is the number of a child dying before reaching five years of age, per 1,000 live births in a given year. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA Population Division) at www.childmortality.org. Log of child mortality rate is taken from Acemoglu et al. 2019.

Colony is defined as countries with data on the log of settler mortality as identified in Acemoglu et al. (2001) paper, or with the presence of European colonisation at a certain point in their history. Also, we match our description with colonised countries listed in Comin et al. (2010).

Per cent of total population ages 15-64 (WDI Ross 2008) Total population between the ages 15 to 64 as a percentage of the total population. The population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The data is original from the World Bank Development Index, but we use the replication provided in Ross 2008 and assessed from https://doi.org/10.7910/DVN/BHU6SP

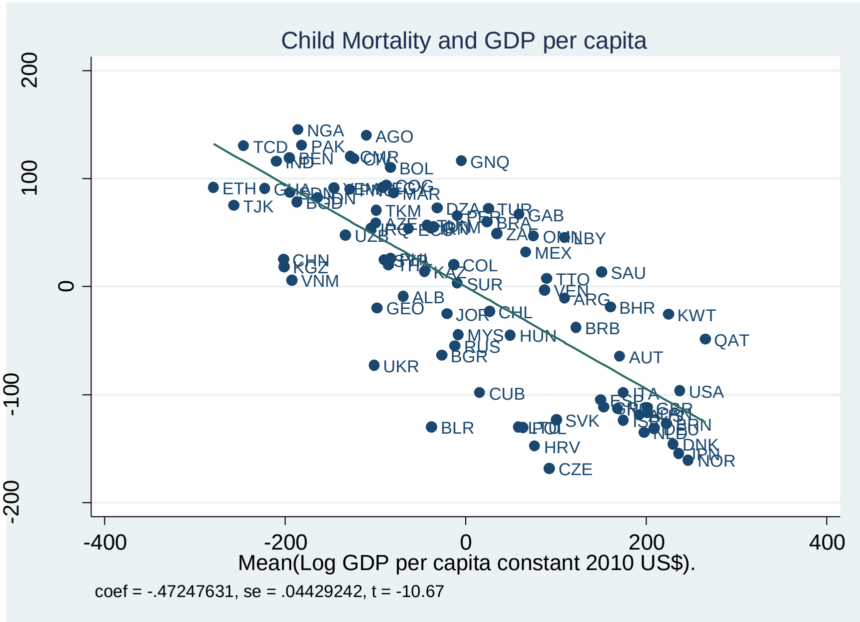

Figure 3.2: Child Mortality per 1000 birth and GDP per capita

Log (Value of Oil Discoveries per capita) is (the log of) longitudinal variation in oil discovery per capita multiplied by the time series variation in the price of crude oil expressed on 1990 USD. The data is secured from the replication data of Cotet and Tsui (2013). For countries with no oil discovery, the authors imputed the zeroes by dividing the smallest observed positive value of the variable oil discovery per capita and crude oil price by 1000. The link to the online appendix where the data is exhaustively described is formed https://www.aeaweb.org/aej/mac/app/2010-0022_app.pdf

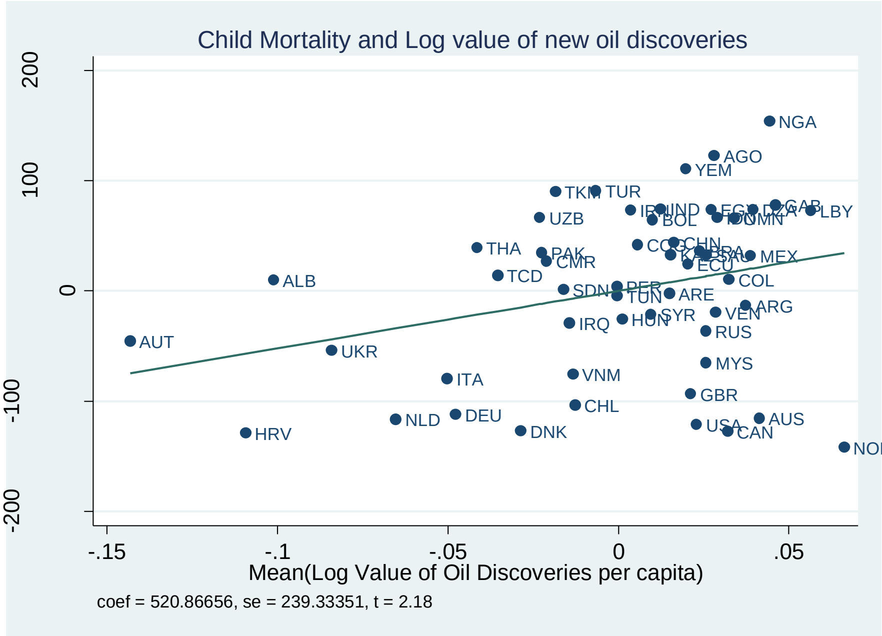

Figure 3.3: Child Mortality per 1000 birth and Log value of discoveries per capita

Labour force, female (% of the total labour force) is the share of the female labour force that is with work. The data is taken from Ross (2008) and can be assessed from https://doi.org/10.7910/DVN/BHU6SP

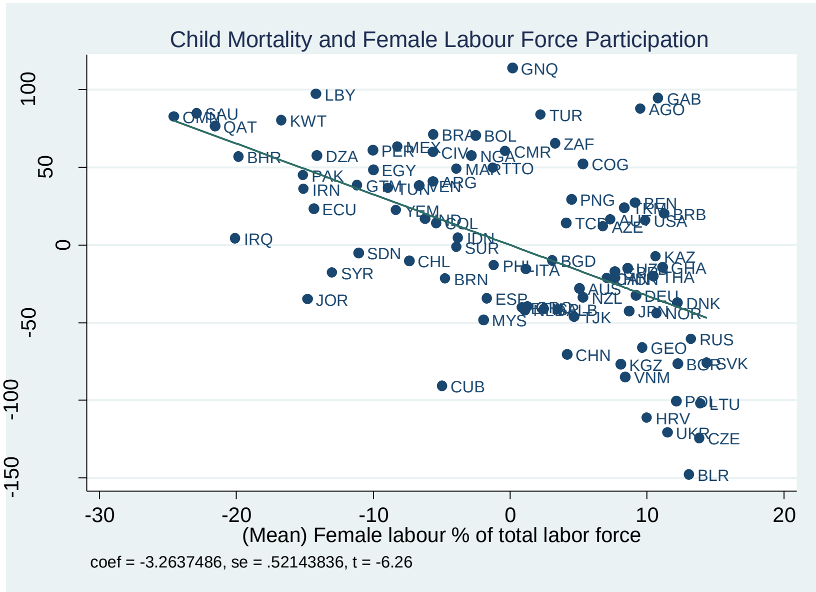

Figure 3.4: Child Mortality per 1000 birth and Female labour force participation

Log (Oil Rents per capita) is taken from the replication data of Cotet and Tsui (2013). The variable is the log of longitudinal variation in oil production per capita multiplied by the time series variation in the price of crude oil expressed in 1990 USD. These are for countries that are already actively producing oil and have started receiving rents. For years with no oil production, the authors imputed the zeroes by dividing the smallest observed positive value of the variable oil production per capita and crude oil price by 1000. The data is from Cotet and Tsui (2013) and can be assessed from https://www.aeaweb.org/aej/mac/data/2010-0022_data.zip . Table 3 in the Appendix II gives the summary and description statistics of the variables.

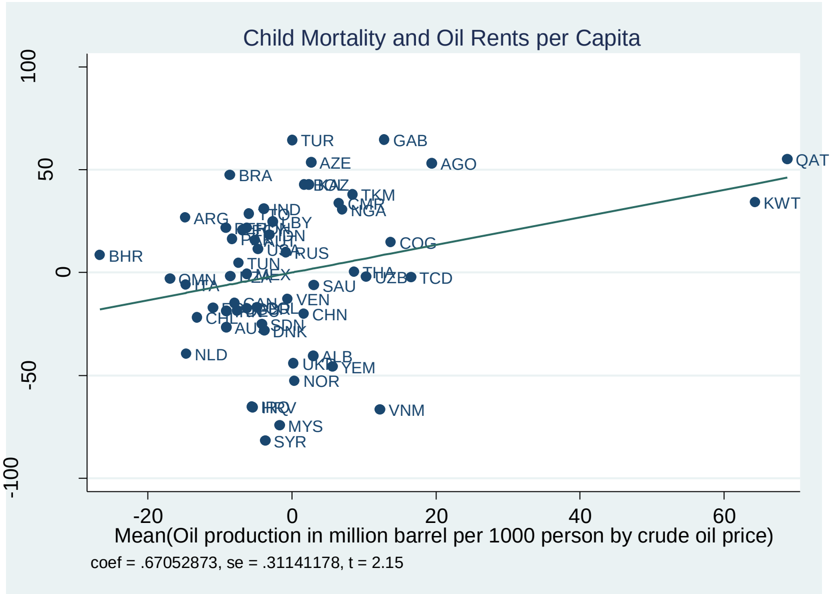

Figure 3.5: Correlation between (mean) Child mortality rate and (mean) Oil-rent per capita

3.4 Results and discussion

This section presents and discusses the results, and the section is divided into three parts. In the first part (Section 3.4.1), we establish the relationship between oil rents per capita and child mortality to explore whether countries with revenue from oil and gas are susceptible to more child mortality (Table 3.1). In the first part, it is not our aim to imply causality as the direction of impact is hard to establish. Instead, we aim to establish a preliminary justification for our study. If countries with more oil revenue cannot reduce child mortality, then it is important to causally identify the direction through which oil price shocks and discoveries relates to child mortality.

In the second part (Section 3.4.2), which is the main result section, we document the conditional relationship of shocks to income per capita (from time series variation in global oil prices given longitudinal variation in discoveries and colonial experience) on child mortality from 1960-2010. This is important because it enables us to understand the direction of causality and help us to identify the impact of income on child mortality. The main results are presented in Tables 3.2 and 3.3. Also, we present statistical tests to validate the strength of our instruments (Table 3.4).

In the third part (Section 3.4.3), we carried out some sensitivity analysis; first, we consider the heterogeneous impact based on ecological zones by restricting our sample to countries in the tropical zones, colonised countries, and consider countries that were colonised and also fall in the tropics. We also consider other outcomes, e.g., maternal mortality, use of basic sanitation, per cent of low birth weight and hospital bed per 1000 population. These are recognised channels that are important for reducing child mortality, and we test if income shocks have any significant impact on these outcomes.

3.4.1 Cross-Country Correlation: Oil Endowment per Capita, Income and Child Mortality

In this section, we establish a preliminary link between a country's oil rents per capita (Log (Oil production in a million barrels per 1000 person × by crude oil price) and child mortality (Table 1). The approach is similar to the results from Wigley (2017) on the effect if oil-wealth per capita on child mortality.

Establishing this link is important to justify our subsequent analysis. The intuition behind this preliminary analysis is that if oil rents per is used efficiently, it could lead to a reduction in child mortality. In essence, absent the resource curse and all things being equal, countries with more rents should have less child mortality. This motivating hypothesis is empirically analysed in Eqn. 3.9.1 and the results are presented in Table 3.1.

$$Y_{j,t} = \beta_0 + \beta_1 (Oil\ rents_{\ j,t}) + \beta_2 (GDP\ per\ capita_{\ jt}) + \lambda_j + \Omega_t + \varepsilon_{j,t} \quad (3.9.1)$$

Where Y is the dependent variable and it is the Log of child mortality per 1000 live birth. The main variable of interest in Table 3.1 is $Oil\ rents$ and it is the log of oil production per capita multiplied by the price of crude oil expressed on 1990 USD. The oil rents per capita variable represents the revenue from oil production for countries that are already oil exporters. This variable is different from log of value of new discoveries (countries with new discoveries might not be earning rents since there is usually a time lag between discoveries and subsequent production).

Table 3.1: Oil rents per capita, GDP per capita and Child Mortality per 1000 birth

	Dependent Variable: Log of child mortality per 1000 birth (multiplied by a 100)			
	Model I	Model II	Model III	Model IV
Log Oil Rents per capita	0.43***	2.53***	3.36***	22.51*
	(0.06)	(0.68)	(0.69)	(12.08)
Log GDP/capita		-0.27***	-0.33***	-0.30*
		(0.06)	(0.057)	(0.15)
Log GDP/capita (squared)			-0.0006***	-0.0003
			(0.0002)	(0.0004)
Per cent of total population ages 15-64		-1.93**	-2.09**	-1.09
		(0.75)	(0.71)	(1.53)
Female Labour force (% of the total labour force)		-3.52***	-2.7***	-5.88***
		(0.58)	(0.65)	(1.23)
Constant	320.78***	774***	567.5***	690.5***
	(3.0)	(50.2)	(36.3)	(79.16)
All Countries Included?	Yes	Yes	Yes	Only African countries
Number of countries	120	114	114	33
Observations	4,590	3,856	3,856	1,200
Within R-square	0.76	0.87	0.88	0.79
F-statistics	215	41.3	47.14	

Notes: Table 3.1 is the Fixed Effect OLS regression of log rents per capita, Log GDP per capita on child mortality. Log Oil Rents per capita is Oil production in countries already producing oil (million barrel per 1000 person × by crude oil price). The data is from Cotet, and Tsui (2013) accessed from https://www.aeaweb.org/aej/mac/data/2010-0022_data.zip, and it covers from 1960-2010.
The dependent variable is the World Bank estimates of the Log Child Mortality taken from Acemoglu et al. (2019): https://www.journals.uchicago.edu/doi/suppl/10.1086/700936/suppl_file/2014340data.zip
Income per capita is in 2000 constant dollars (multiplied by a 100).
Models I-III include all countries described in Cotet and Tsui with oil reserves (2013)
Model IV include only countries from Africa.
All models control for Country and Time FE. The robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively

Consistent across all Models in Table 3.1 is the significant positive correlation between oil rents per capita and child mortality and a negative correlation between income per capita and child mortality. Model I reports the results without any other control and Model II reports with additional controls for Income per capita, per cent of the working population (15-64 ages) of the population and per cent of the female labour force of the total labour force. In Model III we account for non-linearity between income and child mortality as an income may not have the same effect on child mortality reduction between rich and developing countries; increasing income will reduce child mortality more among the developing countries than among rich countries. Model IV restrict our sampled countries to just African countries. More oil rents should lead to more revenue for the government, and such additional revenue could translate into an improvement in the medical and non-medical household consumption. However, a positive correlation between child mortality and oil rents could indicate an aspect of the resource curse that deserves further enquiry.

After establishing that countries with more rents have higher child mortality, it is also important to identify the main medium which is responsible for the relationship. One channel we suspect is through income. To consistently estimate this channel, we need another variable that is not directly correlated with child mortality but serves as a shock to income. Positive shocks from oil discoveries could help in raising income, and through income, we can understand the direction of mechanism. Because these discoveries are new oil-fields have not started producing oil, we can use shocks form their announcement to partial out the exogenous variation in child mortality through income.

3.4.2 Impact of Income per capita on Child Mortality in Oil-rich Countries

In this section, we examine the resource curse in oil-rich countries with respect to child mortality by conditioning the relationship between income and child mortality with the time series variation in global oil prices given new oil discoveries and the experience of the 16th to 19th-century European colonialism. Using a 2-stage IV regression, we estimate in the first stage, the correlation between the logs of the value of discoveries interacted with the colonial experience dummy and income per capita. At a reasonable price, more oil discoveries could make countries potentially richer, and this can improve government spending and more income for citizens (Arezki et al. 2017). However, if anticipated benefits do not transmit to better income because of poor management and an allocation problem, the positive shocks from oil price on income would be immaterial at helping to reduce the number of child mortality.

The instrumental variables help to account for the remaining omitted variables that account for heterogeneity between the income and child mortality. The colonial experience dummy identifies institutional corruption that mediates why shocks from oil discoveries may not translate into a positive impact on child mortality through income per capita. We account for a year lag to allow for income shock to take effect on child mortality gave that vulnerability to mortality might not be immediate as a household may smoothen consumption within a short window of shock. All the models control for country and time fixed effects. The result of the second stage is presented in Table 3.2, and the reduced first-stage result is in Table 3.3.

The FE-IV models in Table 3.2 show a departure from estimates of the impact of income per capita on infant mortality presented in Table 3.1. Specifically, we find in Model V, a statistically weak 0.022 decline in a number of deaths per 1,000 births in oil rich countries with a 10% increase in Log GDP per capita. Richer countries tend to have higher education levels, better public health policies for child health and more importantly, well-developed employment policies that engage and accommodate the female into the workforce. These additional factors can contribute to child mortality independent of income and make the results in Model V biased (Cutler et al. 2006, Baird et al. 2011). In Model VI, we include additional control for Female Labour force participation (% of the total labour force) and the percentage of the active population (ages 15-64) of the total population and find no significant impact of income per capita on child mortality. In Model VII, we also find that similar result after accounting for plausible non-linearity between income and child mortality. In Model VIII, we restrict our sample to only African countries, and in Model IX, we restrict our sampled countries only to oil-producing countries who have been earning rents from the production of oil and gas. In both of these latter cases, we find no significant impact of income on child mortality.

Table 3.2: Instrumental Variable Estimates of Income Shocks and Child Mortality

	Dependent Variable: Log of child mortality per 1000 births (multiplied by a 100)				
	Model V	Model VI	Model VII	Model VIII	Model IX
Log GDP/capita	-0.23*	0.32	0.34	0.17	0.41
	(0.13)	(0.22)	(0.21)	(0.14)	(0.27)
Log GDP/capita (squared)			-0.0002		
			(0.0003)		
Per cent of population ages 15-64		-5.56***	-5.91***	-5.06***	-5.11***
		(1.21)	(1.19)	(1.18)	(0.91)
Female Labour force (% of the total labour force)		-3.17***	-2.79***	-3.68***	-0.67
		(0.21)	(0.52)	(0.922)	(0.45)
Endogenous regressors	1	1	2	1	1
Instruments	2	2	2	2	2
Under-identification test	36.85	23.62	30.2	14.34	15.92
Cragg-Donald Wald F statistic	17.65	12.84	10.79	10.83	10.94
Kleibergen-Paap rk Wald F-stat	20.56	12.55	15.7	13.6	8.11
Over-identification test	8.58	0.55	0.00	0.00	0.01
Number of Countries	97	97	97	33	52
Number of Observations	3,401	3,396	3,396	1,200	1,772

Notes: Table 3.2 is the Second stage (IV) Fixed Effect regression of Log GDP per capita on child mortality. Original data for Oil population per 1000 person is from Cotet, and Tsui (2013) accessed from https://www.aeaweb.org/aej/mac/data/2010-0022_data.zip, and it covers from 1960-2010.
The dependent variable is the World Bank estimates of the Log Child Mortality taken from Acemoglu et al. (2019): https://www.journals.uchicago.edu/doi/suppl/10.1086/700936/suppl_file/2014340data.zip
Income per capita is in 2000 constant dollars (multiplied by a 100).
Models V-VII include all countries described in Cotet and Tsui with oil reserves (2013), Model VIII includes only oil-rich countries from Africa, and Model IX includes only countries with reported earnings from oil production (rents). The robust standard errors are in parenthesis and are clustered at the country level.
*, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively

Across all models, we find a weak and statistically insignificant impact of conditional income shocks on child mortality. The evidence of no significant impact of income shocks on child mortality in Table 2 lies between findings of the positive effect income shock has on improving child health (Summers and Pritchett 1996, Bhalotra 2010, Baird et al. 2011) and findings that document negative effect (e.g., Waldmann 1992, Ruhm 2000, Chay and Greenstone 2003). Several explanations have been proposed in the literature to explain why positive income shocks might not lead to child mortality and why economic recession might be good for reducing infant mortality (Chay and Greenstone 2003, Dehejia and Lleras-Muney 2004). For one, if positive income growth comes from economic activity that increases air pollution, then slower growth might be good for child health and make them less vulnerable to mortality (Chay and Greenstone 2003, Dehejia and Lleras-Muney 2004, Currie and Neidell 2005). Also, positive income shocks might increase the probability of health-damaging behaviours among pregnant mothers, such as smoking and drinking, which may contribute to the higher vulnerability of child mortality. Furthermore, aggregate negative shocks can depress wages and imply a lower opportunity cost (Baird et al. 2011). The implication of this is that mothers and caregivers now value the time spent on looking after the wellbeing and care of the child; e.g., taking children for preventive health visits, breastfeeding, cooking healthy meals, and collecting clean water than the time spent on working for wages (Baird et al. 2011).

Another explanation for no significant impact of income on child mortality can be deduced from historical accounts of mortality and income. For instance, in England from 1750 to 1820, mortality had nothing to do with increased income per head[18] (Cutler et al. 2006). Indeed, the 16th to 18th century English aristocrats with better income and higher nutrition had no life expectancy advantage over the rest of the population and mortality was also not lower in other well-fed populations such as in the United States. Perhaps, the proof behind the non-significant impact of income on child health is that significant improvements in public health policies played an important channel for the reduction of mortality and not income (Cutler et al. 2006). Taking a cue from mortality estimates of the general population, people, irrespective of income levels live longer today because of the improvement in sanitation rather than income than they did several years back. The argument here is that public health improvement and not income is the sole driver of a reduction in mortality.

While there is truth in these positions, however, these explanations obscure other aspects of the problems with resource-rich and colonised countries where suggestions attribute the generally poor economic development to corruption and mismanagement of resources. For one, the previous literature has focused on negative shocks arising from macroeconomic crises and drought. However, positive shocks to income could reduce constraints household face in terms of spending on goods that help to lower child mortality. More importantly, the identified problem in oil-rich countries suggests that if institutions in place discourage an efficient rents allocation, the positive oil-price shocks will not be fully felt on income (Table 3.3), and this might cause a weak and non-significant reduction in child mortality (Table 3.2). Therefore, a contribution to these explanations in respect of resource rich countries could be to use to understand and broaden the scope of the resource curse and to understand the priority of institutional settings (i.e. colonial experience) at explaining the income shocks to lead to a positive outcome.

Longitudinal variation in oil discoveries at a reasonably modest price (time series variation) would likely stimulate economic activities that improve income, which could increase investment and improvement in the consumption of medical and non-medical goods. Such positive income shocks might increase household consumption and contribute to better access to inputs that help in determining child health. However, the extent of how expected benefits from oil wealth translate into significant improvement is premised on government commitment. Particularly, strong institutions that reduce corruption and ensure a socially efficient rent distribution, the investment in health facilities and health policies that make medical care and treatment available for every pregnant mother and child up to a certain age.

[18] Indeed, Wrigley and Schofield (1981) estimate that life expectancy in 1600 was the same as in 1820, with 1750 being the low point of a two-century swing.

Table 3.3: First Stage Regressions for Models IV-IX in Table 3.2

Endogenous regressors	First stages for: [a]Model V Log GDP/capita	[b]Model VI GDP/capita	[c]Model VII GDP/capita	GDP/capita (squared)	[d]Model VIII Log GDP/capita	[e]Model IX GDP/capita
Instrumental Variables						
Log (Value of Oil Discoveries per capita)	87.21***	63.53***	63.53***	20673***	66.38***	54.48***
	(14.33)	(14.26)	(14.26)	(4429)	(17.98)	(15.77)
Log (Value of Oil Discoveries) × Colony (Dummy=1)	-63.87***	-37.99**	-37.99**	-46197***		-31.94*
	(16.64)	(16.99)	(16.99)	(5331)		(18.08)
F-test	20.57	12.55	12.55	45.6	13.6	8.11

Notes: Table 3.3 is the First stage of the IV Fixed Effect regression results for Models V-VIII in Table 3.2.
[a] Model V: The first stage for Model V. The endogenous variable is log GDP per capita.
[b] Model VI: The first stage for Model VI in Table 3.2. The endogenous variable is Log GDP per capita
[c] Model VII: The first stage for Model VII in Table 3.2. The endogenous variables are income and income per capita (squared). The income per capita (squared) is re-centered to reduce multi-collinearity and allow for easy interpretation.
[d]Model VIII: The first stage for Model VIII in Table 3.2, where only African countries are included. The endogenous variable is Log GDP per capita. Because all the African countries that are in our sample were colonised, the interaction effect drops out.
[e]Model IX: The first stage for Model IX in Table 3.2 is only for countries who are already producing oil and gas and are earning rents. The endogenous variable is Log GDP per capita
All models control for Country and time FE and the other controls in the main model. The robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

Institutions matter for mediating the translation of oil-price and discoveries shocks on income per capita that will have a significant impact of reducing child mortality. For instance, institutions that disallow corruption might enable governments in oil-rich countries to make the price shocks meaningfully translate into better income and reduced child mortality. Additionally, the presence of such institutional might matter for governments commitments in the design of public health projects, e.g., providing treated water, sanitation systems, draining swamps for safer environments and undertaking mass vaccination campaigns; as well as providing incentives at the micro level that encourage individuals and households to participate and utilise these projects.

As shown in the first-stage results (Table 3.3), colonial heritage matters for how the expected oil wealth transmits to income and effectively reduces the impact income has reducing child mortality in the second stage regression (Table 3.2). Several studies have identified the underlying cause of the resource curse to corruption that encourages the diversion of expected earnings for personal use (Leite and Weidmann 2002, Kolstad and Søreide 2009, Bhattacharyya and Hodler 2010, Brollo et al. 2013). However, a major problem is how to identify corruption. One major source of corruption in many developing countries is the deep

historical legacies of colonial experience (Mulinge and Lesetedi 1998, Angeles and Neanidis 2015).
Colonialism introduced the abuse of office and power which might get magnified if such colonised states have access to resource wealth. The resultant colonial political structure that favoured extractive institutions was an ideal breeding ground for corruption and how post-colonial elites manage oil wealth for economic growth in terms of income per capita (Mulinge and Lesetedi 1998, Angeles and Neanidis 2015).

As we show in our First-stage results in Table 3, the colonial experience dummy significantly reduces the estimate from the value of oil discoveries on income. The ability of oil price and discovery shocks in oil rich countries to translate into an improvement in GDP and the subsequent consequence on child mortality rests on corruption identified with the enduring impact of colonialism. In relation to previous studies which have found establish the link between colonial heritage and corruption, e.g. Mulinge and Lesetedi 1998, Treisman 2000, Angeles and Neanidis 2015), we also find that given the same oil wealth, colonised oil-rich countries have less income per capita than non-colonised countries.

3.5 Test of the Validity of the Instruments

The validity of our results and conclusion reached rest primarily on how reliable our identification strategy uncovers the true effect of income using oil-price shocks and colonial experience on child mortality. Valid instrumental variables must meet at least two essential criteria (French and Popovici 2011). First, it must be statistically correlated with the endogenous variable(s) of interest and the correlation must reflect a deep and convincing theoretical understanding of real-life situations. The second condition is that it must be exogenous to all other important and unobserved heterogeneities. That is, they must be uncorrelated with the disturbance error term in the structural or outcome equation. This implies that the instrumental variables must not directly cause child mortality and they must also be uncorrelated with the residual effects, e.g., efficient use of technologies and other residual effect of income that could influence infant mortality.

The first assumption is relatively straightforward; implementing the first stage regression establishes a correlation between the instrumental variables and the endogenous regressors. Indeed as shown in Table 3.3, we find that across the five Models we presented the instruments are strongly correlated with the endogenous regressors. Also, the diagnostic tests in Tables 3.2 and 3.3 show that our instruments are not weak; the statistical threshold for a strong instrument when multiple variables are used to instrument for one endogenous regressor is that the F-statistic to be above 10 (Staiger and stock 1997, Stock *et al*., 2002).

It is, however, more challenging to ascertain the second condition of the instruments being exogenous to all other important and unobserved heterogeneities. There is no fairly straightforward and well-accepted test to confirm this condition. Ascertaining this condition is important to validate our instruments. For instance, colonialism can have heterogeneous effects by operating through many mechanisms that can encourage development that may be linked with child mortality. For example, the long-term impact of colonial investment in the human capital (Eynde 2015, Ayesu et al. 2016), the industrial expansion of local processing facilities (Cappelli and Baten 2017, Dell and Olken 2017), and the provision of transportation (railroad, roads) infrastructures (Michalopoulos and Papaioannou, in press) could be useful for reducing child mortality through the non-income channel. Also, because richer countries may have more resources to drill better, richer countries can have a better longitudinal variation in oil discoveries than poorer countries.

To disprove these possibilities, first, we argue, in the case of colonial investment, that because these investments were made a long time ago they are part of the fixed components of the residual term that explains child mortality, and with the introduction of the country fixed effect; these residuals have been effectively removed from the error term. That is they no longer serve as a channel with child mortality. Also, in the case of discoveries being correlated with non-income country capital that reduces child mortality, we argue that the main source of variation in the value of the log of oil discoveries instruments comes from the time series variation in the global oil price which is not correlated with country-level capital. Besides, although countries can choose efforts and investment on exploration, they cannot choose the amount of discoveries they get; that is mainly a function geography of oil formation which is independent of countries' efforts and investment.

We validate these explanations in Table 3.4. First, we conduct a reduced-form regression of the instrumental variables on the log of child mortality (Model X). With this approach, we can see from the sign and/or magnitude of the reduced-form estimates the validity of the identification strategy (Angrist and Krueger 2001). The absence of statistical significance of the instruments in these reduced-form equations could mean that instrumental variables do not affect the outcome (Angrist and Krueger 2001, French and Popovici 2011). Also, the sign on the estimates should justify the direction of expected causality. For instance, in our results in Model X, the estimates on the reduced-form regression of value of oil discoveries and the interaction with colonial experience are intuitively valid as they support the positive, though not significant, the correlation between the instruments and the dependent variable.

Second, we conduct a reduced-form regression of the instruments on oil rents per 1000 population to establish the non-correlation between oil rents and the log of the new oil discoveries (Model XI). This test is to support our assumption that the instrumental variable of discoveries is driven by global oil price, and it is not correlated with the existing oil production per capita. Also, because oil production could be associated with air pollution, the insignificance of the instruments on oil rents suggests in Model XI suggests that the countries with discoveries are not necessarily ones with higher levels of pollution.

Third, we also estimate a reduced-form of the instrumental variables on the number of wildcat drilling to test the relationship between discoveries and investments in oil exploration (Model XII). Wildcat drilling is the measure the number of oil wells drilled in a particular year (Cotet and Tsui 2013). Because of the cost of drilling, wildcat drilling represents effort and investment for an exploration adventure. The non-significance of these estimates suggests that the values of discoveries are not significantly related to capital and efforts.

Table 3.4: Reduced-form Regression of tests of the validity of the Instrumental Variables

	Model X	**Model XI**	**Model XII**	**Model XIII**	**Model XIV**
Dependent Variables:	Log of child mortality per 1000 births (multiplied by a 100**)**	Oil barrel per 1000 population	Number of Wildcat drilling	Likelihood of civil Unrest	Democracy score (Polity IV)
Log (Value of Oil Discoveries per capita)	9.09	50.38	79.23	0.03	-0.11
	(35.7)	(0.65)	(71.95)	(0.27)	(0.33)
Log (Value of Oil Discoveries) **×** Colony (Dummy=1)	8.75	-43.95	959.81	-0.32	-0.04
	(38.9)	(36.43)	(925.38)	(0.39)	(0.42)
Percent of total population ages 15-64	-3.89***	-0.7	6.12	-0.003	-0.00002
	(0.69)	(0.65)	(5.31)	(0.006)	(0.008)
Female Labor force (% of total labor force)	-3.29***	0.09	-7.84	-0.012**	0.007
	(0.58)	(0.17)	(7.93)	(0.004)	(0.008)
Constant	684***	42.66	56.94	0.84**	0.34
	(41.35)	(34.91)	(96.48)	(0.35)	(0.43)
F-test	29.35	11.98	3.65	3.73	2.08
Observations	3,820	4,083	4,083	3,600	3,840
Number of countries	99	100	100	97	99
R-squared	0.86	0.07	0.04	0.03	0.17

Notes: Table 3.4 is a Reduced-form estimation of the test of the validity of the instrumental variables.
Model X: The dependent variable is the Log of Child Mortality
Model XI: The dependent variable is Oil million barrel per 1000 population
Model XII: The dependent variable is the Number of Wildcat drilling
Model XIII: The dependent variable is the Likelihood of civil Unrest
Model XIV: The dependent variable is the Democracy score (Polity IV)
All models test for the correlation between the Instrumental variables and the dependent variable. We aim to establish an insignificant correlation and to justify the validity of the instruments.
All models control for Country and time FE and the other controls in the main model. The robust standard errors are in parenthesis and are clustered at the country level. *, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively.

Fourth, we regress the instruments on the polity score (Model XIII) and, fifth, on the likelihood of civil unrest (Model XIV). These two last cases are important because in the case of conflict, discoveries can generate civil conflict, and conflict may result in high mortality of the vulnerable groups, e.g. children. Our finding rejects this hypothesis, and it is supported by earlier studies suggesting that no evidence back the theory that oil and gas enable civil conflict (Cotet and Tsui 2013). Also, the rejection of correlation between the instrumental variables and the democracy score suggests that the residual effect of institutions that might be correlated with colonialism is plausibly demeaned out of the equation with the fixed effect. Results from Table 3.4 (Model X to XIV) and evidence from the first-stage results (Table 3) suggest that the validity of our identification strategy and the estimates plausibly support the validity of our instruments.

3.6 Heterogeneous Impact of Income Shocks and Child Mortality

Up to this point, we have implicitly assumed that aggregate income shocks from oil price and oil discoveries affect all countries irrespective of ecological zones. However, this need not be so for a host of reasons. According to Sachs (2001), the burden of disease and infant mortality are considerably higher in the tropics and ecology affects the spread of infectious diseases in many tropical countries. Countries located in the tropics have a higher burden of disease, which may make them better at utilising income shocks for reducing child mortality. Income shocks in the tropics may, therefore, have a higher impact on mortality rates among countries in this ecological zone. Although introducing the Fixed Effect estimator helps on partially out the country fixed unobservable heterogeneities, it, however, does not allow us to observe how tropical countries perform in respect of income shocks and child mortality. In Models XV and XVI, we restrict our sample to only countries in the tropical region.

Also, in our previous models, we pool both colonised and non-colonised countries together. This may introduce bias if there is any cofounding variable in the residual that might be correlated with the decision of colonisation. Although, as we argue and show in the previous analysis, none of such exists, nevertheless we restrict our sampled countries to countries that experienced European colonialism in Model (XVI). In Model (XVII), our sample includes countries that are in the tropics and were also colonised. In these Models, we instrument income per capita with the log of value of oil discoveries only; thereby, making the models to be exactly identified.

We first present the results for tropical countries without any instruments in Table 3.5 (Model XV). Specifically, we find a negative income shock on child mortality. In Model XVI, where we introduced an instrumental variable to identify income shocks in Tropical countries, we find that the effect is negative but weakly significant. In Model XVII where we only include colonised countries we find that income is not statistically significant and in Model XVIII, where are sample includes countries that were colonised and that belong in the tropical ecological zones, we find the similar result of a weak statistical impact of income shocks on child mortality. Our results confirm our findings in an earlier analysis that the conditional income shock does not significantly influence child mortality in oil-rich countries.

The results of the first-stages regression for the IV in Table 3.5 are presented in Table 3.6. In the first-stages of Models, XVI, XVII and XVIII, where we use the instrumental variable estimation, we only use the value of the log of value of discoveries per capita as the instrument for income per capita. The results in Table 3.6 and the diagnostic tests in Table 3.5 validate or results.

Table 3.5: Heterogeneous impact of income shocks based on countries stratification

	Dependent variables: Log Child Mortality per 1,000 birth			
	Tropical Countries (No Instruments)	Tropical Countries with Instruments	Colonised Countries with Instruments	Colonised countries in tropical Zones with Instruments
	Model XV	Model XVI	Model XVII	Model XVIII
Log GDP/capita	-0.211***	-0.34*	0.11	0.13
	(0.078)	(0.17)	(0.24)	(0.18)
Percent of total population ages 15-64	-1.48	-0.84	-4.05**	-3.86**
	(1.0)	(1.60)	(1.28)	(1.39)
Female Labour force (% of total labour force)	-3.34***	-4.59***	-3.0***	-2.84***
	(0.85)	(0.75)	(0.46)	(0.71)
Number of endogenous regressors		1	1	1
Number of instruments	No IV	1	1	1
F-stat	65.48	140	223.76	185.8
Kleibergen-Paap rk LM statistic		11.78	11.74	11.39
Cragg-Donald Wald F statistic		15.01	11.94	13.14
Kleibergen-Paap rk Wald F-stat		12.17	11.74	11.48
Number of Countries	62	49	63	44
Number of Observations	2,308	1,828	2,337	1,649

Notes: The robust standard errors are in parenthesis and are clustered at the country level.
*, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively

Table 3.6: First stage regression for Table 3.5

	First stage for Model XVI	First stage for Model XVII	First stage for Model XVIII
Log (Value of Oil Discoveries per capita)	52.47***	34.28***	45.06***
	(15.04)	(10.0)	913.29)
F-test	12.17	11.74	11.48

Notes: Table 3.6 is the First-stage regression for the estimates in Table 3.5 and columns represent the corresponding first stages for Models XVI, XVII, and XVIII respectively
The robust standard errors are in parenthesis and are clustered at the country level.
*, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively

3.7 Income shocks and other potential mechanisms of child mortality

So far, we have only focused on child mortality using the number of death per 1000 birth before the age five as the only possible outcome through which we can observe the impact of income shocks on health. In this section, we extend our analysis by considering other biological and demographic outcomes that are important for reducing improving health and child mortality. It is possible for the effect of income to not materialise on child mortality directly but to reduce the other causes that predispose a child to poor health and increased mortality.

For instance, while child mortality is often attributed to improvement in nutrition brought about by income, however, the usefulness of public sanitation and adoption of hygienic practises often contribute significantly to mortality reduction (Figure 3.6). Improvement in general hygiene and proper sanitation can help to prevent endemic diarrhoea and numerous other globally important infections that could contribute to a decline in the number of child mortality (Bartram and Cairncross 2010).

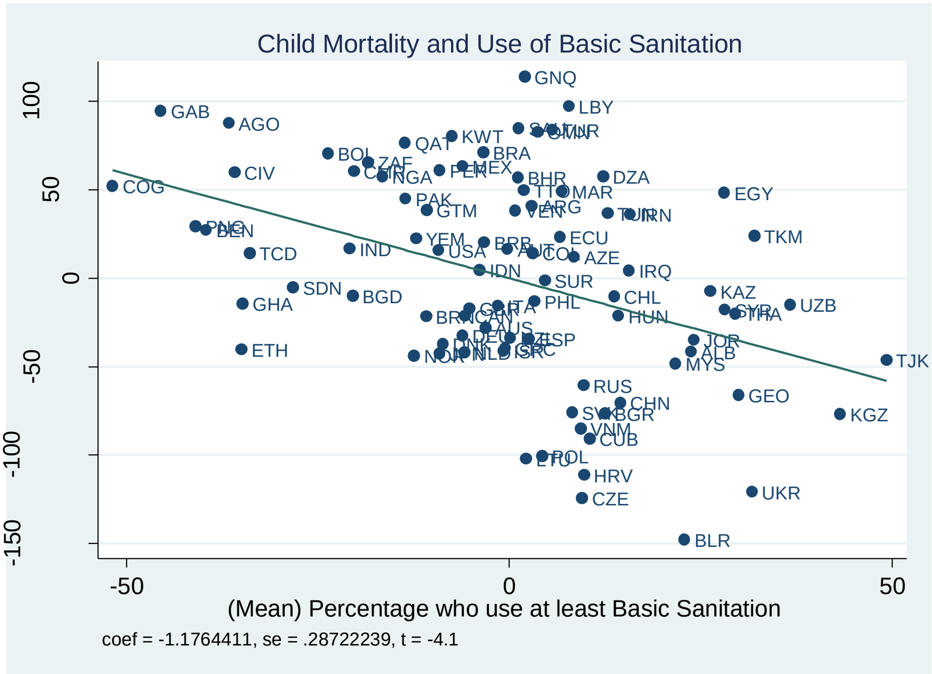

Figure 3.6: Child mortality and percentage of the population with basic sanitation

Also, because maternal health matters significantly for child health (Figure 3.7), e.g. access to breastmilk is a key child survival strategy and investment in mothers' health that reduces maternal mortality could be important for reducing child mortality (Edmond et al. 2006).

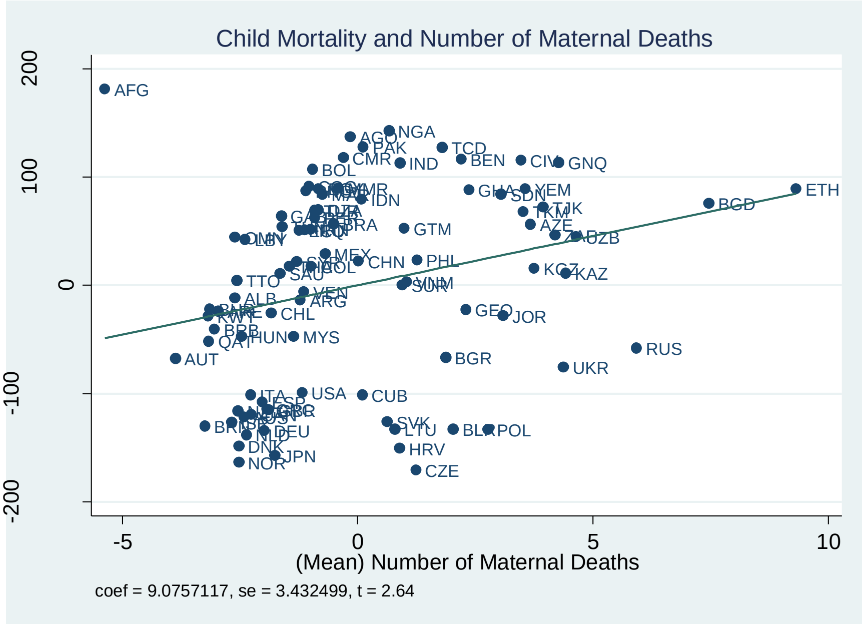

Figure 3.7: Child mortality and maternal death

Improving the quality of care for sick children in the form of investment in hospital facilities could also lead to reduced mortality (Nolan et al. 2001). Improving the quality of emergency care, diagnosis, and inpatient treatment in these hospitals are aspects that could be reflected in the investments in the number of beds (Figure 3.8).

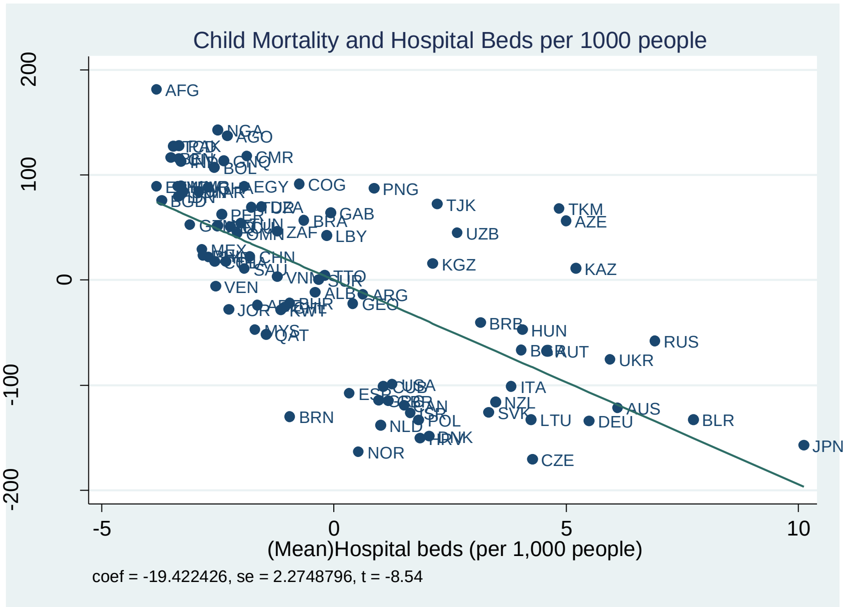

Figure 3.8: Child mortality and hospital beds per capita

Finally, low-birth-weight is a major determinant of child mortality and a worthy channel for exploring the income child mortality nexus (Figure 3.9). Also, low birth weight is associated with poor nutrition, especially in low-income households (McCormick 1985), a population with a higher percentage of babies with low birth weight could suggest poor nourishment in the womb, and such population could have a higher risk of child mortality rate after birth.

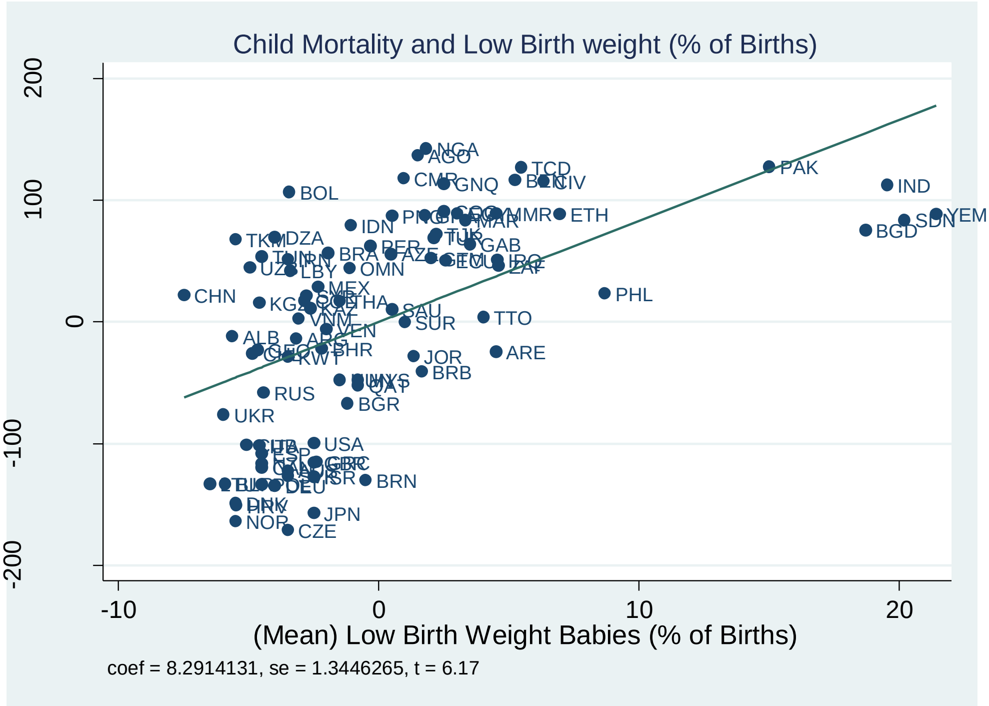

Figure 3.9: Child mortality and Percent of babies with low birth weight

These are worthy channels that deserve exploring with respect to ascertain the impact of income on child mortality. If the conditional income shock, for instance, improves the number of people with access to sanitation or reduces maternal mortality, per cent of the population with low birth weight, then this might be a good justification for proposing policies for governments on how to direct program and investments that could help to reduce mortality.

In Table 3.7, we present the instrumental variable estimates of income conditional on log value of oil discoveries and colonial experience on these outcomes of public sanitation use, maternal death, number of hospital beds and birth weight at birth. Our results suggest that income has no significant influence on these possible channels that are linked to child mortality. These results confirm the previous analysis that the possible shocks from oil price do not translate into sufficient improvement in income that leads to a reduction in child mortality. Also, we find in the first-stage regression that the experience of colonialism reduces the positive impact of oil price shocks on income per capita (Table 3.8).

Table 3.7: IV Estimates of Income shocks on other mechanisms of health care

Dependent variables:	Log % of Population using Basic Sanitation	Log Number of Maternal Deaths	Log Hospital beds per 1,000 people	Log Low birth weight (% of births)
	Model XIX	Model XX	Model XXI	Model XXII
Log GDP/capita	0.017*	0.021	0.005	-0.01
	(0.009)	(0.013)	(0.02)	(0.01)
Percent of total population ages 15-64	-0.065	-0.11	0.06	0.06
	(0.05)	(0.07)	(0.08)	(0.04)
Female Labour force (% of total labour force)	0.02***	-0.14***	0.11***	-0.17*
	(0.006)	(0.01)	(0.015)	(0.009)
Number of endogenous regressors	1	1	1	1
Number of instruments	2	2	2	2
Country and Time FE?	Yes	Yes	Yes	Yes
F-stat	522.7	698.5	35.66	3.89
Kleibergen-Paap rk LM statistic	24.23	24.22	24.22	24.23
Cragg-Donald Wald F statistic	12.82	12.82	12.82	12.82
Kleibergen-Paap rk Wald F-stat	13.12	13.12	13.12	13.12
Hansen test (over identification)	3.87	0.003	0.46	1.72
Number of Countries	98	98	98	98
Number of Observations	3491	3491	3491	3491

Notes: Table 3.7 is the Second stage(IV) Fixed Effect regression of Log GDP per capita on other mechanisms of child mortality
Model XIX: The dependent variable is the Log of People using at least basic sanitation services (% of the population)
Model XX: The dependent variable is the log number of maternal deaths
Model XXI: The dependent variable is the log number of Hospital beds (per 1,000 people)
Model XXII: The dependent variable is the log of Low-birthweight babies (% of births)
The robust standard errors are in parenthesis and are clustered at the country level.
*, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively

Table 3.8: First stage regression for Table 3.7

	First stage for Model XIX	First stage for Model XX	First stage for Model XXI	First stage for Model XXII
Log (Value of Oil Discoveries per capita)	66.30***	66.30***	66.30***	66.30***
	(13.55)	(13.55)	(13.55)	(13.55)
Log (Value of Oil Discoveries) × Colony (Dummy=1)	-48.21**	-48.21**	-48.21**	-48.21**
	(16.55)	(16.55)	(16.55)	(16.55)
F-test	13.12	13.12	13.12	13.12

Notes: Table 3.8 is the First-stage regression for the estimates in Table 3.7 and columns represent the corresponding first stages for Models XIX, XX, XXI and XXII respectively.
The robust standard errors are in parenthesis and are clustered at the country level.
*, ** and *** represent significance level of estimates at p-values of <0.1, 0.05 and 0.01 respectively

3.8 Conclusion

This paper explores how changes in income per capita, conditional on oil-price shocks and enduring impact of European colonialism, affect the risk of child mortality in oil-rich countries. We hypothesise that if oil-rich countries with oil discoveries cannot efficiently translate the oil-price shocks into an improvement in economic development; then, the expected positive shocks to income per capita will fail to lead to a reduction in child mortality in oil rich countries. A finding the role of shocks to income per capita, on child mortality has important implications for the design of socially efficient rents allocation, the development of specific policies that promotes transparency in oil-rich countries, and for the understanding of the multi-faceted channels of the resource curse.

We use a 2-stage Instrumental variable (IV) strategy to estimate the causal effect of aggregate GDP per capita on child mortality per 1,000 births. We instrument aggregate national income per capita with time series variation in global oil prices interacted with longitudinal variation in the log of new oil discoveries and a dummy to capture if a country was a former colony under European colonisation. This strategy helps to isolate a potentially exogenous source of variation in incomes. It also helps us to understand the enduring implication of colonial legacy at fostering institutional barriers that complicate the translation of positive income shocks on the observed child mortality. Our strategy also controls for the country and time fixed effects to account for the unobservable heterogeneities that are possible correlates on income and the instrumental variables.

Conditional on the positive oil price shocks given oil discoveries and colonial legacy, our findings document a weak and statistically insignificant relationship between income per capita and child mortality. Specifically, in the first stage, we find that while oil discoveries and oil-price shocks are positively correlated to income, however, there is a negative gap which reduces the magnitude of this estimate given that a country was colonised. Limited analyses where we restrict our analysis to tropical and colonised countries also find similar results. Also, we find that income per capita does not appear to reduce other potential child mortality mechanisms like the reduction of maternal mortality, investment in hospital facilities, basic sanitation and low birth weights.

Nevertheless, an important finding across all our specifications suggests that improving female labour participation helps in reducing child mortality. Overall women's participation in wage-paid jobs remains low especially in many petroleum-rich countries, and resource wealth has often been linked to lower levels of female labour, economic and political participation (Ross 2008, Simmons 2016). Women empowerment and economic development are closely related (Duflo 2012), and empowering women may bring development benefits that have significant implications for maternal health, birth weights and overall child mortality (Brenner 1979, McAvinchey 1984, Becker et al. 1990, Eswaran 2002).

These findings have practical implication for formulating a policy to reduce child mortality in oil-endowed and colonised countries. First, given the tendency for colonised countries to have less income from oil shocks, we suggest that targeted policies that ensure the accountability of the government in countries that were former European colonies. Second, given that child mortality reduces with female labour market participation, we suggest that policies that economically empower women could have a beneficial effect on child and infant mortality. Also, we recommend the provision of institutional instruments that make the oil-rich government more accountable in the disbursement of oil revenue and by increasing budgetary provision for medical care during an oil-price boom. This can be through the creation of a dedicated child-welfare fund from oil-wealth that assures free medical coverage for pregnant mothers and children for current and future generation, and ensuring insurance coverage for a child and mother welfare from oil wealth.

References

Acemoglu D., Johnson S., & Robinson, J.A. (2001). The colonial origins of comparative development: an empirical investigation. *American Economic Review,* 91:1369–401

Acemoglu, D., & Robinson, J. A. (2010). Why is Africa poor? *Economic history of developing regions*, 25(1), 21-50.

Acemoglu, D., Finkelstein, A., & Notowidigdo, MJ. (2013). Income and health spending: Evidence from oil price shocks. *Review of Economics and Statistics,* 95(4).

Acemoglu, D., Naidu, S., Restrepo, P., & Robinson, J. A. (2019). Democracy does cause growth. *Journal of Political Economy*, *127*(1), 47-100.

Acemoglu, D., Verdier, T., & Robinson, J. A. (2004). Kleptocracy And Divide and Rule: A Model Of Personal Rule. *Journal of the European Economic Association*, 2(2-3), 162-192

Ades, A. and Di Tella, R. (1999). Rents, competition, and corruption. *American Economic Review, 89(4)*, 982–93.

Aldrich, R., & McCreery, C. (2016). *European Sovereigns and their Empires beyond the Seas*. In: Aldrich, R., & McCreery, C. (Eds.), *Crowns and Colonies* (pp 9-11). Manchester: Manchester University Press

Angeles, L. (2007). Income inequality and colonialism.*European Economic Review*, *51*(5), 1155-1176.

Angeles, L., & Neanidis, K. C. (2015). The persistent effect of colonialism on corruption. *Economica*, *82*(326), 319-349.

Angrist, J. D., & Krueger, A. B. (2001). Instrumental variables and the search for identification: From supply and demand to natural experiments. *Journal of Economic Perspectives*, *15*(4), 69-85.

Apouey, B., & Clark, A. E. (2015). Winning big but feeling no better? The effect of lottery prizes on physical and mental health. *Health economics*, *24*(5), 516-538.

Arezki, R., Ramey, V. A., & Sheng, L. (2017). News shocks in open economies: Evidence from giant oil discoveries. *The quarterly journal of economics*, *132*(1), 103-155.

Ayesu, E., Gbormittah, F., & Adum-Kyeremeh, K. (2016). British colonialism and women's welfare in the Gold Coast colony. *Africa Today*, *63*(2), 3-30.

Barro, R. J., & Becker, G. S. (1989). Fertility choice in a model of economic growth. *Econometrica: Journal of the Econometric Society*, 481-501.

Bartram, J., & Cairncross, S. (2010). Hygiene, sanitation, and water: forgotten foundations of health. *PLoS medicine*, *7*(11), e1000367.

Becker, G. S., Murphy, K. M., & Tamura, R. (1990). Human capital, fertility, and economic growth. *Journal of political economy*, *98*(5, Part 2), S12-S37.

Bhalotra, S. (2010). Fatal fluctuations? Cyclicality in infant mortality in India. *Journal of Development Economics*, *93*(1), 7-19.

Bhattacharyya, S., & Hodler, R. (2010). Natural resources, democracy and corruption. *European Economic Review*, *54*(4), 608-621.

Black D., McKinnish, T., and Sanders, S. (2005). The Economic Impact of the Coal Boom and Bust. *Economic Journal* 115, 449–476

Bohn, H., & Deacon, R. T. (2000). Ownership risk, investment, and the use of natural resources. *American Economic Review,90*(3), 526-549.
Brenner, M. H. (1979). Mortality and the national economy: A review, and the experience of England and Wales, 1936-76. *The Lancet*, *314*(8142), 568-573
Brollo, F., Nannicini, T., Perotti, R., & Tabellini, G. (2013). The political resource curse. *American Economic Review*, *103*(5), 1759-96.
Caldwell, J.C. (1986). Routes to Low Mortality in Poor Countries. *Population and Development Review*, 12:171–219
Cappelli, G., & Baten, J. (2017). European Trade, Colonialism, and Human Capital Accumulation in Senegal, Gambia and Western Mali, 1770–1900. *The Journal of Economic History*, 77(3), 920-951.
Chay, K.Y., & Greenstone, M. (2003). The impact of air pollution on infant mortality: evidence from geographic variation in pollution shocks induced by a recession. *The Quarterly Journal of Economics*, *118*(3), 1121-1167.
Christelis, D., Georgarakos, D., Jappelli, T., Pistaferri, L., & van Rooij, M (2019). Asymmetric Consumption Effects of Transitory Income Shocks. *The Economic Journal , uez013*.
Comin, D., Easterly, W., & Gong, E. (2010). Was the wealth of nations determined in 1000 BC?. *American Economic Journal: Macroeconomics*, *2*(3), 65-97.
Cotet, A. M., & Tsui, K. K. (2013). Oil and conflict: what does the cross country evidence really show?. *American Economic Journal: Macroeconomics*, *5*(1), 49-80.
Currie, J., & Neidell, M. (2005). Air pollution and infant health: what can we learn from California's recent experience?. *The Quarterly Journal of Economics*, *120*(3), 1003-1030.
Cust, J., & Harding, T. (2014). Institutions and the location of oil exploration. *Journal of the European Economic Association*.
Cutler, D. M., Knaul, F., Lozano, R., Méndez, O., & Zurita, B. (2002). Financial crisis, health outcomes and ageing: Mexico in the 1980s and 1990s. *Journal of Public Economics*, *84*(2), 279-303.
Cutler, D., Deaton, A., & Lleras-Muney, A. (2006). The determinants of mortality. *The Journal of Economic Perspectives*, 20(3), 97-120
De Soysa, I., & Gizelis, T. I. (2013). The natural resource curse and the spread of HIV/AIDS, 1990–2008. *Social Science & Medicine*, 77, 90-96
Deaton, A. (2003). Health, inequality, and economic development. *Journal of economic literature*, *41*(1), 113-158.
Dehejia, R., & Lleras-Muney, A. (2004). Booms, busts, and babies' health. *The Quarterly Journal of Economics*, 119(3), 1091-1130
Deininger, K., & Mpuga, P. (2005). Economic and welfare impact of the abolition of health user fees: Evidence from Uganda. *Journal of African Economies*, *14*(1), 55-91.
Dell, M. (2010). The persistent effects of Peru's mining mita. *Econometrica; Journal of the Econometric Society*, *78*(6), 1863-1903.
Dell, M., & Olken, B. A. (2017). The Development Effects of the Extractive Colonial Economy: The Dutch Cultivation System in Java (No. w24009). *National Bureau of Economic Research*
Doepke, M. (2005). Child mortality and fertility decline: Does the Barro-Becker model fit the facts?. *Journal of population Economics*, *18*(2), 337-366.
Doepke, M., & Schneider, M. (2006). Inflation and the redistribution of nominal wealth. *Journal of Political Economy,114*(6), 1069-1097.
Duflo, E. (2012). Women empowerment and economic development. *Journal of Economic Literature*, *50*(4), 1051-79.

Easterlin, R.A. (1999). How Beneficent Is the Market? A Look at the Modern History of Mortality. *European Review of Economic History*, 3, 257–94

Edmond, K. M., Zandoh, C., Quigley, M. A., Amenga-Etego, S., Owusu-Agyei, S., & Kirkwood, B. R. (2006). Delayed breastfeeding initiation increases risk of neonatal mortality.*Pediatrics*, *117*(3), e380-e386.

Emami, K., & Adibpour, M. (2012). Oil income shocks and economic growth in Iran. *Economic Modelling*, *29*(5), 1774-1779.

Eswaran, M. (2002). The empowerment of women, fertility, and child mortality: Towards a theoretical analysis. *Journal of Population Economics*, *15*(3), 433-454.

Ferreira, F. H., & Schady, N. (2009). Aggregate economic shocks, child schooling, and child health. *The World Bank Research Observer*, *24*(2), 147-181.

Feyrer, J., & Sacerdote, B. (2009). Colonialism and modern income: islands as natural experiments. *The Review of Economics and Statistics*, *91*(2), 245-262.

Flegg, A. T. (1982). Inequality of income, illiteracy and medical care as determinants of infant mortality in underdeveloped countries. *Population studies*, *36*(3), 441-458.

Fox, M., Cacciatore, J., & Lacasse, J.R. (2014). Child death in the United States: productivity and the economic burden of parental grief. *Death studies*, 38(9), 597-602.

French, M. T., & Popovici, I. (2011). That instrument is lousy! In search of agreement when using instrumental variables estimation in substance use research. *Health Economics*,*20*(2), 127-146.

Furceri, D., Loungani, P., & Zdzienicka, A. (2018). The effects of monetary policy shocks on inequality. *Journal of International Money and Finance*, *85*, 168-186.

González, L. (2013). The effect of a universal child benefit on conceptions, abortions, and early maternal labor supply. *American Economic Journal: Economic Policy*, *5*(3), 160-88.

Grimm, M. (2011). Does household income matter for children's schooling? Evidence for rural Sub-Saharan Africa.*Economics of Education Review*, *30*(4), 740-754.

Heazell, A. E., Siassakos, D., Blencowe, H., Burden, C., Bhutta, Z. A., Cacciatore, J., Dang, N., Das, J., Flenady, V., Gold, K.J. & Mensah, O. K. (2016). Stillbirths: economic and psychosocial consequences. *The Lancet*, *387*(10018), 604-616.

Henderson, J. V., Storeygard, A., & Weil, D. N. (2012). Measuring economic growth from outer space. *American economic review*, *102*(2), 994-1028.

Huck, P. (1995). Infant mortality and living standards of English workers during the industrial revolution. *The Journal of Economic History*, *55*(3), 528-550.

Igbafe, P.A. (1979). *Benin under British administration: the impact of colonial rule on an African kingdom, 1897-1938* (pp. 243-6). London: Longman

Jensen, R. (2000). Agricultural volatility and investments in children. *American Economic Review*, *90*(2), 399-404.

Kolstad, I., & Søreide, T. (2009). Corruption in natural resource management: Implications for policy makers. *Resources Policy*, *34*(4), 214-226.

Lagomarsino, G., Garabrant, A., Adyas, A., Muga, R., & Otoo, N. (2012). Moving towards universal health coverage: health insurance reforms in nine developing countries in Africa and Asia. *The Lancet*, *380*(9845), 933-943.

Leite, C., & Weidmann, J. (2002). Does mother nature corrupt? Natural resources, corruption, and economic growth.*Governance, corruption, and economic performance*, 159-196.

Leonard, D. K. (1991). *African successes: Four public managers of Kenyan rural development*. Univ of California Press.

Levav, I., Kohn, R., Iscovich, J., Abramson, J. H., Tsai, W. Y., & Vigdorovich, D. (2000). Cancer incidence and survival following bereavement. *American Journal of Public Health*,*90*(10), 1601.

Li, J., Laursen, T. M., Precht, D. H., Olsen, J., & Mortensen, P. B. (2005). Hospitalization for mental illness among parents after the death of a child. *New England Journal of Medicine*,*352*(12), 1190-1196.
Mayer, S. E., & Sarin, A. (2005). Some mechanisms linking economic inequality and infant mortality. *Social science & medicine*, *60*(3), 439-455.
McAvinchey, I. D. (1984). Economic factors and mortality some aspects of the Scottish case 1950–1978. *Scottish Journal of Political Economy*, *31*(1), 1-27
McCormick, M. C. (1985). The contribution of low birth weight to infant mortality and childhood morbidity. *The New England journal of medicine*, *312*(2), 82.
Meessen, B., Gilson, L., & Tibouti, A. (2011). User fee removal in low-income countries: sharing knowledge to support managed implementation. *Health policy and planning*, *26*, ii1.
Michaels, G. (2007). The Long-Term Consequences of Resource Based Specialization. *The Economic Journal* 121:551 31–57
Michalopoulos, S., & Papaioannou, E. Historical Legacies and African Development. *Journal of Economic Literature (Forthcoming)*.
Mulinge, M., & Lesetedi, G. (1998). Interrogating Our Past: Colonialism and Corruption in Sub-Saharan Africa. *African Journal of Political Science / Revue Africaine De Science Politique, 3*(2), 15-28. Retrieved from http://www.jstor.org/stable/23493651
Mumtaz, H., & Theophilopoulou, A. (2017). The impact of monetary policy on inequality in the UK. An empirical analysis. *European Economic Review*, *98*, 410-423.
Neher, P. A. (1971). Peasants, procreation, and pensions. *The American Economic Review, 61*(3), 380-389.
Nolan, T., Angos, P., Cunha, A. J., Muhe, L., Qazi, S., Simoes, E. A Giorgio Tamburlini, G., Weber, M. and Pierce, N. F. (2001). Quality of hospital care for seriously ill children in less-developed countries. *The Lancet*, *357*(9250), 106-110.
Paxson, C., & Schady, N. (2005). Child health and economic crisis in Peru. *The World bank economic review*, *19*(2), 203-223.
Pritchett, L., & Summers, L.H. (1996). Wealthier is healthier. *Journal of Human resources*, 841-868.
Rabassa, M., Skoufias, E., & Jacoby, H. G. (2012). *Weather and child health in rural Nigeria*. The World Bank.
Rodgers, G. B. (2002). Income and inequality as determinants of mortality: an international cross-section analysis a.*International journal of epidemiology*, *31*(3), 533-538.
Rosenzweig, M. R., & Wolpin, K. I. (1980). Testing the quantity-quality fertility model: The use of twins as a natural experiment. *Econometrica: journal of the Econometric Society*, 227-240.
Ross, M. L. (2008). Oil, Islam, and women. *American political science review*, *102*(1), 107-123.
Ross, M. L. (2015). What have we learned about the resource curse?. *Annual Review of Political Science*, *18*, 239-259.
Ruhm, C. J. (2000). Are recessions good for your health?. *The Quarterly journal of economics*, *115*(2), 617-650.
Sachs, J. D. (2001). *Tropical underdevelopment* (No. w8119). National Bureau of Economic Research.
Schultz, T. P. (1993). Mortality decline in the low-income world: causes and consequences. *The American Economic Review*, 83(2), 337-342.
Semba, R. D., de Pee, S., Sun, K., Sari, M., Akhter, N., & Bloem, M. W. (2008). Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: a cross-sectional study. *The Lancet*, *371*(9609), 322-328.

Simmons, J. W. (2016). Resource Wealth and Women's Economic and Political Power in the US States. *Comparative Political Studies*, *49*(1), 115-152.
Song, J., Floyd, F. J., Seltzer, M. M., Greenberg, J. S., & Hong, J. (2010). Long‐Term Effects of Child Death on Parents' Health‐Related Quality of Life: A Dyadic Analysis. *Family relations*, *59*(3), 269-282.
Staiger, D., & Stock, J.H. (1997). Instrumental variables regression with weak instruments. *Econometrica*, *65*(3), 557-586.
Sterck, O. (2016). Natural resources and the spread of HIV/AIDS: Curse or blessing?. *Social Science & Medicine*, 150, 271-278
Stock, J. H., Wright, J. H., & Yogo, M. (2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business & Economic Statistics*, *20*(4), 518-529.
Thomas, D. (1994). Like father, like son; like mother, like daughter: Parental resources and child height. *Journal of human resources*, 950-988.
Treisman, D. (2000). The causes of corruption: a cross-national study. *Journal of public economics*, *76*(3), 399-457.
UNICEF. (2018). UN inter-agency group for child mortality estimation. *Levels and trends in child mortality*. https://data.unicef.org/wp-content/uploads/2018/09/U5MR_mortality_rate_2018.xlsx
Van den Berg, G. J., Lindeboom, M., & Portrait, F. (2006). Economic conditions early in life and individual mortality.*American Economic Review*, *96*(1), 290-302.
Van der Ploeg, F., & Poelhekke, S. (2017). The impact of natural resources: Survey of recent quantitative evidence. *The Journal of Development Studies*, *53*(2), 205-216.
van Poppel, F. (2000). Children in one-parent families: Survival as an indicator of the role of the parents. *Journal of Family History*, *25*(3), 269-290.
Waldmann, R. J. (1992). Income distribution and infant mortality. *The Quarterly Journal of Economics*, *107*(4), 1283-1302.
West, K. D. (1988). The insensitivity of consumption to news about income. *Journal of Monetary Economics*, *21*(1), 17-33.
Wigley, S. (2017). The resource curse and child mortality, 1961–2011. *Social Science & Medicine*, *176*, 142-148.
Willis, R. J. (1973). A new approach to the economic theory of fertility behavior. *Journal of Political Economy*, 81(2, Part 2), S14-S64
Wrigley, E. A., & Schofield, R. S. (1981). The population history of England: a reconstruction. *London: Arnold*.

3.1 Appendix I

Conceptual framework

We build on the foundational assumptions of Gary Becker's theories with respect to the family maximising behaviour at equilibrium and extend to the general equilibrium unit because of the expediency with the analyses of child health at the macro-level. Analysing at the macro instead of the family unit is important because health coverage in developing countries often involved substantial government interventions to improve equity in access to health care that are often not fully captured with household income (Deininger and Mpuga 2005, Meessen et al. 2011, Lagomarsino et al. 2012).

Specifically, we extend the Barro-Becker "altruistic" parent model (Barro and Becker 1989) and the income elasticity and the child quality model of Becker and Lewis (1973). At the family level, these models provide a useful framework for understanding fertility rates, family's utility and the child's quantity and quality trade-off. Parents maximise the family's aggregate utility from their own consumption (i.e., parents' utility) and by choosing the number of children to have. The more children a family has, the lesser the quality (more costly investment on education), and the lesser the family's aggregate utility. The implication is that fertility rates decline as families get richer (positive shocks) and as the opportunity cost for having children increases. These well-articulated models have guided the formulation of testable hypotheses, extensions have been provided, and the empirical information required for their verification under a minimal set of restrictions has also been discussed (see for instance; Rosenzweig and Wolpin 1980, Doepke 2005).

These models, despite their comprehensiveness, do not ascribe any significant influence on child mortality (Doepke 2005). Because of the "pension motive" for having children; i.e., having more children is a security for parents at old age (Neher 1971), high mortality rate could reduce the family's aggregate utility in the long term and the decision on the number of children to have. Child's mortality disrupts the family's utility by affecting parents' health; e.g., more hospital admissions (Li et al. 2005), morbidity, e.g., some forms of cancer (Levav et al. 2000), and by affecting their general well-being during and over extended periods of bereavement (Song et al. 2010). More importantly, child mortality has a significant consequence at the macro-economic level; e.g., productivity-related losses from the economic and psychosocial consequence of the bereaved parents (Schultz 1993, Fox et al. 2014, Heazell et al. 2016). Therefore, exploring child mortality as a significant component of the family's utility model is an aspect that can offer a suitable template for developing our analytical strategy at the macro-economic level.

We consider a simple extension that treats child mortality as an important component of the aggregate family utility. We assume that the family derives utility (U_i) from own consumption (c_i) (i.e., parents' medical and non-medical) and from the utility of the child's survival (d_i). Like Barro and Becker (1989), we assume that parents are "altruistic" (β): i.e., they care about the child's survival and are willing to take actions that satisfy the child's wellbeing even if a more rewarding and self-interested alternative exists[19].

[19] An example in this regards could be when a parent avoids certain actions that are not beneficial for the foetus or the child e.g. smoking, or foregoes a higher paying job to focus on the commitment to nursing and raising the child.

Assuming linearity of each of the utility components, the aggregate utility of the *ith* family can be written as (Barro and Becker 1989):

$$U_i = v(c_i) + \beta F(d_i) \quad (3.1)$$

Where (U_i) is that the sum of the family's utility, c_i is parents' own consumption and $v(c_i)$ is the utility from this consumption. d_i is the probability of the child's survival and $F(d_i)$ is the utility from this child's survival. β is the degree of parents' altruism toward their child. We define the altruism parameter (β) as less than one but greater than zero (Barro and Becker 1989) but relax on the assumption of the functional form it takes.

$$0 < \beta < 1 \quad (3.2)$$

Parents' utility function $v(c_i)$ is associated with the price (p) and the quantity of medical (m_i) and non-medical (nm_i) consumption (Eqn. 3.3). Also, the child's survival function[20] $F(d_i)$ is associated with the mother's prenatal and postnatal consumption (b_i) e.g., hospital visits and medical care for the child from conception till birth, and the child's consumption of other goods (q_i) at price (p) during the early stage of development that improves the child's survival (Eqn. 3.4).

$$c_i = p(m_i) + p(nm_i) \quad (3.3)$$

$$d_i = p(b_i) + p(q_i) \quad (3.4)$$

Expenditures on parents' utility (Eqn. 3.3) and the infant's survival (Eqn. 3.4) are constrained by the available budget (income) denoted by w_i. In Eqn (3.5), we re-arrange Eqns. 3.3 and 3.4 and introduce income (w_i) to specify the budget constraint model:

$$p(m_i + nm_i) + p(b_i + q_i) \leq w_i \quad (3.5)$$

Where the first term $p(m_i + nm_i)$ is the expenditure on parents' own medical and non-medical consumption, and the second term $p(b_i + q_i)$, is the expenditure for improving the child's survival (d_i) up to a certain age. Income (w_i) and the cost parameter (p) satisfy the necessary conditions i.e., $w_i > 0$ and $p \geq 0$. At equilibrium, positive shocks to income would increase the aggregate family utility by improving parents' consumption (c_i) and by improving child's survival (d_i).

To make our model analytically tractable and testable with data, we assume that parents' consumption component $(m_i + nm_i)$ is less sensitive to income and to the budget constraint; i.e., parents can smoothen consumption in times of temporary negative income shocks (West 1988). But the child's is more vulnerable to income shocks; negative economic conditions early in life could have a significant impact on their survival and such shocks can reflect the decline in the aggregate family utility and wellbeing (Thomas 1994, Huck 1995 Van den Berg 2006). Besides, child mortality is an outcome that can also serve as an index of parents' living standards and utility (Thomas 1994, Huck 1995, van Poppel 2000, Semba et al. 2008). Using this intuition, we extend Eqn 3.5 by relaxing the parents' consumption component;

[20] Child birth and child rearing are nonmarket activities so the transaction prices used to illustrate the costs associated with the child's survival cannot provide full information on the full range of costs with the child care (Willis 1973).

i.e., $p(m_i + nm_i) = 0$, include time dimension t and consider variation at the family i and community j levels to build our analytical model of income shocks and the child mortality.

We define a reduced form relationship of the income-child mortality as:

$$d_{i,j,t} = \delta(Income_{ijt}) + \mu_{i,j,t} \qquad (3.6)$$

Where d is the rate of child mortality in the *ith* family, community j and year t. $Income$ denotes exogenous income shock at the household level at time t and reflects the marginal elasticity of household income on the probability of the child's survival. The error term is assumed to take the form; $\mu_{i,j,t} = e_{i,j,t} + \gamma_j + \phi_t$ where the two latter terms capture the systematic differences in the infant survival rates fixed across households and communities over time. e_{ijt} is the idiosyncratic error component which reflects maternal genetic factors, differences in altruism that could affect parents' investment on child's survival, other omitted variables, and the approximation errors associated with income and child mortality measurements.

Equation (3.6) represents the equilibrium at the family and community level (j). However, income shocks at this level could hardly explain the variation in child mortality. Investment and interventions at improving the child's survival and health, e.g. the provision of vaccinations and immunisation against infectious disease, are usually done by the government at the macro-level. Also, the government provides subsidies that cater to the health needs of pregnant women and children, especially in many developing countries where out-of-pocket medical expenses are usually low. So a more-informed analysis of Eqn (3.6) will focus on analysing the effects of income shocks on child mortality (CMR) at the macro-level (k).

For the general equilibrium, we take the national averages by countries for equation (3.6) and weigh by population:

$$CMR_{k,t} = \delta(Income\ per\ capita_{k,t}) + \mu_{k,t} \qquad (3.7)$$

Where CMR is the number of child death before age five per 1,000 live births in country k and for a given year t.

3.2 Appendix II

Summary and Descriptive Statistics

	All countries			Colonised			Non-Colonised countries		
Variables	**Obs**	**Mean**	**Std**	**Obs**	**Mean**	**Std**	**Obs**	**Mean**	**Std**
Log GDP per capita	7,143	748	153	3,752	693	126	1,890	838	151
Log Child mortality	8,029	362	103	3,942	403	82	2,199	298	110
Log Value of Oil Discoveries per capita	4,921	-0.13	6	2,816	-0.13	0.09	1,274	-0.11	0.09
Labour force, female	7,259	37	11	3,696	36	10.2	2,222	38	10
Per cent of total population ages 15-64	7,637	58	7	3,858	54.7	4.8	2,330	62	6.1
Log Low-birthweight babies (% of births)	9,383	-4.2	1.6	4,334	-4.1	1.8	2,601	-4.4	1.23
Log Hospital beds (per 1,000 people)	9,384	-2.8	2.7	4,335	-3.4	2.3	2,601	-1.6	3.17
Log Number of maternal deaths	9,353	-0.93	4.9	4,335	-0.13	5.6	2,594	-1.2	4
Log People using at least basic sanitation services (% of population)	9,384	-2.8	3.5	4,335	-2.8	3.4	2,601	-2.7	3.7
Log (Oil Rents per capita)	4,921	3.3	20	2,816	0.5	2	1,274	4.6	24

Political Accountability, Information Asymmetry and the Resource Curse: Evidence from Night-time Lights

Abstract

In this paper, we present two mechanisms for understanding the resource curse from a political economy perspective. First, the boom from giant oil discoveries raises the value of being in power and provides incumbent politicians with incentives to inflate performance through the manipulation of GDP statistics to remain in office. Second, the competition for anticipated rents makes democracy less effective as a measure of accountability that supports growth in the long run. To provide evidence, we use the variation in nighttime lights to identify economic growth and use human right protection as an alternative measure of political accountability. To identify GDP manipulation, we exploit the time lag it requires before the announcement of giant oil discovery causes the GDP to contribute to nighttime lights growth. We estimate Dynamic Panel models for 157 countries from 1992 to 2008 with controls for year and time fixed effects and one-year lag GDP on growth. Our baseline results show that in the long run, the contribution of democracy to GDP reduces by 44% with the announcement of giant oil discovery. GDP per capita is inflated by about 2% in oil-rich countries in the year of discovery relative to the year before discovery. Third, discovery predicts a more negative effect on growth-based nighttime lights than GDP-based growth especially in countries with weak democracy. Fourth, human rights protection contribute to growth, and the effect does not depend on oil discovery. Fifth, increasing nonresource tax improves human rights protection.

Keywords: Nighttime lights, GDP bias, resource curse, human rights, political accountability
JEL codes: D720, O130

4.1 Background and Motivation

Could the boom from natural resource discoveries such as giant oil fields deteriorate the quality of the political process and cause a persistent negative effect on economic growth? If so, how does this happen? Why are citizens unable to strengthen the political process, and why is the fear of removal from office not enough to motivate political agents for improved performance? These are important, though not new, questions for countries who receive large foreign transfers, windfalls from resource discoveries or positive shocks from commodity prices (Robinson et al. 2006, Brollo et al. 2013, Carreri and Dube 2017). Many resource-rich countries perform poorly, and the democratic features of the rule of law, free markets participation and small government consumption often do not work to promote growth and inclusive development[21] (Van de Ploeg 2011, Ross 2013).

The predominant explanations for the "political resource curse": the worse political and economic development in many resource-rich countries are centred around the adverse effect of resource rents on the political process (Tornell and Lane 1999, Robinson et al. 2006), compounded by the selective entry of career-concerned politicians who can afford to under-perform without any fear of losing political office (Tsui 2010, Brollo et al. 2013). Democracy is hinged on competitive elections, and because of the ever-looming electoral cycle, it mounts pressure on politicians to compensate the confidence reposed in them by the electorate to

[21] The link between types of political regime and economic growth has for long attracted significant interest (see e.g., Aleesina and Perotti 1994, Przeworski and Limongi 1993, Barro 1996, Gerring et al. 2012, Giuliano et al. 2013, Acemoglu et al. 2019); we do not attempt a comprehensive scope of this literature. Rather our focus is modest and applies only to recent endeavours in this area, especially in the context of resource-rich countries.

guarantee re-election (Barro 1973, Persson et al. 1997). Within a limited institutional context, the political resource curse theory has been empirically put to the test in oil rich municipalities in Brazil (Brollo et al. 2013) and on the competitiveness of elections in response to oil price shocks in Colombia[22] (Carreri and Dube 2017).

Two main observations make the existing evidence of the political resource curse inconclusive. First, the adverse effect of democratic quality and growth can be short-lived, persistent or gradual and depends on past growth (Brooks et al. 2016, Acemoglu et al. 2019); therefore, an investigation of the political resource curse that goes beyond the short-run changes would give a better insight. In the long-run, nothing prevents nondemocratic governments from implementing economic freedoms that reverse the negative impact of the boom on political institutions. If the resource wealth is used in the short-run to offset the political economy obstacle to reforms and provide citizens with a combination of generous benefits, the long term impact might not necessarily lead to worse economic outcomes (Haggard 1990). Also, resource booms can strengthen democracy if booms legitimise political agents' access to rents and make them support political reforms and encourage greater investment in assets that favour growth for fear of ceding power to rivals (Dunning 2008, pg. 22; Caselli and Cunningham 2009, Haber and Menaldo 2011). Second, the question of the political resource curse in oil-rich countries holds global relevance that goes beyond conclusion reached within the limited institutional context afforded by subnational analysis (Brollo et al. 2013, Carreri and Dube 2017). Although, the within-country strategy poses several identification advantages relative to cross-national studies (Cavalcanti et al. 2019); however, their generalisability is weak, and it offers limited applicability to several other oil-rich countries (Cassidy 2019).

The main focus of the paper is to provide theory and evidence to support the adverse effects of oil wealth on the functioning of political institutions. Our theory identifies two distinct channels. The first applies to the tendency for oil-rich governments to inflate this GDP statistics to give an impression of favourable performance and citizens' inability to validate governments' spending. Resource booms may raise the value of being in office and provide politicians with incentives to influence the outcome of elections by inflating performance while increasing resource misallocation for private benefits. On the other hand, if growth (performance) is computed with externally validated measurement such as nighttime lights, voters can be more informed and allow for better candidates to contest elections. GDP remains an imprecise measure of the standard of living and using nighttime lights as either substitute or complement to GDP can reflect an adjusted measured welfare growth. The concept builds on George Akerlof, Michael Spence, and Joseph Stiglitz's analyses of markets with information asymmetry (Löfgren et al. 2002) and the bounded rationality in the context of citizens' decisions making under imperfect learning (Simon 1979). The idea that GDP-based statistics as a measurement of economic performance is prone to inflation has been articulated in recent policy debates[23]. However, identifying this as premises for the weakening of the political process that contribute to the persistence of the resource curse is our first contribution to the political resource curse.

[22] For instance, Brollo et al. (2013) use the episodes of corruption of incumbent mayors and the average education of candidates seeking for electoral offices in oil-rich municipalities in Brazil and Carreri and Dube (2017) attribute the reduction in number of candidates who contest political office and the wide vote margin with which winners are elected to positive oil price shocks in Columbia.

[23] For example see Martinez (2018) for the case of GDP inflation in countries with weak institutions and Chen et al. (2019) for the specific case of China.

The second applies to the bias with the use of democratic participation as a channel for identifying the political resource curse. Because democracy legitimises politicians' access to political and economic rents, the competition for anticipated rents renders democracy less effective for accountability that supports growth. On the other hand, identifying political resource curse with governments' commitment to protecting human rights can reflect political accountability (Wigley 2018). Revenue from natural resources enables governments to relax non-resource tax income, and it may reduce governments' commitments to protect citizens from human rights abuses. However, unlike democracy, human rights observance does not impose significant constraints on agents' political career and can offer a verifiable channel for understanding the effect of non-resource taxes on good governance (Ross 2004, Besley and Persson 2013). In Section 4.2, we link these mechanisms together and show how they create a channel for the resource curse.

To provide evidence, we identify economic development with the variation in nighttime lights per area (without gas flare cells) from outer space and resource windfall with the news on the timing of giant oil discoveries. In contrast to GDP statistics, nighttime lights as indicators of economic development will be unbiased and relatively devoid of "fiscal gimmickry" (Deaton 2005, Johnson et al. 2013, Pinkovskiy and Sala-i-Martin 2016). Importantly, night lights are an ideal data source for tracking both long term and short term fluctuations in growth across countries over space (Henderson et al. 2012, Pinkovskiy 2017) and are not affected by countrywide institutional structures (Michalopoulos and Papaioannou 2013a). Our measurement of human rights protection recognises the changes in the standards of human right measurement over the time (Fariss 2014) and the democracy indicator consolidates previous measures that address the measurement error with democracy indices (Acemoglu et al. 2019).

To identify GDP manipulation, the identification strategy exploits the time lag between the announcements of giant oil discovery relative to GDP's significant contribution to nighttime lights. Because it takes a relatively long time from the announcement of giant oil discoveries to when rents positively manifest on economic development (Arezki et al. 2017), the contribution of GDP to nighttime lights should not be immediate in the year of discovery relative to the preceding year if there is no manipulation with GDP statistics. Estimating the effect of anticipated windfalls and democracy on economic growth faces several challenges if we account for the rich dynamics of GDP (Acemoglu et al. 2019). To circumvent these hurdles, we estimate dynamic panel-data models with GMM-styled instrumental variable analysis for 157 countries from 1992 to 2008 to isolate useful information and provide more reliable estimates (Arellano and Bond 1991, Blundell and Bond 1998, Roodman 2009). In Sections 4.3 and 4.4, we discuss our data and present the analytical strategies employed to test our predictions.

In Section 4.5, we discuss the results. Our baseline results show that in the long run, the contribution of democracy to GDP per capita reduces by about 44% with the announcement of giant oil discovery. We show evidence of GDP's inflation by about 2% in the year of discovery. Third, discovery predicts a negative growth to nighttime lights, especially in countries with a low score in democratic institutions. Fourth, human rights protection contribute to the growth, and the effect does not depend on the discovery, and increasing nonresource tax improves human rights and offers a verifiable channel for understanding the effect of non-resource taxes on good governance in resource-rich countries. Our findings suggest that transparent and open access to information on government performance; improving governments' compliance to human rights protection in addition to democratic reforms are useful means for reducing the resource curse and improving governments' accountability. We conclude in Section 4.6.

4.2 Conceptual framework

In this section, we conceptualise the general constraint to the political process in resource rich countries. We explain why citizens find it hard to constitutionally replace the existing non-performing government *via* the ballot, constitute an effective opposition constraining the powers of the elites and promote candidates with progressive ideas supporting economic growth. To understand this mechanism, we give three illustrations of the political constraints that surround the resource curse.

Firstly, since calls for institutional change in governance is primarily triggered by adverse income shocks (Lipset 1959, Acemoglu and Robinson 2001, Acemoglu and Robinson 2006, Brückner and Ciccone 2011), then an information asymmetry that limits citizens' understanding of the real economic performance with respect to income per capita can limit effective agitation for institutional change. Governments in oil-rich economies typically have a greater incentive to manipulate economic performance, underreport receipts from rents, window-dress activities associated with GDP accounting and churn out inflated statistics[24] (Caselli 2006). Also, if benefits from rents are shared among few political elites, as it is the case in many rentier states, while many individuals gain little or nothing, then average per-capita GDP is a biased unit to measure economic growth[25]. Therefore, a misrepresentation of the extent of adverse income shocks will limit citizens' drive for institutional change, and the government can continue to embezzle budgets for private gains.

Secondly, the endogenous entry of poorly qualified politicians associated with anticipated revenue might make it hard for citizens to replace weak leaders and policies with progressive candidates constitutionally. Under a democratic system of government, the extent to which anticipated rents could improve growth is intrinsically tied to the quality of politicians who legislate and execute growth favouring policies and the effectiveness of the checks imposed by the separation powers (Persson et al. 1997, Brollo et al. 2013). The windfall to government revenues could selectively undermine the growth potential by reducing the quality of candidates seeking elective offices (Brollo et al. 2013, Carreri and Dube 2017). Also, the checks imposed by the separation of powers of the arms can become ineffective if all arms of the government connive to cooperate and collectively abuse office by strategically agreeing to allocate resources among themselves.

Thirdly, with natural resource discoveries government might relax the tax policy, and increase spending on structures that intimidate the citizens to "submission" and increase the constraint to collective action and coordination efforts for institutional reforms (Conrad and DeMeritt 2013, DeMeritt et al. 2013, Wigley 2018). Because of the state's monopoly on the legitimate use of agents of coercion like military and police forces, citizens face the classic problem of overcoming collective-action and coordination constraints to institutional reforms and the

---

[24] A critical appraisal of the degree of measurement error in the The Penn World Table (PWT) comes from Johnson et al. (2013). Specifically, the authors shed light on two problems in the Penn World Table (PWT) GDP estimates. First, they show that these estimates vary substantially across different versions of the PWT, suggesting a "systematic variability, which is greater: at higher data frequencies, for smaller countries, and the farther the estimate from the benchmark year". Second, they show that the PWT methodology leads to GDP estimates "that are not valued at purchasing power parity (PPP) prices" (Johnson et al. 2013). A more recent critique comes from Martinez (2018) which shows that autocratic regime inflate their GDP estimates to justify their regime practises.

[25] More recent evidence supports this contention in relation to giant oil discoveries and regional inequalities (see Smith and Wills 2018). While new discoveries promote increase in GDP (measured from night lights illumination) at national level, however, they promote regional inequalities because the effect of the increase in growth is limited to towns and no evidence of benefits to the rural poor (Smith and Wills 2018).

constitutional change in government. The logic of collective action, as illustrated in Olson's (1965) study, suggests that in any group, the coordination efforts will face a challenge of how to convince individuals to constitute opposition to governments' mismanagement and not to "free ride" on the efforts of others (Olson 1965, Acemoglu and Robinson 2001). The implied cost attributed to being in the opposition, weak institutions for human rights protection and the forfeited earnings from labour days lost will diffuse the need for overcoming collective action.

To formalise these illustrations, we assume a model with an infinite series of periods where an election to replace the incumbent is held in every period. With it, citizens can sanction incumbents' poor performance by rejection at the polls and reward performance by re-electing to occupy political seats. We identify two classes of actors; the incumbent government (political class, or the agents) and citizens (voters, or the principal). Citizens are the decision-maker, and it is to their advantage that elections are conducted as often as possible. The utility function of citizens hinges on the optimum distribution of revenue by the incumbent in a socially efficient way and the provision of civil liberties and freedom that further enhance economic productivity.

The incumbent government, by nature, wants to appropriate more revenue for private benefits and relax the burden of the provision of civil liberties. However, citizens can constitutionally replace the incumbent with an alternative during an election. There is always an available opponent, identical in all respects to the incumbent, but differ in expected quality. Citizens can assess the incumbent's performance and decide whether to sanction or reward by using a parameter that measures the quality of performance of the incumbent (δ_t). For simplicity, quality (δ_t) is based on the productivity of the total revenue (T_t) allocation for public benefits and the quality of civil liberties in the collective decision-making process (D_t). If citizens can adequately observe (δ_t), then the incumbent government will have to improve on this rating to justify re-election. Otherwise, it will be replaced with a costless alternative (Krause and Méndez 2009).

Governments' total revenue (T_t) could be from resource rents (τ_t) or from personal income (non-resource) tax revenue (γ_t) raised from citizens. With more resource discoveries and higher contribution of rents to total revenue, the incumbent can afford to relax personal income tax from citizens (Ross 2001). Citizens can relatively monitor non-resource tax revenue (γ_t); implying a higher demand for accountability from citizens and a greater incentive for the incumbent government to improve performance. In contrast to personal (non-resource) tax, citizens cannot monitor and verify the amount of revenue from resource (τ_t) which makes the incumbent government more likely to misappropriate revenue for private use (e_t). Also, more resource revenue (τ_t) implies less tax (γ_t) and fewer incentives by the incumbent to guarantee civil liberty and electoral participation. In essence, citizens can no longer be actively involved in the decision-making process and objectively access the quality of the incumbent's performance (δ_t).

However, citizens still need a parameter of quality measurement (δ_t); given citizens' bounded rationality (Simon 1979), the use of performance estimates like GDP statistics, government spending and budgetary provision are convenient means of assessment of the incumbent's performance. Governments usually produce these estimates; they are typically noisy and can be exaggerated to inflate how well the economy is doing and to create the impression that resources are not plundered. Because citizens (principal) can no longer validate these the incumbent's (agents) performance through these estimates, it introduces an informational problem that is similar to George Akerlof, Michael Spence, and Joseph Stiglitz's markets with information asymmetry. In this case, it increases the level of misappropriation of resources and makes the political process inefficient at replacing the incumbent with another candidate with expected better performance[26].

Also, because of the moral hazard with resource rents, resource rents can be used by the incumbent to frustrate attempts at reaching the "critical mass" in "collective action" by investing more in instruments that heightens the costs of participation in the demand for institutional reform and incentives by members to "free ride" on the efforts of others (Olson 1965, Marwell and Oliver 1993).

We express these observations in Eqns (4.1) and (4.2). In Eqn (1), we define the utility maximising electorate[27] (citizens) as a continuum of infinitely-lived voters that are identical in preference for good governance and wish to maximise expected utility from consumption (Persson et al. 1997, Diermeier and Li 2017).

$$\mathrm{E} \sum_{k=1}^{n} \beta^{t} u_k(C_t) \qquad (4.1)$$

Citizens (voters) want to maximise k to n aggregate utilities (u), i.e., from private consumption (e.g. food, clothing and shelter), consumption of the public good and freedom from internal or external aggression. u is a concave utility function that monotonically increases with consumption (C_t). E is the expectation operator of the aggregate utility for all citizens. We define β^t as the time utility discount factor with values ranging from $0 < \beta < 1$. The time discounting ensures that citizens are dynamically consistent, i.e., the relative evaluation of utility from consumption remains constant through time.

Extending Persson et al. (1997), voters' public good consumption C_t is defined in (4.2):

$$C_t = \delta_t[(T_t(\gamma_t, \tau_t) - e_t(\tau_t)) + (1 - \tau_t)D_t] + y_t(\tau_t) \qquad (4.2)$$

Eqn 2 suggests citizens' consumption (C_t) is constrained by the "quality" of the political agent (δ_t) which is determined by how much s/he allocates revenue (T_t) less what s/he misappropriate or under disclosed (e_t), as well by providing a conducive environment that guarantees protection and facilitates participation in the political process (D_t). In essence, quality (δ_t) is a performance parameter measured in terms of allocation of total revenue (T_t) less private diversion and appropriation (e_t), and by the protection granted for civil liberty and political participation (D_t). It is easy for the citizens to re-elect the incumbent if they can observe (δ_t) given that τ_t= 0 and are satisfied. Otherwise, an opponent will be elected.

However, if citizens neither know the real value of total revenue (T_t) nor the degree of liberty and quality of political and civic participation (D_t) because of the composition of total revenue (T_t) comes from rents (τ_t), misappropriation (e_t) will increase. In the case when rents dominate budget ($\text{i.e.}, \tau_t > 0$), citizens can no longer verify the performance parameter δ_t. But citizens can check the quality of performance (δ_t) from GDP statistics and government spending which are provided by the government to gauge the level of public allocation. Because the incumbent

[26] Because of the principal-agent problems, governments' incentive to maintain accountability and stewardship will be compromised and the overall utility of citizens will decline. In essence, the information asymmetry with respect to knowledge of (δ_t) results into "agency loss", and it limits citizens' ability in the context of sanctioning the incumbent by not re-electing and disincentives the incumbent to improve performance.
[27] By the electorate we imply a large number of identical and infinitely lived voters

provides this statistics, s/he will continue with misappropriation of resource (resource curse) without fear of sanctioning through the polls

y_t denotes non-productive transfers from the government to citizens. The government's spending on y_t is a non-productive; it does not raise the aggregate labour productivity and does not contribute to stimulating growth like an investment in the industrial or manufacturing sectors. But it could be strategically deployed by a non-performing incumbent to raise the citizens' utility in a bid to ensure re-election (e.g., transfer during the election period to induce voting in a certain pattern). Because citizens are forgetful and they tend to overweigh their more recent experiences in forming their attitudes toward the incumbent (Diermeier and Li 2017), strategic allocation on y_t close to election period could win some sympathy for the incumbent. The implication of this last point reflects why citizens easily forgive the poor performance of the incumbents in the early period and why politicians might increase the value of y_t around the election, period to garner some support for their re-election bid which might further bias the quality of electoral democracies in resource-rich countries.

The timing and sequence of events and the summary of the argument presented so far as follows:

1. At the start of each period *t*, voters choose a voting rule conditional on their information on the performance (δ_t) of the government at the end of the period.
2. The citizens voting depend on an indicator of the performance of the government (δ_t) which is how their positive expectations from revenues (resource rents and non-resource taxes) and political accountability have been met. At the end of period *t*, the voting takes place and depending on whether there is full information or not, citizens may or may not observe δ_t.
3. The decision, given the full observation of δ_t is to reappoint the incumbent if the utility is maximised. Otherwise, the incumbent political agent is not re-elected, and an opponent is elected. There is always an available opponent, identical in all respects to the incumbent, but differ in expected quality.
4. If the citizens cannot audit performance, the government supplants performance-based growth with GDP statistics and increases expropriation without the fear of removal from office
5. Also, with more rents comes low tax composition of total revenue and the competition for resource rent impose high political transaction costs which impose constraints on citizens' collective action for institutional change and the observation of δ_t.
6. These make the incumbent continue with misappropriation of resource (resource curse) without fear of sanctioning through the polls.

4.3 Data, definition, measurement and descriptive statistics

4.3.1 Human Rights Protection (HRP)

Human rights are the norms or standards that help to protect people from severe political, legal, and social abuses; these rights are fundamental and inalienable for every human person (Nickel 2014). These norms encompass a wide variety; including right to a fair trial, protection of the physical integrity, protection against enslavement, the right to free speech, and the right to education (Roser 2018). The protection of these rights is inalienably linked with good governance and thus could be useful indicators of political accountability and indicative of the strength of the separation of powers and the quality of service delivery to the public (Office of the United Nations High Commissioner for Human Rights 2007). Human rights protection, like property rights, could also be useful for boosting investors' confidence and reducing uncertainty in the financial markets by fostering trade and attracting foreign investments into the economy. Subsequently, it could help to create an enabling environment useful for economic growth and inclusive shared prosperity and an important channel worthy for exploring to reduce the resource curse.

However, from a measurement perspective, attributing quantitative values to changes in human rights protection is a challenge. For instance, one way of measuring the protection of human rights is perhaps to count the number of human rights treaties that countries ratify. However, in practice, the agreement reached by signing or ratification of such treatise is not legally binding, and government authorities rarely fulfil the agreements. They can use policy tools to make it challenging to quantify repressive activities. Another strategy is to create an index based on information included in annual reports produced by the US Department of State and Amnesty International rights. Examples of such indices include the widely used Political Terror Scale (PTS) and the CIRI Physical Integrity Index (Fariss 2014, Cingranelli and Filippov 2018). However, such indices are also likely to be biased if they do not incorporate changes arising from raising the standards of human rights protection over time (Fariss 2014).

Fariss (2014) in a landmark paper, challenges the finding that human right repression scores have remained unchanged over the last 35 years, suggesting a potential bias in the way these indices were generated. Specifically, the author argues that it is unlikely that there has not been an improvement in human rights abuses despite the general improvement in democracy rating over time (Fariss 2014, Cingranelli and Filippov 2018). Fariss (2014) concludes that these indices might reflect an inconsistency in the way major monitoring agencies, like Amnesty International and the U.S. State Department, interpret the information collected. For instance, the improvement in human right score might be obscured because more recent reports may incorporate critiques and suggestions proffered on an earlier version, thus making it appear that there have been no changes (Hafner-Burton and Ron 2009, Clark and Sikkink 2013, Fariss 2014). Such biases, which Fariss (2014) collectively terms, *changing the standard of accountability* may make human rights reports used in these indices unreliable, and it is argued that a quantitative index of human rights score should incorporate the changes arising from raising the standards of human rights protection over time.

Fariss' statistical approach is to re-evaluate human rights indicators that incorporate the 'changing standard of accountability' by estimating a latent variable model for human rights scores that captures the unobservable component of human rights score. Since repression is regime-specific and is caused by choices made by regime type, therefore, the true level of repression is latent, i.e., unobservable, but can be estimated using observable outcomes. These observables are coded scores using content analysis from documents on human rights by analysts working for the Amnesty International and the U.S. State Department by research analysts (e.g., Cingranelli and Richards 1999, 2012*a*, *b*; Hathaway 2017).

The study by Fariss (2014) shows that is possible to generate a new index of human right protection that accommodates changes in the standard of accountability by comparing the latest model in which the probability of documenting a repressive action changes over time (dynamic standard model) to results from the previous model in which this probability does not change (constant standard model). To illustrate, consider, for instance, the trends in human rights measurement from a cross-section of countries in our sample using three methods of analysis in Figures 4.1 and 4.2. Figure 1 is the time trend using data on CIRI Physical Integrity Index, and Figure 2 reports the patterns using the human rights score from Fariss (2014) which accounts for changes in standards of accountability for reporting human rights. At first glance, the quality of human rights appears to be relatively constant for developed countries under the year reviewed (except perhaps for the US). We can also observe a steady and slight improvement in the standards in less developed countries in Africa (e.g. South Africa) and the Americas (e.g. Guatemala). A drop is observed for Austria around the year 2000 and 2005, which is possible due to backlash following the torture of Gambian citizen by three police officers in Vienna in 2006. The strict application of slander laws around this period tended to discourage reports of police abuse and may encourage arbitrary arrest and detention by the police.

Figure 4.1: Trends in Physical Integrity for a Cross-Sample of Countries (CIRI): 1992-2008

To create the index, Fariss (2014) exploits the dynamic versions of the Item Response Theory (IRT) which allow for recording the indicators to change over time and with this, introduced a unique version of IRT to estimate latent human rights scores. To accommodate for the changing standard, it parameterised the *standard of accountability* using the dynamic standard model (Cingranelli and Filippov 2018). This allows the baseline probability of observing a given level of repression for a specific repression indicator (as modelled by time-varying item cut points) to vary as a function of time in one model (dynamic standard model) and compare the resulting estimates to another in which this probability is constant (constant standard model). The standards-based data sources are from (Cingranelli and Richards 1999, 2012a,b Gibney et al. 2012, Conrad et al. 2013), and the constant item difficulty cut-point include the binary event-based data sources from Harff and Gurr (1998), Harff 2003, Rummel 1994, 1995, Eck and Hultman 2007, and Taylor and Jodice 1983).

The goal essentially is to estimate a logistic distribution $F(.)$ for θ_{it}, the latent level of respect for physical integrity rights of country i in year t. For each item j, there is an "item discrimination" parameter β_j and a set of k_{j-1} "item difficulty cut points" (α_{jk}). Following Fariss (2014), the probability of distribution for a given response to item j in the constant standard model can be represented in eqns (4.3, 4.4 and 4.5) and for the dynamic standard model; it merely involves the addition of the time superscript on the α parameters.

$$P[y_{itj} = 1] = F(\alpha_j 1 - \theta_{it}\beta_j), \quad (4.3)$$

$$P[y_{itj} = k] = F(\alpha_{jk} - \theta_{it}\beta_j) - F(\alpha_{jk-1} - \theta_{it}\beta_j), \quad (4.4)$$

$$P[y_{itj} = k] = 1 - F(\alpha_{jk-1} - \theta_{it}\beta_j) \quad (5.5)$$

Eqns 4.3 to 4.4 refer to the probability of observing a particular hypothetical level k. In Eqn 4, the distribution takes the ordered logistic regression, and the parameters are analogous to the slope and cut points whereas Eqn (5) takes the logistic regression and a slope and the intercept term. The likelihood function in Eqn 4.6 refers to the probability of the observed level in the data (Fariss 2014).

$$\chi = \prod_{i=1}^{N}\prod_{t=1}^{T}\prod_{j=1}^{J}[F(\alpha_{jk-1} - \theta_{it}\beta_j) - F(\alpha j y_{itj-1} - \theta_{it}\beta_j)] \quad (4.6)$$

Eqn. 4.6 is the constant standard likelihood function for β, α, and θ

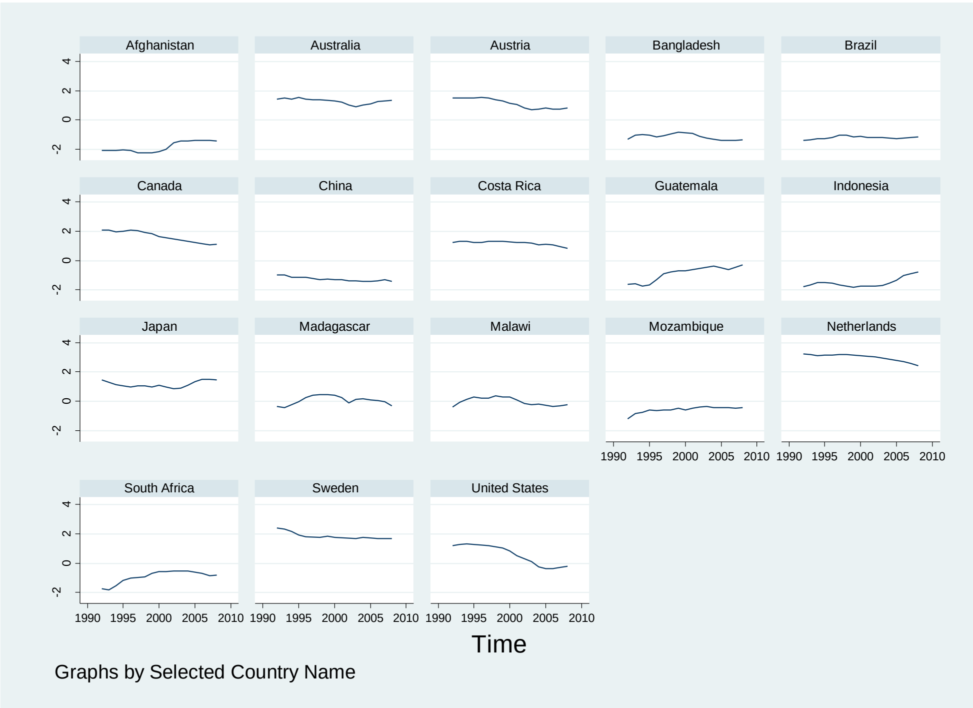

Figure 4.2: Trends in Protection of Human rights for a Cross-Sample of Countries (Fariss 2014): 1992-2008

The human rights protection score from Fariss' index is a variable that combines scores for the protection of the physical integrity of citizens using indicators of torture, government killing, political imprisonment, extrajudicial executions, mass killings and disappearances. It has global geographical coverage, and the time spans from 1949 to 2014.

4.3.2 Economic development using Nighttime lights data

Gross Domestic Product (GDP) is perhaps an essential variable in analyses of economic growth (Henderson e al. 2012). It allows comparing levels and growth rates of income across countries or for making international comparisons of countries' relative performance (Stiglitz et al. 2009). However, international comparisons are indeed possible only if the procedures and definitions used to compute the accounts are comparable.

To measure changes in levels over time requires distinguishing price and quantity effects, which in turn depends on the quality infrastructure and access and extent of disclosure of data on inputs used in national income accounting which may vary across countries. This problem with GDP measurement is a sensitive matter especially in many resource-dependent countries, and it could constitute a significant drawback on its usefulness for making a policy decision and for credibly ascertaining the extent of growth and development in resource rich countries. In these countries, a much larger fraction of economic activity is conducted within the informal sector, and the government might be negatively disposed to accurately reporting the inputs necessary for GDP estimation with respect to rent receipts and spending (Caselli 2006).

Before the creation of national income accounts, economists have used several proxies to measure economic growth (Henderson e al. 2012). Proxies such as the number of letters mailed per capita (Good 1994) and the skeletal quality of exhumed corpse have been used as a measure of the average standard of living and the degree of inequality (Steckel and Rose 2002). More recent proxies include using electricity consumption (IMF 2006), microeconomic data from Demographic and Health Surveys (Young 2012) and night lights (Croft 1978, Sutton and Costanza 2002, Ghosh et al. 2010).

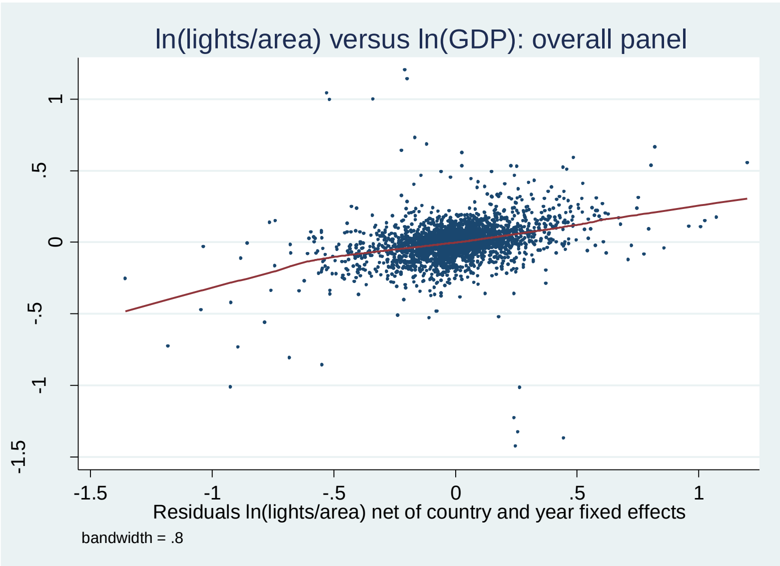

Figure 4.3: Night lights versus GDP

More specifically, economic activities can be deduced from outer space through the use of geographic information systems (GIS). Ever since the seminal contribution of Henderson et al.'s (2012) "Measuring Economic Growth from Outer Space", economists are increasingly finding the use of geographic information systems (GIS) to be useful for estimating economic activity (Donaldson and Storeygard 2016, Kudamatsu 2018) (Figures 4.3). There are at least three reasons for this. For one, GIS allows observing economic activities that were previously unobserved either due to slips from official statistics or due to the sensitive nature of the information. Another reason for its usefulness for estimating economic activities is because of the weak state capacity and infrastructure necessary for data collection in many developing countries the use of night lights has been suggested to help in illuminating the national account household surveys (Pinkovskiy and Sala-i-Martin 2016). Perhaps, the most important reason is that they help to identify causal impacts in a more credible way than previously possible (Kudamatsu 2018).

In this study, economic development is proxied using within-country growth in night lights intensity (luminosity) of a country. Existing studies have adopted the use of luminosity for proxying economic development when GDP data are either not available or of bad quality (Henderson et al. 2012, Michalopoulos and Papaioannou 2013a, 2013b, Hodler and Raschky 2014, Weidmann and Schutte 2017). Nighttime light data is also used as a proxy for economic activity by Sutton and Costanza 2002, Doll et al. 2006) and inequality (Smith and Wills 2018). Night lights are particularly favoured as a measure of economic activity (Chen and Nordhaus 2011) perhaps because it is highly correlated with GDP per capita and other means of prosperity (e.g., electricity provision, Baskaran et al. 2015). In the context of testing for resource curse, we test how the multiplier effect from giant oil discoveries helps in stimulating economic activities (night lights) conditional on the moderating influence of human rights protection structures and the stock of existing physical capital.

The data on GDP and nighttime lights come from Henderson et al.'s (2012) study on night lights as a measure of economic activity. Henderson et al. (2012) use raw data on nighttime luminosity derived from the National Oceanic and Atmospheric Administration (NOAA) where data on nighttime lights are available at the pixel-year level (roughly 0.86 square kilometres at the equator) since 1992 to 2008. For each pixel, 30 different satellites provide a lights digital number (DN) ranging from 0 (unlit) to 63 (top-coded). Henderson et al. (2012) calculate simple averages for each pixel-year across satellites and construct an area-weighted average of DN among the pixels within each country (Martinez 2018).

4.3.3 Total non-resource tax

Total non-resource tax revenue, excluding social contributions, is calculated as "Taxes excluding social contributions" minus "resource taxes". According to Prichard et al. (2018), this is the variable recommended for econometric analysis of government revenue, as it is complete and consistent across countries, and it is available from UNU-WIDER https://www.wider.unu.edu/project/government-revenue-dataset. Non-resource taxation as a source of revenue for the government is central to the concept of a social, fiscal contract and an important mechanism for reducing inequality by improving accountability in public service, reducing wastage and patronage, and strengthening the state's capacity for the services delivery. With more contribution to revenue from the non-resource tax, the citizen can request for egalitarian market reform, legal institutions and improved economic activities that generate inclusive growth reduce inequality and promote sustainable development.

4.3.4 Giant oil discoveries

We define the discovery of a giant oil and gas field as a binary variable, which is unity if there was a discovery in a particular year for a particular country during the years under review. Data covers the period from 1960-2010, and it is sourced from Horn (2014). A giant oil and gas discovery represents the discovery of an oil and/or gas field that contains at least 500 million barrels of ultimately recoverable oil equivalent. Like news shocks on business cycles (Jaimovich and Rebelo 2008, Jaimovich and Rebelo 2009), news of the discovery of giant oil reserve is a potential source of shocks with an enormous ripple effect on governments' anticipative spending (Arezki et al. 2017).

Unlike the size of reserves discovered the timing of discoveries and global price are plausibly exogenous (Arezki et al. 2017) and uncorrelated with the level of development. Oil exploration is a hit-or-miss business (Cotet and Tsui 2013); while richer countries may be able to discover more oil reserves, however, states cannot choose the time when these discoveries will happen,[28] nor do individual countries hold absolute power on what the global oil price will be at the time of discoveries.

4.3.5 Democracy Measure

The binary (dummy variable with values 0 or 1) measure of democracy is taken from Acemoglu et al. (2019) who employ the measurement of democracy from the Freedom House and Polity IV and supplemented with secondary sources from Cheibub et al. (2010) and Boix et al. (2012) to resolve ambiguous cases (i.e., those in which Polity and Freedom house report contrary assessments), or those without data coverage in Freedom House or Polity IV. The dummy measure of democracy in Acemoglu et al. (2019) covers 183 countries from 1960 and until 2010. For robustness, we also use Papaioannou and Siourounis's (2008) data, which contains the exact year of a permanent transition to democracy for many countries.

4.3.6 Descriptive and Graphical Illustrations of Variables

An essential aspect we are interested in is the contribution of human rights protection to economic growth. The literature is inconclusive on the general economic contribution of human rights; however, there appears to be a convergence on the positive contribution of property rights on economic growth. Property rights represent the liberty of individuals or groups to own economic goods and its protection from the state's predation. We present a correlation of human rights index with property rights in Figure 4.4.

Also, we relate human rights with the colonial legacy, which has often been suggested as the cause of differences in property rights among European colonised countries. For instance, in an innovative paper, Acemoglu et al. (2001) traced the origin of property rights to colonial practices and related this to current economic performance. To support our measurement, we

[28] Even with the most advanced technology, the success rate of exploration drilling is still less than half (Cotet and Tsui 2013).

show a correlation between human rights protection and the colonial settler mortality (Figure 4.5). This could suggest that the practice of human rights like property rights has constitutive roots in the relationship between colonisers and colonised peoples during the colonial periods. It is therefore likely to emerge as a reaction to the colonial practice of exploitation or settlement types of colonialisation that dates back to the 18th and 19th century.

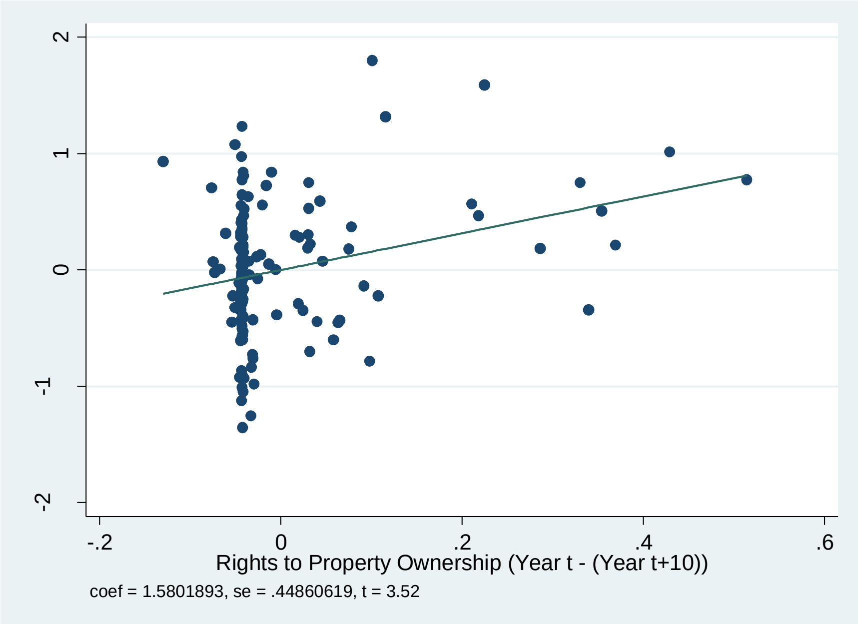

Figure 4.4: Human Rights Protection (mean) and Property Rights (mean) with control for Per capita income

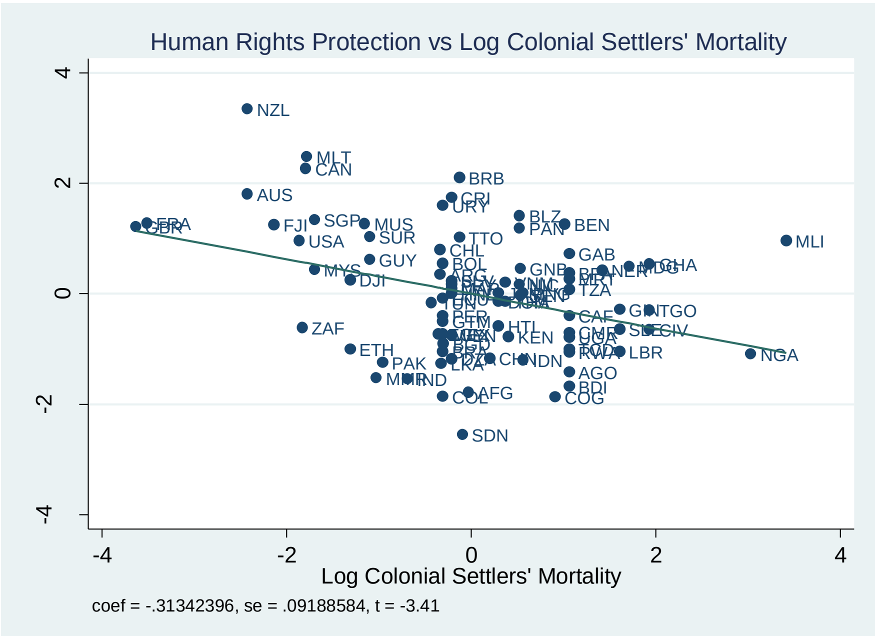

Figure 4.5: Human Rights Protection (mean) and Log of Colonial Settlers' Mortality (mean)

The assertion that protection of human rights is linked with economic performance forms part of our hypothesis, which we believe is an aspect worthy of understanding in the resource curse debate. However, to justify this assertion, we need to establish that a correlation exists between how countries protect the rights of their citizens and how this relates to a measure of economic activities (Figure 4.6). Night light data observed from the outer space using satellites could help proxy the extent of economic activities rather than the traditional uses of GDP computed from national accounting.

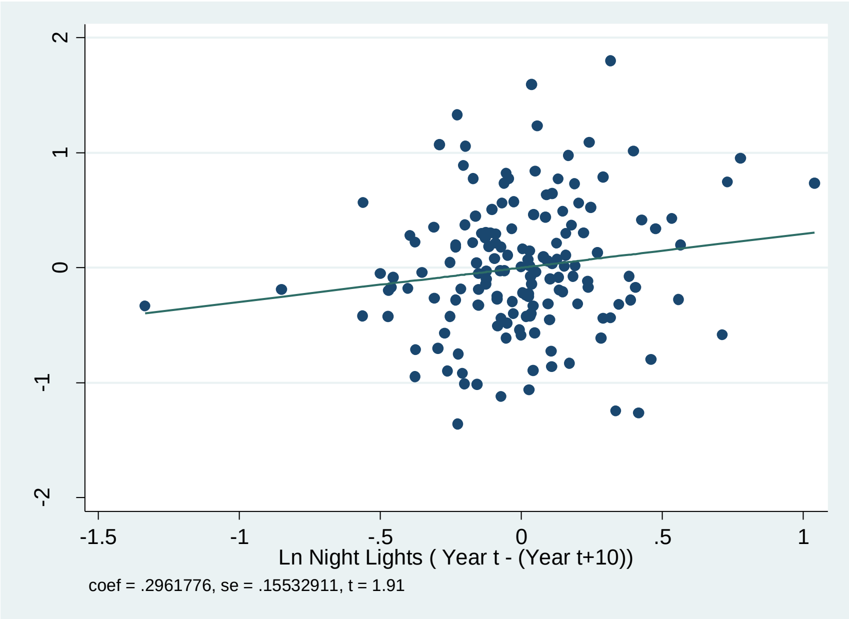

Figure 4.6: Human Rights Protection (mean) and Log Night-Lights (area-weighted average lights digital number (DN) per cell) (mean) with control for Per capita income

Also integral to our hypothesis is that natural resources endowment may interrupt the political incentive structure and reduce the burden on the government to uphold and protect citizens' rights. More importantly, we need to justify the incentives to adhere to the protection of rights get reduced with more dependence on rents as a contribution to GDP (Figure 4.7) and improves with more contribution from non-resource taxation contribution to GDP Figure 4.8).

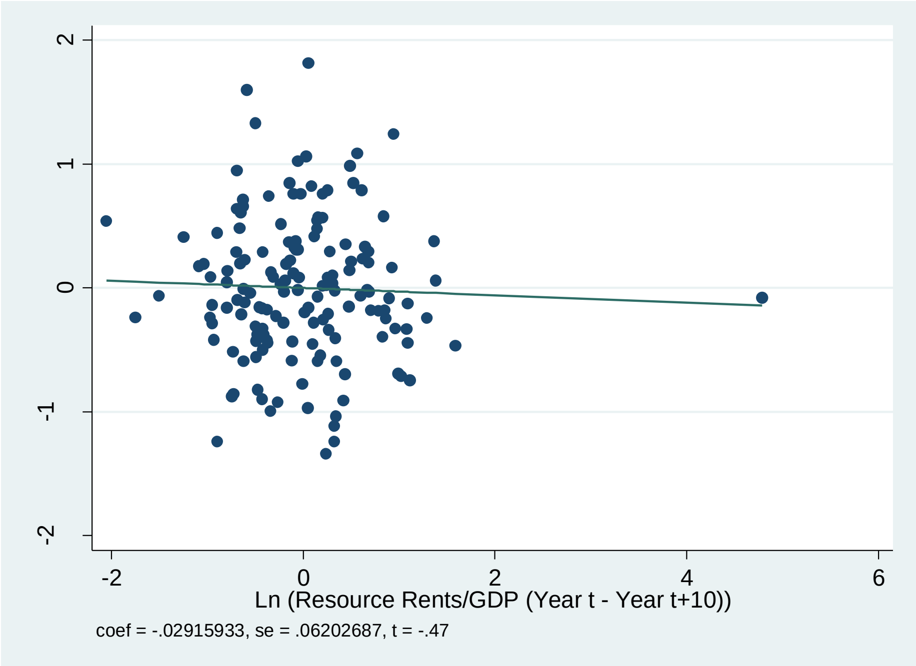

Figure 4.7: Human Rights Protection (mean) and Log Oil Reserves per Capita (mean) with control for Per capita income

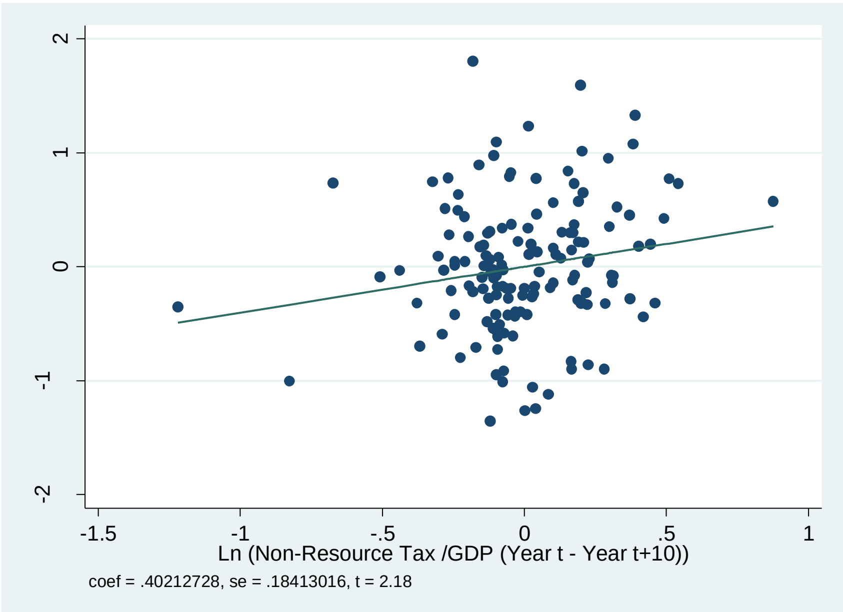

Figure 4.8: Human Rights Protection (mean) and Non-Resource Tax as a percentage of GDP per Capita (mean) with control for Per capita income

Nevertheless, there are still issues with Fariss' (2014) index, and these criticisms have been subjected to further criticism (e.g., see Cingranelli and Filippov 2018). Therefore, to validate our measurement, it is essential to compare it with other variables of interest that are useful for measuring political accountability and democratic quality. In Figures 4.9 and 4.10, we relate this measurement with democracy quality index and a score of performance on electoral quality.

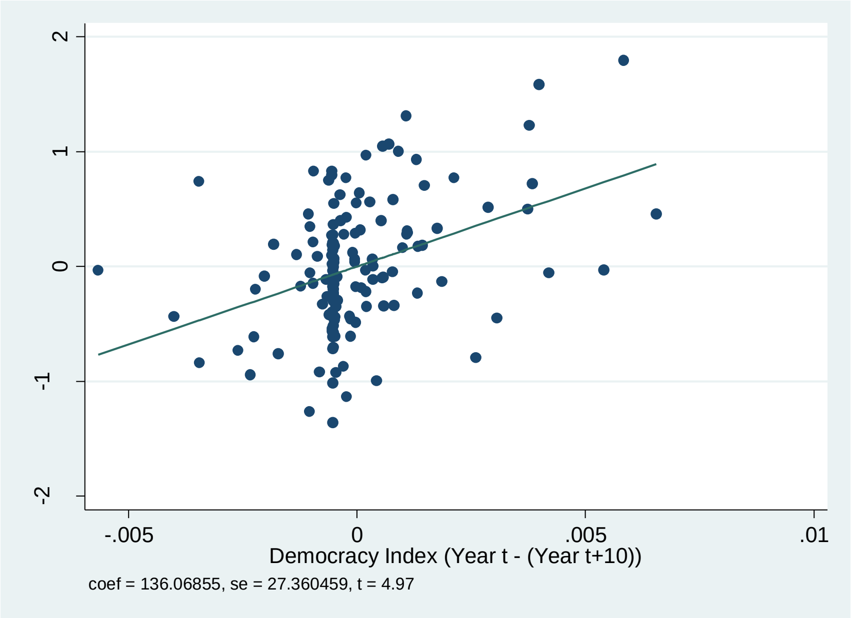

Figure 4.9: Human Rights Protection (mean) and Democracy Index (mean) with control for Per capita income

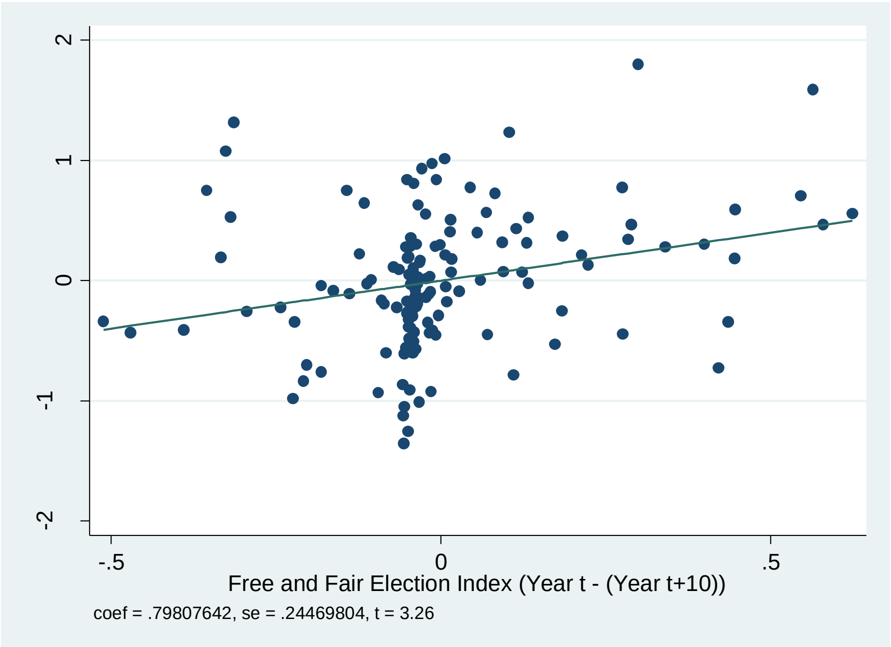

Figure 4.10: Human Rights Protection (mean) and Electoral Quality (mean) with control for Per capita income

We may also wish to illustrate how the measurement created using the indicators of protection drawn from indicators of torture, government killing, political imprisonment, extrajudicial executions, mass killings and disappearances relates with other measures of human rights used in the literature (Figure 4.11).

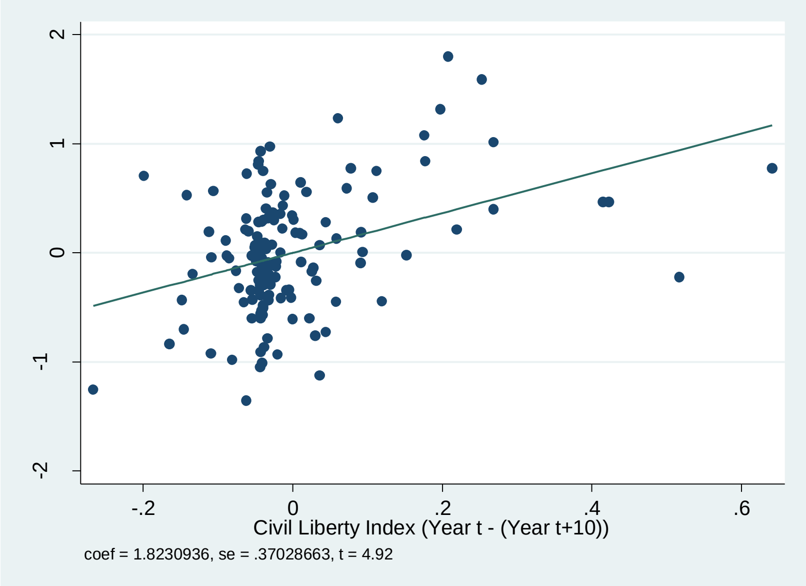

Figure 4.11: Human Rights Protection (mean) and Civil Liberties Index (mean) with control for Per capita income

Finally, we might worry if a linear specification in the relationship between night-light growth and our other variables is appropriate. For instance, if the error in official GDP per capita is driven the country's statistical capacity, then the relationship between nighttime lights and true GDP per capita can be nonlinear and vary with geographic location (Hu and Yao 2019). Figure 4.12 and 4.13 imply a linear relationship between nighttime lights and oil discoveries. Figure 4.12 is particularly important because there are reasons to suspect that not all lights emissions are generated purely from economic activity in towns. This is particularly very relevant in some oil-producing regions in developing countries where high luminosity is usually because of gas flares. To correct for this, Henderson et al. (2012) provide an alternative to night measurement where luminosity is treated to remove cells that are likely to be contaminated with gas flare.

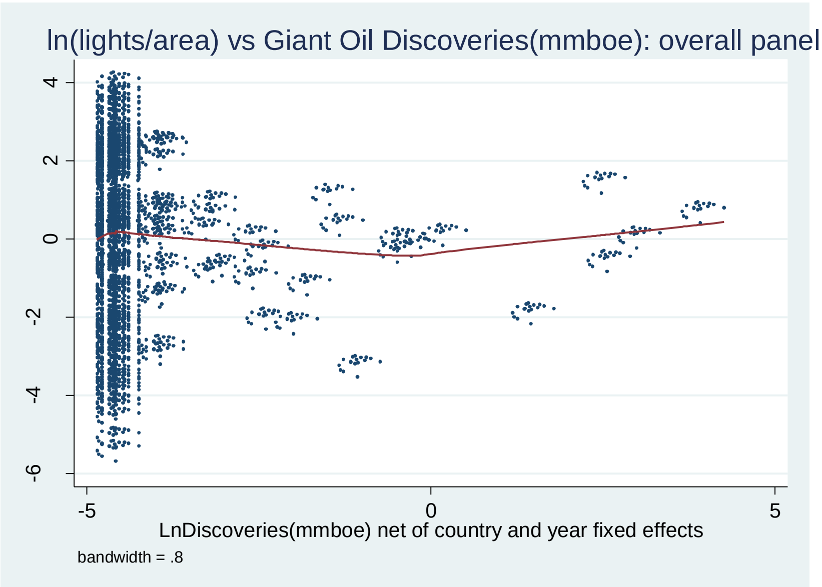

Figure 4.12: Night lights and Giant oil Discoveries

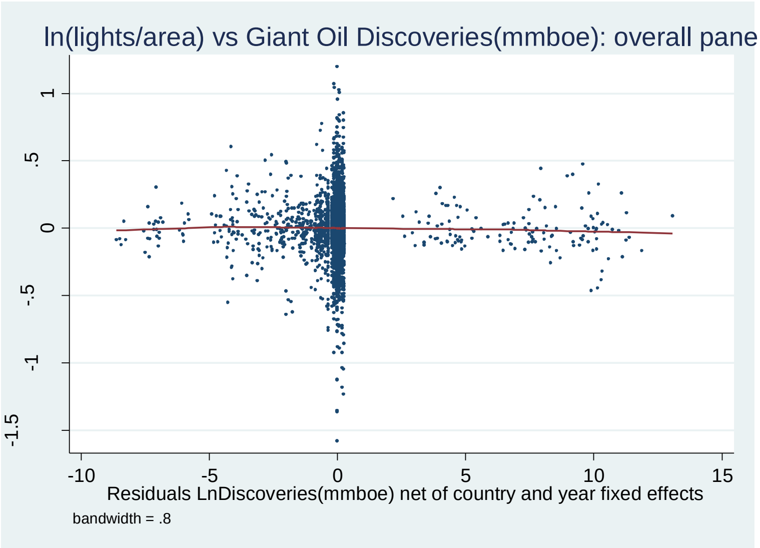

Figure 4.13: Residuals of Night lights and Giant Oil Discoveries (mmboe)

Table 4.1: Summary and descriptive statistics of variables

	All countries			With Giant oil discoveries			Without Giant oil discoveries		
	N	Mean	Std dev	Obs	Mean	Std dev	Obs	Mean	Std dev
ln(GDP)	191	25.25	3.98	40	26.89	4.11	151	24.8	3.8
ln(area-weighted average nightlights)	222	0.18	2.14	40	-0.04	1.4	182	0.23	2.27
ln(area-weighted avg lights, w/o gas flare lights)	222	0.14	2.17	40	-0.22	1.56	182	0.21	2.28
Area Lit (Log, km2)	210	5.89	2.65	40	8.34	1.78	170	5.32	2.5
Oil rents (% of GDP)	208	3.22	8.28	40	11.36	13	168	1.29	5.1
Democracy (Acemoglu et al. 2019)	228	0.79	0.4	40	0.58	0.5	188	0.83	0.37
Ln(non-resource tax excluding social contributions)	178	2.58	0.7	36	2.28	0.82	142	2.62	0.65
ln(Population)	204	15.1	2.23	40	17.1	1.74	164	14.6	2.2
Fraction of lights digital number (DN) deriving from gas flare polygons	222	0.032	0.11	40	0.12	0.19	182	0.01	0.07
ln(number of cells unlit)	227	9.88	4.24	40	13.5	2.09	187	9.11	4.18
ln(number of cells topcoded)	227	2.96	2.87	40	5.97	2.25	187	2.31	2.57

4.4 Analytical Framework

The extant empirical literature has ambitiously tested the link between oil wealth and the political economy of the resource curse (Ross 2001, Aslaksen 2010, Tsui 2011, Ross 2015). The results, however, are mixed[29] , and no satisfactory answer has yet been provided (Alexeev and Conrad 2009, Cotet and Tsui 2013, Haber and Menaldo 2011, Brooks and Kurtz 2016, Venables 2016). Two main problems make the existing evidence from cross-country analysis inconclusive (Cotet and Tsui 2013, Haber and Menaldo 2011). First, resource endowment is endogenous to country-level of development and political institutions which makes it hard to interpret the results as causal estimates of the effect of resource abundance (Cust and Harding 2014, Cassidy 2019). Second, the underlying process of political institutions and growth are likely dynamic (Acemoglu et al. 2019): past growth conditions the effect of political institutions, and modelling growth with GDP dynamics enables a proper investigation of whether the political resource curse is short-lived or gradual. As shown in Acemoglu et al. (2008, 2019) and Brückner and Ciccone (2011), previous income shocks are a strong indicator of the propensity to democratise and not accounting for this dynamics will lead to biased estimates of democracy on GDP (Acemoglu et al. 2019).

Recent contributions have exploited subnational data to identify short-run causal effects of resource income and pin down specific mechanisms of the political resource curse economy (Monteiro and Ferraz 2010, Brollo et al. 2013, Cavalcanti et al. 2019). However, if the relationship between quality of political institutions and the incentives offered by resource boom are reflected at the capacity of the central government and manifest in the medium to long run, then such will require analysis will understate the effect, and the national level will give a better account (Cassidy 2019).

Other studies have suggested the identification strategy using within-country variation is proposed will give a better statistical relationship between oil and political outcomes[30] (Haber and Menaldo 2011). However, such studies cannot isolate the endogenous effect of resource abundance on growth through other time-varying features that drive growth also cause political institutions and resource discoveries (Cotet and Tsui 2013, Cust and Harding 2014, Brooks and Kurtz 2016). Besides, because of the introduction of the rich dynamics of GDP on growth, a severe difficulty arises with the fixed-effects model. The Fixed effect estimator utilises the demeaning process that subtracts the individual mean values of the dependent and independent variables also create a correlation between the regressors (lagged variable) and the error (Nickell 1981). Therefore, the within-country variation would yield bias estimators that cannot account for the dynamics of GDP, changes on political institutions and growth.

To circumvent these challenges, we estimate an Arellano-Bond dynamic panel data model in the context of the Generalized Method of Moments GMM-styled (GMM) to construct more efficient estimates of the dynamic panel data model. According to Roodman (2009), the Arellano-Bond (Arellano and Bond 1991) dynamic panel estimators are general estimators designed for situations when: 1); there are few periods and many countries; 2), the relationship is linear; 3), the left-hand-side variable is dynamic; 4) some of the independent variables are not strictly exogenous; 5) there is a control for fixed individual effects implying unobserved

[29] See Brooks and Kurtz (2016), Ross (2015), Haber and Menaldo (2011) Venables (2016) for more elaborate review of findings.
[30] For instance, in Cotet and Tsui (2013) and Haber and Menaldo (2011) also find no association between resource abundance and civil conflict once country fixed effects are accounted.

heterogeneity; and 6), there are heteroscedasticity and autocorrelation within countries in panel but not across them.

The Arellano–Bond estimation first difference all regressors and uses the generalised method of moments (GMM) (Hansen 1982) to isolate useful information by making use of available instruments that are "internal" and based on lags of the endogenous variables (Arellano and Bond 1991, Blundell and Bond 1998, Roodman 2009). The difference and system generalised method-of-moments estimators do not assume that the right instruments are available outside the ones the immediate dataset can provide (Roodman 2009).

Given the intuitive appeal of the Arellano–Bond dynamic estimator for identifying the political resource curse, we estimate the following equation using a Dynamic panel-data estimation, one-step difference GMM:

$$LnY_{j,t} = \varphi_0 + \varphi_1(D_{j,t} = 1) + \varphi_2(LnGDP_{j,t-1}) + \varphi_3(Dem_{j,t} = 1) + \varphi_4(Tax_{j,t}) + \varphi_5(Oil\ rents_{j,t}) + \varphi_6(D_{j,t} \times LnGDP_{j,t-1}) + \varphi_7(D_{j,t} \times Dem_{j,t}) + \varphi_8(LnGDP_{j,t-1} \times Dem_{j,t}) + \varphi_9(Dem_{j,t} \times LnGDP_{j,t-1}) + \varepsilon_{j,t} \quad (4.7)$$

Where $LnY_{j,t}$ is the log of economic performance measured as both nighttime lights intensity and GDP per capita. Previous studies have shown that nighttime lights and economic activity measured using GDP are positively correlated (Doll et al. 2006, Michalopoulos and Papaioannou 2013, 2014, 2018; Donaldson and Storeygard 2016, Martinez 2018). In contrast, nighttime lights will better isolate how discovery contributes to economic development because they are hard to be manipulated by the national government. Besides, areas with more discoveries are also expected to have more illumination if gas flaring is more prevalent. In many instances, the environmental control and regulatory mechanism in many oil-rich countries are weak, which may mean that more gas flares come from oil exploitation which might contaminate the night lights data. We address this by using night lights without gas flare cells. Besides, our identification comes within-country variation, which helps to further country any time fixed heterogeneities that might bias our estimates.

$D_{j,t}$ is a dummy variable accounting for the timing of the discovery of a giant oil and gas field, and $LnGDP_{j,t-1}$ is the log of GDP per capita (one year lag), and it helps to control for convergence and how existing stock of physical assets contributes to growth. Though largely overlooked in previous work, failure to accurately model GDP dynamics, and how past GDP influence the conditions the effect of political institutions and the resource curse will lead to biased estimates. Modelling growth with GDP dynamics would also enable an investigation of whether the resource curse impact on GDP is short-lived or gradual. However, the GDP in the lag year will be endogenous to growth. A vital aspect of the Arellano–Bond estimator is the assumption that instrumental variables based on lagged values of the instrumented variable(s) take account of the endogeneity concerns.

The main identification strategy in eqn. 4.7 to identify the bias with GDP statistics and the quality of the political process exploits the time lag between the exogenous timing of discoveries, production and the receipt of oil rents (Arezki et al. 2017) to economic growth. Because it takes considerable time from the announcement of discoveries to when rents positively manifest on economic development, the difference between the contribution of GDP to nighttime growth in the year of preceding discovery and the year of discovery should not be significantly different. In essence, the discovery and lag GDP ($D_{j,t} \times LnGDP_{j,t-1}$) interaction estimate on night-time growth should not be significantly different from zero. A positive and significant effect on night-time lights as an indicator of GDP inflation.

The democracy variable ($Dem_{j,t}$) is a dummy variable from Acemoglu et al. (2019). The Discovery ($D_{j,t} = 1$), democracy ($Dem_{j,t}$) and the Discovery and democracy interaction $\left(D_{j,t} \times Dem_{j,t} = 1\right)$ estimates are useful for identifying the political resource curse. First, ($D_{j,t} = 1$), ($Dem_{j,t} = 1$) and the $\left(D_{j,t} \times Dem_{j,t}\right)$ estimates test how discovery reduces the quality of democracy on growth and how the contribution of discovery on growth is artificially inflated in countries with poor democracy. The $LnGDP_{j,t-1}$ and the $Dem_{j,t}$ interaction ($Dem_{j,t} \times LnGDP_{j,t-1}$) show if there is a significant difference between GDP contribution to night-time growth between democratic and non-democratic countries. The hypothesis is that the effect will be negative and different from zero if democratically weak countries inflate GDP and insignificant if there is no inflation.

$Oil\ rents_{j,t}$ measures the percentage of oil rents contribution to GDP. $LnTax_{j,t}$ is the log of the contribution of non-resource tax (excluding social contribution) to GDP. Both oil rents and tax are also endogenous to growth: resource-dependent countries will have higher oil rents to GDP value, and fragile states may lack the capacity to implement tax reforms for the non-resource sectors. We account for these by using their lagged values as instruments for consistent estimation. Therefore, GDP growth channel will no longer identify economic performance. σ_j and Ω_t represent the fixed country and time effects. The error term ($\varepsilon_{j,t}$) is assumed to take the form; $\varepsilon_{j,t} = e_{j,t} + \alpha_j + \Omega_t$ where the two latter terms capture the countries and time fixed effects. $e_{j,t}$ is the stochastic error term.

To estimate the human rights protection channel, we estimate eqn. 8 using the Arellano–Bond estimator with the assumption of that the included lagged values of HRP, non-resource tax and oil rents can be instrumented for with their lagged values to give consistent estimates.

$$HRP_{j,t} = \lambda_0 + \lambda_1\left(HRP_{j,t-1}\right) + \lambda_2\left(HRP_{j,t-2}\right) + \lambda_3\left(D_{j,t} = 1\right) + \lambda_4\left(Dem_{j,t}\right) + \lambda_5\left(D_{j,t} \times Dem_{j,t}\right) + \lambda_6\left(Tax_{j,t}\right) + \lambda_7\left(D_{j,t} \times Tax_{j,t}\right) + \lambda_8\left(Oil\ rents_{j,t}\right) + \varepsilon_{j,t} \qquad (4.8)$$

Where$HRP_{j,t}$ is the Human rights protection score taken from Fariss (2014) and $HRP_{j,t-1}$ and $HRP_{j,t-2}$ represent the year one and year two lags to control for the dynamic effect of previous human rights sore on current attainment. $D_{j,t}$ is a dummy variable that represents the timing of giant oil discoveries, Dem is democracy dummy, $Tax_{j,t}$ is the non-resource tax and $Oil\ rents_{j,t}$ is the contribution of oil rents to GDP. Human rights are linked with good governance that defines civic responsibility, indicative of the strength of the separation of powers and the quality of service delivery to the public. These rights could also be useful for boosting investors' confidence and reducing uncertainty in the financial markets by fostering trade and attracting foreign investments into the economy. We aim to account for the impact of discovery and nonresource tax on human rights. According to Wigley (2018), the logic of the "political resource curse" can be extended to how resource rents make governments more likely to restrict personal liberties. However, if discovery does not worsen human rights abuse, we can substantiate the claim that the political resource curse does not go beyond democratic processes and representation, and identifying political accountability with human rights records can prove useful for improving the political process. Second, we can identify citizens' collective action with human rights protection and identify how improving tax strengthens political accountability through the strengthening of human rights practices.

4.5 Results and discussion

This section is divided into three parts. In the first part (Section 4.5.1), we motivate the analysis by using log GDP per capita as the outcome variable for economic activities and include a lagged dependent variable as a control in the dynamic panel. Table 4.2 is the baseline model, and we show the long-run contribution of democracy conditional on the interaction with giant oil discovery to GDP. We find that the contribution of democracy to GDP is reduced by 44% with the announcement of giant oil discovery. Table 4.2 establishes the political resource curse: the reduction in the quality of the political process as a result of incentives offered by the resource boom.

In the second section (Section 4.5.2), we present the main findings by replacing income per capita with nighttime lights. In contrast to findings in Table 4.2, we find a negative and statistically significant effect of giant oil discoveries on nighttime lights in Tables 4.3 and 4.4. We find support for GDP inflation by about 2% in oil-rich countries in the year of discovery relative to the year before discovery. Also, we find support for the contribution of human rights protection contribute to growth, and the effect does not depend on oil discovery and find that increasing nonresource tax improves human rights protection.

In the third part (Section 4.5.3), we explore other potential mechanisms through which giant oil discoveries, non-resource taxation, human rights and democracy might affect economic activities. Our approach in this regards is to understand their influence on stimulating economic development through economic reforms, TFP, the share of trade in GDP, electricity consumption (Log, Billion kWh), and education. Political and economic freedoms often go hand in hand and strengthening market reforms, improving factor productivity, trade and education could all stimulate economic development with a broader outcome on poverty reduction.

4.5.1 Giant Oil discoveries, Human Right Protection (HRP) and GDP per capita

In Table 4.2, we motivate the analysis by using log GDP per capita as the outcome variable for economic activities and include a one-year lagged GDP (dependent variable) as a control in the dynamic panel to control for convergence and how existing stock of physical assets contributes to growth and whether the resource curse impact on GDP is short-lived or gradual.

Model I utilises a Fixed Effect estimator with controls for the lagged GDP per capita. Because of the lagged dependent variable, the results of the fixed-effects model in Model I is no longer consistent due to the correlation between the regressors and the error component (see, e.g., Nickell 1981, Roodman 2009). In Models II to IV we utilise the Arellano Bond (Dynamic Panel Data) in a Generalized Method of Moments (GMM) context to construct more efficient estimates of the dynamic panel data model (Arellano and Bond 1991). With the difference GMM estimators in Models II to IV, we isolate the effect of the lagged GDP per capita, oil rents contribution to GDP, the log non-resource tax with their respective lags (Table 4.2). We report the Hansen test results and the AR test for autocorrelation of the residuals. According to Roodman (2009), ideally, the residuals of the differenced equation should possess serial correlation in AR (1), but should not exhibit significant AR (2) behaviour. Also, Hansen test p-value below 0.1 and higher values are potential signs of trouble.

Table 4.2: Democracy, Giant Oil Discoveries and Growth in Per-capita Income

	Dependent Variable: LnGDP/capita			
	Model I	Model II	Model III	Model IV
Ln GDP/capita $_{i}$, (1 year lagged)	0.92***	0.87***	0.845***	0.845***
	(0.02)	(0.02)	(0.03)	(0.03)
Discovery Giant Oil $_{i,t}$ (Disc =1)	0.006	-0.007	-0.04	-0.04
	(0.005)	(0.01)	(0.09)	(0.09)
GDP $_{i, t-1}$ × Disc $_{i,t}$ (Disc =1)			0.001	0.001
			(0.003)	(0.003)
Democracy (Dem=1) $_{i,t}$	0.01*	0.06**	0.09***	0.09***
	(0.008)	(0.03)	(0.02)	(0.02)
Democracy (Dem=1) $_{i,t}$ × Disc $_{i,t}$ (Disc =1)			-0.05**	-0.05**
			(0.02)	(0.02)
Ln Non-resource tax $_{i, t}$	0.007	0.03*	0.03	0.03
	(0.02)	(0.02)	(0.02)	(0.02)
Ln Non-resource tax $_{i, t}$ × Disc $_{i,t}$ (Disc =1)			0.004	0.004
			(0.01)	(0.01)
Oil rents (%contribution to GDP)	0.002**	0.001	-0.04	-0.04
	(0.001)	(0.001)	(0.9)	(0.9)
Estimator	Fixed-effects (within) dynamic panel regression	DPD one-step difference GMM	DPD one-step difference GMM	DPD two-step difference GMM
Arellano-Bond test for AR(1)		-3.22***	-3.32***	-3.41***
Arellano-Bond test for AR(2)		0.80	1.05	1.05
Hansen_df		159.98	150.96	150.96
Hansen test of overid (p statistics)		0.274	0.196	0.196
Lags used as Instruments		L(2/8)	L(3/7)	L(3/7)
Number of instruments		245	235	235
Number of observations	2,461	2264	2264	2264
Number of countries	166	164	164	164

Notes: All regressions control for log population size, country and time fixed effects.
DPD means Arrelano-Bond Dynamic Panel Data estimation
Estimates in parenthesis are standard errors clustered at the country level. Data is from 1992-2008.
The measure of democracy is based on Acemoglu et al.'s 2019.
Instrumented Variables: Log GDP, Oil rents, Ln Non-resource tax
*** Significant at the 1 per cent level.
** Significant at the 5 per cent level.
* Significant at the 10 per cent level.

Table 4.2 (Models III and IV) speak to two of our predictions. First, discovery weakens the quality of democracy on growth; therefore, the net effect of democracy on growth is not absolute, but conditional on the incentives introduced by resource discoveries. This contrasts recent findings on the unconditional contribution of democracy and growth (see Acemoglu et al. 2019). Second, when taken alone or when democracy score is zero, news of discoveries of natural resources do not significantly contribute to slow growth, but at a higher level of democracy, discovery leads to negative growth in GDP per capita. In general, our findings in Table 4.2 suggest that GDP as a measure of growth could be understated in countries with weak democracy and confirm the need to utilise better proxy for identifying the resource curse that is not subject to manipulation and endogenous selection issues. According to our predictions, governments in democratically weak countries want to appear as not embezzling funds, and as such, have a higher incentive to give the impression of performance relative to when democracy is effective.

The results in Table 4.2 justify our initial concern that GDP per capita might be a poor outcome of economic activities when the governments have higher incentives for manipulating data to appear as not plundering wealth. Naturally, national governments provide inputs used to produce these GDP estimates. Given a high level of corruption and unofficial leakages (Van der Ploeg 2011), the true contribution of anticipated rents to GDP might be inflated to exaggerate how well the economy is doing. The manipulation of GDP statistics might further strengthen the resource curse. How the government manages the anticipated benefits from resource benefits depends largely on the extent to which they can be held accountable by the citizen. While democratic principles are essential for improving accountability and growth, however, the political resource curse theory suggests that the effect is weakened with the additional incentives that support corruption and democratic participation in oil rich countries comes with a high political transaction cost and endogenous selection (Brollo et al. 2013).

4.5.2 Giant Oil discoveries, Human Right Protection (HRP) and Nightlights Growth

In Table 4.3, we replace the outcome variable of development with log Nighttime lights and also include a control for the lagged GDP per capita and the interaction of GDP per capita with discovery year dummy. The aims in Table 3 are to; first, test for the bias in GDP per capita statistics as a means for identification of growth in oil rich countries and second, examine if the use nighttime lights can better isolate the resource curse. To test for the bias, the identification strategy exploits the time lag it takes for giant oil discovery's contribution to GDP to manifest on night-time lights. According to Arezki et al. (2018), it takes roughly five to seven years for oil discoveries to manifest into significant economic outcomes. If GDP in the year shortly before discovery (one year lagged) is not biased, then the estimate of GDP's contribution to nighttime light growth in the following year of discovery should be insignificantly different from zero.

Intuitively, for discovery to improve GDP and significantly improve nighttime radiance, oil fields must have started producing oil and government would have started earning rents for a significantly longer period which are not usually possible within a year from discovery. Therefore, any evidence that shows a significant difference within such a short time calls for questioning. Our second strategy to test the bias with GDP is to look at the reported contribution of GDP to nighttime lights in countries with democracy (Dem=1) in contrast to countries with a low level of democracy (Dem =0). The results in Table 3 justify our initial concern that uses GDP per capita might be a poor outcome of economic activities when the governments have higher incentives for manipulating data to favour growth and to appear as not plundering wealth. In Table 3, we find that the contribution of GDP to nightlight is inflated in countries year of discovery (GDP × Disc =1) and countries with a low level of democracy (Democracy =1 × GDP).

GDP as a measure of economic activities might be biased if resource booms raise the value of being in power and provide politicians with incentives to influence the outcome of elections by inflating performance while increasing resource misallocation for private benefits. Because voters often do not have perfect information to determine the credibility of the incumbents, inflating the performance through GDP growth provides a suitable way for the incumbent to secure re-election. The tendency to inflate and exaggerate performance will be high in countries at a low level of democracy that promotes accountability and state competence since these institutions will ameliorate the perverse political incentives that such booms create.

We find that nighttime light is better at isolating the resource curse on growth compared to GDP-based statistics. To control for the dynamic effect of the lagged GDP, we estimated an Arrelano-Bond dynamic panel estimator and find in Model VI that countries nighttime light in years of discoveries lead to 45% less within-country variation in nighttime lights. In Models V and VI, nighttime lights intensity assumes that night lights are generated purely from economic activities. Especially in oil-producing regions, the composition of nighttime lights intensity is not entirely from economic and/or social activities but could also reflect illumination arising from gas flaring activities. In Henderson's et al. (2012) replication data, the authors remove pixels that record gas flare in major oil-producing cities and include this variable as part of the dataset. In Models VII and VIII, we use night lights without gas flaring cells and find that significant negative growth (50%) in nighttime lights in the year of giant oil discovery.

Our findings also make a contribution to the impact of democracy on growth. In Models VI to VIII where we account for the dynamic panel with the AB estimator, we find weak support for the effect of democracy on nighttime light growth which is bigger in poor countries than in countries with high GDP and insignificant to nighttime relative to years without discovery. While democratic principles are essential, however, the effect might not be significant at influencing how the government in oil rich countries transform the expected benefits from the discoveries into a significant economic advantage. In general, our main findings are particularly relevant for researchers and policy formulation interested in assessing governments' performance concerning expectations from resource endowments. Such assessment, we think, will be more valid by using measures of economic growth (e.g. night lights) that are not subject to manipulation and endogenous selection issues.

Table 4.3: Capturing the Bias in GDP through Changes to Nighttime

	Dependent Variable: Nighttime Lights			
	Model V (Nighttimewith gas flare cells)	Model VI (Nighttime with gas flare cells)	Model VII (Nighttime without gas flare cells)	Model VIII (Nighttime without gas flare cells)
Ln GDP/capita $_{i,t}$ (1 year lagged)	0.38***	0. 05	0.57***	0.57***
	(0.12)	(0.12)	(0.11)	(0.09)
Discovery Giant Oil $_{i,t}$ (Disc =1)	-0.38**	-0.46**	-0.51**	-0.51**
	(0.17)	(0.20)	(0.2)	(0.2)
Democracy (Dem=1) $_{i,t}$	0.09	0.48**	0.49*	0.48*
	(0.05)	(0.22)	(0.25)	(0.25)
GDP $_{i,t-1}$ × Disc $_{i,t}$ (Disc =1)	0.01**	0.015**	0.016**	0.016**
	(0.006)	(0.007)	(0.007)	(0.007)
Democracy (Dem=1) × Disc $_{i,t}$(Disc =1)	0.007	-0.11**	-0.06	-0.06
	(0.01)	(0.05)	(0.06)	(0.06)
Democracy (Dem=1) × GDP $_{i,t-1}$	-0.003	-0.01*	-0.02*	-0.015*
	(0.003)	(0.007)	(0.01)	(0.008)
Ln Non-resource tax $_{i, t}$	0.20***	0.10*	-0.03	-0.03
	(0.06)	(0.06)	(0.05)	(0.06)
Ln Non-resource tax × Disc $_{i,t}$(Disc =1)	0.02	0.009	0.01	0.01
	(0.02)	(0.038)	(0.04)	(0.04)
Oil rents (%contribution to GDP)	0.004**	0.002**	0.0002	0.0002
	(0.001)	(0.001)	(0.0008)	(0.0008)
Ln Unlit cells $_{i, t}$	-0.06*	0.01	0.05	0.05
	(0.03)	(0.06)	(0.06)	(0.06)
Ln top coded cells $_{i, t}$	0.04***	0.04***	0.03**	0.03**
	(0.006)	(0.01)	(0.01)	(0.01)
Fraction of lights from gas flare polygons $_{i, t}$	1.52***	1.6***	-1.01*	-1.0*
	(0.20)	(0.34)	(0.55)	(0.55)
Estimator	Fixed-effects (within) regression	DPD one-step difference GMM	DPD one-step difference GMM	DPD two-step difference GMM
Arellano-Bond test for AR(1)		-3.44***	- 3.57***	-3.48***
Arellano-Bond test for AR(2)		0.35	0.27	0.27
Hansen_df		149.19	148.47	148.47
Hansen test of overid (p statistics)		0.153	0.170	0.170
Lags used as Instruments		L(3/7)	L(3/7)	L(3/7)
Number of instruments		235	235	235
Number of observations	2,461	2274	2264	2264
Number of countries	166	165	165	165

Notes: All regressions control for log population size, country and time fixed effects. DPD means Arrelano-Bond Dynamic Panel Data estimation

Estimates in parenthesis are standard errors clustered at the country level. Data is from 1992-2008. The measure of democracy is based on Acemoglu et al.'s 2019 and Nighttime Lights is from Henderson et al. 2012.

Instrumented Variables: Log GDP, Oil rents, Ln Non-resource tax

* Significant at the 1 per cent level, ** Significant at the 5 per cent level, *** Significant at the 10 per cent level.

In Table 4.4, we consider an additional test to confirm the bias with GDP reporting. We replace the lagged GDP with Total Factor Productivity (TFP). TFP is a portion of the growth in output not explained by growth in traditionally measured inputs of labour and capital used in production and a primary contributor to GDP growth rate. If our hypothesis of bias in GDP stands, then the difference in the contribution of TFP to growth should be insignificant in the year of discovery. If discovery significantly increases the contribution of GDP to nighttime lights, intuitively, it should also increase the contribution of TFP to nighttime lights. However, in Table 4, we find a statistically insignificant effect of TFP in the year of giant oil discoveries on nighttime lights and GDP growth further suggesting that the contribution of GDP to economic development is inflated in countries with giant oil discoveries.

Table 4.4: Additional test for GDP bias using the contribution of TFP to growth

	Dependent Variables			
	Model IX (Log GDP)	Model X (Nighttime with gas flare cells)	Model XI (Nighttime without gas flare cells)	Model XII (Ln (Area Lit/km^2)
Ln TFP $_{i}$, $_{(1\ year\ lagged)}$	0.008***	0.004***	0.004***	0.007**
	(0.0007)	(0.001)	(0.001)	(0.003)
Discovery Giant Oil $_{i,t}$ (Disc =1)	-0.12**	-0.12**	-0.14**	-0.14*
	(0.05)	(0.06)	(0.06)	(0.08)
TFP $_{i,\ t-1}$ × Disc $_{i,t}$ (Disc =1)	0.001	0.002	0.003	0.002
	(0.001)	(0.002)	(0.003)	(0.003)
Democracy (Dem=1) $_{i,t}$	0.11	0.19*	0.20*	0.14
	(0.04)	(0.10)	(0.10)	(0.16)
Democracy (Dem=1) × Disc $_{i,t}$(Disc =1)	-0.04	-0.07	-0.07	-0.05
	(0.03)	(0.05)	(0.05)	(0.07)
Ln Non-resource tax $_{i,\ t}$	0.006	0.10*	0.06	0.17
	(0.03)	(0.06)	(0.05)	(0.11)
Ln Non-resource tax × Disc $_{i,t}$(Disc =1)	0.05**	0.06**	0.06**	0.03
	(0.02)	(0.03)	(0.03)	(0.04)
Oil rents (%contribution to GDP)	0.002	0.001	0.003	0.002
	(0.001)	(0.002)	(0.002)	(0.004)
Arellano-Bond test for AR(1)	-1.87*	-4.20 ***	--4.16 ***	-3.41***
Arellano-Bond test for AR(2)	1.27	1.48	1.37	1.05
Hansen_df	85.65	88.81	88.36	150.96
Hansen test of overid (p statistics)	0.1	0.284	0.29	0.196
Lags used as Instruments	L(3/5)	L(4/7)	L(4/7))	L(3/7)
Number of instruments	153	180	180	235
Number of observations	1381	1404	1404	2264
Number of countries	100	101	101	164

Notes: All regressions control for log population size, country and time fixed effects. The estimator is the one-step difference GMM style Arrelano-Bond Dynamic Panel Data estimation
Estimates in parenthesis are standard errors clustered at the country level. Data is from 1992-2008.
The measure of democracy is based on Acemoglu et al.'s 2019 and Nighttime Lights is from Henderson et al. 2012.
Instrumented Variables: Log TFP, Oil rents, Ln Non-resource tax
*** Significant at the 1 per cent level.
** Significant at the 5 per cent level.
** Significant at the 10 per cent level.

In the previous section (Table 4.2), we demonstrate why resource boom corrupts the political process through the contribution of democracy to economic growth. Our initial hypothesis is to test for an alternative measure of political accountability that is not susceptible to the resource boom and can be used to monitor the government's performance in terms of accountability.

Building on the premise of the "political resource curse" theory, resource boom can reduce the quality of democracy and make likely governments to restrict personal liberties. On the other hand, most of the human rights abuse are likely to involve the mining and exploration companies and the indigenous people. Because mining corporations are becoming more aware of the human rights implications of their activities and the positive business implications of dealing appropriately with human rights issues, resource boom may not trigger significant changes to their values relative to the pre-boom period. Also, human rights abuses bring about agitations from the local community, which could lead to disruption and suspension of exploration activities. Ideally, the government do not want this to happen. Therefore, the resource boom may unlikely cause a significant change in human relative to the initial level before the year of oil discovery. Because they can also constitute an instrument for political accountability, human rights protection can provide a channel for understanding how resource boom cause growth in monitoring growth.

In Tables 4.5, the results show that discovery predict more resource curse with the use of nighttime light and with the use of GDP when democracy is zero. The effect of the resource curse (slow growth) is higher when democracy is high. This suggest two things: first, at low level of democracy, the resource curse is downplayed with both GDP and nighttime light as outcomes. Second, the result show that discovery work to reduce the quality of democratic process but not Human right protection in oil rich countries. Therefore, human rights protection is not vulnerable and can be used to identify political accountability in oil-rich countries. How the government manages the anticipated benefits from resource benefits depends largely on the extent in which they can be held accountable by the citizen and on the stock of existing economic infrastructure (e.g. the level of industrialisation accounted for by stock of physical capital). While democratic principles are essential for improving accountability, however, our the effect might not be significant at influencing how the government in oil rich countries transform the expected benefits from the discoveries into a significant economic advantage. One reason is that democratic participation in oil rich countries comes with a high political transaction cost and endogenous selection (Brollo et al. 2013).

In Table 4.6, we show that human rights protection is not a channel for the resource curse, but stronger in countries with more revenue from the non-resource tax, suggesting that improving the contribution of non-resource taxation can help to strengthen political accountability and relax constraints faced by citizens for collective action. Another useful and consistent finding from our estimations in Table 6 is that improving non-resource taxation is a significant channel for enhancing human rights. In contrast to revenue from resource rents, funding governance by using citizens' contribution in the form of tax could be particularly significant in making government accountable. Also, the non-resource taxation's contribution to the GDP is particularly useful on its own for justifying policy measures advocating policies for reducing the resource curse. One of such policies is that the government in resource rich countries should implement an unconditional transfer of the resource rent revenue to the citizen and, attempt to recover it back directly from citizens through effective taxation policy. This policy could reduce the moral hazard and the principal-agent informational problem associated with holding the government responsible for rents distribution for the provision of the public good.

Table 4.5: Human Right, Democracy and Growth before and after Oil Discovery

	Dependent Variables			
	Model XIII (Log GDP)	Model XIV (Nighttime)	Model XV (Log GDP)	Model XVI (Nighttime)
Ln GDP/capita $_{i,t}$ (1 year lagged)	0.93***	0. 39***	0.86***	0.09
	(0.03)	(0.12)	(0.03)	(0.12)
Discovery Giant Oil $_{i,t}$ (Disc =1)	0.04	-0.39**	-0.03	-0.47**
	(0.03)	(0.17)	(0.09)	(0.2)
Democracy (Dem=1) $_{i,t}$	0.008	0.02	0.08***	0.12
	(0.008)	(0.03)	(0.03)	(0.11)
Human Rights Protection $_{i,t}$	0.019**	0.05*	0.06**	0.05
	(0.006)	(0.03)	(0.003)	(0.07)
GDP $_{i,t-1}$ × Disc $_{i,t}$ (Disc =1)	-0.0001	0.014**	0.002	0.016**
	(0.001)	(0.006)	(0.003)	(0.008)
Democracy (Dem=1) × Disc $_{i,t}$(Disc =1)	-0.01	0.01	-0.05**	-0.10**
	(0.006)	(0.02)	(0.02)	(0.05)
Human Rights × Disc $_{i,t}$(Disc =1)	0.0001	0.02*	0.004	-0.008
	(0.003)	(0.01)	(0.01)	(0.03)
Ln Non-resource tax $_{i, t}$	0.006	0.18**	0.03	0.09
	(0.02)	(0.07)	(0.02)	(0.06)
Ln Non-resource tax × Disc $_{i,t}$(Disc =1)	-0.002	0.006	-0.006	0.008
	(0.007)	(0.02)	(0.01)	(0.04)
Oil rents (%contribution to GDP)	0.002**	0.004**	0.0005	0.003**
	(0.001)	(0.002)	(0.9)	(0.001)
Estimator	Fixed-effects (within) regression	Fixed-effects (within) regression	DPD one-step difference GMM	DPD one-step difference GMM
Arellano-Bond test for AR(1)			-3.09***	-5.41***
Arellano-Bond test for AR(2)			1.32	1.16
Hansen_df			135.36	137.1
Hansen test of overid (p statistics)			0.475	0.361
Lags used as Instruments			L(3/7)	L(3/7)
Number of instruments			235	235
Number of observations	2,229	2,239	2056	2066
Number of countries	152	152	150	151

Notes: All regressions control for log population size, country and time fixed effects. DPD means Arrelano-Bond Dynamic Panel Data estimation

Estimates in parenthesis are standard errors clustered at the country level. Data is from 1992-2008. The measure of democracy is based on Acemoglu et al.'s 2019 and Nighttime Lights is from Henderson et al. 2012.

Instrumented Variables: Log GDP, Oil rents, Ln Non-resource tax

* Significant at the 1 per cent level, ** Significant at the 5 per cent level, *** Significant at the 10 per cent level.

Table 4.6: Human Rights Channel for the Political Resource Curse

	Dependent Variable: Human Right Protection			
	Model XIII	Model XIV	Model XV	Model XVI
HRP $_{i,t-1}$ (1 year lagged)	1.33***	1.22***	1.2***	1.17***
	(0.03)	(0.08)	(0.08)	(0.08)
HRP $_{i,t-2}$ (2 year lagged)	-0.46***	-0.42***	-0.41***	-0.39***
	(0.03)	(0.09)	(0.09)	(0.09)
Discovery Giant Oil $_{i,t}$ (Disc =1)	-0.008	-0.01	-0.004	-0.0006
	(0.035)	(0.06)	(0.06)	(0.06)
Democracy (Dem=1) $_{i,t}$	0.05***	0.06	0.05	0.05
	(0.01)	(0.06)	(0.07)	(0.07)
Democracy (Dem=1) × Disc $_{i,t}$ (Disc =1)	-0.04	0.04	0.04	0.04
	(0.03)	(0.04)	(0.04)	(0.04)
Ln Non-resource tax $_{i,t}$	0.03**	0.06**	0.05**	0.05**
	(0.01)	(0.02)	(0.02)	(0.02)
Ln Non-resource tax × Disc $_{i,t}$(Disc =1)	0.0004	-0.02	-0.008	-0.009
	(0.02)	(0.02)	(0.02)	(0.03)
Oil rents (%contribution to GDP)	0.0009	0.0004	0.0003	0.0002
	(0.0005)	(0.0008)	(0.0008)	(0.0008)
Coup $_{i,t}$ (Dummy=1)			0.005	0.01
			(0.04)	(0.04)
Fearon War $_{i,t}$ (Dummy=1)			-0.08*	-0.08*
			(0.05)	(0.05)
Estimator	Fixed Effect	DPD one-step difference GMM	DPD one-step difference GMM	DPD two-step difference GMM
Arellano-Bond test for AR(1)		-5.69***	-5.28 ***	-4.96***
Arellano-Bond test for AR(2)		-0.25	-0.15	-0.26
Hansen_df		136.23	134.34	134.34
Hansen test of overid (p statistics)		0.598	0.572	0.596
Lags used as Instruments		L(5/10)	L(5/10)	L(5/10)
Number of instruments		239	239	239
Number of observations	2,130	1958	1944	1944
Number of countries	152	151	151	150

Notes: All regressions control for log population size, country and time fixed effects.
Estimates in parenthesis are standard errors clustered at the country level. Data is from 1992-2008.
The measure of democracy is based on Acemoglu et al.'s 2019, Nighttime Lights is from Henderson et al. 2012, and HRP is the Human Rights Protection score taken from Fariss (2014).
Instrumented Variables: HRP $_{i,t-1}$ (1 year lagged), HRP $_{i,t-2}$ (2 year lagged), Oil rents, Ln Non-resource tax
*** Significant at the 1 per cent level.
** Significant at the 5 per cent level.
** Significant at the 10 per cent level.

4.5.3 Mechanisms

In this section, we explore the potential mechanisms through which giant oil discoveries, non-resource taxation, human rights and democracy might affect economic activities. Even though we cannot exhaust all possible mechanisms, our approach in this regards is to understand their influence on the overall welfare, poverty and aggregate productivity that we believe are important in stimulating economic development.

We estimate models of the form:

$$X_{j,t} = \sigma_0 + \sigma_1(D_{j,t} = 1) + \sigma_2(HRP_{j,t}) + \sigma_3(LnTax_{j,t}) + \sigma_4(LnGDP_{j,t-1}) + \sigma_5(Dem_{j,t}) + \sigma_6(LnD_{j,t} \times HRP_{j,t}) + \sigma_7(LnD_{j,t} \times LnGDP_{j,t-1}) + \sigma_8(LnD_{j,t} \times Dem_{j,t}) + \varepsilon_{j,t} \qquad 4.9$$

Where $X_{j,t}$ is one of several potential channels that we used to replace nighttime lights. These include the measure of economic reforms introduced by Giuliano et al. (2013; normalised between 0 and 100), TFP (in logs), the share of trade in GDP (in logs), Electricity Consumption (Log, Billion kWh), and primary school enrolment. Controlling for lagged of GDP on the right-hand side of equation (10) help remove the mechanical effect of greater GDP on some of these intermediating variables.

Political and economic freedoms often go hand in hand (Giuliano et al. 2013), and because talent and creativity are likely to thrive under favourable human rights condition, strengthening it could lead to market reforms that stimulate economic growth, improve factors productivity and trade and boost the confidence of investors in the financial institutions the business cycles. There are ongoing debates on the contribution of resource wealth and education (Davis, 1995; Gylfason 2001; Stijns 2006). Stijns (2006), for instance, believes that human capital accumulation should accompany mineral activities which are represented by subsoil wealth and resource rents per capita. However, evidence suggests that in contrast to resource-poor economies like Singapore, Taiwan or South Korea who spend enormous efforts on education, many resource rich countries spend significantly less on quality education (Gylfason 2001). To illustrate this situation, OPEC member countries send 57 per cent of their youngsters to secondary school compared with 64 per cent for the world as a whole and they spend less than 4 per cent of their GNP on education on average compared with almost 5 per cent for the world as a whole (Gylfason et al. 1999). Except for Botswana, many countries blessed with abundant and reliable rent stream, allocate less expenditure relative to income on education. Gylfason et al. (1999) and Gylfason (2001), suggest that nations that are confident of revenue from natural resources rents devote inadequate attention and expenditure to education and school enrolment at all levels tends to be inversely related to natural resource abundance (Gylfason et al. 1999).

More importantly, electricity consumption is strongly correlated with darkness and poverty. Lack of access to electricity is a barrier to development and industrialisation with potential impacts on a wide range of indicators like health, education, food security, gender equality, livelihoods, and poverty reduction. The provision of light depends on how effectively central governments provide electricity grids Thus without proper accountability mechanism that ensures investment of proceeds; time-constrained political agents might discount the benefits for an elaborate plan for investment plans in universal access to electricity as a means to boosting industrialisation that will promote growth and development.

In Table 4.7, we find that improving human rights protection have a positive effect on market reforms and democracy helps to reduce the negative effect of a giant oil discovery on economic reform. Improving non-resource tax revenue contribution to GDP increase factor productivity and countries with discoveries of giant oil reserves are less reliant on revenue from trade. Whilst giant oil discoveries and non-resource tax contribution on their own, both have no significant contribution to electricity consumption. However, countries with discoveries and with better human rights protection have better consumption of electricity. With access to natural endowments from oil and gas reserves, one would have thought that oil rich countries should be some of the countries in the world with adequate and sufficient access to affordable, clean energy. However, many natural gas-rich countries waste natural gas, which could be used for power generation by flaring in large volumes (Bazilian et al. 2013). According to the International Energy Agency (IEA), many oil-producing countries (e.g. in Sub-Saharan Africa) are generally characterised by low electricity access levels, with less than one-third of the population having access to a stable and reliable supply of electricity (IEA 2010). Investment requirements for ensuring stable access to electrification are enormous (IEA 2011), and the benefits are not usually immediate.

Finally, we find that countries with more reliance on non-resource taxation contribution to GDP record more enrolment in primary education in contrast to countries with less reliance. Poor enrolment in education could inhibit growth in the secondary sector by raising training costs, lowering wages and may deter hiring, learning, and growth. The dependence on export earnings from rents and may neglect education and human capital development because they might not see it as having an immediate need for improving revenue. Education increases the efficiency of the labour force, and it helps in fostering democracy and the demand for accountability (Aghion et al. 1999, Barro 2001).

Table 4.7: Effects of Democracy, Human rights, and Giant Oil Discoveries on Potential Mechanisms

	Dependent Variables				
	Index of Market Reforms (0-100) Model XVII	Log of TFP Model XVIII	Log of Trade Share in GDP Model XIX	Electricity Consumption (Log, Billion kWh) Model XX	log of primary school enrolment (multiplied by 100) Model XXI
Ln GDP/capita $_{i,}$ $_{(1\ year\ lagged)}$	4.48	54.9***	-1.03	0.56***	-0.59
	(4.64)	(7.93)	(8.18)	(0.08)	(6.85)
Discovery Giant Oil $_{i,t}$ (Disc =1)	-12.1*	-6.28	-48.6***	-0.07	1.21
	(6.3)	(8.97)	(15.5)	(0.18)	(7.14)
HRP $_{i,\ t}$	3.03**	-0.36	6.16**	-0.02	2.83**
	(1.31)	(1.51)	(2.66)	(0.03)	(1.42)
HRP $_{i,\ t}$ × Disc $_{i,t}$ (Disc =1)	-0.30	0.43	0.64	0.04**	-0.14
	(0.56)	(0.57)	(2.49)	(0.02)	(0.48)
Ln Non-resource tax $_{i,\ t}$	2.88	11.52**	2.59	0.06	14.12***
	(2.43)	(4.56)	(6.02)	(0.04)	(4.24)
Ln GDP/capita $_{(1\ year\ lagged)}$ × Disc $_{i,t}$ (Disc =1)	0.39*	0.28	1.69**	0.003	-0.06
	(0.21)	(0.35)	(0.62)	(0.007)	(0.27)
Democracy Index $_{i,t}$ (Dem)	-1.85	-3.0	1.04	-0.02	4.43
	(1.58)	(2.04)	(3.48)	(0.03)	(3.19)
Democracy(ANRR)×Disc $_{i,t}$ (Disc =1)	3.63**	-1.55	3.93	-0.02	1.19
	(1.65)	(1.84)	(5.47)	(0.04)	(1.43)
Within R-square	0.52	0.64	0.18	0.72	0.41
Number of observations	1,576	1,427	2,202	2,207	1,854
Number of countries	130	97	152	150	149
F-stat	20.35	10.65	6.04	52.9	3.76

Notes: All regressions control for log population size, country and time fixed effects. Estimates in parenthesis are standard errors clustered at the country level. Data is from 1992-2008.
*** Significant at the 1 per cent level.
** Significant at the 5 per cent level.
* Significant at the 10 per cent level

4.6 Conclusion

According to the resource curse literature, a common cause of economic backwardness in resource rich countries can be traced to the weakening of the political process (Brollo et al. 2013). The risk that resource revenue could reduce the quality of political participation cannot be neglected, and it is important to understand how citizens can be made more involved at strengthening the political process for managing the resource curse.

In this study, we present two mechanisms for the understanding of the resource curse. The first mechanism we explore builds on the premise that governments in resource rich countries want to appear as not plundering resource wealth. Because citizens cannot observe resource revenue, the incumbent has a higher incentive to misappropriate more revenue while giving the impression of positive performance with compromised GDP statistics and estimates of government spending from national statistics. The second applies to the bias with the use of democratic participation as a channel for identifying the political resource curse. On the other hand, identifying political accountability with governments' commitment to policies that protect human rights can reflect political accountability that is distinct from democratic processes and representation (Wigley 2018).

We provide empirical evidence by using satellite data on nighttime light intensity in 157 countries with yearly observations from 1992 to 2008. Our identification strategy draws on nighttime lights as a measure of economic development because of the problems with GDP measurements in resource-dependent countries. Also, we use the information on human rights protection that accounts for changes in the standards of measure of human rights protection over time. Because it takes a relatively long time from the announcement of discoveries to when rents positively manifest on economic development (Arezki et al. 2017), the contribution of GDP to nighttime lights should not be immediate in the year of discovery relative to the preceding year if there is no manipulation with GDP statistics. We estimate dynamic panel-data models with GMM-styled instrumental variable analysis for 157 countries from 1992 to 2008 to isolate useful information and provide more reliable estimates (Arellano and Bond 1991, Blundell and Bond 1998, Roodman 2009)

Our baseline results show that in the long run, the contribution of democracy to GDP per capita reduces by about 44% with the announcement of giant oil discovery. We show evidence of GDP's inflation by about 2% in the year of discovery. Third, discovery predicts a negative growth to nighttime lights, especially in countries with a low score in democratic institutions. Fourth, human rights protection contribute to the growth, and the effect does not depend on the discovery, and increasing nonresource tax improves human rights and offers a verifiable channel for understanding the effect of non-resource taxes on good governance in resource-rich countries. Our findings suggest that transparent and open access to information on government performance; improving governments' compliance to human rights protection in addition to democratic reforms are useful means for reducing the resource curse and improving governments' accountability.

We submit that using the structures in place for improving human rights conditions might be a useful channel for more accountable for resource management. Also, given the significant role of non-resource tax contribution to economic development, we encourage the development of taxation friendly policies with more government revenue to come more from non-resource tax.

References

Acemoglu, D., & Robinson, J. A. (2001). A theory of political transitions. *American Economic Review*, *91*(4), 938-963.

Acemoglu, D., & Robinson, J. A. (2006). *Economic origins of dictatorship and democracy*. Cambridge University Press.

Acemoglu, D., Johnson, S. and Robinson, J.A. (2001). The colonial origins of comparative development: an empirical investigation. *American Economic Review*, vol. 91, pp. 1369–401.

Acemoglu, D., Naidu, S., Restrepo, P., & Robinson, J. A. (2019). Democracy does cause growth. *Journal of Political Economy*, *127*(1).

Aghion, P., Caroli, E., & Garcia-Penalosa, C. (1999). Inequality and economic growth: the perspective of the new growth theories. *Journal of Economic Literature*, *37*(4), 1615-1660.

Alesina, A., & Perotti, R. (1994). The political economy of growth: a critical survey of the recent literature. *The World Bank Economic Review*, *8*(3), 351-371.

Alexeev, M., & Conrad, R. (2009). The elusive curse of oil. *The Review of Economics and Statistics*, *91*(3), 586-598.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, *58*(2), 277-297.

Arezki, R., Ramey, V. A., & Sheng, L. (2017). News shocks in open economies: Evidence from giant oil discoveries. *The Quarterly Journal of Economics*, *132*(1), 103-155.

Aslaksen, S. (2010). Oil and democracy: More than a cross-country correlation?. *Journal of Peace Research*, *47*(4), 421-431.

Barro, R. J. (1973). The control of politicians: an economic model. *Public choice*, 19-42.

Barro, R. J. (1996). Democracy and growth. *Journal of economic growth*, *1*(1), 1-27.

Barro, R. J. (2001). Human capital and growth. *American economic review*, *91*(2), 12-17.

Baskaran, T., Min, B., & Uppal, Y. (2015). Election cycles and electricity provision: Evidence from a quasi-experiment with Indian special elections. *Journal of Public Economics*, *126*, 64-73

Bazilian, M., Onyeji, I., Aqrawi, P. K., Sovacool, B. K., Ofori, E., Kammen, D. M., & Van de Graaf, T. (2013). Oil, energy poverty and resource dependence in West Africa. *Journal of Energy & Natural Resources Law*, *31*(1), 33-53.

Besley, T., & Persson, T. (2013). Taxation and development. In *Handbook of public economics* (Vol. 5, pp. 51-110). Elsevier

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, *87*(1), 115-143.

Boix, C., Miller, M., & Rosato, S. (2013). A complete data set of political regimes, 1800–2007. *Comparative Political Studies*, *46*(12), 1523-1554.

Brollo, F., Nannicini, T., Perotti, R., & Tabellini, G. (2013). The political resource curse. *American Economic Review*, *103*(5), 1759-96.

Brooks, S. M., & Kurtz, M. J. (2016). Oil and Democracy: Endogenous Natural Resources and the Political “Resource Curse”. *International Organization*, *70*(2), 279-311

Brooks, S. M., & Kurtz, M. J. (2016). Oil and democracy: endogenous natural resources and the political “resource curse”. *International Organization*, *70*(2), 279-311.

Brückner, M., & Ciccone, A. (2011). Rain and the democratic window of opportunity. *Econometrica*, *79*(3), 923-947.

Carreri, M., & Dube, O. (2017). Do natural resources influence who comes to power, and how?. *The Journal of Politics*, *79*(2), 502-518

Caselli, F. (2006). Power struggles and the natural resource curse. LSE working paper.

Caselli, F., & Cunningham, T. (2009). Leader behaviour and the natural resource curse. *Oxford economic papers*, *61*(4), 628-650.

Caselli, F., & Tesei, A. (2016). Resource windfalls, political regimes, and political stability. *Review of Economics and Statistics*, *98*(3), 573-590

Cassidy, T. (2019). The long-run effects of oil wealth on development: Evidence from petroleum geology. *The Economic Journal*, *129*(10), 2745-2778.

Cavalcanti, T., Da Mata, D., & Toscani, F. (2019). Winning the oil lottery: The impact of natural resource extraction on growth. *Journal of Economic Growth*, *24*(1), 79-115.

Cheibub, J. A., Gandhi, J., & Vreeland, J. R. (2010). Democracy and dictatorship revisited. *Public choice*, *143*(1-2), 67-101.

Chen, W., Chen, X., Hsieh, C. T., & Song, Z. (2019). *A Forensic Examination of China's National Accounts* (No. w25754). National Bureau of Economic Research.

Chen, X., & Nordhaus, W. D. (2010). *The value of luminosity data as a proxy for economic statistics* (No. w16317). National Bureau of Economic Research.

Cingranelli, D. L., & Richards, D. L. 2012a. “The Cingranelli-Richards (CIRI) Human Rights Data Project Coding Manual Version 2008.3.13.” http://ciri.binghamton.edu/documentation/ciri_coding_guide.pdf

Cingranelli, D. L., & Richards, D. L. 1999. Measuring the level, pattern, and sequence of government respect for physical integrity rights. *International studies quarterly*, 43(2), 407-417.

Cingranelli, D. L., & Richards, D. L. 2012b. “The Cingranelli-Richards Human Rights Dataset Version 2008.03.12.” http://www.humanrightsdata.org

Cingranelli, D., and Filippov, M. (2018). Are Human Rights Practices Improving?. *American Political Science Review*, 1-7.

Clark, A. M., & Sikkink, K. (2013). Information effects and human rights data: Is the good news about increased human rights information bad news for human rights measures. *Hum. Rts. Q.*, 35, 539.

Conrad, C. R., & DeMeritt, J. H. (2013). Constrained by the bank and the ballot: Unearned revenue, democracy, and state incentives to repress. *Journal of Peace Research*, *50*(1), 105-119.

Conrad, C. R., Haglund, J., & Moore, W. H. (2013). Disaggregating torture allegations: Introducing the ill-treatment and torture (ITT) country-year data. *International Studies Perspectives*, 14(2), 199-220.

Cotet, A. M., & Tsui, K. K. (2013). Oil and conflict: What does the cross country evidence really show?. *American Economic Journal: Macroeconomics*, 5(1), 49-80.

Croft, T. A. (1978). Nighttime images of the earth from space.*Scientific American*, *239*(1), 86-101.

Cust, J., & Harding, T. (2014). Institutions and the location of oil exploration. *Journal of the European Economic Association*.

Davis, G. A. (1995). Learning to love the Dutch disease: Evidence from the mineral economies. *World development*,*23* (10), 1765-1779.

Deaton, A. (2005). Measuring poverty in a growing world (or measuring growth in a poor world). *Review of Economics and statistics*, *87*(1), 1-19.

DeMeritt, J. H., & Young, J. K. (2013). A political economy of human rights: Oil, natural gas, and state incentives to repress. *Conflict Management and Peace Science*, 30(2), 99-120.

Di Tommaso, M. L., Raiser, M., & Weeks, M. (2007). Home grown or imported? Initial conditions, external anchors and the determinants of institutional reform in the transition economies. *The Economic Journal*, *117*(520), 858-881.

Diermeier, D., & Li, C. (2017). Electoral control with behavioural voters. *The Journal of Politics*, *79*(3), 890-902.

Doll, C. H., Muller, J. P., & Elvidge, C. D. (2000). Night-time imagery as a tool for global mapping of socioeconomic parameters and greenhouse gas emissions. *AMBIO: a Journal of the Human Environment*, *29*(3), 157-163.

Doll, C. N., Muller, J. P., & Morley, J. G. (2006). Mapping regional economic activity from night-time light satellite imagery. *Ecological Economics*, *57*(1), 75-92.

Donaldson, D., & Storeygard, A. (2016). The view from above: Applications of satellite data in economics. *Journal of Economic Perspectives*, *30*(4), 171-98.

Dunning, T. (2008). *Crude democracy: Natural resource wealth and political regimes* (Vol. 7). Cambridge: Cambridge University Press.

Eck, K., & Hultman, L. (2007). One-sided violence against civilians in war: Insights from new fatality data. *Journal of Peace Research*, 44(2), 233-246.

Elvidge, C. D., Baugh, K. E., Kihn, E. A., Kroehl, H. W., Davis, E. R., & Davis, C. W. (1997). Relation between satellite observed visible-near infrared emissions, population, economic activity and electric power consumption. *International Journal of Remote Sensing*, *18*(6), 1373-1379.

Elvidge, C. D., Imhoff, M. L., Baugh, K. E, Hobson, V. R., Nelson, I., Safran, J. Dietz, J. B.and Tuttle, B. T. (2001). "Night-time lights of the world: 1994–1995." *ISPRS Journal of Photogrammetry and Remote Sensing* 56, no. 2: 81-99.

Elvidge, C.D., Baugh, K.E., Sutton, P.C., Bhaduri, B., Tuttle, B.T., Ghosh, T., Ziskin, D. and Erwin, E.H., (2011). Who's in the Dark—Satellite Based Estimates of Electrification Rates. *Urban Remote Sensing: Monitoring, Synthesis and Modeling in the Urban Environment*, *250*, pp.211-224.

Elvidge, C.D., Safran, J., Tuttle, B., Sutton, P., Cinzano, P., Pettit, D., Arvesen, J. and Small, C., (2007). Potential for global mapping of development via a nightsat mission. *GeoJournal*,*69*(1-2), pp.45-53.

Fariss, C. J. (2014). Respect for human rights has improved over time: Modeling the changing standard of accountability. *American Political Science Review*, 108(2), 297-318.

Gerring, J., Thacker, S. C., & Alfaro, R. (2012). Democracy and human development. *The Journal of Politics*, *74*(1), 1-17.

Ghosh, T., L Powell, R., D Elvidge, C., E Baugh, K., C Sutton, P., & Anderson, S. (2010). Shedding light on the global distribution of economic activity. *The Open Geography Journal*, *3*(1).

Gibney, M., Cornett, L., & Wood, R. M. (2012). "Political Terror Scale." http://www.politicalterrorscale.org/

Giuliano, P., Mishra, P., & Spilimbergo, A. (2013). Democracy and reforms: evidence from a new dataset. *American Economic Journal: Macroeconomics*, *5*(4), 179-204.

Good, D. F. (1994). The economic lag of Central and Eastern Europe: income estimates for the Habsburg successor states, 1870–1910. *The Journal of Economic History*, *54*(4), 869-891.

Graham, B. S., Hahn, J., Poirier, A., & Powell, J. L. (2018). A quantile correlated random coefficients panel data model. *Journal of Econometrics*, *206*(2), 305-335

Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review*, *45*(4-6), 847-859.

Gylfason, T., Herbertsson, T. T., & Zoega, G. (1999). A mixed blessing: natural resources and economic growth.*Macroeconomic Dynamics*, *3*(2), 204-225.
Habakkuk, H. J. 1962. *American and British Technology in the Nineteenth Century: The Search for Labour-Saving Inventions*. Cambridge and New York: Cambridge University Press.
Haber, S., & Menaldo, V. (2011). Do natural resources fuel authoritarianism? A reappraisal of the resource curse. *American Political Science Review,* 105(1), 1-26.
Hafner-Burton, E. M., & Ron, J. (2009). Seeing double: Human rights impact through qualitative and quantitative eyes. *World Politics*, 61(2), 360-401.
Haggard, S. (1990). *Pathways from the periphery: The politics of growth in the newly industrializing countries*. Cornell University Press.
Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica: Journal of the Econometric Society*, 1029-1054.
Harff, B. (2003). No lessons learned from the Holocaust? Assessing risks of genocide and political mass murder since 1955. *American Political Science Review*, 97(1), 57-73.
Harff, B., & Gurr, T. R. (1988). Toward empirical theory of genocides and politicides: Identification and measurement of cases since 1945. *International Studies Quarterly*, 32(3), 359-371
Hathaway, O. A. (2017). *Do human rights treaties make a difference*?. In International Law and Society (pp. 3-110). Routledge.
Henderson, J. V., Storeygard, A., & Weil, D. N. (2012). Measuring economic growth from outer space. *American Economic Review*, *102*(2), 994-1028.
Henderson, V., Storeygard, A., & Weil, D. N. (2011). A bright idea for measuring economic growth. *American Economic Review*, *101*(3), 194-99.
Hodler, R., & Raschky, P. A. (2014). Regional favouritism. *The Quarterly Journal of Economics*, *129*(2), 995-1033.
Horn, Myron K. (2014). "Giant Oil and Gas Fields of the World," http://www.datapages.com/AssociatedWebsites/GISOpenFiles/HornGiantFields.aspx, 2014.
Hu, Y., & Yao, J. (2019). *Illuminating Economic Growth* (No. 19/77). International Monetary Fund.
IEA Press, 09 November (2011). World Energy Outlook Press release, London
IEA, U. (2010). UNIDO. 2010. *Energy Poverty–How to make modern energy access universal*.
International Monetary Fund. 2006. "Jamaica: Selected Issues." IMF Country Report 06/157.
Jaimovich, N., & Rebelo, S. (2008). News and business cycles in open economies. *Journal of Money, Credit and Banking*, *40*(8), 1699-1711.
Jaimovich, N., & Rebelo, S. (2009). Can news about the future drive the business cycle?. *American Economic Review*, *99*(4), 1097-1118.
Johnson, S., Larson, W., Papageorgiou, C., & Subramanian, A. (2013). Is newer better? Penn World Table revisions and their impact on growth estimates. *Journal of Monetary Economics, 60*(2), 255-274.
Krause, S., & Méndez, F. (2009). Corruption and elections: An empirical study for a cross-section of countries. *Economics & Politics*, *21*(2), 179-200.
Kudamatsu, M. (2018). GIS for credible identification strategies in economics research. *CESifo Economic Studies*,*64*(2), 327-338.
Lipset, S. (1959): "Some Social Prerequisites for Democracy: Economic Development and Political Legitimacy," *American Political Science Review*, 53, 69–105

Löfgren, K. G., Persson, T., & Weibull, J. W. (2002). Markets with asymmetric information: the contributions of George Akerlof, Michael Spence and Joseph Stiglitz. *The Scandinavian Journal of Economics*, *104*(2), 195-211.

Martinez, L. R. (2017). How Much Should We Trust the Dictator's GDP Estimates?. University of Chicago Working paper, 2018. URL https://ssrn.com/abstract=3093296.

Marwell, G., & Oliver, P. (1993). *The critical mass in collective action*. Cambridge University Press.

Michalopoulos, S., & Papaioannou, E. (2013a). National institutions and subnational development in Africa. *The Quarterly Journal of Economics*, *129*(1), 151-213

Michalopoulos, S., & Papaioannou, E. (2013b). Pre-colonial ethnic institutions and contemporary African development. *Econometrica*, *81*(1), 113-152.

Michalopoulos, S., & Papaioannou, E. (2018). Spatial patterns of development: A meso approach. *Annual Review of Economics*, (0).

Monteiro, J., & Ferraz, C. (2010). Does oil make leaders unaccountable? Evidence from Brazil's offshore oil boom. *unpublished*, *PUC-Rio*.

Moore, M. (1998). Death without taxes. *The democratic developmental state: politics and institutional design. New York, OUP*.

Morrison, K. M. (2009). Oil, nontax revenue, and the redistributional foundations of regime stability. *International Organization*, 63(1), 107-138.

Munck, G. L., & Verkuilen, J. (2002). Conceptualizing and measuring democracy: Evaluating alternative indices. *Comparative political studies*, *35*(1), 5-34.

Nickel, J. (2014). with assistance from Thomas Pogge, MBE Smith, and Leif Wenar (December 13, 2013). *Stanford Encyclopedia of Philosophy, Human Rights*.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica: Journal of the Econometric Society*, 1417-1426.

Office of the United Nations High Commissioner for Human Rights. (2007). Good Governance Practices for the Protection of Human Rights.

Olson, M. (1965). *The logic of collective action: Public goods and the theory of groups*; Cambridge, MA: Harvard University Press

Papaioannou, E., & Siourounis, G. (2008). Democratisation and growth. *The Economic Journal*, *118*(532), 1520-1551.

Persson, T., Roland, G., & Tabellini, G. (1997). Separation of powers and political accountability. *The Quarterly Journal of Economics*, *112*(4), 1163-1202.

Pinkovskiy, M.L. Growth discontinuities at borders. *J Econ Growth* **22,** 145–192 (2017)

Pinkovskiy, M., & Sala-i-Martin, X. (2016). Lights, Camera… Income! Illuminating the national accounts-household surveys debate. *The Quarterly Journal of Economics*, *131*(2), 579-631.

Prichard, W., Salardi, P., & Segal, P. (2018). Taxation, non-tax revenue and democracy: New evidence using new cross-country data. *World Development*, *109*, 295-312.

Przeworski, A., & Limongi, F. (1993). Political regimes and economic growth. *Journal of economic perspectives*, *7*(3), 51-69.

Robinson, J. A., Torvik, R., & Verdier, T. (2006). Political foundations of the resource curse. *Journal of development Economics*, *79*(2), 447-468.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The stata journal*, *9*(1), 86-136.

Roser, M (2018) - "Human Rights". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/human-rights' [Online Resource]

Ross, M. L. (2001). Does oil hinder democracy?. *World politics*, *53*(3), 325-361.

Ross, M. L. (2013). *The oil curse: How petroleum wealth shapes the development of nations*. Princeton University Press.

Ross, M. L. (2015). What have we learned about the resource curse?. *Annual Review of Political Science*, *18*, 239-259.
Rummel, R. J. (1994). Power, genocide and mass murder.*Journal of Peace Research*, 31(1), 1-10.
Rummel, R. J. (1995). Democracy, power, genocide, and mass murder. *Journal of Conflict Resolution*, 39(1), 3-26.
Sachs, J. D., & Warner, A. M. (1995). *Natural resource abundance and economic growth* (No. w5398). National Bureau of Economic Research.
Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European Economic Review*, *45*(4-6), 827-838.
Sala-i-Martin, X., & Subramanian, A. (2013). Addressing the natural resource curse: An illustration from Nigeria. *Journal of African Economies*, *22*(4), 570-615.
Simon, H. A. (1979). Rational decision making in business organizations. *The American Economic Review*, *69*(4), 493-513.
Smith, B., & Wills, S. (2018). Left in the dark? Oil and rural poverty. *Journal of the Association of Environmental and Resource Economists*, *5*(4), 865-904.
Steckel, R. H., & Rose, J. C. (Eds.). (2002). *The backbone of history: health and nutrition in the Western Hemisphere* (Vol. 2). Cambridge University Press.
Stiglitz, J., Sen, A., & Fitoussi, J. P. (2009). The measurement of economic performance and social progress revisited. *Reflections and overview. Commission on the Measurement of Economic Performance and Social Progress, Paris*.
Stijns, J. P. (2006). Natural resource abundance and human capital accumulation. *World Development*, *34*(6), 1060-1083.
Sutton, P. C., & Costanza, R. (2002). Global estimates of market and non-market values derived from nighttime satellite imagery, land cover, and ecosystem service valuation. *Ecological Economics*, *41*(3), 509-527.
Taylor, C. L., & Jodice, D. A. (1983). World Handbook of political and social indicators. Yale University Press.
Tornell, A., & Lane, P. R. (1999). The voracity effect. *American Economic Review*, *89*(1), 22-46.
Tsui, K. K. (2010). More oil, less democracy: evidence from worldwide crude oil discoveries. *The Economic Journal*, 121(551), 89-115.
Tsui, K. K. (2010). Resource curse, political entry, and deadweight costs. *Economics & Politics*, *22*(3), 471-497.
Van der Ploeg, F. (2011). Natural resources: curse or blessing?. *Journal of Economic Literature*, *49*(2), 366-420.
Van der Ploeg, F., & Poelhekke, S. (2010). The pungent smell of “red herrings”: Subsoil assets, rents, volatility and the resource curse. *Journal of Environmental Economics and Management*, *60*(1), 44-55.
Venables, A. J. (2016). Using natural resources for development: why has it proven so difficult?. *Journal of Economic Perspectives*, *30*(1), 161-84.
Weidmann, N. B., & Schutte, S. (2017). Using night light emissions for the prediction of local wealth. *Journal of Peace Research*, *54*(2), 125-140.
Wigley S. (2018). Is There a Resource Curse for Private Liberties?, *International Studies Quarterly*, Volume 62, Issue 4, Pages 834–844
Young, A. (2012). The African growth miracle. *Journal of Political Economy*, *120*(4), 696-739.

Chapter 5

General discussion and conclusion

5.1 Introduction

This chapter summarises the research covered in this thesis and opens a general discussion on the method/modelling, data and results. We conclude with implications for policy and the resource curse as a concept. We also propose aspects that require further investigation.

The main aim of this thesis was to contribute to the understanding of the resource curse; i.e., provide an extension to theories and the mechanism proposed in the existing literature and extend the empirical evidence using a new set of data. In general, we examined the resource curse, not as isolated speculations, but as an integral part of an economic, social and political outcome; one that builds on and reflects an underlying character of institutions and the historical antecedents that lay the foundations for the quality of existing socio-political and economic structures. We combine in this thesis historical (colonial mercantilism and the legacy of extractive institutions) and political economy perspectives (information asymmetry and political accountability).

In the first part, our results support the recent research on the resource curse that emphasises the crucial role of institutions; countries with weak institutions suffer a negative impact of natural resource abundance, whereas countries with strong institutions do not (Mehlum et al. 2006). In support of earlier findings, we show that reducing the resource curse requires institutional reforms that will promote sustainable allocation of rents. However, in order to reform institutions, we need to understand how they came into being and what discourages institutional reform; this is an aspect that is currently under-researched in the existing literature and the main focus in this thesis.

In the second part, we investigated the income-public health nexus in oil-rich countries. Our approach is to focus on one specific channel of causation of windfall from oil discoveries and the enduring legacy of colonialism (corruption) on under-five child mortality: the one operating through shocks to income per capita. If the effect of a positive shock to income (oil-price shocks given oil discoveries) is compromised by the inefficiency with revenue allocation and management (e.g., the resource curse and/or corruption from the enduring impact of the 16th to 19th-century European colonialism), the effect on income might not reduce child mortality. An improved understanding of child mortality channel in the context of the resource curse broadens the scope of the resource curse and useful for the design of a socially-efficient rent allocation system that improves maternal, perinatal and paediatric healthcare in resource-rich countries.

In the third part, we formalised the mechanisms of the political resource curse and empirically analysed why the political process in resource-rich countries is less efficient. We examined the resource curse as an information asymmetry problem that characterises how citizens hold political leaders responsible for rents allocation. We showed that with resource richness the incentive for governments to exaggerate economic growth is present; governments in resource rich countries want to appear as not plundering resource wealth and are likely to manipulate indicators of economic performance. We contributed by identifying the resource curse using economic performance deduced from outer space through the use of geographic information systems (GIS) because of the bias in data on performance from nationally computed GDP per capita based statistics. Nighttime lights are useful because it captures economic activities that were previously unobserved either due to slips from official statistics or due to the sensitive nature of the information and for estimating economic activities is because in countries with weak state capacity and infrastructure (Pinkovskiy and Sala-i-Martin 2016).

The next section opens a general discussion on the theoretical and conceptual issues. We next provide a discussion of method/modelling, data and conclude with implications for policy and further research.

5.2 Discussion of Theoretical and Conceptual Issues

Perhaps one of the most researched yet crucial questions in the field of resource curse economics is: how can natural resource endowment translate into an improvement in socio-economic and political outcome in endowed countries? Specifically, how much of the positive outcome from resource endowments depend on the quality of institutions? If institutions matter so much, then why is it so hard to reform institutions that promote growth and promote sustainable transformation?

Traditional neoclassical growth models ascribe economic outcomes to features like geographical location, knowledge base, and capital stock, and to institutional features like governance, the rule of law, property rights, culture and trust. More specifically, North (1991) defines institutions as the: "the rules of the game in a society or, more formally, … the humanly devised constraints that shape human interaction". This view on the primacy of institutions as the main course of development is well shared among economists; and many insights have been provided about the mechanics and how it helps to foster economic development (North 1986, Alston et al. 1996, Acemoglu and Robinson 2005).

Institutions are particularly more relevant for guiding countries on how to manage resources and achieve the desired growth and shared prosperity. But institutions are determined endogenously (Acemoglu and Johnson 2005) and they can take different forms, i.e., economic, cultural and political. The economic institution, e.g., property rights, play a crucial role in determining the economic incentive for investment, allocation of resources and economic outcomes (Acemoglu and Johnson 2005). The political institution determines the distribution of political power (Aghion et al. 2004), which, in turn, determines how the resource is allocated.

The representativeness of the power structure and the inclusiveness of power would directly affect the growth and development and indirectly affect the economy by creating an incentive for pro-growth economic reforms. Without representativeness and balance in the political structure, the group with the greater political power can choose the set of economic reforms to carry out and determine how to allocate resource (North 1992, pp. 13-15). In a democracy, the power rests with the people who vote, in a contestable election, a set of representatives. The cultural aspect of institutions refers to religious beliefs and how it shapes the incentive for capital accumulation (Guiso et al. 2006, Tabellini 2010). For example, certain religious beliefs might discourage the accumulation of wealth, while others tend to encourage people to save more. This can be a potential source of economic growth that could be directly attributed to culture and beliefs (McCleary and Barro 2006).

Institutions have a two-way interaction with the resource curse and the political economy. In the first instance, institutions are viewed as a dependent variable, and the impact of natural resources on the quality of institutional is considered as a transmission channel of the resource curse — resources endowments matter for the quality of institutions and how these take shape. Resources rent create perverse incentives for agents to change the rule of the game to favour private expropriation of rents in contrast to a socially efficient allocation system that favours all the citizens. In this instance, corruption, poor service, lack of accountability and transparency are often attributed to the outcomes of the resource curse in many resource rich countries.

This second interaction builds on the "voracity effect" of Tornell and Lane (1999) and identifies poor institutions as the cause of the diverging experiences of resource-rich countries (Torvik 2002, Melhum et al. 2006). Melhum et al. (2006) put this theory to test in an empirical study and show that the negative impact of resources on GDP growth is significantly larger in countries with bad institutions, but not in countries with good institutions and strong legal-political and economic, institutional infrastructure.

Because institutions are endogenous (Acemoglu et al. 2001, Aghion et al. 2004), these explanations, although very genuine, are unable to provide a fundamental answer for how to go about changing institutions and what can be done to incentivise agents to be more favourably disposed to institutional reform, the answers revolve around how historical precedents and contextual constraints contribute to institutional reform. We need to first understand how institutions evolved, get transmitted and created the ideal incentives for informing institutional reforms, and second, unravel the natural constraints to political power structures that make it hard for reform to be realised (North 1992).

One way of understanding how institutions evolved is to examine the historical colonial extractive institution and how resource endowments have had an initial role in shaping institutions (Acemoglu et al. 2001, Engerman and Sokoloff 2002). Colonial powers typically organised economic activities in their respective colonies to maximise their economic returns (Dell and Olken 2017). To achieve this involved the setting up of favourable institutions that would promote the extraction and the formation of elitist governance structures that empowers selected individuals (Angeles 2007). Could these institutions and governance structure established during the colonial era persist to the post-independence period (Tadei 2013)?

To answer this question, we show in Chapter 2 that initial, post-independence endowment of the institutional setting before the discovery of resource matters in explaining a part of the resource curse. Colonialism did not merely impact the development of these societies via the quality of institutions; it also affected the incentive to restructure if more wealth from large natural resources is realised after the expiration of colonialism. For instance, colonialism and the action of empowering favourable locals with political and social power could have, inadvertently, created inequality in access to opportunities. With independence and the discovery of significant resource revenue, the elite has little incentive to restructure the inherited institutions, and this could further widen the social gap over time. Also, colonialism ended up creating very distinct sorts of institutional legacies in different places. In a related study, Acemoglu and Robinson (2012) explained that the reason for this is not due to the difference in how European powers transplanted different sorts of institutions, but that outcomes vary because of the difference in initial conditions in the colonies.

In Chapter 3, our framework extends the early colonial legacies by using it with oil price shocks, given oil discoveries to explain how income shocks affect the aggregate infant mortality rate in oil-rich countries. An important argument is underpinning the resource curse centres on the mismanagement of the positive expectations from resource wealth. If positive income shocks reduce inequality, then we should expect a reduction in child mortality as child mortality is concentrated among the poor (Waldmann 1992). However, positive shocks from oil discoveries may not be evident at reducing child mortality either because of the inefficiency arising from the resource curse and/or because of corruption that aggravates rents allocation in resource-rich countries (Ades and Di Tella 1999, Wigley 2017). An important finding of our research is that making the benefits from oil endowment to translate into an improvement per capita income and female labour market participation could have a beneficial effect on child mortality.

By explicitly conceptualising for the enduring impact of European colonisation and oil reserves and price volatility on child mortality, we demonstrate that oil-wealth may not improve social welfare if there are no systematic structures that ensure efficient allocation of rents for public benefits. If institutional quality is weak, the distribution and allocation of rents in time of boom will not be socially efficient, and hence with a crash in oil-price, the economic recession from reduced government spending will amplify the spread of poverty, deprivation and increased susceptibility to child mortality.

In Chapter 4, we take a different approach to explaining why citizens in many resource rich countries, though willing, are incapacitated to demand a change in the institutional arrangement that is unfavourable. Our theory builds on the premise that citizens can effect a change in government through electing individuals that favour pro-growth reforms that will lead to sustainable allocation of resources. Essentially, elections serve as a means for making political agents and governments work to promote growth. However, citizens need conducive environments, e.g. civil liberty and the ability to observe the performance of the incumbent in order to reward or sanction accordingly with respect to resource management.

We extend the principal-agent logic in the context of information asymmetry in the allocation priorities of the incumbent political agents. Citizens' utility is maximised if they can observe how efficient is the political agent in the allocation of resource for public benefits and also in the provision of civil liberties that guarantee human right protection. However, with information asymmetry, gauging the quality of the performance of the incumbent political agents causes poor performance and the inability of citizens to collectively sanction poor-performance by executing a costless and constitutional replacement via the ballot.

Governments in many resource-rich countries want to appear as not plundering resource wealth, so they have a higher incentive to give an incomplete report on budgetary allocations. Also, governments relax tax policy, which makes it hard for citizens to monitor how the government achieves the allocation priorities. If citizens cannot independently verify the allocation priorities of the incumbent, this information asymmetry will cause inefficiency in electoral markets and leave room for abuse of power and expropriation of revenue for private benefits. Subsequently, elections will be insufficient to hold public officials accountable, and the resource curse is observed, and resource rents will impose constraints on the collective action by reducing political accountability and improve on performance.

We have focused on the conceptual issues of the resource curse. We also show that to reduce the resource curse; we need to start by tracing the evolution of institutions via colonial legacies and the abuse of power by political leaders due to information asymmetry. In the light of these theoretical considerations, the natural question is to ask how valid are these theories and how adaptable and realistic are these to empirical implementation given the problem with data quality and measurement? We answer these questions in the next section by discussing the empirical and methodological issues.

5.2.1 Empirical and Methodological Issues

The methodological issues we discussed in this section relate to the validity of the data measurement and empirical identification strategies and the estimation techniques.

The first empirical issue addressed in Chapters 2 and 3 was the measurement of colonial heritage. Several empirical studies have used different indicators to measure colonial heritage. Bertocchi and Canova (2002) used the identity of the metropolitan ruler, and by the degree of economic penetration, Price (2003) utilized the twentieth-century malaria infection (a proxy for settler's mortality), and Angeles and Neanidis (2015) used the measures the percentage of European settlers with respect to total population in colonial times.

The general issue with the use of colonial heritage has to do with authenticating the measurement as the colonialization event happened years back. Because the colonial events happened long way past, historical data on colonialism is often unverifiable. For instance, in Acemoglu et al.'s (2001), the authors' assigned mortality rates for 36 of the 64 countries in the sample. According to Albouy (2012), the basis for the assignment was based on mistaken or conflicting evidence, and the mortality rates from populations of labourers, bishops, and soldiers were often combined in a manner that favours the hypothesis. Controlling for this, Albouy (2012) showed that the relationship between mortality and expropriation risk lacks robustness. As pointed out in Albouy (2012), the major problem is verifying the data on the actual amount of settler that died in centuries past. This remains a central issue with the use of the settlers' morality data (Albouy 2012).

Perhaps, another statistical issue with validating the colonial instrument is to show that it does not influence current development outside of the institutional channels suggested. For instance, if colonisation involved military invasion and defeat of the indigenous population, it is possible for places with sophisticated technology to have avoided being colonised (Iyer 2010). Because of the enduring effect of early technology adoption on current economic development (Comin et al. 2010), an empirical challenge is to show that this is not the case and test that the selection of countries as colonies had nothing to do with early technology adoption. Other minor issues related to how to distinguish colonies that were mere protectorates and used for trading purposes from those that had active economic exploitation. For instance, the protectorate status of many countries in the gulf where there was no active economic exploitation and direct engagement with the indigenous people cannot be classified as colonisation (see Comin et al. 2010). Other studies suggest that the identification of the colonisers matter on the extent of abuses and post-colonial outcomes. For example, (La Porta et al., 1997 and 2008) suggest that the historical origin of a country's laws is highly influenced by the legal system of the colonising country; i.e., the common law which is more practised in English-ruled colonies and the civil law more common in French-administered colonies.

In Chapters 2 and 3, we use a dummy measure of colonialism based on whether they had European colonial experience and used this as an instrument for institutional quality. We define a country as a former colony if: first, data on settler mortality exists for such a country and second if the official language used in such countries is European. There is a consensus that settler mortality is an indication of European interest and economic exploitation (Acemoglu et al. 2001). However, the point of departure is the estimates and values ascribed to the settler mortality in some countries. By defining colonialism with a dummy measurement, we aim to reduce the measurement error with estimates of the settler mortality data identified in Albouy (2012). Language played a key role in fostering economic partnership and was an instrument used in the subjugation of the indigenous members in the colonies. The use of European languages as the official medium of communication reflects a critical dimension of colonialism in colonies where Europeans have significant economic interest (Phillipson 1992, Migge and Léglise 2008). Imposing a standard language was critical for the effective administration of colonies, and an effective way of recognising countries with substantial colonial influence was the post-colonial dominance of the European language as an official language used as a medium of communication.

To validate the instruments in Chapter 2, we show early discoveries, adoption and use of military, agricultural, transportation, communication technologies plausibly had no direct effect on the decision to colonise. We run a reduced-form regression of the average sectoral technology adoption indexes (agricultural, communication, military transportation and industry) in period 1000BC on the instruments and colony dummy while also controlling for other covariates using data on early technology adoption taken from Comin et al. (2010). The absence of statistical significance between colonial instruments and early technology adoption could plausibly validate our assumption.

In the case of colonial investment, we argue in Chapter 3 that because colonial investments that could be correlated with current child mortality happened time ago they are part of the fixed components of the residual term that explains child mortality, and with the introduction of the country fixed effect, these residuals have been removed from the error term. That is they no longer serve as a channel with child mortality. Also, in the case of discoveries being correlated with non-income country capital that reduces child mortality, we argue that the main source of variation in the value of the log of oil discoveries instruments comes from the time series variation in the global oil price which is not correlated with country-level capital. Besides, although countries can choose efforts and investment in exploration, they cannot choose the number of discoveries they get; i.e., the geography of oil formation is independent of countries' efforts and investment.

Chapter 4 fundamentally differs in both the conceptual and theoretical concepts, and as such, the methodological issues we addressed were different. In Chapter 4, the empirical issues related to devising a measurement for human rights protection and how to economically identify the resource curse given to the tendency for resource rich government to compromise national statistics and GDP estimates.

To statistically quantify human rights, we can count the number of human rights treaties that countries ratify. However, such agreement reached by signing or ratification might not be legally binding as government authorities rarely fulfil the agreements and can use policy tools to make it challenging to quantify repressive activities. Another strategy is to create an index based on information included in annual reports produced by the US Department of State and Amnesty International rights. Examples of such index include the widely used Political Terror Scale (PTS) and the CIRI Physical Integrity Index (Fariss 2014). However, such indexes are also likely to be biased if they do not incorporate changes arising from raising the standards of human rights protection over time (Fariss 2014).

From a different perspective, Fariss (2014) in a landmark paper, challenges the finding that human right repression scores have remained unchanged over the last 35 years. Fariss (2014) concludes that these indexes might reflect an inconsistency in the way major monitoring agencies, like Amnesty International and the U.S. State Department, interpret the information collected. For instance, the improvement in human right score might be obscured because more recent reports may incorporate critiques and suggestions proffered on an earlier version, thus making it appear that there have been no changes (Fariss 2014). Such biases, which Fariss

(2014) collectively terms, changing the standard of accountability may make human rights reports used in these indexes unreliable, and it is argued that a quantitative index of human rights score should incorporate the changes arising from raising the standards of human rights protection over time. In chapter 3, we adopt Fariss' statistical approach that re-evaluated human rights indicators by incorporating the 'changing standard of accountability'.

The economic identification of the resource curse with estimates from GDP could be potentially misleading. GDP measurement is a sensitive matter, especially in many resource-dependent countries (Caselli 2006). A major drawback of its use is that it could constitute a significant drawback for credibly ascertaining the extent of growth and development in resource rich countries. In these most resource-rich countries, a larger fraction of economic activity is conducted within the informal sector, where more corruption and misappropriation of funds exist, and the government might compromise the validity of the inputs necessary for GDP estimation with respect to rent receipts and government spending (Caselli 2006). Several proxies have been proposed, e.g., the number of letters mailed per capita (Good 1994) and the skeletal quality of exhumed corpse has been used as a measure of the average standard of living and the degree of inequality (Steckel and Rose 2002). However, recent emphasis suggests the usefulness of nighttime lights intensity (Elvidge et al. 1997, Chen and Nordhaus 2010, Henderson et al. 2012).

5.2.2 Issues with Estimation Techniques

Another challenge has to do with the estimator choice to use in Chapter 2.

The structural model in Chapter 2 has log(ΔGDP) as the dependent variable, where log(ΔGDP) is the log of change in income per capita as the ratio of GDP/capita five years after and four years before oil discovery $Log\left(\frac{GDP\ \ per\ capita_{t+5}}{GDP\ \ per\ capita_{\ t-4}}\right)$. Following Mehlum et al. (2006), the key explanatory variables are institutional quality, amount of oil discoveries and interaction between these two. The other explanatory variables include a lagged dependent variable.

A common concern with this sort of regressions is that the dependent variable may be correlated with unobserved factors that can also affect the institutional quality and the estimates of resource abundance. Richer countries may have more capital to build and strengthen institutions and incur fewer exploration costs than poorer countries (Acemoglu et al. 2001, Cust and Harding 2014). As a result, the ordinary least squares estimator is generally biased and inconsistent. A standard solution to the endogeneity of education is to find instrumental variables for institutions, oil discoveries and the lagged dependent variable.

We instrument institutional quality with a colonial dummy (Acemoglu at al. 2001), oil discoveries with log depth and depth(squared) of oil fields and the interaction between colony dummy and depths. If these were the only endogenous concerns with the model, this would have been fine. However, the introduction of the lagged dependent variable as part of the covariates in the model introduces serial correlation in the error which makes it also endogenous. Therefore, we further introduce lags two and three of the GDP as instrumental variables for the differenced lagged dependent variable (Anderson and Hsiao 1982, Woodridge 2001).

Estimating this model becomes challenging, and the standard two-stage least square is no longer consistent. First, we have nine over-identifying restrictions and second; there is a serial correlation between the dynamic model (additional lagged moments). In this case, using the

2-stage GMM estimator instead of the 2-stage SLS can provide more precise estimates of the parameters (Hansen 1982, Hall 2000, Wooldridge 2001). Specifically, the GMM is well suited for obtaining efficient estimators that account for the serial correlation (Arellano and Bond 1991, Wooldridge 2001) and dynamic model estimation (Ghysels and Hall 1990, Van Reenen 1996) with additional moment conditions (Blundell and Bond 1998, Hall 2015).

In Chapter 3, the estimation challenge was how to capture the omitted variables that are likely to be correlated with the instruments of colonial investment that might be likely correlated with the residuals of child mortality and GDP. We address this concern by introducing the Fixed Effects estimators to account for the omitted variables bias. We utilised the 2-stage Fixed Effect (IV) estimator to explore how shocks to per capita income from time series variation in global oil prices interacted with cross-sectional variation in the oil discoveries, and from the enduring effect of European colonialization affect the risk of child mortality. The income per capita and child health covary at the national level for a variety of reasons; therefore, simple correlations would reveal inconsistent estimates. Our approach of instrumenting GDP per capita with the time series variation in lagged oil prices interacted with oil discoveries (Oil wealth) follows Acemoglu et al. (2013).

In Chapter 4, we used data on the variation in nighttime lights intensity to overcome the identification constraint and information asymmetry with the use of GDP statistics. Also, we analyse the dynamics of human rights protection as forms of political institutions that guarantee political accountability using Fariss 2014 data. Our panel strategy controls for country and time fixed effects. We find that the use of nighttime lights suggests a bias with GDP per capita as an economic indicator for measuring development associated with giant oil discoveries. If citizens rely on the use of GDP per capita to assess incumbents' performance, they cannot independently gauge how rents are allocated and the resource curse will persist as the incumbent can grab more rents with more discoveries despite poor performance.

5.3 Recommendations and Implications for Policies Formulation

In this section, we explain how the results of this study are useful for contributing to a more robust and sensitive policy for the resource curse and to suggesting options for removing constraints to institutional reforms. Also, we explain prospects for future research that could help to further elucidate our understanding of the management of resource wealth for sustainable development and shared prosperity. We sub-divide this section 3; the first part discusses the policy recommendation implied from our findings, the second discusses the implication for methodologies on the resource curse and the third highlights the limitations and some implications for further research.

5.3.1 Implications for Policies Formulation

5.3.1.1 Investment in education for social mobility for institutional reform

Despite the available evidence supporting institutions, strengthening them is an aspect that has received minimal attention (Casey et al. 2012). One important result from exploring the historical impact of colonial legacy is to understand that institutions are endogenous and therefore, the reasons for the resources curse could be how institutions were formed rather than the institutional quality per se. Colonialism in the 16^{th} to 19^{th} century created inequality through the allocation of privileges and an imbalance in the social structure; these are likely to amplify the resource curse. Socioeconomic inequality and unequal access to opportunities introduced during the colonial era will always be a disadvantage to any reform that promises change without enhancing social mobility. An important instrument that can reduce the imbalance in the social structure and create a critical mass of enlightened individuals is through improving access to education and the strengthening of human capital.

5.3.1.2 Promoting open access to information on growth performance and government spending

Natural resource wealth can only lead to sustained prosperity only if the government is publicly accountable and are transparent. The need for promoting accountability and transparency is the main focus of several transparency initiatives like the National Resource Governance Institute (NRGI) and the Extractive Industries Transparency Initiative (EITI). The EITI promotes transparent, open and accountable management of oil, gas and mineral resources and the NRGI policy options and practical advice for governments, societies and the international community on how best to manage resource wealth.

In many resource rich countries, there is a significant gap in the revenue generated from oil and gas and what was spent on public benefits. If citizens do not have access to information on governments' revenue, this information asymmetry will aggravate the resource curse by making it easy for the incumbent to misappropriate more funds for personal use while manipulating national statistics on growth to give the impression of the positive performance of the economy. Having open access to the government revenue and expenditure could make the government less likely to misappropriate resources and citizens to challenge governments' mismanagement and critical for reducing the resource curse.

5.3.2 Implications on empirical strategies for the evaluation of the resource curse

5.3.2.1 Developing credible identification for the economic evaluation of the resource curse

There are many studies on the economic impact of the resource endowment; such studies mostly have relied on economic indicators like the GDP, national statistics and government expenditures and spending. However, anecdotal evidence suggests that such data might be falsified and basing them to determine government performance might limit the understanding of the resource curse. More generally, the basic problem is that researchers have been too reductionistic; explaining development performance in terms of the size of GDP might not give an accurate picture of the nature of the resource curse and can lead to flawed conclusions.

A consensus is emerging among social scientists that economic identification using nighttime lights or any other of such indicators with reduced measurement errors might be a credible way of economic identification where there are uncertainties and institutional lapses in national income and wellbeing determination. The advantage of this approach is that these variables are shaped by a range of factors that are strongly correlated with the development and outside the control of the state government.

5.3.2.2 Developing credible measurement for identifying the quality of political institutions

The assessment at the country level of the quality of political and governance performance relies on the subjective measurement of several indicators into a composite score. While these composite scores are widely used, they face several limitations. First, there are measurement issues which might make them statistically unreliable, and there is the tendency to "cherry-pick" and suppress individual cases or data that seem to not conform to a particular position (Casey et al. 2012). In our study, we find that changing the mixture of indicators and/or sources has a significant impact on the statistical precision of the estimation. Second, the measurements are perception-based and lack transparency. Using indicators for measuring the quality of democracy need to be more constructive and to reflect the quality of participation, engagement and representativeness. Governance indicators that focus more on human rights protection as indicators of tolerance, accountability, service delivery, and independence of the judiciary should be used to supplement other indicators that reflect the performance of the government in terms of the quality of the political institutions.

5.3.3 Implications for further research

5.3.3.1 Government Myopia, Sovereign Debt, and the Resource Curse?

The apparent time lag between resource discoveries when revenue starts to make a potential impact is not definite. Arezki et al. (2017) proposed 5-7 years, but countries with anticipation of benefits can start spending the moment the discovery is certain as can be observed from the exogenous surge in countries' debt profile. Perhaps, an important extension would be to investigate how resource discovery constitutes a potential channel for the resource curse by raising the debt profile and an increase in the size of the government in resource rich countries.

With sovereign debt at extremely high levels in many resource rich countries, understanding how these are related to resource curse is an important concern for policymakers and international credit financial institutions. To study the channel of the resource curse through the sovereign debt profile, we suggest the linking of the timing of resource discoveries as exogenous shifters in a regression discontinuity design to the amount of debt incurred at national level conditional on the durability of the tenure of the government.

5.3.3.2 Natural Resource Wealth: Blessing or Curse on Quality of Education?

We propose in this thesis that reforms in the education sector are an essential mechanism for reducing the resource curse. By improving the quality of education, the human capital could be improved, and education can help in creating a critical mass of innovators that can effectively hold the government accountable and ensure a sustainable allocation in the distribution of rents. However, the available evidence is mixed. One group of studies suggest growth in skill-intensive exports increases schooling and export in less skill-intensive exports depress average educational attainment (Blanchard and Olney 2017). Gylfason (2001) and Cockx and Francken (2016) find that dependence on resource rents leads to low spending on education. Other researchers dispute this conclusion (Stijins 2006); because natural resources generate easily taxable rents, the government can earn more and subsequently spend more on education.

Perhaps an important divergence and inconsistency in research outcome with reality is the channel linking natural resource rents with government spending on education and the quality of education. There are several reasons why government spending on education and the quality of education might not necessarily be the same. Good quality education that would provide the required human capital useful for institutional reforms and productive labour requires more than just funding. First, good quality education requires several reforms geared at academic freedom, creating a conducive environment suitable for attracting the best talents among researchers and students and funding. Providing some, e.g., funding and not others might not necessarily generate the expected positive spillovers. Second, given that data on government spending on education is noisy and prone to measurement error, this additional bias makes identification not easily ascertainable.

To study the channel of the resource curse through education outcomes, we suggest the linking of the timing of resource discoveries as exogenous shifters of quality of the universities education as observed in the global ranking of the number of universities per country. Data on these can be found from independent sources like the Academic Ranking of World Universities (ARWU), Times Higher Education World University Ranking (THE), and the Quacquarelli Symonds (QS) among other global and regional rankings of world universities based on research quality, reputation and teaching.

5.3.3.3 Resource Curse and Models of Power-Sharing

In a recent study, Francois et al. (2015) examine how power is shared in African politics. The study shows that political power is allocated proportionally to population shares across ethnic groups. Perhaps an extended study could analyse if the same pattern is observed depending on the ethnic group with resource endowment. Specifically, there is a need to understand how votes share per ethnicity or the possession of a natural resource base to determine political power allocation. For instance, what happens if the ethnic majority also possess access to the resource pool or if the possession of the resource is in the hands of the minority group? Could this constitute a basis for power-sharing or alienation from power? How do the minority but resource-rich group bargain for a fair share of the power structure? Could this be the cause of recently renewed calls for a referendum demanding for independence and a sovereign state by minorities in resource rich countries? These are important questions that could shed more lights on how ruling elites evolve, organise, and respond to particular shocks. They are also central to an understanding of how to strengthen democracies in resource rich countries for inclusive representation and development.

5.3.3.4 Country-level experience of the resource curse varies

Recent scholarships emphasis that results can be improved by focusing on the potential dynamics using within-country analyses with variation at the subnational level (Cust and Poelhekke 2015, Van der Ploeg and Poelhekke 2017) that identify spillover effects using causal inference. Critical reviews suggest using subnational datasets to improve the identification of the resource curse (Cust and Poelhekke 2015). A valid extension would be to test the theories proposed in this thesis by leveraging on within household variation in the exposure to oil and gas production to identify the effect of the resource curse on economic and social livelihoods. The main contribution here would be to examine the environmental, social and economic impact of oil and gas production rather than just focusing on the channel of allocation or the transfer of windfalls that is the most common channel explored in the literature. Applying such approach, for instance, in Nigeria, by using the recently available Nigerian General Household Surveys (GHS) that covers the 36 states and Federal capital territory of Nigeria collected in three waves (2010 and 2011 in Wave I, 2012 and 2013 in Wave 2 and 2015 and 2016 in Wave 3) in the oil-producing Niger Delta region of Nigeria is plausibly a contribution to the resource curse literature.

5.3.3.5 Resource curse, colonialism and the episodic conflict-trap

The question of whether natural resource endowment is a cause of civil conflict is well studied in the economic and political science literature (see, e.g., Berman et al. 2017). Of more interest, perhaps, is to understand the conflict trap hypothesis; the pattern when civil conflicts repeat themselves (Collier and Sambianis 2002), and how new resource discovery can affect conflict (Hirshleifer 1991, 1995), either by creating an opportunity for renewal or settlement of hostilities. Also, it is essential to test how the effects of colonialism aggravate the postcolonial civil violence in resource rich countries (Lange and Dawson 2009). Analyses of the effects of colonialism on civil violence will provide many insightful qualitative analyses on the historical processes and contexts as well as highlight potential causal mechanisms on the evidence that colonialism aggravates the civil conflict trap.

References

Acemoglu, D., & Johnson, S. (2005). Unbundling institutions. *Journal of Political Economy*, *113*(5), 949-995.

Acemoglu, D., & Robinson, J. A., (2013). *Why nations fail: The origins of power, prosperity, and poverty*. Crown Books.

Acemoglu, D., Finkelstein, A., & Notowidigdo, MJ. (2013). Income and health spending: Evidence from oil price shocks. *Review of Economics and Statistics,* 95(4).

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review*, *91*(5), 1369-1401.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2002). Reversal of Fortune: Geography and institutions in the making of the modern world income distribution. *The Quarterly Journal of Economics*, *117*(4), 1231-1294.

Ades, A. and Di Tella, R. (1999). Rents, competition, and corruption. *American Economic Review, 89(4),* 982–93.

Aghion, P., Alesina, A., & Trebbi, F. (2004). Endogenous political institutions. *The Quarterly Journal of Economics*, *119*(2), 565-611.

Albouy, D. Y. (2012). The colonial origins of comparative development: an empirical investigation: comment. *American Economic Review*, *102*(6), 3059-76.

Alston, L. J., Eggertsson, Þ., Eggertsson, T., & North, D. C. (Eds.). (1996). *Empirical studies in institutional change*. Cambridge University Press.

Anderson, T. W., & Hsiao, C. (1982). Formulation and estimation of dynamic models using panel data. *Journal of econometrics*, *18*(1), 47-82.

Angeles, L. (2007). Income inequality and colonialism. *European Economic Review*, 51(5), 1155-1176.

Angeles, L., & Neanidis, K. C. (2009). Aid effectiveness: the role of the local elite. *Journal of Development Economics*,*90*(1), 120-134.

Angeles, L., & Neanidis, K. C. (2015). The persistent effect of colonialism on corruption. *Economica*, *82*(326), 319-349.

Arezki, R., Ramey, V. A., & Sheng, L. (2017). News shocks in open economies: Evidence from giant oil discoveries. *The Quarterly Journal of Economics*, *132*(1), 103-155.

Berman, N., Couttenier, M., Rohner, D., & Thoenig, M. (2017). This mine is mine! How minerals fuel conflicts in Africa. *American Economic Review*, *107*(6), 1564-1610.

Bertocchi, G., & Canova, F., (2002). Did colonization matter for growth? An empirical exploration into the historical causes of Africa's underdevelopment. *European Economic Review*, *46*(10), 1851-1871

Blanchard, E. J., & Olney, W. W. (2017). Globalization and human capital investment: Export composition drives educational attainment. *Journal of International Economics,106*, 165-183.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, *87*(1), 115-143.

Caselli, F. (2006). Power struggles and the natural resource curse. LSE working paper.

Caselli, F., and Michaels G. (2013). Do Oil Windfalls Improve Living Standards? Evidence from Brazil. *American Economic Journal*: *Applied Economics. 51*:208-38

Casey, K., Glennerster, R., & Miguel, E. (2012). Reshaping institutions: Evidence on aid impacts using a preanalysis plan.*The Quarterly Journal of Economics*, *127*(4), 1755-1812

Chen, X., & Nordhaus, W. D. (2010). *The value of luminosity data as a proxy for economic statistics* (No. w16317). National Bureau of Economic Research

Cockx, L., & Francken, N., (2016). Natural resources: A curse on education spending?. *Energy Policy*, *92*, 394-408.

Collier, P., & Sambanis, N., (2002). Understanding civil war: a new agenda. *Journal of Conflict Resolution*, *46*(1), 3-12.

Comin, D., Easterly, W., & Gong, E. (2010). Was the wealth of nations determined in 1000 BC?. *American Economic Journal: Macroeconomics*, *2*(3), 65-97.

Currie, J., & Neidell, M. (2005). Air pollution and infant health: what can we learn from California's recent experience? *The Quarterly Journal of Econom*ics, 120(3), 1003-1030.

Cust, J., & Harding, T. (2014). Institutions and the location of oil exploration. *Journal of the European Economic Association*

Cust, J., & Poelhekke, S., (2015). The local economic impacts of natural resource extraction. *Annu. Rev. Resour. Econ.*, *7*(1), 251-268.

Dell, M., & Olken, B. A., (2017). *The development effects of the extractive colonial economy: The Dutch cultivation system in Java* (No. w24009). National Bureau of Economic Research.

Elvidge, C. D., Baugh, K. E., Kihn, E. A., Kroehl, H. W., Davis, E. R., & Davis, C. W. (1997). Relation between satellite observed visible-near infrared emissions, population, economic activity and electric power consumption. *International Journal of Remote Sensing*, *18*(6), 1373-1379.

Engerman, S. L., & Sokoloff, K. L. (2002). *Factor endowments, inequality, and paths of development among new world economics* (No. w9259). National Bureau of Economic Research.

Fariss, C. J. (2014). Respect for human rights has improved over time: Modeling the changing standard of accountability. *American Political Science Review*, 108(2), 297-318

Findlay, R. (1992). The roots of divergence: Western economic history in comparative perspective. *The American economic review*, *82*(2), 158-161.

Francois, P., Rainer, I., & Trebbi, F. (2015). How is power shared in Africa?. *Econometrica*, *83*(2), 465-503.

Ghysels, E., & Hall, A. (1990). A test for structural stability of Euler conditions parameters estimated via the generalized method of moments estimator. *International Economic Review*, 355-364.
Good, D. F. (1994). The economic lag of Central and Eastern Europe: income estimates for the Habsburg successor states, 1870–1910. *The Journal of Economic History*, *54*(4), 869-891.
Guiso, L., Sapienza, P., & Zingales, L. (2006). Does culture affect economic outcomes?. *Journal of Economic perspectives*, *20*(2), 23-48.
Gylfason, T., (2001). Natural resources, education, and economic development. *Eur. Econ. Rev., 45* (4−6) pp. 847-859
Hall, A. R. (2000). Covariance matrix estimation and the power of the overidentifying restrictions test. *Econometrica, 68*(6), 1517-1527.
Hall, A. R. (2015). Econometricians have their moments: GMM at 32. *Economic Record, 91*, 1-24.
Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica: Journal of the Econometric Society*, 1029-1054.
Henderson, J. V., Storeygard, A., & Weil, D. N. (2012). Measuring economic growth from outer space. *American Economic Review*, *102*(2), 994-1028
Hirshleifer, J., (1991). The technology of conflict as an economic activity. *The American Economic Review, 81*(2), 130-134
Hirshleifer, J., (1995). Theorizing about conflict. *Handbook of defense economics*, *1*, 165-189.
Hoffman, P. T. (2012). Why was it Europeans who conquered the world?. *The Journal of Economic History*, *72*(3), 601-633.
Hoffman, P. T. (2017). *Why did Europe conquer the world?*(Vol. 54). Princeton University Press.
Iyer, L. (2010). Direct versus indirect colonial rule in India: Long-term consequences. *The Review of Economics and Statistics*, *92*(4), 693-713.
La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2008). The economic consequences of legal origins. *Journal of economic literature*, *46*(2), 285-332.
La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1997). Legal determinants of external finance. *The journal of finance*, *52*(3), 1131-1150.
Lange, M., & Dawson, A. (2009). Dividing and ruling the world? A statistical test of the effects of colonialism on postcolonial civil violence. *Social Forces*, *88*(2), 785-817.
McCleary, R. M., & Barro, R. J. (2006). Religion and economy.*Journal of Economic perspectives*, *20*(2), 49-72.
Mehlum, H., Moene, K., & Torvik, R., (2006). Institutions and the resource curse. *The Economic Journal*, *116*(508), 1-20.
Migge, B., & Léglise, I. (2008). Language and colonialism: Applied linguistics in the context of creole communities. In *Hellinger, A. and Pauwels, P.(eds.). Handbook of Language and Communication: Diversity and Change*. De Gruyter
North, D. C. (1986). The new institutional economics. *Journal of Institutional and Theoretical Economics (JITE)/Zeitschrift für die gesamte Staatswissenschaft*, *142*(1), 230-237.
North, D. C. (1991). Institutions. *Journal of Economic Perspectives*, *5*(1), 97-112.
North, D. C. (1992). *Transaction costs, institutions, and economic performance* (pp. 13-15). San Francisco, CA: ICS Press.
Phillipson, R. (1992). Linguistic imperialism. *The Encyclopedia of Applied Linguistics*, 1-7.
Pinkovskiy, M., & Sala-i-Martin, X. (2016). Lights, camera… income! Illuminating the national accounts-household surveys debate. *The Quarterly Journal of Economics*, *131*(2), 579-631.
Price, G. N. (2003). Economic Growth in a Cross-section of Nonindustrial Countries: Does Colonial Heritage Matter for Africa?. *Review of Development Economics*, *7*(3), 478-495.

Steckel, R. H., & Rose, J. C. (Eds.). (2002). *The backbone of history: health and nutrition in the Western Hemisphere* (Vol. 2). Cambridge University Press

Tabellini, G. (2010). Culture and institutions: economic development in the regions of Europe. *Journal of the European Economic Association*, *8*(4), 677-716.

Tadei, F., (2013). Extractive institutions and gains from trade: Evidence from colonial Africa. *IGIER Wor ing Paper*, (536).

Tornell, A., & Lane, P. R., (1999). The voracity effect. *American Economic Review*, *89*(1), 22-46.

Torvik, R., (2002). Natural resources, rent-seeking and welfare. *Journal of Development Economics*, *67*(2), 455-470.

Van der Ploeg, F., & Poelhekke, S. (2017). The impact of natural resources: Survey of recent quantitative evidence. *The Journal of Development Studies*, *53*(2), 205-216.

Van Reenen, J. (1996). The creation and capture of rents: wages and innovation in a panel of UK companies. *The Quarterly Journal of Economics*, *111*(1), 195-226.

Waldmann, R. J. (1992). Income distribution and infant mortality. *The Quarterly Journal of Economics*, *107*(4), 1283-1302

Wigley, S. (2017). The resource curse and child mortality, 1961–2011. *Social Science & Medicine*, *176*, 142-148

Wooldridge, J. M. (2001). Applications of generalized method of moments estimation. *Journal of Economic perspectives*,*15*(4), 87-100.