Barcelona School of Economics

Master in Specialized Economic Analysis – International Trade, Finance and Development

"A Blessing or a Curse: Oil Dependence and Human Capital in Nigeria"

Sarah Burkinshaw, Judith Indalecio González, Jana Silberring, Gregory Simkins

Fernando Broner, Ruben Durante

June 11, 2022

ABSTRACT IN ENGLISH (100 words):

Using all four waves of the Nigerian General Household Survey between 2011-2019, we implement a panel data model to investigate oil dependence and household human capital investment. We also supplement our analysis with a dynamic difference-in-differences event study of the 2014 global oil price shock. Our results find a strong relationship between changes in the global oil price and household school enrollment in Nigeria. Moreover, we find this effect is stronger for poorer households. Our study contributes to the within-country resource dependence literature and is one of the first to focus on Nigeria.

ABSTRACT IN CATALAN/ SPANISH (100 words)

Utilizando la Encuesta General de Hogares de Nigeria entre 2011 y 2019, implementamos un modelo panel para investigar la dependencia del petróleo y la inversión de los hogares en capital humano. Además, complementamos nuestro análisis con un estudio dinámico de Diferencias en Diferencias del choque mundial del precio del petróleo en 2014. Nuestros resultados muestran una fuerte relación entre la fluctuación mundial del precio del petróleo y la matriculación en las escuelas, especialmente en los hogares más pobres. Nuestro estudio contribuye a la literatura sobre la maldición de los recursos y es uno de los primeros en centrarse en Nigeria.

KEYWORDS IN ENGLISH (3):

Resource curse
School enrollment
Nigeria

KEYWORDS IN CATALAN/ SPANISH (3):

Maldición de los recursos
Matriculación escolar
Nigeria

A Blessing or a Curse: Oil Dependence and Human Capital in Nigeria *

Sarah Burkinshaw, Judith Indalecio González,
Jana Silberring, Gregory Simkins

June 11, 2022

Abstract

Using all four waves of the Nigerian General Household Survey between 2011-2019, we implement a panel data model to investigate oil dependence and household human capital investment. We also supplement our analysis with a dynamic difference-in-differences event study of the 2014 global oil price shock. Our results find a strong relationship between household school enrollment and changes in the global oil price. Our analysis shows that a one standard deviation increase in the oil price reducing the share of enrolled children by 4.4 percentage points. Moreover, we find this effect is stronger for poorer households. Our study contributes to the within-country resource dependence literature, and is one of the first to focus specifically on Nigeria. We hope our findings provide further impetus for policy makers in Nigeria to address the negative consequences of oil dependence on human development.

*We thank our advisors Fernando Broner, Ruben Durante, and Maria Ptashkina for their invaluable advice and help. We would also like to thank Arinze Nwokolo for providing us with Nigerian data on oil production.

Contents

List of Tables

List of Figures

1 Introduction

Oil resources generate substantial amounts of income for oil-exporting countries. However, when a country becomes over-reliant on oil, it can lead to a phenomenon known as the "resource curse". This can reduce growth, as well as lead to economic inequality, conflict, corruption, and authoritarianism (Ross 2015).[1] Moreover, recent research has found that resource dependence can have adverse effects on the instrumental components of development, such as education and health (Mousavi and Clark 2021).

Our research question examines whether oil price volatility affects household human capital investment in Nigeria. We primarily focus on the volatility of the oil price as a key mechanism in destabilising household human capital investment decisions. We focus on human capital for three reasons. First, it is a key ingredient for economic growth. Second, several studies show that education can bring a host of social benefits such as greater social cohesion and engagement in democracy (World Bank 2018). Moreover, given the fast growing and young population in Nigeria, education is crucial for the country's economic development.

Yet, Nigerian dependence on oil revenues leaves the country very vulnerable to oil price shocks which can distort incentives to invest in human capital (Badeeb, Lean, and Clark 2017). For example, Becker (1964) argues that education is an investment which weighs current costs and discounts future expected benefits. Therefore, individuals may decide to pursue education if the expected future gains are more significant than the current opportunity costs. For instance, during an oil boom, the opportunity cost of investing in education can increase and this may lead to under-investment in human capital. Moreover, at a more basic level, dependence on oil revenue on income and government transfers can result in large fluctuations in income when the oil price changes. This may also affect the ability of households to pursue education.

While oil is a large component of Nigeria's economy, the country only holds a small share of the world market and therefore cannot influence world oil prices. We use this exogeneity, alongside a novel dataset of oil production in Nigeria, to investigate the effects of the oil price on the school enrollment of households living in oil and non-oil producing Local Government Authorities (LGAs)[2]. To supplement our analysis, we also conduct an event study analysis of the 2014 oil price shock, when the price of a barrel of oil crashed by 56%, one of the three largest declines since World War II (Stocker et al. 2018).

Our main finding is that an increase in the oil price by one standard deviation leads to 4.4 percentage points lower average household school enrollment at the national level; however, we find that in oil producing LGAs, this effect is counterbalanced. Our results at the national level corroborate with other studies which find that commodity booms lead to reduced school participation in resource dependent countries (Mousavi and Clark 2021). We also find that this effect holds for all levels of school enrollment, including primary school. We supplement our analysis by breaking down the results by household income and gender.

[1]This is not inevitable. Countries such as Norway, Saudi Arabia, and Botswana have managed to develop with large resource endowments. Moreover, we focus on oil, but other commodities such as minerals, coffee, or diamonds have also been found to display resource curse effects (Di John 2011)

[2]LGAs are the administrative units of Nigeria below the state level. The 774 Local Government Authorities In Nigeria, are spread across 36 states, each are administered by a local government council.

Concerningly, we find that they are driven by the poorest households. Moreover, nationally, female household members experience a larger fall in school enrollment as a result of a rise in oil prices than males. However, girls in oil producing LGAs experience less volatility in school enrollment.

Our findings have important implications for Nigerian education policy. We argue that oil price volatility, should, a priori, have no effect on the educational participation of Nigerian citizens, in particular, for those of primary school age. Nevertheless, we find that this is the case, and that global oil price fluctuations have the largest effect on girls, as well as on poor households. Hence, we recommend these groups be a focus of policy, especially during global oil price shocks. In the long term, a policy of diversifying away from oil should also be enacted.

The remainder of the paper is structured as follows: Section 2 provides a brief background on oil and education in Nigeria, Section 3 reviews the existing literature on the resource curse, Section 4 presents our data and summary statistics, Section 5 outlines our empirical strategy, and Section 6 presents our results. Finally, in Section 7, we conclude with a brief discussion and policy recommendations.

2 Background

In this section we provide a brief overview of the history of oil in Nigeria and its importance to the Nigerian economy. Also, to motivate our focus on household participation in education, we discuss the current situation regarding education in Nigeria.

2.1 Oil in Nigeria

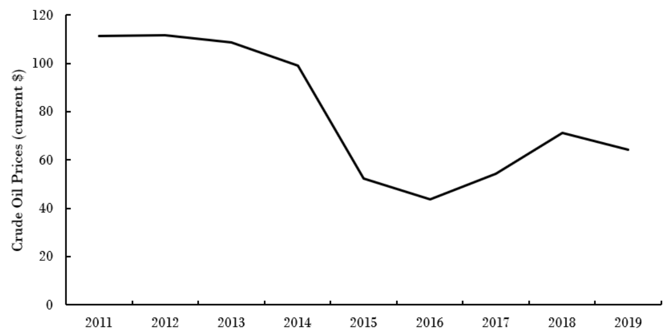
After nearly half a century of exploration, oil was first discovered at Oloibiri in the Niger Delta in 1956. Since this first discovery, the Nigerian economy has become heavily dependent on oil with the country establishing over 500 oil fields, of which 193 are producing in 2020. (NNPC 2020b; OPEC 2022). As of writing, Nigeria is the leading oil producing country in Africa, with estimated production reaching over 644 million barrels in 2020 (NNPC 2020a). The grip of oil revenue on the finances of the country is striking. In 2021 it accounted for over 86% of exports, half of government revenues, a third of banking sector credit, and 10% of GDP (World Bank 2022b). This has made Nigeria a text-book example of a country highly susceptible to the resource curse.

The World Bank highlights oil dependency and a lack of economic diversification as two of Nigeria's main development challenges (World Bank 2022b). The development statistics are dire, in 2018, 40% of Nigerians (83 million people) lived below the poverty line, while an additional 25% were vulnerable. Following the COVID-19 pandemic, Nigeria experienced its deepest recession in two decades, largely due to the decline in global oil prices. Moreover, oil revenues have led to widespread corruption which can be attributed to a system characterized by weak political institutional arrangements and a lack of effective restraints to guarantee the accountability of politicians and bureaucrats, both within the Niger Delta and the central government (Obi and Rustad 2011).

2.2 The 2014 Oil Price Shock

Between mid-2014 and early 2016, the world economy experienced one of the largest oil price drops in recent history. Figure 1 shows price stability at around 100 USD per barrel between 2011 and 2014, with historically high prices, followed by a steep and sudden drop to a 15 year low at around 40 USD per barrel. From peak to trough the total decline reached 60%. The oil price recovered slightly in 2017 to 2019, returning to around 70 USD.

Figure 1: Crude Oil Prices 2011-2019



Source: Our World in Data (2020)

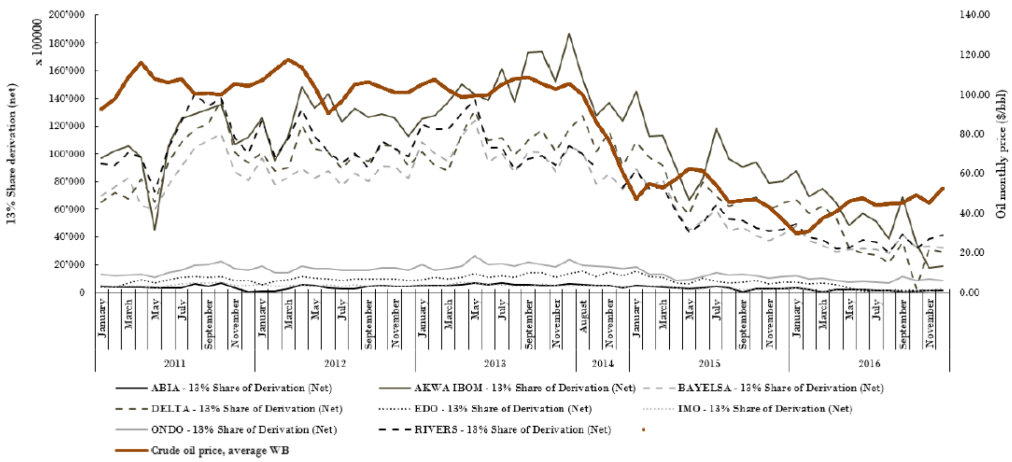
This shock had a disastrous impact on Nigeria. In its aftermath, the economy was pushed into a recession and Nigeria had a major budgetary crisis at the national and state levels (Stocker et al. 2018). The impact of the shock also had several spill-overs into non-oil sectors. GDP decelerated from 6.3% growth in 2014 to -1.6% in 2016.

We conducted our own analysis of this crisis' impact on Nigeria by compiling data on oil revenue allocation.[3] Figure 2 below displays how the 13% oil revenue deviation for oil producing states experienced a huge decline in 2014, contributing to the budgetary crisis.[4]

[3]We digitized the disbursement reports published by the National Bureau of Statistics for all the months available between 2011 and 2016.

[4]Under the current oil revenue sharing formula, the budgeted oil revenue goes to the Federation Account and Allocation Committee (FAAC), which then distributes 52.68% of revenues to the federal government, 26.72% to the states, and 20.60% to the LGAs. The horizontal revenue sharing formula for states and LGAs are based on weights that depend on factors such as population, social development, and equality of units. A minimum of 13% oil revenue must be reserved for oil producing states (Haysom and Kane 2009).

Figure 2: FAAC Redistribution (13% share)



Source: National Bureau of Statistics - Nigeria (2021) and World Bank (2022a)

2.3 Education in Nigeria

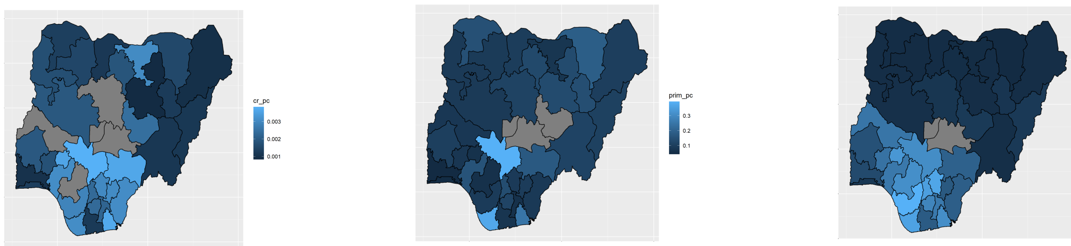
Nigeria has a very youthful and fast growing population. For example, it currently accounts for 20% of Sub-Saharan Africa's (SSA) population and is projected to be the 3rd most populous country in the world by 2040. Therefore, human capital has immense potential, and is also of critical importance to the development of the Nigerian economy (World Bank 2018). However, the country is failing to reach it's education goals.

For example, primary school education, which runs from the ages of six to eleven, is free and compulsory in Nigeria, however, roughly 10.5 million of the country's children aged 5-14 years are not in school - making it one of the worst performing countries in the world for out-of-school children. Furthermore, for the children that do progress to secondary school, many are not able to complete their education. For example, the completion rate for adolescents of lower-secondary school is 62.6%, and for upper-secondary education is even worse at 49.2%. The poor completion rate is evidenced in the final examinations to enter tertiary education. In order to progress to the tertiary level, students must pass the senior-school certificate examination prepared by the West African Examination Council and the National Examination Council, but only 34-43% of eligible students sat the senior-school certificate examinations from 2013-2016, with an 8% female gender gap (National Bureau of Statistics - Nigeria 2017; UNICEF 2018).

Furthermore, there is regional disparity in education within Nigeria, as Figure 3 below visualizes. Unfortunately, data is very scarce at the state level and therefore we are constrained to data for 2009 only. Nonetheless, we combine data on the number of classrooms, primary enrolled pupils, and university applications with the latest available population estimates for each state (National Bureau of Statistics 2014). Hence, we see how these metrics are distributed on a per capita basis across Nigerian states.

We find that there is a clear geographic imbalance between the Northern regions of Nigeria and the Southern (oil producing) regions in terms of the number of university appli-

Figure 3: Education Overview of Nigeria



(a) Classrooms p.c. (b) Primary School Students p.c. (c) University Applications p.c.

cations. However, we do not find the same degree of polarity when it comes to the supply of classrooms or the number of primary school students. Our empirical models shed more light on the role of oil production and oil prices in driving these geographical disparities.

3 Literature Review

The literature on the economic consequences of natural resource endowments is vast. However, following a recent survey of the literature by Mousavi and Clark (2021), we identify our paper as fitting within a strand of the literature concerned with the effects of sub-national resource dependence on educational participation. Nonetheless, since many of the consequences of national resource dependence are believed to filter to the sub-national level, we begin this literature review with a brief account of the history and current consensus on the resource curse in general, before turning to cross country and micro-level studies of the resource curse and human capital.

3.1 The Resource Curse

The role of natural resources in the context of economic development has long been recognised in the history of economic thought. For example, Smith (1776) understood the importance of natural capital in the process of economic growth. Many years later, scholars such as Rostow (1959) highlighted the central role of natural resources in the growth take-off process. This view is held by Pomeranz (2000), who argued that British coal resources were a key factor in facilitating the Industrial Revolution in the North-East of England, and therefore were a central reason behind the "The Great Divergence" between Europe and China.

However, beginning in the 1990s, researchers began to question the benefits of natural resources for economic growth. The term "resource curse" was first coined by Auty (1994), who found that abundant resources tended to harm economic growth. Furthermore, dependency theory, drawing on work conducted by Prebisch (1962), explained how the terms of trade of primary commodities tended to deteriorate relative to manufacturing over time - leaving exporters of commodities worse off.

Yet, the seminal contribution in the field came from Sachs and Warner (1995). Using a cross-country panel of 97 countries, they found that resource dependence - measured by primary exports as a share of total exports in 1970 - was negatively correlated with subsequent economic growth in the years 1970-1989. This result is robust to several measures of resource dependence and controlling for determinants of economic growth such as openness and institutional quality. Gylfason, Herbertsson, and Zoega (1999) found similar evidence with a larger cross-country sample. Using the percentage of the labor force in the primary sector, they find a strong negative effect of resource dependence on growth. For example, they find that if the share of primary sector employment in total employment increases from 5% to 30%, per capita output growth drops by about 0.5% per annum, ceteris paribus.

However, in recent years, the literature has moved towards within-country analysis of the impact of resource dependence, alongside pivoting towards an understanding of how resource dependence affects the instrumental components of development, such as education and health.

3.2 The Resource Curse and Human Capital

The role of human capital in economic development is well known to be pivotal. Several studies have found how human capital differences are a key factor in the cross-country differences in development rates (Valencia Caicedo 2019; Mankiw, Romer, and Weil 1992; Glaeser et al. 2004). However, the relationship between resource dependence and human capital is less studied. The paper by Gylfason (2001) uses a cross-country sample of 65 countries in 1994 to examine the effects of natural capital dependence on human education inputs, outputs, and participation measures. They find an increase in natural capital's share in output is negatively associated with secondary school enrollment rates.

Turning to the sub-national resource curse literature, other than Nwokolo (2022),we are not aware of any published paper which specifically studies this in the context of Nigeria. However, researchers have tended to find negative effects of resource dependence on human capital at the sub-national level. For example, Santos (2014) studies the impact of a gold boom on school attendance and child labor in Colombia. He finds that a gold boom is associated with a decrease in school attendance by 0.2 standard deviations. He argues that the main driver of this effect comes from the increased opportunity cost of school attendance in times of a boom - which makes it more profitable to send children to work in mines.

Similarly, Zhan, Duan, and Zeng (2015) exploit within-country heterogeneity in resource abundance using a panel data set of 31 Chinese provinces between 1999 and 2009. They focus on public provision of human capital and healthcare goods rather than household participation. Nonetheless, they find that resource dependence negatively affects local public expenditures on education and health care. They supplement their analysis using five case studies of mining areas in China and find evidence of a crowding out effect of primary manufacturing. They also find that labor demand is lower in these areas since the mining industry employs fewer and less skilled workers. These effects are exacerbated during boom times. Kruger (2007), studying coffee production in Brazil, also shows that in periods of commodity booms, the education of the poor and middle-income children is adversely affected, and that this effect is most pronounced on children in poorer households.

Turning to the U.S., research by Cascio and Narayan (2022) has shown that the fracking industry led to an increase in high school dropout rates. They argue this is driven by a reduction in the wage premium for higher education as the fracking industry favored the employment of low-skill workers. Kumar (2015) also finds that the oil boom in Texas resulted in lower college enrollment in the cohort experiencing the boom compared to previous cohorts. Again, the central mechanism being the improved job opportunities resulting from the oil boom, which drives up the opportunity cost of education and also potentially reduces the college wage premium.

3.3 Contribution to the Literature

We contribute to the literature concerning the resource curse in several ways. Firstly, we find additional support for the existence of a national resource curse, which builds on a historical literature finding several negative effects of oil dependence on development. Secondly, we contribute to a the new and growing literature concerning the within-country resource curse. For example, we are only aware of one study which exploits the geographical heterogeneity of oil production within Nigeria to analyse development (Nwokolo 2022), and we are the first to analyse this specifically for household education. Finally, we also contribute to a small sub-literature on the impacts of the 2014 oil price shock.

4 Data

We use data from two main sources. First, we use the Nigerian General Household Survey (NGHS) from the World Bank to construct our measures of school enrollment rates and household characteristics (Nigeria National Bureau of Statistics 2011; NNBS 2013; NNBS 2016; NNBS 2019). Second, we use data collected by Nwokolo (2022), which identifies oil production in Nigeria at the LGA level. We also use data on oil prices and our own analysis of state allocations of oil revenue from government reports (see Section 2).

4.1 Oil Production

To determine whether households live in oil producing areas, we use a novel and recently constructed data set by Nwokolo (2022). This data set provides the number of oil wells and total oil production in each LGA between 1998 and 2016.[5] We define an oil producing LGA as one which produced oil in any of the years of the NGHS, between 2011 and 2019.[6] Figure 4 shows the geographical location of oil production at the state level.[7]

[5]The data is based on the annual reports that provide firm-level information from the Nigerian National Petroleum Corporation (NNPC). As a secondary source, Nwkolo uses reports of oil firms as well as concession maps.

[6]We test this definition in our robustness section 6.4 and find that our results remain consistent to alternative definitions. Unfortunately, we do not have oil production data for the survey year 2018-19, so we miss LGAs which only began producing in 2019. However, our research of news articles show no new oil fields beginning production in 2019 (Nigerian Neopedia 2019).

[7]We define an oil producing state as a state with at least one LGA that produced oil between 2011 and 2016.

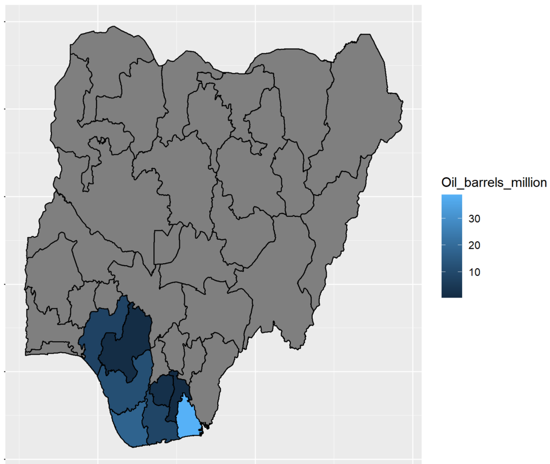


Figure 4: Location of Oil Production in Nigeria

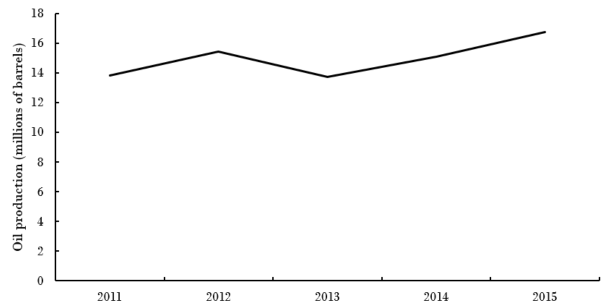


Figure 5: Volume of Oil Production in Nigeria

Nigeria mainly produces oil in the Niger Delta region, located in the southern tip of the country. We identify 8 states producing oil out of a total of 36 states. Akwa Ibom, shown as the state in light blue, is the most intensive oil producing region of Nigeria between 2010 and 2015, with an average production level of 39 million barrels a year. The least intensive states are Edo and Abia, with an average production of 0.8 million barrels and 0.2 million barrels per year, respectively.[8]

Figure 5 shows oil production in each year across Nigeria as a whole. We find that oil production has risen fairly steadily during the years of the survey.[9]

4.2 Oil Price

Our panel data model also uses the price of oil as an explanatory variable and an interaction term in the determination of household school enrollment. Moreover, in Section 5.2 we conduct an event study which analyses the global oil price shock in 2014. We take the average annual crude oil price from Our World in Data (2020).

4.3 Nigeria General Household Survey

Our household data comes from the Nigeria General Household Survey (NGHS), a panel-data survey conducted by the World Bank in collaboration with the Nigerian Government. We have four waves of data: 2010-2011, 2012-2013, 2015-2016 and 2018-2019.[10] Each wave of the survey was conducted twice, during the post-planting period and during the post-harvest period. In our analysis, we use the post-harvest surveys, which, unlike the post-planting surveys, include questions on education for each individual in the household.

The survey also includes a detailed roster section which gathers general information on the household characteristics. We use this to construct control variables in our empirical

[8] See Appendix 9 for a map of oil producing LGAs analogous to Figure 4.1. This shows an identical story, all oil producing LGAs are located in the Niger Delta and the most intensive is located in Akwa Ibom.

[9] Our data source on oil production contains unreliable figures for 2016, so we omit these.

[10] The GHS has a sample of 5000 households, in 581 LGAs. The attrition rate from 2010 to 2019 was only 8.3% but was concentrated in some zones (19.5% in North East, 14% in South West).

analysis. We also included geographical controls such as annual precipitation and land work-ability which are taken from a separate geo-variable section of the survey.

4.3.1 Education Variables

Section 2 of the NGHS asks several questions about the educational participation of household members. Using this data, we construct four main dependent variables for our analysis. Each of these captures the share of eligible household members enrolled in different educational bands: primary school, secondary school, and further education, as well as overall enrollment of school-aged children. These variables proxy for household human capital investment. We also use household reported annual expenditure on education to test our findings.

The shares are calculated by dividing the number of household members enrolled in the given education tier by the total number of household members eligible for that tier of education. For example, if a household contains five children of primary school age (6 - 11 years old), and two of those children are enrolled in primary school, then the enrollment share would be 40%. For secondary school education, we look at the share of members between the ages of 12-17. For further education, we define all household members between the age of 18 and 65 as being eligible for further education.[11]

Table 1 below shows the summary statistics for each of the education variables we use in our analysis. We split these variables by non-oil and oil producing LGAs and use the sample average across the time periods. We find that enrollment is highest for primary school at 88% in non-oil producing LGAs and 97% in oil producing LGAs. We also find that households in oil producing LGAs send a slightly higher proportion of eligible household members to secondary school and into further education.

The largest difference between non-oil and oil producing LGAs can clearly be seen in the average annual expenditure on education. We find significantly higher expenditure by households in oil producing LGAs with a figure close to 54,000 Naira (around 130 USD).[12] This is over twice as large as the education expenditure of households in non-oil producing LGAs.

Table 1: Summary Statistics - Education

Variable	N	Mean	SD	Variable	N	Mean	SD	Min	Max
LGA: Non-oil									
Primary school children enrolled (%)	8830	0.88	0.3	Education Expenditure (1000s Naira)	18196	21.31	61.71	0	2445.81
Secondary school children enrolled (%)	7838	0.83	0.35						
Household members in further education (%)	14950	0.11	0.23						
LGA: Oil									
Primary school children enrolled (%)	2756	0.97	0.14	Education Expenditure (1000s Naira)	6047	53.71	121.07	0	1630.54
Secondary school children enrolled (%)	2745	0.93	0.23						
Household members in further education (%)	5438	0.13	0.24						

[11]For many individuals, the specific question "Is [NAME] presently in school?" was marked as missing, however, for the same individual "In what level is [NAME] enrolled this year?" the member specified being enrolled in a given school a level of schooling or alternatively, in a separate question "Why is [NAME] not currently in school?" they marked a reason why they were not enrolled in school. We treated those individuals as enrolled and not enrolled respectively.

[12]We adjust all currency variables in our analysis to real figures.

4.3.2 Control Variables

We include several controls in our empirical model to capture household and local geographic characteristics which are likely to affect school enrollment rates. We construct these variables from various sections of the NGHS.

Table 2 below shows the descriptive statistics for households on average across the four survey waves. We display each of the variables for non-oil and oil producing LGAs. We include total household consumption in thousands of Naira, which we use to proxy for the households income. We also measure a number of household characteristics such a household size, dependency ratio, and education level of the household head.

Table 2: Summary Statistics - Control Variables

Variable	N	Mean	SD	Min	Max	Variable	Count	Percent
				LGA: Non-oil				
Household Consumption (1000s of Naira)	18196	384.05	509.44	18.58	39786.35	Ownership Status	18354	
Household Size	18299	4.98	2.91	0	31	No		29%
Number of Children	16195	1.81	1.8	0	19	Yes		71%
Share in Employment	17509	0.65	0.34	0	1	Location	18317	
Dependency Ratio	18299	0.2	0.21	0	1	Urban		32%
Age of Head	18209	51.03	15.23	0	130	Rural		68%
Gender of Head	18297					Workability of Land	18578	
Male		83%				... Not Workable		1%
Female		17%				... No or Slight Constraint		61%
Education of Head	18298					... Moderate Constraint		32%
Non-Literate		3%				... Severe Contraint		6%
Literate		73%				Annual Precipitation (1000s mm)	18578	1.4
School-Educated		19%						
Degree-Educated		5%						
				LGA: Oil				
Household Consumption (1000s of Naira)	6047	573.26	435.96	47.32	5047.23	Ownership Status	6124	
Household Size	6155	4.78	2.52	1	15	No		46%
Number of Children	5701	1.55	1.54	0	7	Yes		54%
Share in Employment	5962	0.63	0.34	0	1	Location	6157	
Dependency Ratio	6155	0.15	0.19	0	1	Urban		29%
Age of Head	6106	50.92	14.76	16	110	Rural		71%
Gender of Head	6148					Workability of Land	6157	
Male		73%				... Not Workable		12%
Female		27%				... No or Slight Constraint		75%
Education of Head	6155					... Moderate Constraint		6%
Non-Literate		3%				... Severe Contraint		7%
Literate		60%				Annual Precipitation (1000s mm) and	6157	2.67
School-Educated		27%						
Degree-Educated		11%						

Households in oil and non-oil LGAs are very similar in terms of general household characteristics such as the age of the head, household size, the dependency ratio and the share of members employed. However, households in oil producing LGAs tend to have higher consumption with a mean of 573,000 Naira (1,378 in USD) compared to 384,000 (923 in USD) in non-oil producing LGAs. Moreover, they also tend to have a higher educated household heads. For example, 5% of household heads in non-oil producing LGAs have a degree compared to 11% in oil LGAs. Furthermore, we also find that households in oil producing LGAs tend to have a higher percentage of female heads.

In regards to land work-ability, there is a striking difference between oil producing LGAs and non-oil producing LGAs in terms of the proportion of non-workable land. We find 12% of households are located in areas with non-workable land in oil LGAs compared to 1% in non-oil producing LGAs. Although, overall land-work-ability seems to be fairly similar.

To supplement our analysis, we also investigate the reasons why individuals did not enroll in school in 2013 and 2016. For brevity, we include the data table in the Appendix (Table A1). In general, there is no noticeable difference between the oil and non-oil producing regions. However, we do find overwhelming evidence suggesting reasons for not enrolling are driven by demand-side variables.[13]

Moreover, in Table A2 we analyse a breakdown of education expenditure across different components. We find that households in oil producing LGAs tend to spend substantially more on education costs, in particular, on school fees. This could be stemming from the higher average level of consumption in these areas.

5 Empirical Strategy

We run two main empirical strategies. The first is a panel data model with time periods. We exploit the fact that the oil price is exogenous to Nigeria, given that Nigeria is too small of a producer of oil to impact the price. We also conduct an event study analysis around the negative oil price shock of 2014, where we compare outcomes for households in oil and non-oil producing LGAs before and after the shock.

5.1 Panel Data Model

Our panel data model captures the effect of local oil production and oil price volatility on household school enrollment decisions. In contrast to the event study, the panel data analysis is useful to analyse both what happens when the oil price increases as well as decreases.

Compared to the rest of the world, Nigeria produced 6.76% of the world crude oil production. In 2016, this share had decreased to 4.06% (OPEC 2022). Given these small shares, we can assume that changes in oil prices are exogenous to our dependent variable, since an increase or decrease in Nigeria's oil production would not affect the world supply enough to change prices.

We estimate household-level panel regressions of the following specification:

$$Y_{ijt} = \alpha + \beta_1(Oil_j \times OilPrice_t) + \beta_2 X'_{ijt} + \delta_j + \gamma_t OilPrice_t + u_{ijt} \tag{1}$$

Our dependent variable Y_{ijt} is the school enrollment in household i, LGA j and year t. $Oil_j \times OilPrice_t$ captures the interaction between the oil production of LGAs and the oil price. Our main coefficient of interest is therefore β_1. X_{ijt} is a vector of household covariates, including total real consumption, the ratio of dependents, the age, sex and education of the household head, and whether the household owns their dwelling. We also include agricultural geovariables, specifically the workability of the land and the annual precipitation.

We also control for LGA fixed effects (δ_j). We use the oil price to control for year fixed effects, since we use a constant average oil price for the year. The change in the oil price

[13] This includes reasons such as "No time or interest" or "Lack of money".

is common to all households in Nigeria, and therefore, this term fully captures year fixed effects. Finally, our error term u_{ijt} is clustered at the LGA level.

5.2 Event Study

In 2014, there was a very clear drop in the oil price (Figure 1). In order to analyse the oil price shock, we use the difference-in-difference framework. In the first analysis, we create a dummy that is 1 if the time period is after the oil price shock in 2014. We run the following regression:

$$Y_{ijt} = \alpha + \beta(Post_t \times Oil_j) + \eta X_{ijt} + \delta_j + \gamma_t + u_{ijt} \tag{2}$$

Y_{ijt} is the share of school enrollment of household i in LGA j in year t. Oil_j is a dummy that is equal to 1 if the household lives in an LGA that is oil producing and $Post_t$ is a dummy equal to 1 if the time period is after the oil price shock and 0 otherwise. The same vector of control variables X_{ijt} are used as in the panel analysis. We include LGA and year fixed effects. The standard errors are clustered at the LGA level.

In a second step, we implement a dynamic difference-in-difference analysis to assess in detail how school enrollment is affected in each of the years.

The relevant regression equation is specified as follows:

$$Y_{ijt} = \alpha + \beta_{-3}(t_{-3t} \times Oil_j) + \beta_{+2}(t_{+2t} \times Oil_j) + \beta_{+5}(t_{+5t} \times Oil_j) + \eta X_{ijt} + \delta_j + \gamma_t + u_{ijt} \tag{3}$$

Where again Y_{ijt} is our dependent variable of the share of school enrollment and Oil_j is a dummy equal to 1 if the LGA produces oil and 0 otherwise. t_{-3t}, t_{+2t}, and t_{+5t} are dummies equal to 1 if the year is 2011, 2013 and 2015 respectively. The β's are the coefficients of the interaction terms between the oil dummy and the time to treatment dummy, which are measured in the difference of the years compared to 2014. We also include LGA and year fixed effects and cluster the standard errors at the LGA level. The base year is 2013. Therefore, we measure the effects in comparison to the share of enrollment in 2013.

In order to correctly measure the effect of the oil price shock, the parallel trend assumption must hold. To analyze this, the interaction term between the year dummy for 2011 and the oil LGA dummy should be statistically insignificant. This will mean that we cannot reject the Null-Hypothesis that β_{-3} is statistically different from zero and therefore there is no difference in the trend of the treatment and control group between 2011 and 2013. While an insignificant coefficient does not fully prove the parallel trend assumption, it supports it. Additionally, we compare the oil LGAs with the non-oil LGAs pre-treatment to see if they differ in relevant characteristics.

6 Results

6.1 Baseline Results

6.1.1 Panel Data Model

Table 3 reports the result of our baseline panel data model. A rise in the oil price reduces school enrollment in all regions, with a one standard deviation increase (approx. 28 USD) in the oil price reducing the share of enrolled children by 4.4 percentage points. This is a sizeable effect, and it holds for both younger (6 to 11 years old), and older children (12 to 17 years old). We also find a statistically significant positive coefficient on the oil price and oil LGA interaction term. This captures the heterogeneity in the oil price effect between oil and non-oil producing LGAs. We find that an increase in the oil price by one standard deviation increases school enrollment by 4.5 percentage points in oil producing LGAs compared to non-oil producing LGAs. Adding the two coefficients together, overall, oil producing LGAs exhibit a small increase in school enrollment when the oil price rises.

In summary, this analysis finds that, while the oil price has a negative effect nationally on school enrollment, it is the non-oil producing LGAs that are most affected.

Table 3: Regression Results - School Enrollment

	Dependent variable:			
	Under 18	6 to 11	12 to 17	18 to 65
	(1)	(2)	(3)	(4)
Oil price	-0.044***	-0.057***	-0.027***	-0.011***
	(0.005)	(0.005)	(0.006)	(0.002)
Oil LGA*Oil price	0.045***	0.061***	0.029**	0.019**
	(0.009)	(0.009)	(0.012)	(0.009)
Fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	14,878	11,478	10,471	20,096
R^2	0.030	0.052	0.011	0.069
Adjusted R^2	-0.008	0.003	-0.045	0.041
Note:	*p<0.1; **p<0.05; ***p<0.01			

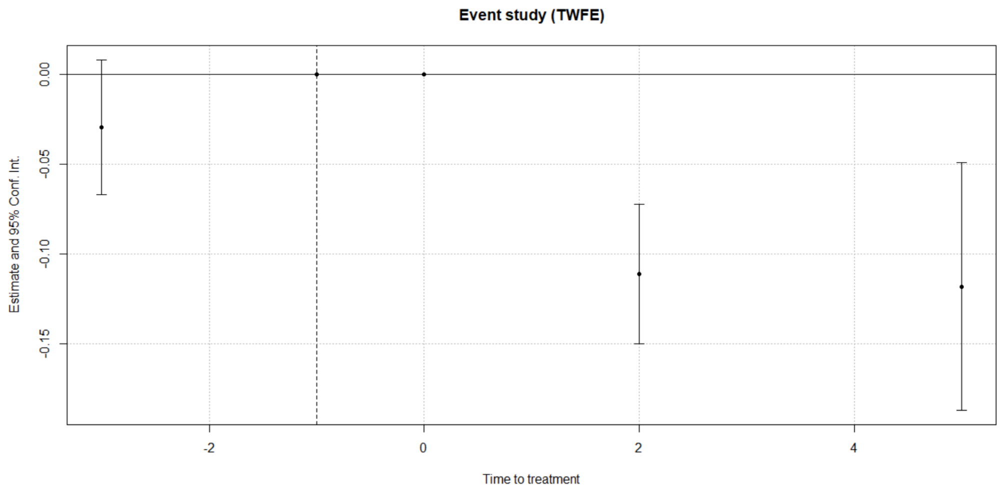
The sample is restricted to households with at least one child of the appropriate age, and standard errors are clustered at the LGA level. The variable "Oil price" is standardized. For a full table with all the controls, see Table B1

6.1.2 Event Study

We now move to a more explicit examination of the large negative oil price shock of 2014. Analyzing the results of the two periods difference-in-difference analysis, we can see that the interaction term has a statistically significant negative coefficient. Therefore, the oil price shock in 2014 decreased average household school enrollment by 10 percentage points compared to non-oil producing LGAs (regression results can be found in the Appendix, Table B5 in column 1 and 2).

When analysing the event study of multiple time periods, it is visible in Figure 6 that school enrollment dropped significantly two years after the oil price shock in 2014 (Table B5, column 3 and 4). Specifically, school enrollment dropped by 11 percentage points from 2013 to 2016 in oil producing LGAs compared to non-oil producing LGAs. β_{-3} is statistically insignificant. Therefore, we have evidence that the parallel trend assumption holds.[14]

Figure 6: Dynamic Event Study



Note: The regression includes year and LGA fixed effects as well as a set of control variables. The base year is 2013 and time=0 refers to the year 2014 which is when the oil shock happened (see Appendix, Table B5).

The findings from our event study support the results from the panel data analysis, where we found a small increase in school enrollment in oil producing regions when the oil price increases. Since the drop in the oil price was around 60 USD between 2013 and 2016, the difference in the drop in school enrollment was substantial between oil and non-oil producing LGAs.

To conclude, oil producing and non-oil producing regions have opposite effects when the oil price changes. We find evidence that Nigeria is subjected to a national resource curse since a change in oil price affects school enrollment nationally. However, we find limited evidence for the sub-national resource curse since school enrollment is less affected by a change in oil price in oil producing regions. In order to better understand what drives the results, we will now analyze which households are most affected and explore possible channels.

6.2 Decomposition of Results

We test for household heterogeneity by income and gender to further understand who is most vulnerable to oil price volatility.

6.2.1 Panel Data Model

To analyse the effect of different household income, we run a triple interaction, interacting the dummy for oil production with both the oil price and dummies for consumption quartiles. We use consumption as a proxy for income because the income data from the household

[14]We compare the covariates of the two groups in 2013 pre-treatment to further analyse the difference between the two groups before the oil price shock (Table B8).

survey is unreliable. The lowest consumption quartile (CQ1) includes all households with real per capita consumption expenditure less than 43,030 Naira (about 104 USD), while the highest consumption quartile (CQ4) has consumption expenditure over 115,968 Naira (about 270 USD). The base category are the households in non-oil producing regions and in the first consumption quartile (CQ1). The results of the triple interaction can be interpreted as the difference in school enrollment between the top 3 consumption quartiles and the lowest quartile (Table 4).

When the oil price increases, the overall effect on enrollment for school-aged children is less negative for the richer households (CQ2-CQ4). The richest households have a 6.1 percentage point higher school enrollment compared to the poorest households. For oil producing regions, the positive effect of school enrollment appears to be coming from the lowest income households. The triple interaction shows that richer households in oil producing regions have a lower increase in school enrollment compared to the poorest households.

Therefore, we can conclude that the above found effects of the national resource curse is driven by the reactions of the poorer households. Again we can see the counteracting effect of oil vs. non-oil producing regions, and we show that richer households are less sensitive to the volatility of the oil price.

Table 4: Regression Results - School Enrollment by Consumption Quartiles

	Dependent variable:			
	Under 18	6 to 11	12 to 17	18 to 65
	(1)	(2)	(3)	(4)
Oil price	-0.073***	-0.094***	-0.036***	-0.021***
	(0.008)	(0.009)	(0.009)	(0.004)
Oil LGA*Oil price	0.118***	0.140***	0.050	0.015
	(0.036)	(0.035)	(0.043)	(0.015)
Oil price*CQ2	0.039***	0.051***	0.005	0.004
	(0.008)	(0.009)	(0.009)	(0.005)
Oil price*CQ3	0.063***	0.078***	0.030**	0.008
	(0.010)	(0.010)	(0.012)	(0.006)
Oil price*CQ4	0.061***	0.083***	0.023*	0.027***
	(0.010)	(0.010)	(0.013)	(0.007)
Oil LGA*Oil price*CQ2	-0.085**	-0.093***	0.003	0.027
	(0.039)	(0.031)	(0.042)	(0.025)
Oil LGA*Oil price*CQ3	-0.094***	-0.126***	-0.031	0.015
	(0.035)	(0.034)	(0.047)	(0.022)
Oil LGA*Oil price*CQ4	-0.129***	-0.134***	-0.068	-0.030
	(0.040)	(0.035)	(0.051)	(0.018)
Fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	14,878	11,478	10,471	20,096
R^2	0.034	0.066	0.012	0.037
Adjusted R^2	-0.005	0.016	-0.045	0.007
Note:		*p<0.1; **p<0.05; ***p<0.01		

The sample is restricted to households with at least one child of the appropriate age, and standard errors are clustered at the LGA level. The variable "Oil price" is standardized. Consumption quartiles: CQ1: 0-25 percentile, CQ2: 25-50, CQ3: 50-75, and CQ4: 75 to 100. The base category is CQ1.

We also decompose the effect by gender (Table 5). The negative effects on school enrollment from an increase in the oil price is larger for girls than it is for boys. Furthermore, the positive effect of living in an oil producing LGA compared to a non-oil producing LGA is lower for girls than boys. In fact, adding the interaction term and the oil price coefficient gives a negative impact for girls even in oil producing areas.

In contrast, boys in oil producing LGAs increase school enrollment when the oil price rises by 2.2 percentage points. As well, for adult further education, the effect of the oil price is non-significant in non-oil areas for boys, and positive in oil areas. Nevertheless, boys' school enrollment is more affected by the oil price in oil producing areas, hence it is more volatile.

Table 5: Regression Results - School enrollment by Gender

	Dependent variable:							
	Under 18, girls	Under 18, boys	6 to 11, girls	6 to 11, boys	12 to 17, girls	12 to 17, boys	18 to 65, girls	18 to 65, boys
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Oil price	-0.055***	-0.043***	-0.061***	-0.056***	-0.034***	-0.020***	-0.012***	-0.003
	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)	(0.006)	(0.003)	(0.003)
Oil LGA*Oil price	0.049***	0.065***	0.053***	0.066***	0.024	0.038**	0.019**	0.032**
	(0.010)	(0.010)	(0.013)	(0.009)	(0.016)	(0.015)	(0.008)	(0.014)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,213	11,855	7,205	7,720	6,320	6,954	17,521	16,984
R^2	0.034	0.025	0.056	0.045	0.015	0.013	0.038	0.090
Adjusted R^2	-0.018	-0.024	-0.023	-0.029	-0.078	-0.073	0.006	0.058

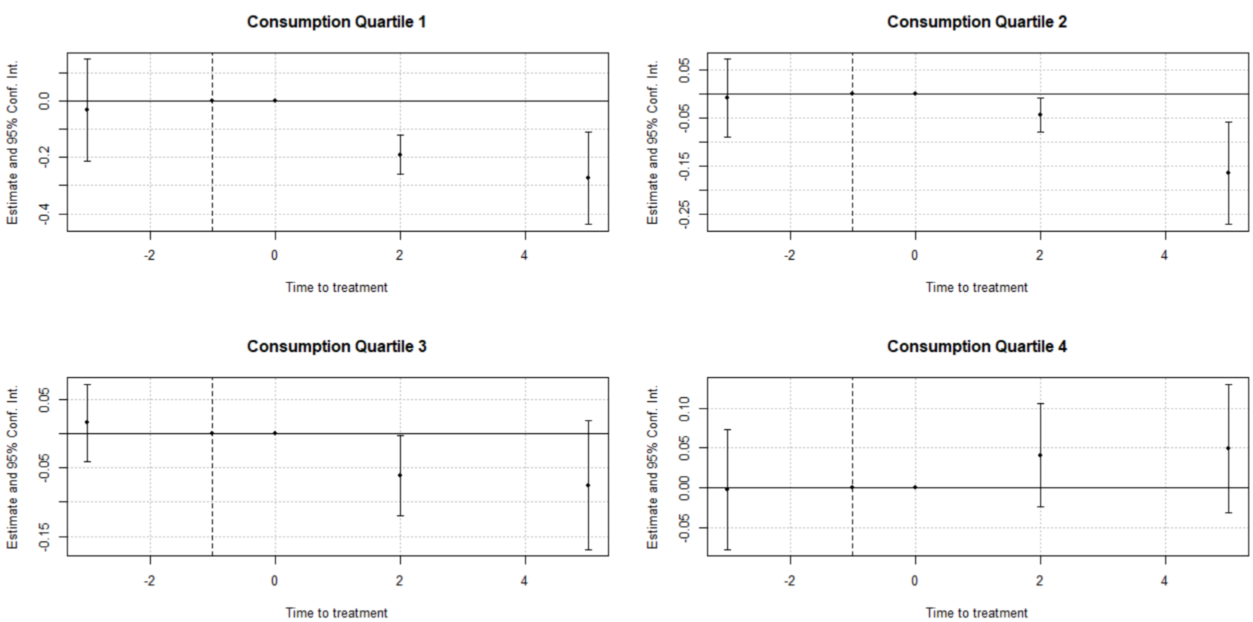
Note: *p<0.1; **p<0.05; ***p<0.01

The sample is restricted to households with at least one child of the appropriate age, and standard errors are clustered at the LGA level. The variable "Oil price" is standardized.

6.2.2 Event Study

Looking at the event study, we also split up the analysis for different consumption quartiles.

Figure 7: Dynamic Event Study by Consumption Quartile



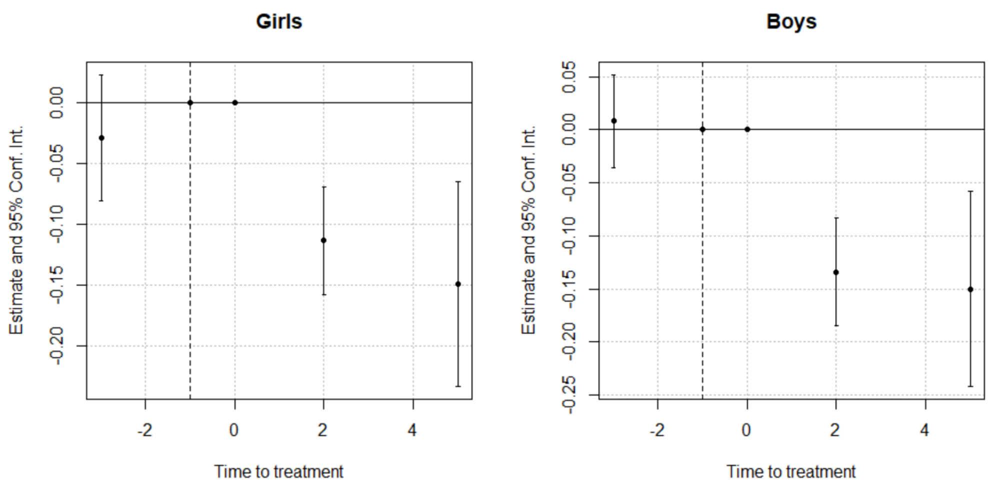
Note: All regressions include year and LGA fixed effects as well as a set of control variables. The base year is 2013 and time=0 refers to the year 2014 which is when the oil shock happened (see Appendix, Table B6).

From the results it is visible that the decrease in school enrollment following the 2014 price shock stems from the lower two consumption quartiles (Figure 7). The fourth quartile does not seem to be affected by the oil price shock at all, whereas the poorest households experience a clear drop in school enrollment in 2016 compared to 2013 (Table B6). The poorest households experience the sharpest decline. The enrollment share of households in the second lower consumption quartile also drops significantly but less than the first quartile (coefficients -0.19 for CQ1 vs. -0.04 for CQ2). The effect for the third quartile is -0.06, meaning that the share of kids enrolled in school drops by 6 percentage points in oil producing LGAs compared to 2013 non-oil producing LGAs.

The significance drops when moving from poorer to richer households since the coefficient of the second and third quartile are only significant at the 95% significance level compared to the first quartile that is significant on the 99.9% significant level.

Looking at gender, we find similar effects for boys and girls. Both experience a decline in school enrollment after the oil price shock in oil producing regions compared to non-oil producing regions. The decline for boys is slightly higher than for girls, supporting our findings that boys in oil producing LGAs are more sensitive to a change in the oil price.

Figure 8: Dynamic Event Study by Gender



Note: All regressions include year and LGA fixed effects as well as a set of control variables. The base year is 2013 and time=0 refers to the year 2014 which is when the oil shock happened (see Appendix, Table B7).

The results from our decomposition analysis suggest that the lower income households experience higher volatility in school enrollment in both directions. We also find that in non-oil producing LGAs, the school enrollment of girls is more sensitive to a change in the oil price. However, boys are more affected (positively and negatively) in oil producing LGAs.

6.3 Channels

As shown above, we find that richer households are less affected by oil price fluctuations. This suggests that composition effects could be partly driving our results. Oil producing regions are on average wealthier and more educated (Table 2, Section 4). Therefore, this could be muting the average effect of an oil price change on households in oil producing LGAs.

However, composition effects do not explain why we see a negative effect in the first place. To that end, we also examine several different potential mechanisms of how oil prices may affect human capital investment.

6.3.1 Income

Fluctuations in the oil price can have different effects on household income. On one hand, a boom in the oil price expands government revenue at all levels, but especially in oil producing areas (see Figure 2 for Nigeria's change in government revenue). Additionally, it increases the revenue of oil companies. If this spills-over to the non-oil sector, it can also have a positive impact on household incomes. On the other hand, an increase in the price of oil may decrease worldwide demand, and increase the price of imports and the cost of production. This could lead to inflation, with consumers suffering from escalating prices of goods and commodities (Ogochukwu 2016). Hou et al. (2015) use the 2014 global oil price drop as an example of these effects.

To test this mechanism, we regress household consumption on the oil price interacted with whether or not the household lives in an LGA which produces oil. We find that there is an increase in consumption in all regions when the oil price increases (Table B2). However, oil producing regions do not seem to increase consumption more than non-oil producing regions. We would expect an increase in income to boost school enrollment, but in fact we see the opposite effects. An explanation is that households do not respond to temporary increases in income, which backs up results found in previous literature (Kruger 2007).

6.3.2 Employment

We further test how a change in oil price in different regions in Nigeria affects employment. Theory suggests that there exists a trade-off between human capital investment and employment, and indeed, several papers have found that commodity booms have negative effects on human capital investment.[15] In Nigeria, few people are employed directly in the oil industry, but high oil prices could boost indirect employment. However, higher costs of production in sectors such as agriculture might reduce employment. Additionally, an increase in the oil price leads to higher levels of civil conflict in oil producing regions which could subsequently affect employment (Nwokolo 2022).

However, we find that an increase in oil price has a small negative effect on the share of employed individuals in a household. The effect does not significantly differ between oil and non-oil producing regions (Table B3). The fact that volatility of the oil price seems to affect employment in the country is further evidence that Nigeria suffers from a resource curse. However, it is difficult to determine which effects drive this decrease given the availability of data.

We also break down employment by sectors. We calculate the sector employment share for each household by dividing the number of people working in each sector by the number of households members employed. We find that an increase in oil price increases the share of people working in agriculture. However, there is a counter effect in oil producing regions. The service sector seems to have an increased share overall, whereby oil producing regions experience an even greater increase, supporting the idea that the indirect employment from the oil industry increases when the oil price increases. The increase in employment in agriculture could be because of lower productivity - high oil prices might cause capital to be replaced by labor, increasing the share of people employed in this sector.

[15]See Section 3 for a discussion on the relevant literature.

Table 6: Regression Results - Employment by Sector

	Dependent variable:						
	Agriculture	Mining	Manuf	Tech	Services	Ctr, Trp, Elec	Publ, educ, health
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Oil price	0.191***	0.0003	0.027***	0.005	0.138***	0.019***	-0.002
	(0.009)	(0.0003)	(0.002)	(0.006)	(0.002)	(0.002)	(0.002)
Oil LGA*Oil price	-0.116***	0.003	-0.017***	0.001	0.057***	0.019*	0.0001
	(0.020)	(0.002)	(0.005)	(0.017)	(0.008)	(0.011)	(0.004)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,141	19,141	19,141	19,141	19,141	19,141	19,141
R^2	0.279	0.005	0.027	0.009	0.228	0.040	0.014
Adjusted R^2	0.256	-0.027	-0.004	-0.023	0.204	0.010	-0.017

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

The shares are constructed as the number of people working in the specified sector over the total number of people working. Note that approximately 60% did not specify a sector. Standard errors are clustered at the LGA level, and the variable "Oil price" is standardized.

Linking this to school enrollment, Nigeria has a large child labour problem (ILO 2020). An estimated 47.5% of children 5 to 14 are working, and 39.9% combine work and school. In our data, we see a small negative effect on employment for workers under 18 (Table B4). However, our effects on school enrollment could be driven by students dropping out to help with household duties and informal work while their parents increase their work hours. This is supported both by the fact that the poorest households and girls are the most affected nationally. Conflict could also play a role - increased conflict could increase the danger for children, especially girls, in going to school, aside from effects from higher child soldiers. Unfortunately, we are limited by the availability of the data, and cannot test these channels directly.

To conclude, the oil price volatility seems to affect income at the national level, but this does not seem to have an effect on school enrollment. Additionally, employment is affected by the oil price which could explain the changes in school enrollment. However, further research would be needed to sufficiently understand why school enrollment is dependent on the oil price.

6.4 Robustness Checks

We perform several robustness checks. To address possible measurement error, we use alternate measures of school enrollment. We chose to run our main analysis breaking down enrollment by age (since there were fewer missing values); however, the household survey also asks participants which level of schooling they are enrolled in. Running the same analysis with shares of primary and secondary students produces similar results (Table C1).

We also run our analysis using educational expenditure to test our definition of human capital investment and find no results (Table C2). This could simply be because educational expenditure is not a large component of deciding to invest in school, especially at younger ages.

We test for spurious effects with a placebo analysis where we randomly assign which LGAs are oil producing. As expected, we find insignificant results, supporting our findings (Table C3).

Finally, we define a region as oil producing if they produced oil during our sample years (2011 to 2019). However, there is a concern that there could some omitted variable that affects both school enrollment and the oil production of the LGA during this period. To address this, we re-define an oil producing district as any LGA that produced oil between 1998 and 2016 (Table C4). We also restrict our sample to LGAs that had continuous oil production from 2011 to 2019 (Table C5). This stable oil production will exclude districts that might have stopped producing oil completely during the oil price shock. We find similar results to our baseline in both cases.

7 Discussion and Conclusion

This paper contributes to a body of literature that analyses whether resource rich countries benefit from their endowments or whether reliance on commodity revenues has negative effects. We focus specifically on human capital and examine how a change in the oil price affects the school enrollment of households living in oil producing and non-oil producing LGAs in Nigeria.

We find that human capital investment is strongly affected by oil price volatility, supporting the existence of a national resource curse. However, we do not find evidence supporting a sub-national resource curse. It seems that oil producing LGAs can better mitigate the effects of oil price volatility. Descriptive statistics of the household survey show how these households have higher incomes and are more educated - which seems to drive their ability to weather the shocks of the oil price. Furthermore, our heterogeneity analysis reveals that school enrollment of richer households is less affected by the oil price, while the school enrollment of poorer households is more sensitive to oil price shocks in either direction.

Nonetheless, at the national level, the existence of a non-trivial link between school enrollment and global oil prices poses a serious issue for Nigeria's economic development. Schooling is a vital part of a child's upbringing and if completed successfully, increases future financial stability, job prospects, health outcomes, and multiple other aspects of the child's future life. Moreover, a better educated society contributes to greater social cohesion, engagement with politics, and increased prosperity. Therefore, it is critical to de-couple human capital investment and commodity prices, especially for primary school children.

In light of our findings, we conclude that government policy should support households in times of oil price shocks and mitigate the destabilising affect of this shock on household human capital investment, especially for poorer households. Furthermore, on a macro-level, the government should continue to promote diversification of the economy away from the oil sector in order to separate the fortunes of its development objectives from the price of a single commodity.

We are one of the first studies to investigate the effects of oil dependence at the sub-national level in Nigeria, and, to our knowledge, the only paper to analyse the impact of this with regard to education. As such, our research is subject to multiple limitations which we hope other authors can rectify. First, a key limitation is the paucity of data in Nigeria. For example, we would ideally be able to construct a continuous measure of oil revenue dependence at the LGA level, however, we were constrained by the lack of data on LGA incomes and budgets. Additionally, we use household survey data, which has a limited sample and possible measurement errors. Specifically, the survey was not conducted in regions in Nigeria with high instability, so our results might not apply for these areas. Should further data become available, it might provide a fuller picture of the impacts of oil price shocks in Nigeria. Additionally, data constraints limited our ability to investigate in more detail the channels through which oil price volatility affects human capital. Specifically, it would be valuable to look more into the effects of the oil price on unemployment and child labour.

In conclusion, by highlighting the strong link between oil price movements and household school enrollment, we hope this research can invigorate greater urgency within policy makers to address the key issue of oil dependence within Nigeria.

References

Auty, R. M. (1994). "Industrial policy reform in six large newly industrializing countries: The resource curse thesis". In: *World development* 22.1, pp. 11–26.

Badeeb, R., H. H. Lean, and J. Clark (2017). "The evolution of the natural resource curse thesis: A critical literature survey". In: *Resources Policy* 51 (C), pp. 123–134.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago press.

Cascio, E. U. and A. Narayan (2022). "Who needs a fracking education? The educational response to low-skill-biased technological change". In: *ILR Review* 75.1, pp. 56–89.

Di John, J. (2011). "Is There Really a Resource Curse? A Critical Survey of Theory and Evidence". In: *Global Governance* 17.2, pp. 167–184. URL: http://www.jstor.org/stable/23033728 (visited on 06/10/2022).

Glaeser, E. L., R. La Porta, F. Lopez-de Silanes, and A. Shleifer (2004). "Do institutions cause growth?" In: *Journal of economic Growth* 9.3, pp. 271–303.

Gylfason, T. (2001). "Natural resources, education, and economic development". In: *European economic review* 45.4-6, pp. 847–859.

Gylfason, T., T. T. Herbertsson, and G. Zoega (1999). "A mixed blessing: natural resources and economic growth". In: *Macroeconomic dynamics* 3.2, pp. 204–225.

Haysom, N. and S. Kane (Nov. 2009). "Negotiating natural resources for peace: Ownership, control and wealth-sharing". In: p. 22.

Hou, Z., J. Keane, J. Kennan, and D. W. t. Velde (2015). "The oil price shock of 2014". In: *Working paper* 2015 (415), pp. 1–53.

ILO (2020). "Child Labor and Forced Labor Reports - Nigeria". In:

Kruger, D. I. (2007). "Coffee production effects on child labor and schooling in rural Brazil". In: *Journal of development Economics* 82.2, pp. 448–463.

Kumar, A. (2015). "Oil boom lowers human capital investment in Texas". In: *Ten-Gallon Economy*. Springer, pp. 79–90.

Mankiw, N. G., D. Romer, and D. N. Weil (1992). "A contribution to the empirics of economic growth". In: *The quarterly journal of economics* 107.2, pp. 407–437.

Mousavi, A. and J. Clark (2021). "The effects of natural resources on human capital accumulation: A literature survey". In: *Journal of Economic Surveys* 35 (4), pp. 1073–1117.

National Bureau of Statistics (2014). *Socioeconomic statistics*. URL: https://nigeria.opendataforafrica.org/iynrgrf/socioeconomic-statistics.

National Bureau of Statistics - Nigeria (2017). *National Examinations Council 2013-2016*. URL: https://nigeria.opendataforafrica.org/sttzqvd/national-examinations-council-2013-2016.

— (2021). *Mean age when starting school or work in Nigeria as of 2021, by area*. URL: https://www.statista.com/statistics/1244572/mean-age-when-starting-school-or-work-in-nigeria-by-area/.

Nigeria National Bureau of Statistics (2011). *General Household Survey, Panel (GHS-Panel) 2010-2011*. URL: www.microdata.worldbank.org. accessed: April 19, 2022.

Nigerian Neopedia (2019). *Full List of Oil Producing States in Nigeria*. URL: https://nigerianinfopedia.com.ng/oil-producing-states-in-nigeria/.

NNBS (2013). *General Household Survey, Panel (GHS-Panel) 2012-2013*. URL: www.microdata.worldbank.org. accessed: April 19, 2022.
— (2016). *General Household Survey, Panel (GHS-Panel) 2015-2016*. URL: www.microdata.worldbank.org. accessed: April 19, 2022.
— (2019). *General Household Survey, Panel (GHS-Panel) 2018-2019*. URL: www.microdata.worldbank.org. accessed: April 19, 2022.
NNPC (2020a). *2020 Annual Statistical Bulletin*. URL: https://www.nnpcgroup.com/NNPCDocuments/Annual%20Statistics%20Bulletin%E2%80%8B/2020%20Annual%20Statistical%20Bulletin%20ASB.pdf.
— (2020b). *Corporate Information*. URL: https://www.nnpcgroup.com/About-NNPC/Pages/Corporate-Information.aspx.
Nwokolo, A. (2022). "Oil price shocks and civil conflict: Evidence from Nigeria". In: *The World Bank Economic Review* 36.1, pp. 171–197.
Obi, C. I. and S. A. Rustad (2011). *Oil and Insurgency in the Niger Delta: Managing the Complex Politics of Petro-violence*. Zed Books.
Ogochukwu, O. N. (2016). "The Oil Price Fall and the Impact on the Nigerian Economy:A Call for Diversification". In: *Journal of Law, Policy and Globalization* 48 (NA), pp. 1–93.
OPEC (2022). *Nigeria facts and figures*. URL: https://www.opec.org/opec_web/en/about_us/167.htm.
Our World in Data (2020). *Crude Oil Prices*. URL: https://ourworldindata.org/grapher/crude-oil-prices.html.
Pomeranz, K. (2000). "The great divergence". In: *The Great Divergence*. Princeton University Press.
Prebisch, R. (1962). "The economic development of Latin America and its principal problems". In: *Economic Bulletin for Latin America*.
Ross, M. L. (2015). "What Have We Learned about the Resource Curse?" In: *Annual Review of Political Science* 18, pp. 239–259.
Rostow, W. W. (1959). "The Stages of Economic Growth". In: *The Economic History Review* 12.1, pp. 1–16. ISSN: 00130117, 14680289. URL: http://www.jstor.org/stable/2591077 (visited on 06/09/2022).
Sachs, J. D. and A. Warner (1995). *Natural resource abundance and economic growth*.
Santos, R. J. (2014). "Not all that glitters is gold: Gold boom, child labor and schooling in colombia". In: *Documento cede* 2014-31.
Smith, A. (1776). *The wealth of nations [1776]*. Vol. 11937. na.
Stocker, M., J. Baffes, M. Y. Some, D. Vorisek, and C. M. Wheeler (2018). "The 2014-16 Oil Price Collapse in Retrospect : Sources and Implications". In: *Policy Research Working Paper* (8419), pp. 1–35.
UNICEF (2018). *UNICEF Data Warehouse*. URL: https://data.unicef.org/resources/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=NGA.ED_CR_L2+ED_CR_L3..&startPeriod=2016&endPeriod=2022.
Valencia Caicedo, F. (2019). "The mission: Human capital transmission, economic persistence, and culture in South America". In: *The Quarterly Journal of Economics* 134.1, pp. 507–556.
World Bank (2018). "World Development Report 2018: LEARNING to Realize Education's Promise". In:

World Bank (2022a). *Commodity Markets*. URL: https://www.worldbank.org/en/research/commodity-markets.
— (2022b). *The World Bank in Nigeria*. URL: https://www.worldbank.org/en/country/nigeria/overview#1.
Zhan, J. V., H. Duan, and M. Zeng (2015). "Resource dependence and human capital investment in China". In: *The China Quarterly* 221, pp. 49–72.

A Supplementary Descriptive Statistics

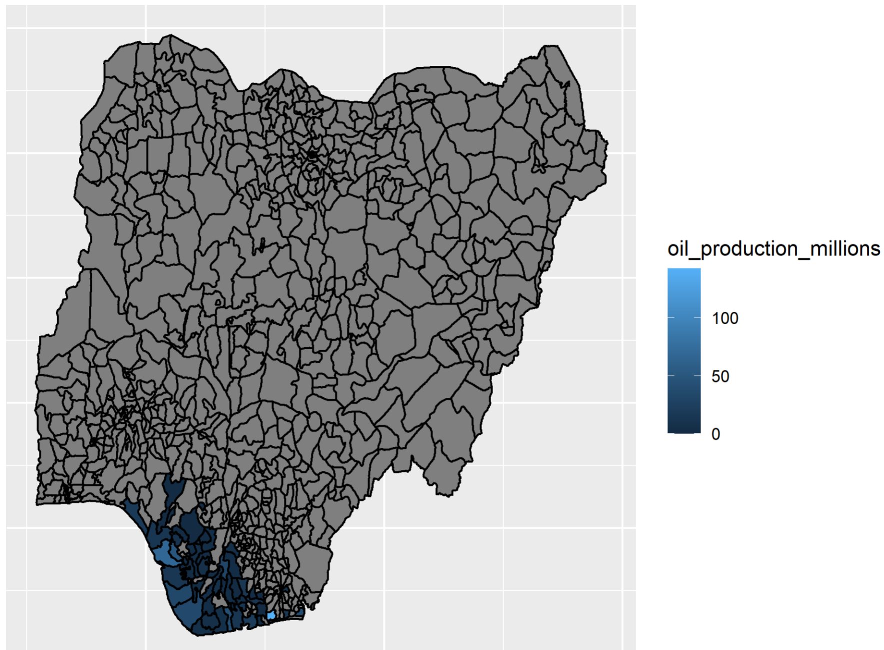
Table A1: Summary Statistics - Reasons for not Enrolled in School

Variable	Count	Percent
Reasons for not enrolled in current school year	80952	
Demand	17430	22%
Supply	411	1%
Other	10401	13%
Missing	52710	65%

Table A2: Summary Statistics - Education Expenditure

Variable	N	Mean	SD	Min	Max	Variable	N	Mean	SD	Min	Max
LGA_year: Non-oil 2013											
School fees	4506	0.13	2.55	0	120	Transport	4506	0.02	0.34	0	12
Parent Teacher Association	4506	0.01	0.18	0	10	Food,Boarding,and Lodging	4506	0.04	1.53	0	100
Uniforms	4506	0.02	0.23	0	8	Extra-tuition	4506	0.01	0.21	0	7.5
Books	4506	0.06	1.18	0	70	Other	4506	0.02	0.48	0	30
LGA_year: Oil 2013											
School fees	1692	1.03	8.88	0	100	Transport	1692	0.1	0.9	0	10
Parent Teacher Association	1692	0.01	0.13	0	1.5	Food,Boarding,and Lodging	1692	0.73	9.68	0	150
Uniforms	1692	0.04	0.28	0	2.5	Extra-tuition	1692	0.09	1.18	0	18
Books	1692	0.5	4.75	0	70	Other	1692	0.57	6.59	0	96.5
LGA_year: Non-oil 2016											
School fees	4319	2.46	13.17	0	654	Transport	4319	0.37	2.19	0	56.67
Parent Teacher Association	4319	0.14	0.51	0	15	Food,Boarding,and Lodging	4319	0.61	5.05	0	160
Uniforms	4319	0.39	1.23	0	43	Extra-tuition	4319	0.15	0.86	0	20
Books	4319	0.82	2.4	0	40	Other	4319	0.48	6.54	0	400
LGA_year: Oil 2016											
School fees	1668	10.11	33.46	0	303.75	Transport	1668	1.37	5.92	0	60
Parent Teacher Association	1668	0.3	0.95	0	7.49	Food,Boarding,and Lodging	1668	2.05	10.36	0	105
Uniforms	1668	0.75	1.51	0	11.5	Extra-tuition	1668	0.41	1.58	0	13
Books	1668	2.68	7.39	0	89.5	Other	1668	2.51	13.23	0	190

Figure 9: Oil Production: Nigerian LGAs



B Supplementary Regression Tables

Table B1: Regression Results - School Enrollment

	Dependent variable:			
	Share of school-aged children enrolled			
	OLS		*panel linear*	
	(1)	(2)	(3)	(4)
Oil LGA	0.085***	0.089***		
	(0.004)	(0.004)		
Oil price		-0.062***	-0.040***	-0.044***
		(0.003)	(0.005)	(0.005)
Real consumption				0.043***
				(0.007)
Dependency Ratio				0.042**
				(0.020)
HH head age				-0.0003
				(0.0003)
HH head sex				-0.006
				(0.010)
HH head education				0.026***
				(0.008)
Dwelling owned				-0.017**
				(0.007)
Land workability				0.012
				(0.013)
Annual precipitation				0.00001
				(0.0001)
Oil LGA*Oil price		0.069***	0.044***	0.045***
		(0.004)	(0.009)	(0.009)
Constant	0.862***	0.859***		
	(0.003)	(0.003)		
Observations	15,026	15,026	15,026	14,878
R^2	0.016	0.051	0.018	0.030
Adjusted R^2	0.016	0.051	-0.021	-0.008
Residual Std. Error	0.285 (df = 15024)	0.280 (df = 15022)		
Note:				*p<0.1; **p<0.05; ***p<0.01

Table B2: Regression Results - Consumption

	Dependent variable:			
	Total consumption			
	OLS		*panel linear*	
	(1)	(2)	(3)	(4)
Oil LGA	0.432***	0.429***		
	(0.010)	(0.010)		
Oil price		0.084***	0.066***	0.061***
		(0.005)	(0.006)	(0.006)
Oil LGA*Oil price		-0.033***	-0.040	-0.038
		(0.010)	(0.032)	(0.032)
Fixed effects	No	No	Yes	Yes
Controls	No	No	No	Yes
Observations	24,243	24,243	14,959	14,878
R^2	0.071	0.082	0.011	0.105
Adjusted R^2	0.071	0.082	-0.028	0.070
Residual Std. Error	0.679 (df = 24241)	0.674 (df = 24239)		

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

Total consumption is deflated by the average price index in Nigeria. Standard errors are clustered at the LGA level. The variable "Oil price" is standardized.

Table B3: Regression Results - Employment

	Dependent variable:			
	Share of employed individuals in household			
	OLS		*panel linear*	
	(1)	(2)	(3)	(4)
Oil LGA	-0.022***	-0.021***		
	(0.005)	(0.005)		
Oil price		-0.001	0.003	-0.010***
		(0.003)	(0.003)	(0.003)
Oil LGA*Oil price		-0.013***	-0.009	0.006
		(0.005)	(0.007)	(0.008)
Fixed effects	No	No	Yes	Yes
Controls	No	No	No	Yes
Observations	23,270	23,270	23,270	20,096
R^2	0.001	0.001	0.0001	0.134
Adjusted R^2	0.001	0.001	-0.025	0.108
Residual Std. Error	0.336 (df = 23268)	0.336 (df = 23266)		
Note:		*p<0.1; **p<0.05; ***p<0.01		

Shares are constructed as the number of people who indicated that they were employed over the number of people between 16 and 65 in the household. The variable "Oil price" is standardized.

Table B4: Regression Results - Under 18 Employment

	Dependent variable:			
	Share of employed people under 18			
	OLS		*panel linear*	
	(1)	(2)	(3)	(4)
Oil LGA	-0.091***	-0.090***		
	(0.004)	(0.004)		
Oil price		-0.014***	-0.013***	-0.011***
		(0.003)	(0.004)	(0.004)
Oil LGA*Oil price		0.001	0.005	0.003
		(0.004)	(0.007)	(0.007)
Fixed effects	No	No	Yes	Yes
Controls	No	No	No	Yes
Observations	16,990	16,990	16,990	16,891
R^2	0.018	0.021	0.002	0.012
Adjusted R^2	0.018	0.020	-0.033	-0.023
Residual Std. Error	0.287 (df = 16988)	0.287 (df = 16986)		
Note:			*p<0.1; **p<0.05; ***p<0.01	

Shares are constructed as the number of people under 18 who indicated that they were employed over the number of people under 18 in the household. Standard errors are clustered at the LGA level. The variable "Oil price" is standardized.

Table B5: Dynamic Event Study

	two periods	two periods	dynamic	dynamic
Post*Oil dummy	-0.10^{***}	-0.10^{***}		
	(0.02)	(0.02)		
2011*Oil dummy			-0.03	-0.03
			(0.02)	(0.02)
2016*Oil dummy			-0.11^{***}	-0.11^{***}
			(0.02)	(0.02)
2019*Oil dummy			-0.11^{**}	-0.12^{***}
			(0.03)	(0.04)
Controls	No	Yes	No	Yes
Num. obs.	15026	14878	15026	14878
Num. groups: lga	562	562	562	562
Num. groups: year	4	4	4	4
R^2 (full model)	0.29	0.30	0.29	0.30
R^2 (proj model)	0.01	0.02	0.01	0.02
Adj. R^2 (full model)	0.27	0.28	0.27	0.28
Adj. R^2 (proj model)	0.01	0.02	0.01	0.02

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Note: Column 1 and 2 shows the two-period Diff-in-Diff results where Post is a Dummy = 1 if the year is after 2014. Column 3 and 4 show the dynamic Diff-in-Diff results where we include a dummy for each year. All regressions include time and LGA fixed effects and the standard errors are clusterd at the LGA level. Additonally, column 2 and 4 include the standard set of control variables. The base category is 2013 and the sample is restricted to households with at least one child.

Table B6: Dynamic Event Study by Consumption Quartiles

	CQ1	CQ2	CQ3	CQ4
2011*Oil dummy	-0.03	-0.01	0.02	-0.00
	(0.09)	(0.04)	(0.03)	(0.04)
2016*Oil dummy	-0.19^{***}	-0.04^{*}	-0.06^{*}	0.04
	(0.04)	(0.02)	(0.03)	(0.03)
2019*Oil dummy	-0.27^{**}	-0.16^{**}	-0.08	0.05
	(0.08)	(0.05)	(0.05)	(0.04)
Controls	Yes	Yes	Yes	Yes
Num. obs.	4614	4289	3587	2388
Num. groups: lga	497	522	487	341
Num. groups: year	4	4	4	4
R^2 (full model)	0.42	0.37	0.35	0.34
R^2 (proj model)	0.02	0.02	0.02	0.02
Adj. R^2 (full model)	0.34	0.28	0.25	0.22
Adj. R^2 (proj model)	0.02	0.02	0.02	0.02

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Note: CQ1-CQ4 are the consumption quartiles, where CQ1 includes the poorest households and CQ4 the richest. All regressions include time and LGA fixed effects and the standard errors are clusterd at the LGA level. Additonally, all regressions include the standard set of control variables. The base category is 2013 and the sample is restricted to households with at least one child.

Table B7: Dynamic Event Study by Gender

	Girls	Boys	Girls	Boys
2011*Oil dummy	-0.03	0.00	-0.03	0.01
	(0.03)	(0.02)	(0.03)	(0.02)
2016*Oil dummy	-0.11^{***}	-0.13^{***}	-0.11^{***}	-0.13^{***}
	(0.02)	(0.03)	(0.02)	(0.03)
2019*Oil dummy	-0.14^{**}	-0.14^{**}	-0.15^{***}	-0.15^{**}
	(0.04)	(0.05)	(0.04)	(0.05)
Controls	No	No	Yes	Yes
Num. obs.	11319	11983	11213	11855
Num. groups: lga	558	559	558	559
Num. groups: year	4	4	4	4
R^2 (full model)	0.30	0.27	0.31	0.27
R^2 (proj model)	0.01	0.01	0.02	0.02
Adj. R^2 (full model)	0.26	0.23	0.27	0.24
Adj. R^2 (proj model)	0.01	0.01	0.02	0.02

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Note: All regressions include time and LGA fixed effects and the standard errors are clusterd at the LGA level. Additonally, regressions 3 and 4 include the standard set of control variables. The base category is 2013 and the sample is restricted to households with at least one child.

Table B8: 2013 Comparing Oil vs. Non-Oil LGAs

		(1)	
	Mean Non-Oil	Mean Oil	Difference
Real consumption	12.72879	13.15932	-.4305216***
Dependency Ratio	.1673496	.1275284	.0398212***
Number of kids	2.608225	2.348022	.2602022***
HH head age	50.46308	50.04111	.4219648
HH head sex	1.13386	1.235997	-.1021364***
HH head education	.2001066	.3076719	-.1075653***
Dwelling owned	.7502668	.5595112	.1907557***
Land workability	1.478817	1.594638	-.1158207***
Annual precipitation	1352.334	2660.167	-1307.833***
Observations	15026		

C Robustness checks

Table C1: Regression Results - School Enrollment, levels of education

	Dependent variable:			
	Under 18	Primary	Secondary	Above secondary
	(1)	(2)	(3)	(4)
Oil price	-0.044***	-0.042***	-0.018***	-0.011***
	(0.005)	(0.005)	(0.006)	(0.002)
Oil LGA*Oil price	0.045***	0.044***	0.043***	0.019**
	(0.009)	(0.009)	(0.012)	(0.009)
Fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	14,878	11,478	10,471	20,096
R^2	0.030	0.014	0.029	0.069
Adjusted R^2	-0.008	-0.038	-0.026	0.041
Note:	*p<0.1; **p<0.05; ***p<0.01			

Table C2: Regression Results - Education Expenditure

	Dependent variable:			
	Real education expenditure, log			
	OLS		*panel linear*	
	(1)	(2)	(3)	(4)
Oil LGA	1.477***	1.482***		
	(0.078)	(0.078)		
Oil price		-0.105***	-0.059*	0.041
		(0.037)	(0.034)	(0.035)
Dependency Ratio				-4.545***
				(0.286)
HH head age				-0.002
				(0.006)
HH head sex				-1.354***
				(0.223)
HH head education				0.392*
				(0.208)
Dwelling owned				1.043***
				(0.153)
Land workability				-0.208
				(0.189)
Annual precipitation				0.002
				(0.002)
Oil LGA*Oil price		-0.047	-0.065	-0.074
		(0.071)	(0.123)	(0.118)
Constant	6.150***	6.171***		
	(0.040)	(0.040)		
Observations	18,345	18,345	18,345	18,175
R^2	0.020	0.020	0.0004	0.071
Adjusted R^2	0.020	0.020	-0.026	0.046
Residual Std. Error	4.628 (df = 18343)	4.627 (df = 18341)		

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

Table C3: Robustness Test - Placebo Oil LGA

	Dependent variable:			
	Under 18	6 to 11	12 to 17	18 to 65
	(1)	(2)	(3)	(4)
Oil price	-0.031***	-0.041***	-0.018***	-0.006*
	(0.005)	(0.005)	(0.005)	(0.003)
Fake Oil LGA*Oil price	-0.006	0.008	-0.016	0.028
	(0.014)	(0.019)	(0.017)	(0.024)
Fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	14,878	11,478	10,471	20,096
R^2	0.024	0.039	0.009	0.068
Adjusted R^2	-0.015	-0.011	-0.047	0.040
Note:	*p<0.1; **p<0.05; ***p<0.01			

Table C4: Regression Results - School Enrollment, Oil production 1998 to 2016

	Dependent variable:			
	Under 18	6 to 11	12 to 17	18 to 65
	(1)	(2)	(3)	(4)
Oil price	-0.044***	-0.057***	-0.027***	-0.011***
	(0.005)	(0.005)	(0.006)	(0.003)
Oil LGA*Oil price	0.046***	0.061***	0.030**	0.018**
	(0.009)	(0.008)	(0.013)	(0.009)
Fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	21,322	16,173	15,148	29,356
R^2	0.026	0.053	0.007	0.069
Adjusted R^2	-0.001	0.018	-0.031	0.050
Note:	*p<0.1; **p<0.05; ***p<0.01			

Table C5: Regression Results - School Enrollment, stable oil production

	Dependent variable:			
	Under 18	6 to 11	12 to 17	18 to 65
	(1)	(2)	(3)	(4)
Oil price	-0.043***	-0.056***	-0.027***	-0.011***
	(0.005)	(0.005)	(0.006)	(0.002)
Oil LGA*Oil price	0.044***	0.058***	0.031**	0.018*
	(0.009)	(0.008)	(0.013)	(0.010)
Fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	14,612	11,301	10,264	19,710
R^2	0.030	0.051	0.011	0.067
Adjusted R^2	-0.010	0.001	-0.046	0.039
Note:	*p<0.1; **p<0.05; ***p<0.01			