The Local Economic Effects of Natural Resources: Evidence from Ghana

By Josephine Ofori Adofo, Nori Tarui, and Tomomi Tanaka*

Abstract

Using household survey data and location information on oilfields, this paper examines the short-term welfare impacts of Ghana's offshore oil discovery and production. We find that the oil discovery and production increased real income and employment by 4 percent and 4.5 percent, respectively. However, it had no effect on consumption and poverty reduction. The Income effects are larger for skilled workers than for unskilled workers. The positive effects on employment in non-oil local sectors are concentrated in manufacturing and construction. We do not find significant impacts on employment in the agricultural and service sectors where a large proportion of individuals below the poverty line are engaged. This largely explains why the oil discovery and production had positive impacts on income but not on poverty reduction, as it benefited non-poor rather than poor.

Keywords— *Natural resources, local labor markets, poverty, Oil*
JEL: Q32, O13, O15, R20, J21

*Ofori Adofo: Department of Economics, University of Hawaii at Manoa, Honolulu, HI 96822, USA, (Email: joa94@hawaii.edu). Tarui: Department of Economics, University of Hawaii at Manoa, Honolulu, HI 96822, USA, (Email: nori@hawii.edu). Tanaka: Poverty and Equity Global Practice, The World Bank, Washington D.C, 20006, USA, (Email: ttanaka@worldbank.org). We thank Inessa Love and Teresa Molina for their comments and suggestions. We are grateful to Dan Pavelesku for his help.

1. Introduction

Does the discovery of a new resource exacerbate the resource curse? It has been long debated whether natural resource endowments promote economic development (Van der Ploeg 2011b). Previous research indicates mixed findings (Alexeev and Conrad 2009, van der Ploeg 2011a, Smith 2015). Cross-country studies based on aggregate data suggest that resource abundance could have negative effects on economic growth (Sachs and Warner 1995, Sachs and Warner 2001).[1] The literature on "natural resource curse" has identified several factors that influence the relationship between resource abundance and economic growth. These factors include conflicts (Angrist and Kugler 2008), the presence of weak institutions, and the extent of democracy (Aragón, Chuhan-Pole, and Land 2015).[2]

The primary objective of this paper is to examine the impacts of natural resource discovery on welfare and employment at the sub-national level. We study Ghana's offshore oil discovery in 2007, which is the largest and most significant oil discovery in the country's history. Has the discovery of oil and subsequent oil production increased local employment and income, contribution to poverty reduction? Economic theory suggests that local economies benefit from natural resource discovery through increased local demand for labor not only in the mining sector but also in non-mining sectors due to spillover effects (Black, McKinnish, and Sanders 2005, Marchand 2011). In addition, households can benefit from windfall revenues if the government redistributes the revenues in the form of transfers or provision of public goods. Whether and how

[1] Cotet and Tsui (2013) shows oil discoveries increase military spending.
[2] Aragón, Chuhan-Pole, and Land (2015) provide a literature review of both cross-country and subnational level impacts of natural resources.

households are ultimately affected by a shock to natural resource availability is an empirical question, which we address in this paper.

We use three waves of household survey data covering the period 1998 to 2013 and location information on oil fields to estimate the economic impacts of the oil discovery. We exploit the quasi-experimental nature of the discovery by comparing districts in regions associated with oil (treatment group) and districts in regions without oil (control group). The identification strategy assumes that the trends in outcomes for households in the treatment and the comparison groups would have been similar in the absence of the discovery of oil. Although this assumption is untestable, we demonstrate that households in the treatment group were not significantly different from those in the comparison group prior to the oil discovery.

Our results indicate that the oil discovery increased real income and employment by 4 percent and 4.5 percent, respectively, but had no significant impacts on consumption and poverty reduction. The positive effects on employment in non-oil local sectors are mostly concentrated in manufacturing and construction. The increase in the manufacturing employment indicates that the manufacturing sector may have benefited from agglomeration effects (Greenstone, Hornbeck, and Moretti 2010) due to offshore oil operations (Aragón, Chuhan-Pole, and Land 2015). However, the positive employment impacts are not observed beyond these sectors: we do not find significant impacts on employment in the agriculture and services sectors where a large proportion of individuals below the poverty line are engaged. In order to explore the heterogeneous impacts on employment, we investigate how the effects differ between educated and less educated workers, and between men and women. We find that the positive effects are more concentrated on educated workers compared to less educated workers, and the impacts are similar for both men and women.

How do these findings compare with what we have learned from the existing studies? Several studies have examined local economic impacts of resource discovery on wealth, income, employment, inequality, and standard of living (Loayza, Teran, and Rigolini 2013, Berman et al. 2017, Aragón and Rud 2013, Douglas and Walker 2017,

Chuhan-Pole et al. 2015, Kotsadam and Tolonen 2016). Their findings suggest that oil discovery increases employment in the oil extraction and manufacturing sectors (Michaels 2011), and lead to small increases in household income when windfall revenues are distributed through transfers. Similarly, Fleming and Measham (2015) found an increase in income among families living in regions with natural gas compared to families in other regions in Australia. Aragón and Rud (2013) find that the expansion of Peru's gold mine had a positive effect on income, household consumption and poverty reduction. In the case of mining in Africa, the expansion of mining activities increased women's employment in the services sector and shifted employment away from the agricultural sector (Kotsadam and Tolonen 2016). Chuhan-Pole et al. (2015) demonstrate that infant mortality considerably decreased in mining communities in Ghana.

This paper contributes to the existing literature in three important ways. First, our paper complements the literature on local impacts of natural resources by providing new evidence. Most of the studies on the local impacts of resources, as summarized above, focus on developed countries (Black, McKinnish, and Sanders 2005, Michaels 2011) while a few others focus on developing countries mainly in Latin America such as Peru and Brazil (Aragón and Rud 2013, Caselli and Michaels 2013). Their findings may not be applicable to other developing countries, especially in Africa because the socioeconomic impacts may change under different economic structures and development stages. Our finding about Ghana's offshore oil discovery has direct implications to other low-income countries, including those in West Africa with large prospects on offshore oil development. Second, this paper departs from the literature, which focuses on traditional onshore discovery of oil and mineral resources, by evaluating the impacts of offshore oil on local employment and standard of living in Africa. Research on theses impacts is scarce (Hilson 2009, Aragón, Chuhan-Pole, and Land 2015, Kotsadam and Tolonen 2016, Berman, Couttenier, and Rohner 2017). Out of the available research, only a few have investigated the impacts of offshore oil discoveries. The local economic impacts of offshore oil development may be different from those of conventional onshore oil and other minerals in an important way. Offshore oil development is more capital-intensive than other

conventional oil and gas explorations because the facilities required for extraction and delivery of products are typically more complex with the offshore development. Because of its capital-intensive nature, offshore oil development requires relatively more skilled labor workforce than the inland counterpart. These feastures of offshore oil indicate that the positive direct economic impacts, if they exist, may be concentrated on those workers with high skills. In fact, our empirical finding is consistent with this conjecture. To the extent that the future resource exploration involves capital-intensive development, our findings indicate possibly limited roles of offshore oil development on poverty reduction.

Finally, we evaluate the effects of oil discovery at the household and individual level. We apply a difference in difference approach to a newly constructed household income data combined with location information of households to analyze the impact of oil discovery on household's income. This approach allows us to address individual-level impacts of offshore oil discovery, which tend to be masked in most previous studies based on municipality, county or province level data.

The remainder of the paper is organized as follows: Section 2 provides a brief overview of oil in Ghana, Section 3 discusses related theories and channels through which natural resources affect the local economy, Section 4 describes the dataset used for analysis, summary statistics, empirical strategy and a discussion on the validity of the identification strategy. Section 5 reports empirical results, Section 6 discusses alternative mechanisms, and Section 7 concludes.

2. An overview of oil in Ghana

Oil exploration in Ghana began in the 19th century. The first onshore oil was discovered and drilled in 1896. Following this discovery, exploration activities continued between 1957 and 1966. Offshore oil is more recent, with discovery and drilling taking place in the 1970's.[3] By 1983, the country had 54 well counts of both onshore and

[3] Ghana has 3 offshore sedimentary basins and one onshore basin: Tano-Cape Three Point Basin, Saltpond Basin, Accra-Keta Basin and Voltarian Basin. Current productive oil fields lie within the Tano-Cape Three Basin.

offshore oil, yet production and commercialization were not on a large scale. Crude oil was discovered in the Western region 2007, which is the most significant discovery among all discoveries because it puts Ghana on the forefront of exporting oil in much larger quantities.

The discovery has drawn attention from both within Ghana and international organizations due to the significantly large size of the reserve and possible daily production quantities. Actual production for exporting began in 2010. According to a report by Ghana Extractive Industries Transparency Initiative, an average of 63,932 barrels was produced per day in December 2010 (Ministry of Finance 2014). This makes it the most important discovery in the country's history of oil and gas exploration. Export of oil is ranked among the top five commodities of Ghana's exports (World Trade Integrated Solution 2016) and has substantially contributed to GDP growth. Figure 1 shows a clear increase in the share of oil rents in GDP in 2010, when oil production from the offshore fields started. In 2014, exports of crude oil averaged 101,922 barrels per day.

In terms of control and management, the Petroleum Commission, a state institution, regulates the oil industry. The major function of the Petroleum Commission is to regulate and manage the upstream petroleum operations. Actual exploration, production and the supply of petroleum products are the sole responsibilities of the Ghana National Petroleum Corporation (GNPC), Ghana's main oil company. With respect to the distribution of royalties and tax revenue from the oil industry, a large part of the revenue is allocated to Ghana National Petroleum Corporation (GNPC), followed by the Annual Budget Funding Amount (ABFA), Stabilization Fund and Heritage Fund. The Annual Budget Funding Amount (ABFA) allocates funds for the provision of infrastructure in sectors such as agriculture, energy, education, housing and health. Local communities are supposed to benefit from the windfall revenue through the provision of infrastructure.

The main focus of the paper is on the direct and indirect impacts of the oil through labor demand and income effects. We do not focus on the impact of the windfall allocation because the oil revenues are not redistributed to households in the form of transfers from the government in Ghana. For robustness, we address concerns that

distribution of government transfers may be driving our results.

3. Local Economic Impacts of Natural Resources

The impact of natural resources on economic growth at the national level is well documented (Bulte, Damania, and Deacon 2005, Mehlum, Moene, and Torvik 2006, Gylfason and Zoega 2006, van der Ploeg 2011a). However, empirical evidence on the channels through which extraction of natural resources affects the local economy is still lacking. In this section, we describe the possible channels through which local economies maybe be affected by natural resources. We do not attempt to evaluate all the channels, but rather provide insights on the overall empirical effects of natural resources on the local economy—specifically, how local demand shocks from the oil discovery may affect the local labor markets and households.

Natural resources may generate both positive and negative impacts[4] on the local economy. On the positive side, the discovery of a new resource and subsequent extraction can create new jobs for the local economy where the resource discovery and production occur. In the case of oil extraction, jobs at firms such as oil refinery companies emerge, which increase the demand for labor and in turn increase income. As theory predicts, the increase in income will likely lead to increases in spending on both tradable and non-tradable goods, thereby creating employment in other sectors, particularly, the non-tradable sector. Besides the influx of oil-related jobs, other non-mining sector jobs are more likely to be created through a multiplier effect. This is because a positive shock to the tradable sector has the potential of creating employment opportunities in the non-tradable sector through a local multiplier effect (Moretti 2010). For example, accommodation business may experience a higher demand due to inflows of workers and other businesses into the local economy.[5]

[4] Aragón and Rud (2015) demonstrate how gold mining industry caused pollution and negatively impacted agricultural productivity in Ghana.
[5] See Morreti (2010) for a detailed discussion on "Local Multipliers".

On the negative side, the extraction of oil may crowd out other sectors of the economy. Workers might move from other sectors such as agriculture and manufacturing to the mining sector due to higher wages. Moreover, housing prices, land prices and prices of other local goods may increase in the locations affected by the oil extraction activities. The local economy will not benefit from the resource if higher prices increase the cost of living and discourage businesses from operating in affected districts.

Another channel through which oil extraction affects the local economy is through oil windfalls. Some governments redistribute oil windfalls through income transfers and provision of public goods such as roads, health facilities, classroom blocks and public water supply. The provision of public goods benefits both households and businesses. On the other hand, the presence of oil revenues can create corruption (Ades and Di Tella 1999), rent seeking behavior (Brollo et al. 2013a), and even conflicts (Angrist and Kugler 2008). Vicente (2010), for example, finds that offshore oil discovery in Sao Tome and Principe led to perceived increases in corruption.

4. Research Design

In this paper, we examine the impact of natural resources on the local economy by focusing on the effects of oil extraction on employment and standard of living of households in affected districts. We use consumption and poverty status of the household as a measurement of the standard of living besides income.

4.1. Data

We use three rounds of Ghana Living Standards Survey (GLSS) covering the period between 1998 and 2013 (1998/1999-GLSS4, 2005/2006-GLSS 5 and 2012/2013-GLSS 6).[6] GLSS is a nationally representative household survey and is collected by the Ghana Statistical Service (GSS). It reports detailed information on demography, income, expenditure and other household and individual characteristics. With the support of Ghana Statistical Service, we created a complete dataset of location information of

[6] We use GLSS 5 (2005/2006) and 6 (2012/2013) in the main analysis, and GLSS 4 (1998/1999) in a test for similarity in pre-trends. We exclude GLSS 4 from the main analysis because it contains only 102 districts.

enumeration areas of the household surveys. The GLSS 6 sample includes 818 enumeration areas (EAs), 580 EAs in GLSS 5, and 300 EAs in GLSS 4[7]. Based on the location information, we match households to districts of regions with oil and non-oil regions. The GLSS 5 data includes 110 districts while GLSS 6 includes 170 districts.[8] The number of districts in Ghana has increased over the years from 110 districts in 2000 to 170 districts in 2010. With information on both the original districts that have been split and newly created districts, we are able to match the new districts back to the old districts that existed in 2000.

Data on household income is taken from the Rural Income Generating Activities project (RIGA), which is compiled by the Food and Agriculture Organization of The United Nations.[9] The RIGA income data is constructed using household survey data (GLSS), with the idea of including all sources of household income that are often neglected in the computation of income. Such sources include income from self-employment and income from own-farm production of crops. Additionally, we use information on the location of oil fields from Petroleum Commission of Ghana to determine the oil and non-oil regions. The data contains information on the number of offshore oil fields, wells, location, year of discovery and status of operation, which is whether the oil field is currently producing, under appraisal or exploration.

The empirical analysis focuses on several regions in Southern Ghana by comparing households and individuals in treatment and control areas. We focus on the southern part of Ghana for two reasons. First, we limit our focus on offshore oil. The oil discovered in 2007 as well as the subsequent discoveries are offshore. We define treatment areas as districts in regions that face offshore oil or districts in regions that have oil in its offshore boundaries. Second, districts considered in our analysis are more similar to each other

[7] GLSS is geocoded at the locality level. The 6th wave (GLSS 6) contains a total of 1200 localities but our sample includes 818 EAs out of the total, because GPS information on 382 localities were missing. Majority of the missing EAs are located in the Northern regions. These regions are not included in our main analysis since we focus on the south.. However, we use EAs in the Northern regions with GPS information to show that excluding these regions do not affect our results.

[8] Districts are second level sub-national administrative units in Ghana after regions.

[9] Rural Income Generating Activities (RIGA) project- Food and Agriculture Organization, United Nation. http://www.fao.org/economic/riga/riga-database/en/

compared to districts in the north. One of the regions in the south that has oil, i.e. the Central region, is excluded, because the oil field in that region was discovered years before the 2007 discovery. Oil production from this field is smaller compared to the production from the oil fields discovered in 2007. Daily production of oil from this oil field was 700 barrels per day in 2006 (Ministry of Finance 2014). Besides its size, there have been several shutdowns and operation resumptions on the field due to operational issues. By excluding this region, we avoid attributing changes in the outcome of the control group due to a change in the existing oil operation to the 2007 offshore oil discovery. This also ensures that our control group is comparable to the treatment group. Figure 2 shows the districts in our sample: control and treatment districts.

4.2. Descriptive statistics

The descriptive statistics of variables used for household analysis are presented in Table 1. The number of households in our sample is 14,106 after excluding the Central region. On average, 56.4 percent of the households in our sample live in an urban area while 17.6 percent of them are classified as poor.[10] The average household size and age are approximately 5 and 46, respectively. The share of household members working in industry is 22.7 percent whereas the share of members working in agriculture is 47.8 percent. About 66.1 percent of the households have access to electricity. While the majority of the household heads have secondary school education (55.4 percent), only 7.9 percent of them have completed tertiary education. Table A-1 in the Appendix presents the summary statistics of the main variables used in analyzing the employment effects of the oil discovery. These variables are summarized for periods before and after the discovery.

4.3. Empirical Strategy

We apply a difference in difference estimation strategy by comparing households (and individuals) in districts of oil and non-oil regions before and after the discovery of

[10] The variable poor defines the poverty status of a household based on the poverty line. The poverty line is GH¢1,314 per adult equivalent per year in 2013 prices.

oil. The identification strategy assumes that the trends in outcomes for households in our treatment group and comparison group would have been similar in the absence of the oil.

We define the treatment group as households who live in districts in a region with oil. Specifically, a treatment district refers to a district in a region whose offshore oil was discovered in 2007 or after 2007 and whose oil was extracted during or after 2010. All households in such districts are assigned to the treatment group. The treatment definition is based on data of all oil fields in Ghana. The data gives information on the status of the oil fields (that is, whether the field is under exploration, appraisal, being drilled, or inactive). We estimate the following regression for household-level outcome variables:

$$Y_{hdt} = \alpha + Post_t + \sigma T_d * Post_t + \gamma X_h + \lambda_d + \varepsilon_{hdt}$$

where Y_{hdt} is the outcome variable (real income and real consumption of household *h* in district *d* at time *t*. Variable T_d represents a dummy variable that takes the value of 1 if the household lives in a region with offshore oil and 0 otherwise; *Post* is a time dummy for the year 2012/2013 (post oil discovery); and X_h a vector of household and individual covariates, including level of education, a dummy for whether the household has access to electricity, sex of the household head, share of household members working in agriculture, share of household members working in industry, share of household members working in services, a dummy for whether the household lives in an urban area and geographic controls[11], λ_d denotes a district fixed effects and ε_{hdt} is the error term. The coefficient of interest is σ, which is the DD (difference-in-difference) estimator.

For individual-level outcome variables, we estimate the following regression:

$$Y_{idt} = \alpha + Post_t + \sigma T_d * Post_t + \gamma X_i + \lambda_d + \varepsilon_{idt}$$

[11] The geographical controls include GPS location (longitude and latitude) of a locality. For robustness, we include ecological zones such as coastal, forest, and savannah as additional geographic controls.

where Y_{idt} is employment of individual *i* in district *d* at time period *t*. Specifically, employment takes the value of 1 for an employment category and 0 otherwise[12]. These categories include manufacturing, agriculture, services, construction and retail and wholesale. We estimate all regression models by using sample weights. We control for individual characteristics such as age, sex and whether an individual lives in an urban area[13].

4.4 Validity of the Identification assumption

Our identification strategy requires the treatment group and the control group to have similar trends from the pre-treatment periods. One could argue that members of a local community of a region with oil do not have control over oil exploration and drilling activities, and hence, oil assignment cannot be influenced. In addition, the households did not have prior information on the geology of the offshore region with respect to oil. Therefore, the location of offshore oil fields would not have influenced their settlement decisions. Hence, there is unlikely to be self-selection as a result of the oil prior to the discovery, which supports our identification assumption. We show trends in the conditional mean of real income for households in the treatment and control groups. As seen in Figure 3, both the control and treatment households had similar trends prior to the discovery.

In Table A-2 in the Appendix, similarity in pre-trends is tested by regressing income and employment on the interaction between time trend and treatment status (*T*) for periods before and after the discovery. As seen in columns 1 and 2, both groups had similar trends in income and employment. Columns 3 and 4 indicate the subsequent change in trends after the discovery.

To further support the validity of the identification, household and individual characteristics are compared across the treatment and control groups before the discovery. While significant differences in characteristics between the groups would not

[12] All employment variables are estimated using a linear probability model for ease of interpretation.
[13] We restrict the working-age group to individuals aged between 15 and 65.

necessarily violate our identification assumption, similarity across the two groups would help support the idea that these two groups would have shown similar trends in characteristics in the absence of oil discovery. In Table 2, we show that households in the treatment and control group have similar characteristics. There is no significant difference in the education level, age, household size and the share of households with access to electricity except for the percentage of households headed by men.[14] This similarity in characteristics lends support to the idea of the treatment and control groups having similar trends in the absence of the oil.

Secondly, we test whether our interaction variable of interest, *T*Post*, is correlated with household and individual characteristics. Differential trends in any household characteristic might be an indication of differential trends in other characteristics such as income and consumption. To determine whether household characteristics of the treatment and control groups trended differently overtime, we regress these characteristics on the interaction between treatment and *Post*. The results indicate that the interaction variable is not correlated with household characteristics (see Table A-3 in the Appendix). The fact that there is no differential trend overtime suggests that our parallel trends assumption is unlikely to be violated. We ran a similar test for the individual analysis using the sample on individuals. These results are presented in Table A-3 in the Appendix, which show that individual characteristics are not correlated with treatment variable (*T*Post*).

5. Empirical Results

5.1 Effects on Income

The results from estimating the impacts on the real income are presented in Table 3.[15] All specifications include district fixed effects and household characteristics. Column

[14] Our sample includes a higher percentage of males than females. Hence, differences between the treatment and control areas might just be an indication that most household heads in Ghana are men.

[15] Data on price index used to compute the real income in this study is compiled by Ghana Statistical Service (GSS). This data is available in the 3 rounds of GLSS data. We considered other components of household income such as transfers, income from self-employment and wages. Although not presented in the paper, we find that real income from self-employment and wage employment increased but no significant increase in transfers.

1 to 6 present results with household control variables and district fixed effects. In columns 3 to 6, we interact all control variables with the *Post* variable to allow for differential trends in the control variables that may be correlated with the outcome variables. The results remain the same whether we interact the control variables with the post variable or not, which is unsurprising given the results in Table 2. The coefficient for the log of real income is positive and significant. This indicates that a 1 percent increase in oil extraction activities increased household income by approximately 0.4 percent for households living in an oil region compared to households in non-oil regions.

5.2 Effect on Consumption

As seen in Table 3 columns 2 and 5, the coefficient on real consumption is positive but not statistically significant. We also investigate the poverty status of the household. The dummy variable $Poor$ is equal to one if a household is below the poverty line and zero otherwise[16]. The Columns 3 and 6 present the results. The coefficients have the right sign, which indicates a reduction in poverty even though the results are not statistically significant. The results indicate that the increase in real income did not translate into significant increases in consumption. In a separate section, we discuss alternative reasons for these results.

5.3 Effect on Employment

Oil production can have indirect impacts on other sectors.[17] To determine the indirect effects of the oil discovery on employment in various sectors, we construct indicators of employment in sectors such as manufacturing, retail and wholesale trade, construction, services and agriculture. These indicators are dummy variables for the sector of employment for each individual who falls within the age group under

[16] The variable poor defines the poverty status of a household based on the poverty line. The poverty line is GH¢1,314 per adult equivalent per year in 2013 prices

[17] Direct local employment in the oil and gas sector constitutes a small percentage (0.039%) of total employment (Ministry of Finance, 2014).

consideration. We control for the individual's age, gender, whether the individual lives in an urban or rural area and geographic controls. Table 4 reports regression results on employment. Employment in general increased by 4 percent. Manufacturing and construction employment increased significantly. A percentage increase in oil production increases manufacturing employment by approximately 4 percent and construction by 2 percent. Employment in the agricultural, retail and services sectors increased although not significant. The findings of IFC (2018) indicate that, despite Ghana's local content regulation that started in 2014,[18] limited opportunities are available to the local workforce, mainly because of the knowledge and technology intensive nature of the industry, and lack of education and vocational training of local labor force. Our results are consistent with these findings.

5.4 *Robustness Checks*

We conduct a number of robustness checks. First, as discussed in section 4, we excluded the Central region due to an existing onshore oil field[19]. We examine the sensitivity of the results to the inclusion of districts in this region. The results are presented in Table 5a. The sample includes the excluded region and all regions in the main results. The results are robust to the inclusion of districts in this region, indicating that our main results are not driven by the exclusion of these districts. We also examine whether the findings on employment are sensitive to the inclusion of these districts. In Table 5b, we show that manufacturing and construction employment remain significant. The coefficients on retail and services remain positive and insignificant.

Secondly, in order to ensure that the control group is similar to the treatment group, we use non-oil regions that are within 200 miles of the oil region. Unlike the main results that include all districts in non-oil regions, this specification restricts the control group to only districts in non-oil regions within 200 miles. The results remain unchanged

[18] In Ghana, the local content regulation requires that, within a decade from the date of effectiveness of the license or the petroleum agreement, over 60 percent of goods and services be sourced from local companies and over 70 percent of technical and management staff be Ghanaians (IFC, 2018).

[19] In addition to the central region, we show that including regions in the north as control regions does not affect the main results.

for income, consumption and employment. There is an increase in income for households in the oil region compared to those in the non-oil region. Employment increased in both manufacturing and construction sectors. The results are robust to different thresholds of distance (as opposed to 200 miles). These results are presented in Tables A-4 and A-5 in the Appendix.

Third, in a separate regression, we look at public transfers received by households. According to official documents, the government does not redistribute oil revenues in the form of transfers to households. Consistently, pur result indicates that the government transfers do not drive the observed results of income increases. Nor do we find significant increases in public transfers due to offshore oil production. [20]

Finally, the interaction of a time trend and an indicator variable for households that live in coastal areas was included as a control. This addresses concerns that coastal areas might be seeing an improvement in income and employment over the time period under consideration due to reasons other than the oil. As an alternative to the indicator for coastal areas, we include distance to the port city as a control. These results are presented in Tables 6 and A-6 in the Appendix.

5.5. *Heterogeneous Effects*

Our results indicate that oil discovery increased household income and likelihood of gaining employment in the manufacturing and construction sectors. We examine heterogeneous impacts by gender and education of workers. Offshore oil development is more capital-intensive than other conventional oil and gas explorations because the facilities required for extraction and delivery of products are typically more elaborate. As a result of its capital-intensive nature, offshore oil development may require relatively more educated labor workforce than the inland counterpart. This observation indicates that the local labor workforce with high level of education is more likely to benefit from the positive impacts.

[20] These results are not included in the main paper due to small sample size. Public transfer is defined as all income transfers from the government, including income from Ghana's conditional transfer program (LEAP). Also, the results lend support to the argument that any increase in income is as a result of the oil rather than other factors.

To explore the differential effect on education of labor force, we use the education level of the household head. We define educated workers as those whose years of education exceed the median years of schooling in the sample.[21] The results in Table 7 show that the positive effect on income is concentrated mainly on educated workers as opposed to less educated workers. This is consistent with the findings by IFC (2018). Additionally, to determine the gender differences, we run regressions for male and female separately. We find that there is no evidence of gender differences in impacts.

5.6. *Why did the increase in income not translate into increases in consumption expenditure?*

Our results show that though the oil discovery increased households' income this did not translate into an increase in consumption. The coefficient on consumption is positive but not statistically significant. We examine possible explanations for this result. First, the oil discovery increased employment in manufacturing and construction sectors where only a small percentage of the poor are engaged. Yet, it had no impacts on retail, services and agricultural employment in which a large proportion of the poor are engaged. Second, changes in the composition of household spending can result in reduced spending.[22] Households can shift expenditure on food, for example, to more durable goods (Banerjee et al. 2015).[23]

Lastly, since the consumption and poverty variables have the right signs, the insignificant results suggest that it may take some time for the effects to become visible. Note our results are consistent with previous studies. Aragón, Chuhan-Pole, and Land (2015) find that total expenditure for households in gold mining communities in Ghana did not increase though wages increased.

[21] Average years of schooling refer to the median years of schooling in the sample, which is equivalent to having secondary level education. The median years of schooling is 10 years; hence, households with 10 years or more years of schooling are classified as skilled workers. In addition, we use the actual level of education defined as primary, secondary and tertiary education rather than the number of years. These are binary variables for each category. Both definitions give the same results.

[22] Banerjee et al. (2015) find that households' access to microcredit did not lead to significant increases in total consumption, but a shift in the composition of consumption goods from non-durable goods to durable goods such as refrigerators and motorcycles.

[23] Our measure of total expenditure includes both food and non-food expenditures.

6. Alternative Mechanisms

Are the results driven by selective migration?

Migration is likely to bias our results if households moved into districts of the oil region in pursuit of better opportunities as a result of the oil. There is a possibility of households self-selecting into the region after the discovery. Additionally, given that the oil region has mining sites, there is a likelihood that some households migrated into the region because of mining. For example, there will be an upward bias in our results if people who already have jobs or earn more income move into the oil region. Thus, it is important to ensure that our results are not driven by such compositional changes.

In addressing this concern, we restrict the analysis to the non-migrant sub-population. We define non-migrants as households (or individuals) who lived in the same region before and after the oil discovery[24]. The results are presented in Tables 8a and 8b. The results remain unchanged, indicating that our results are not necessarily driven by selective migration into the region.

7. Conclusion

This paper examined the local impacts of Ghana's offshore oil discovery in 2007. We find that the oil discovery increased real income and employment for households and individuals in districts associated with oil discovery compared to those without such discovery. Income increased by 4 percent for households living in the oil region compared to households in non-oil regions. The increase in income is stronger for workers with higher levels of education relative to less educated workers. We find similar effects when studying employment outcomes. Local employment in general increased by 4.5 percent, with the discovery having an indirect impact on other non-oil local sectors such as

[24] Our data allows us to determine individuals who migrated from other regions and when they moved.

manufacturing and construction. There were no significant impacts on agriculture and service employment.

Though we find the effect of offshore oil production on income to be significant, we do not find a statistically significant impact on consumption. This may be because poor households that are mainly involved in the agricultural and service sectors did not benefit from the increase in employment or because of shifts in consumption from non-durable to durable goods.

We note that these results should be viewed as short-run effects because offshore oil discovery in Ghana was relatively recent and thus we examine the impacts only a few years after the discovery. In order to explore the longer-term effects of oil on local communities, an extension of the time period with a more recent wave of household survey data (GLSS 7) will be carry out. Later waves of household survey will provide in-depth insights on the long-term impacts of oil on local communities.

Overall, the findings suggest that the offshore oil discovery and production can create opportunities for local firms and workers in other sectors. They also indicate that the positive economic impacts may be limited to those households with educated workers. The fact that the benefits reached more educated workforce implies that investment in education and skills training is important for the local labor force and could serve as a poverty reduction tool. Investigating whether such distributional impacts can be resolved over time requires further studies with longer-term observations upon offshore oil discovery.

There is large potential create economic benefits of the oil development locally through transfers of oil revenue from the central government to the district governments. It can support investment in education and infrastructure. Such investment can strengthen the positive impacts of oil development and reduce poverty. Thus, efficient public spending needs to be given a high priority on the policy agenda.

The quality of governance and institutions has tremendous impacts on the allocation of revenue (Anderson, Francois, and Kotwal 2015, Besley and Burgess 2002, Bhattacharyya and Hodler 2010, Brollo et al. 2013b, Lizzeri and Persico 2001). Empirical

evidence from other countries suggest oil revenue can bring about corruption and rent seeking behavior. Transparency of revenue collection and allocation is critical to prevent the misuse of the revenue.

References

Ades, Alberto, and Rafael Di Tella. 1999. "Rents, competition, and corruption." *American economic review* 89 (4):982-993.

Alexeev, Michael, and Robert Conrad. 2009. "The Elusive Curse of Oil." *The Review of Economics and Statistics* 91 (3):586-598. doi: 10.1162/rest.91.3.586.

Anderson, Siwan, Patrick Francois, and Ashok Kotwal. 2015. "Clientelism in Indian villages." *American Economic Review* 105 (6):1780-1816.

Angrist, Joshua D, and Adriana D Kugler. 2008. "Rural windfall or a new resource curse? Coca, income, and civil conflict in Colombia." *The Review of Economics and Statistics* 90 (2):191-215.

Aragón, Fernando M, Punam Chuhan-Pole, and Bryan Christopher Land. 2015. The local economic impacts of resource abundance: What have we learned? In *Policy Research Working Papers*: The World Bank.

Aragón, Fernando M, and Juan Pablo Rud. 2013. "Natural resources and local communities: evidence from a Peruvian gold mine." *American Economic Journal: Economic Policy* 5 (2):1-25.

Aragón, Fernando M, and Juan Pablo Rud. 2015. "Polluting industries and agricultural productivity: Evidence from mining in Ghana." *The Economic Journal* 126 (597):1980-2011.

Banerjee, Abhijit, Esther Duflo, Rachel Glennerster, and Cynthia Kinnan. 2015. "The miracle of microfinance? Evidence from a randomized evaluation." *American Economic Journal: Applied Economics* 7 (1):22-53.

Berman, Nicolas, Mathieu Couttenier, and Dominic Rohner. 2017. "This Mine is Mine! How Minerals Fuel Conflicts in Africa." *American Economic Review* 107 (6):1564-1610.

Berman, Nicolas, Mathieu Couttenier, Dominic Rohner, and Mathias Thoenig. 2017. "This Mine is Mine! How Minerals Fuel Conflicts in Africa." *American Economic Review* 107 (6):1564-1610. doi: 10.1257/aer.20150774.

Besley, Timothy, and Robin Burgess. 2002. "The political economy of government responsiveness: Theory and evidence from India." *The Quarterly Journal of Economics* 117 (4):1415-1451.

Bhattacharyya, Sambit, and Roland Hodler. 2010. "Natural resources, democracy and corruption." *European Economic Review* 54 (4):608-621.

Black, Dan, Terra McKinnish, and Seth Sanders. 2005. "The Economic Impact Of The Coal Boom And Bust*." *Economic Journal* 115 (503):449-476. doi: 10.1111/j.1468-0297.2005.00996.x.

Brollo, Fernanda, Tommaso Nannicini, Roberto Perotti, and Guido Tabellini. 2013a. "The political resource curse." *The American economic review* 103 (5):1759-1796. doi: 10.1257/aer.103.5.1759.
Brollo, Fernanda, Tommaso Nannicini, Roberto Perotti, and Guido Tabellini. 2013b. "The political resource curse." *American Economic Review* 103 (5):1759-96.
Bulte, Erwin H., Richard Damania, and Robert T. Deacon. 2005. "Resource intensity, institutions, and development." *World Development* 33 (7):1029-1044. doi: 10.1016/j.worlddev.2005.04.004.
Caselli, Francesco, and Guy Michaels. 2013. "Do oil windfalls improve living standards? Evidence from Brazil." *American Economic Journal: Applied Economics* 5 (1):208-238.
Chuhan-Pole, Punam, Andrew Dabalen, Andreas Kotsadam, Aly Sanoh, and Anja Tolonen. 2015. *The local socioeconomic effects of gold mining: evidence from Ghana*: The World Bank.
Cotet, Anca M, and Kevin K Tsui. 2013. "Oil and conflict: What does the cross country evidence really show?" *American Economic Journal: Macroeconomics* 5 (1):49-80.
Douglas, Stratford, and Anne Walker. 2017. "Coal mining and the resource curse in the eastern United States." *Journal of Regional Science* 57 (4):568-590.
Fleming, David A, and Thomas G Measham. 2015. "Local economic impacts of an unconventional energy boom: the coal seam gas industry in Australia." *Australian Journal of Agricultural and Resource Economics* 59 (1):78-94.
Greenstone, Michael, Richard Hornbeck, and Enrico Moretti. 2010. "Identifying agglomeration spillovers: Evidence from winners and losers of large plant openings." *Journal of Political Economy* 118 (3):536-598.
Gylfason, Thorvaldur, and Gylfi Zoega. 2006. "Natural Resources and Economic Growth: The Role of Investment." *World Economy* 29 (8):1091-1115. doi: 10.1111/j.1467-9701.2006.00807.x.
Hilson, Gavin. 2009. "Small-scale mining, poverty and economic development in sub-Saharan Africa: An overview." *Resources Policy* 34 (1):1-5.
IFC. 2018. Estimating the Effects of the Development of the Oil and Gas Sector on Growth and Jobs in Ghana (2015-30): A Modelling and Value Chain Analysis. Washington DC.
Kotsadam, Andreas, and Anja Tolonen. 2016. "African mining, gender, and local employment." *World Development* 83:325-339.
Lizzeri, Alessandro, and Nicola Persico. 2001. "The provision of public goods under alternative electoral incentives." *American Economic Review* 91 (1):225-239.
Loayza, Norman, Alfredo Mier Y. Teran, and Jamele Rigolini. 2013. *Poverty, Inequality, and the Local Natural Resource Curse*: The World Bank.
Marchand, Joseph. 2011. "Local labor market impacts of energy boom-bust-boom in Western Canada." *Journal of Urban Economics*. doi: 10.1016/j.jue.2011.06.001.
Mehlum, Halvor, Karl Moene, and Ragnar Torvik. 2006. "Institutions and the Resource Curse*." *Economic Journal* 116 (508):1-20. doi: 10.1111/j.1468-0297.2006.01045.x.

Michaels, Guy. 2011. "The long term consequences of resource-based specialisation." *The economic journal : the journal of the Royal Economic Society* 121 (551):31-57. doi: 10.1111/j.1468-0297.2010.02402.x.
Ministry of Finance, MOF. 2014. Final Report on the Production of Oil & Gas Sector GHEITI Report For 2012 and 2013. Accra, Ghana.
Moretti, Enrico. 2010. "Local multipliers." *The American Economic Review* 100 (2):373-377.
Sachs, Jeffrey D, and Andrew M Warner. 1995. Natural resource abundance and economic growth. National Bureau of Economic Research.
Sachs, Jeffrey D., and Andrew M. Warner. 2001. "The curse of natural resources." *European Economic Review* 45 (4):827-838. doi: 10.1016/S0014-2921(01)00125-8.
Smith, Brock. 2015. "The resource curse exorcised: Evidence from a panel of countries." *Journal of Development Economics* 116:57-73.
van der Ploeg, F. 2011a. "Natural resources: Curse of blessing?" *The Journal of Economic Literature* 49 (2):366-420. doi: 10.1257/jel.49.2.366.
Van der Ploeg, Frederick. 2011b. "Natural resources: curse or blessing?" *Journal of Economic Literature* 49 (2):366-420.
Vicente, Pedro C. 2010. "Does oil corrupt? Evidence from a natural experiment in West Africa." *Journal of Development Economics* 92 (1):28-38. doi: 10.1016/j.jdeveco.2009.01.005.

Table 1: Summary statistics

Variables	Mean	SD	N
Income Per capita	3,682.2	16,693.4	14,106
Consumption Per capita	1,564.6	2,264.2	14,300
Household Size	5.3	2.8	14,300
Migrant	51.5%	50.0%	8,356
Male	73.1%	44.4%	14,300
Age	46.2	13.9	14,300
Urban	56.4%	49.6%	14,300
Electricity	66.1%	47.3%	14,291
No Education	17.6%	38.1%	13,686
Primary Education	19.1%	39.3%	13,686
Secondary Education	55.4%	49.7%	13,686
Tertiary Education	7.9%	27.0%	13,686
HH. members in Industry	27.7%	44.8%	12,614
HH. members in Services	53.8%	49.9%	12,614
HH. members in Agriculture	47.8%	50.0%	12,614
Poor	17.6%	38.1%	14,300

Notes: Means are estimated using sample weights. HH. members in (Industry, Service and Agriculture) refers to the share of household members in each of the sectors. Income and consumption are measured in Ghana Cedi. Poor refers to percentage of households below the poverty line.

Table 2: Baseline household characteristics between treatment and control groups

	Control Group		Treatment Group			
Variables	Mean	SD	Mean	SD	Difference	
Household Size	5.30	(2.79)	5.60	(2.85)	0.36	(0.32)
Male	0.72	(0.45)	0.77	(0.42)	0.04*	(0.02)
Age	46.31	(13.99)	45.61	(13.57)	-0.70	(0.70)
Urban	0.57	(0.50)	0.56	(0.50)	0.19	(0.14)
Electricity	0.67	(0.47)	0.62	(0.48)	-0.02	(0.10)
No Education	0.18	(0.38)	0.18	(0.38)	0.00	(0.03)
Primary Education	0.19	(0.39)	0.22	(0.41)	0.02	(0.03)
Secondary Education	0.56	(0.50)	0.54	(0.50)	0.00	(0.04)
Tertiary Education	0.08	(0.27)	0.07	(0.25)	-0.02	(0.02)
HH. members in Industry	0.28	(0.45)	0.26	(0.44)	-0.08	(0.05)
HH. members in Industry	0.56	(0.50)	0.42	(0.49)	-0.14	(0.09)
HH. members in Agriculture	0.45	(0.50)	0.62	(0.49)	0.16	(0.12)

Notes: This table reports average characteristics of the control and treated groups. Standard errors of the differences in average characteristics are in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table3: Impact of oil discovery on household income and consumption

Variables	Ln (Real Income)	Ln (Real Expenditure)	Poor	Ln (Real Income)	Ln (Real Expenditure)	Poor
	(1)	(2)	(3)	(4)	(5)	(6)
*T*Post*	0.399***	0.038	-0.026	0.436***	0.036	-0.025
	(0.131)	(0.061)	(0.043)	(0.131)	(0.066)	(0.045)
Constant	3.200**	3.824***	0.229	3.340**	3.870***	0.195
	(1.604)	(0.931)	(0.638)	(1.566)	(0.906)	(0.631)
*X*Post*	No	No	No	Yes	Yes	Yes
Observations	5,617	6,571	6,571	5,617	6,571	6,571
R-squared	0.645	0.882	0.236	0.647	0.884	0.242

Notes: Each column includes household controls and district fixed effects. In columns 4-6 we include interaction of the control variables and post variable. The controls include age of the household head, indicator for whether the household live in an urban area, have access to electricity, education of the household head and share of household members in industry, agriculture and services. All regressions include geographical location of the household. Poor is a dummy variable that indicates the poverty status of the household. It is estimated with a linear probability model. Standard errors in parentheses are clustered at the enumeration area level.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Impact of oil discovery on employment

Variables	Employment	Agriculture	Manufacturing	Employment	Agriculture	Manufacturing
	(1)	(2)	(3)	(4)	(5)	(6)
*T*Post*	0.040**	-0.030	0.039*	0.045***	-0.006	0.040*
	(0.017)	(0.046)	(0.020)	(0.017)	(0.038)	(0.021)
Constant	-0.092	-0.766*	0.862***	0.063	-1.020***	0.878***
	(0.133)	(0.441)	(0.178)	(0.128)	(0.378)	(0.174)
*X*Post*	No	No	No	Yes	Yes	Yes
Observations	17,672	12,794	12,794	17,672	12,794	12,794
R-squared	0.768	0.372	0.040	0.765	0.445	0.044
Variables	Construction	Retail	Services	Construction	Retail	Services
	(7)	(8)	(9)	(10)	(11)	(12)
*T*Post*	0.021**	0.027	0.017	0.021**	0.017	0.008
	(0.010)	(0.027)	(0.026)	(0.010)	(0.023)	(0.022)
Constant	0.076	0.519**	0.067	0.109	0.709***	0.299
	(0.091)	(0.215)	(0.242)	(0.091)	(0.204)	(0.212)
*X*Post*	No	No	No	Yes	Yes	Yes
Observations	12,794	12,794	17,896	12,794	12,794	17,896
R-squared	0.063	0.153	0.227	0.066	0.172	0.248

Notes: All outcome variables are indicators of employment. That is, a dummy variable equal to 1 if an individual works in a particular sector. Employment refers to whether an individual is employed or not. These are estimated using a linear probability model. Each column includes district fixed effects. Columns 4-6 and columns 10-12 include an interaction of the control variables and post variable. Standard errors in parentheses are clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0

Table 5a: Robustness check: Real income and consumption

Variables	Ln (Real Income)	Ln (Real Expenditure)	Poor	Ln (Real Income)	Ln (Real Expenditure)	Poor
	(1)	(2)	(3)	(4)	(5)	(6)
*T*Post*	0.563***	0.049	-0.031	0.470***	0.034	-0.029
	(0.127)	(0.061)	(0.043)	(0.132)	(0.066)	(0.043)
Constant	1.275	4.785***	0.021	1.305	4.858***	-0.096
	(1.507)	(0.787)	(0.580)	(1.508)	(0.761)	(0.570)
*X*Post*	No	No	No	Yes	Yes	Yes
Observations	6,960	8,091	8,091	6,960	8,091	8,091
R-squared	0.641	0.882	0.303	0.644	0.885	0.318

Note: We include other non-oil regions that were not part of the control group in the main results as part of the control group. The results remain unchanged. Each column includes household controls and district fixed effects. In columns 4-6 we include an interaction of the control variables and post variable. All regressions include geographical location
of the household. Poor is a dummy variable that indicates the poverty status of the household. Standard errors in parentheses are clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0.1

Table 5b: Robustness check: Employment

Variables	Employment	Agriculture	Manufacturing	Employment	Agriculture	Manufacturing
	(1)	(2)	(3)	(4)	(5)	(6)
T*Post	0.046***	-0.042	0.038*	0.051***	-0.019	0.038*
	(0.016)	(0.045)	(0.012)	(0.017)	(0.038)	(0.021)
Constant	-0.069	-0.950**	0.916***	0.098	-1.092***	0.951***
	(0.122)	(0.407)	(0.170)	(0.119)	(0.350)	(0.167)
Control*Post	No	No	No	Yes	Yes	Yes
Observations	19,327	13,895	13,895	19,327	13,895	13,895
R-squared	0.776	0.372	0.044	0.773	0.444	0.048
Variables	Construction	Retail	Services	Construction	Retail	Services
	(7)	(8)	(9)	(10)	(11)	(12)
*T*Post*	0.012**	0.032	0.024	0.019*	0.021	0.015
	(0.0096)	(0.026)	(0.025)	(0.010)	(0.022)	(0.021)
Constant	0.088	0.590***	0.115	0.111	0.717***	0.262
	(0.083)	(0.197)	(0.218)	(0.082)	(0.188)	(0.195)
*X*Post*	No	No	No	Yes	Yes	Yes
Observations	13,895	13,895	19,604	13,895	13,895	19,604
R-squared	0.062	0.152	0.223	0.066	0.172	0.243

Notes: All outcome variables are indicators of employment. That is, a dummy variable equal to 1 if an individual works in a particular sector. Employment refers to whether an individual is employed or not. These are estimated using a linear probability model. Each column includes district fixed effects. Columns 4-6 and columns 10-12 include an interaction of the control variables and post variable. Standard errors in parentheses are clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0

Table 6: Additional robustness check: Income and consumption

Variables	Ln (Real Income)	Ln (Real Expenditure)	Poor	Ln (Real Income)	Ln (Real Expenditure)	Poor
	(1)	(2)	(3)	(4)	(5)	(6)
*T*Post*	0.415***	0.056	-0.024	0.405***	0.036	-0.024
	(0.136)	(0.065)	(0.045)	(0.139)	(0.062)	(0.043)
Constant	2.638	4.023***	0.225	2.473	3.820***	0.349
	(1.682)	(0.919)	(0.646)	(2.311)	(1.04)	(0.717)
Observations	5,447	6,391	6,391	5,447	6,391	6,391
R-squared	0.643	0.885	0.236	0.642	0.884	0.236

Notes: Columns 1-3 include an interaction of a time trend and an indicator for coastal areas. Columns 4-6 include distance to the port city. Each column includes household controls and district fixed effects. Standard errors in parentheses are clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Heterogeneous impacts

Variables	Skilled	Unskilled	Men	Women
	(1)	(2)	(3)	(4)
Panel A: Income				
T*Post	0.507***	0.298	0.369**	0.539**
	(0.140)	(0.219)	(0.156)	(0.235)
Constant	3.03*	2.797	3.542*	1.571
	(1.776)	(2.49)	(1.933)	(3.068)
Observations	3,466	2,151	4,039	1,578
R-squared	0.66	0.635	0.651	0.654
Panel B: Manufacturing				
T*Post	0.056**	0.025	-0.011	0.056**
	(0.023)	(0.029)	(0.025)	(0.023)
Constant	0.831***	0.882***	0.658***	0.831***
	(0.272)	(0.201)	(0.178)	(0.272)
Observations	6,507	6,287	6,214	6,507
R-squared	0.046	0.048	0.054	0.046
Panel C: Construction				
T*Post	0.018	0.023**	0.039**	0.018
	(0.014)	(0.012)	(0.019)	(0.014)
Constant	-0.003	0.119	0.216	-0.003
	(0.155)	(0.106)	(0.171)	(0.155)
Observations	6,507	6,287	6,214	6,507
R-squared	0.056	0.084	0.059	0.056

Notes: All regressions include district fixed effects. Standard errors in parentheses are clustered at the enumeration area level. Skilled and unskilled are binary variables based on the level of education of an individual. *** p<0.01, ** p<0.05, * p<0.1

Table 8a: Selective migration: Real income and consumption

Variables	Ln (Real Income)	Ln (Real Expenditure)	Poor
	(1)	(2)	(3)
*T*Post*	0.405***	0.036	-0.025
	(0.130)	(0.061)	(0.043)
Constant	3.217**	3.803***	0.217
	(1.606)	(0.937)	(0.642)
Observations	5,527	6,460	6,460
R-squared	0.645	0.882	0.237

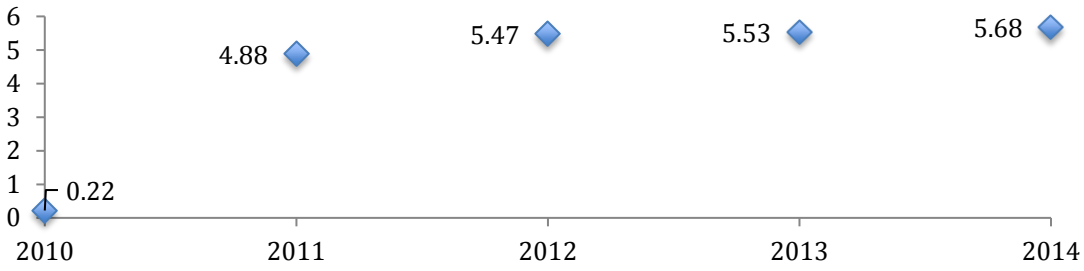
Notes: All regressions include district fixed effects Standard errors in parentheses area clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0.1

Table 8b: Selective migration: Employment

Variables	Agriculture	Manufacturing	Construction	Retail	Service
	(1)	(2)	(3)	(4)	(5)
T*Post	-0.033	0.039*	0.022**	0.030	0.018
	(0.047)	(0.020)	(0.010)	(0.027)	(0.026)
Constant	-0.746*	0.859***	0.082	0.516**	0.061
	(0.439)	(0.178)	(0.091)	(0.213)	(0.241)
Observations	12,609	12,609	12,609	12,609	17,633
R-squared	0.375	0.041	0.063	0.153	0.227

Notes: All regressions include district fixed effects. Standard errors in parentheses are clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Oil rents as a percentage of GDP



Source: World Development Indicators

Figure 2: The districts in our sample: treatment and control districts

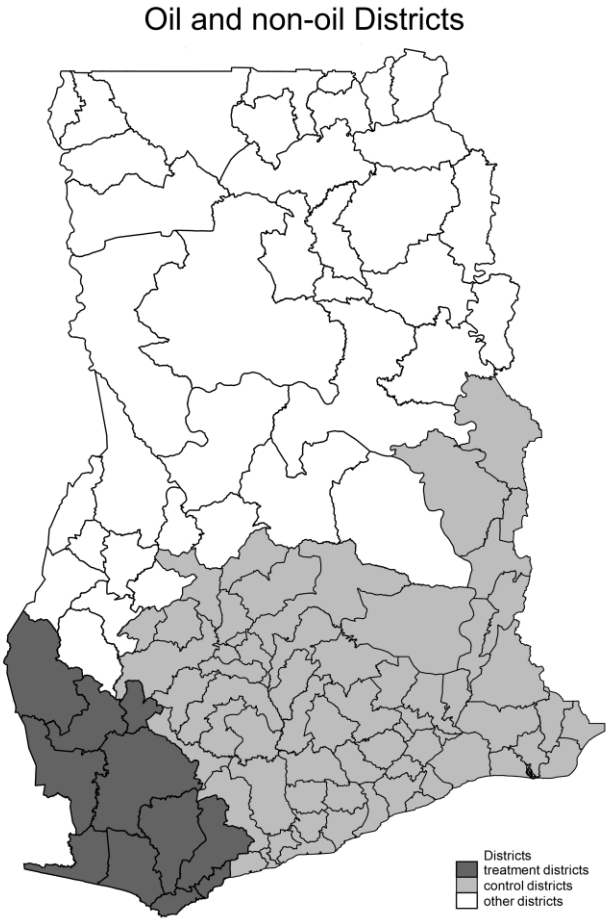
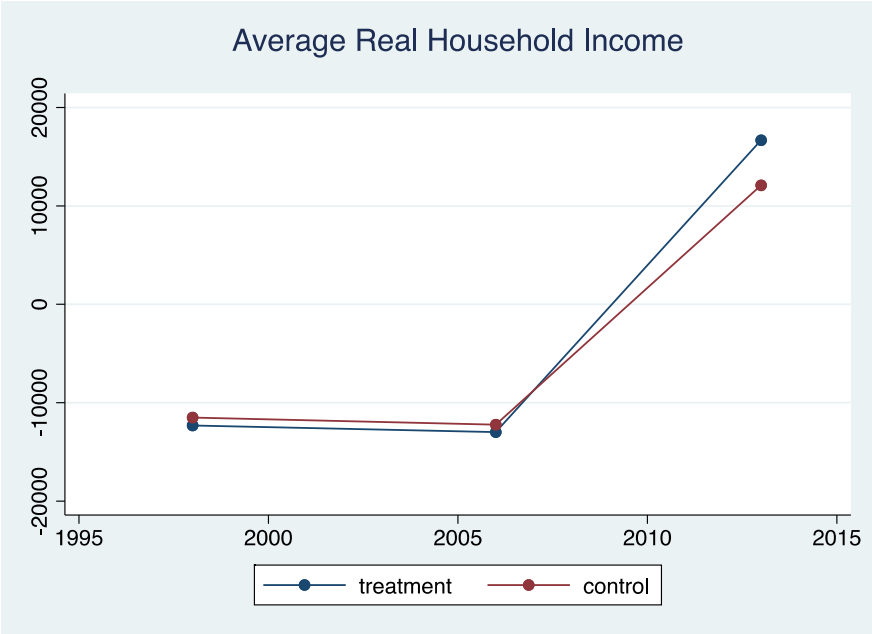


Figure 3: Conditional mean of real income.



Notes: This figure plots the trends in real income of households in the treatment and control groups.

Appendix

Table A-1: Summary statistics: Employment

	Pre-discovery			Post-discovery		
	Mean	SD	N	Mean	SD	N
Agriculture	60.4%	48.9%	14,039	50.5%	49.9%	30,866
Manufacturing	10.6%	30.8%	14,039	8.5%	27.9%	30,866
Construction	1.4%	11.7%	14,039	2.7%	16.3%	30,866
Retail	14.1%	34.7%	14,039	18.0%	38.5%	30,866
Service	13.8%	34.5%	20,657	21.6%	41.1%	3,9423
No education	30.8%	46.1%	18,801	21.3%	40.9%	38,670
Primary education	26.5%	44.1%	18,801	31.0%	46.2%	38,670
Secondary education	39.7%	48.9%	18,801	43.1%	49.5%	38,670
Tertiary education	2.9%	16.9%	18,801	4.5%	20.7%	38,670
Migrant	33.0%	47.0%	13,043	32.6%	46.8%	27,693
Male	46.4%	49.9%	20,657	45.4%	49.8%	39,423
Age	32.1	13.7	20,657	32.3%	13.6	39,423
Muslim	3.6%	18.6%	20,653	20.8%	40.6%	39,410
Urban	63.8%	48.1%	20,657	47.8%	49.9%	39,423
Ewe	11.3%	31.6%	20,220	12.5%	33.0%	38,983

Note: Means are estimated using sample weights.

TableA-2: Test for pre-trends

Variables	Ln (Real Income)	Employment	Ln (Real Income)	Employment
	(1)	(2)	(3)	(4)
T*Post	-1.252	0.044	0.412***	0.040**
	(0.800)	(0.079)	(0.138)	(0.017)
Sample	1999, 2006	1999, 2006	2006, 2013	2006, 2013
Constant	4.523	-0.012	3.043*	-0.092
	(2.766)	(0.136)	(1.660)	(0.133)
Observations	1,881	17,745	5,447	17,672
R-squared	0.342	0.768	0.642	0.768

Notes: All regressions include district fixed effects. In Columns 1 and 2 the sample is restricted to 1998/1999 and 2005/2006 to test for pre-trends, and the sample is restricted to 2005/2006 and 2012/2013 for subsequent changes after the discovery. Standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A-3: Correlations between treatment variable with observable characteristics

Variables	No education	Primary	Secondary	Tertiary	Non-Akan	Gender	Migrant	Muslim	Employed	Urban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
T*Post	-0.020	0.035	-0.016	0.001	-0.001	0.011	-0.051	-0.027	-0.008	-0.367
	(0.023)	(0.030)	(0.041)	(0.010)	(0.018)	(0.012)	(0.074)	(0.042)	(0.038)	(0.254)
Constant	0.167***	0.273***	0.522***	0.039***	0.205***	0.463***	0.347***	0.050***	0.641***	0.508***
	(0.023)	(0.025)	(0.038)	(0.0069)	(0.033)	(0.005)	(0.039)	(0.011)	(0.032)	(0.102)
Observations	30,125	30,125	30,125	30,125	30,614	31,155	20,056	31,144	30,878	31,155
R-squared	0.005	0.003	0.001	0.003	0.020	0.000	0.010	0.014	0.005	0.019

Notes: All regressions include sample weights. Sample is restricted to individuals. Standard errors in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table A-4: Robustness check: control regions within 200 miles and 250 miles of oil region

Variables	Ln (Real Income) (1)	Ln (Real Expenditure) (2)	Poor (3)	Ln (Real Income) (4)	Ln (Real Expenditure) (5)	Poor (6)
Panel A: Within 200 miles						
T*Post	0.399***	0.030	-0.020	0.434***	0.032	-0.029
	(0.132)	(0.062)	(0.043)	(0.134)	(0.068)	(0.045)
Constant	3.121*	3.808***	0.260	3.308**	3.880***	0.188
	(1.619)	(0.945)	(0.650)	(1.577)	(0.921)	(0.637)
Control*Post	No	No	No	Yes	Yes	Yes
Observations	5,586	6,539	6,539	5,586	6,539	6,539
R-squared	0.643	0.882	0.241	0.645	0.886	0.253
Panel B: Within 250 miles						
T*Post	0.399***	0.038	-0.026	0.438***	0.040	-0.034
	(0.131)	(0.061)	(0.043)	(0.134)	(0.067)	(0.045)
Constant	3.200**	3.824***	0.229	3.348**	3.890***	0.149
	(1.604)	(0.931)	(0.638)	(1.563)	(0.908)	(0.625)
*X*Post	No	No	No	Yes	Yes	Yes
Observations	5,617	6,571	6,571	5,617	6,571	6,571
R-squared	0.645	0.882	0.236	0.647	0.886	0.249

Notes: Each column includes household controls and district fixed effects. In columns 4-6 we include an interaction of the control variables and post variable. The controls include age of the household head, indicator for whether the household live in an urban area, have access to electricity, education of the household head and share of household members in industry, agriculture and services. Poor is a dummy variable that indicates the poverty status of the household. Standard errors in parentheses are clustered at the locality level. *** p<0.01, ** p<0.05, * p<0.1

Table A-5: Robustness check: Control regions within 200 miles and 250 miles of oil region

Variables	Agriculture (1)	Manufacturing (2)	Construction (3)	Retail (4)	Service (5)	Agriculture (6)	Manufacturing (7)	Construction (8)	Retail (9)	Service (10)
Panel A: Within 200 miles										
T*Post	-0.030	0.041**	0.022**	0.0252	0.015	-0.008	0.042**	0.022**	0.0151	0.004
	(0.046)	(0.021)	(0.0098)	(0.027)	(0.026)	(0.039)	(0.021)	(0.010)	(0.023)	(0.022)
Constant	-0.587	0.822***	0.068	0.434**	-0.013	-0.674*	0.799***	0.071	0.535**	0.0833
	(0.451)	(0.179)	(0.092)	(0.219)	(0.246)	(0.393)	(0.176)	(0.092)	(0.209)	(0.216)
Control*Post	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	12,740	12,739	12,739	12,739	17,803	12,739	12,739	12,739	12,739	17,803
R-squared	0.375	0.040	0.063	0.153	0.228	0.450	0.045	0.067	0.174	0.251
Panel B: Within 250 miles										
T*Post	-0.030	0.039*	0.021**	0.027	0.017	-0.007	0.034*	0.021**	0.018	0.007
	(0.046)	(0.020)	(0.010)	(0.027)	(0.026)	(0.039)	(0.021)	(0.010)	(0.023)	(0.022)
Constant	-0.766*	0.862***	0.0762	0.519**	0.067	-0.772**	0.831***	0.075	0.585***	0.119
	(0.441)	(0.178)	(0.091)	(0.215)	(0.242)	(0.383)	(0.176)	(0.091)	(0.205)	(0.213)
*X*Post	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	12,794	12,794	12,794	12,794	17,896	12,794	12,794	12,794	12,794	17,896
R-squared	0.372	0.04	0.063	0.153	0.227	0.45	0.045	0.067	0.174	0.251

Notes: this table presents results on employment. Sample is restricted to individuals. Standard errors in parentheses are clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0.1

Table A-6: Additional robustness check: Employment

Variables	Employment	Agriculture	Manufacturing	Construction	Retail	Services
	(1)	(2)	(3)	(4)	(5)	(6)
T*Post	0.037**	-0.043	0.043**	0.020**	0.032	0.023
	(0.017)	(0.045)	(0.021)	(0.010)	(0.026)	(0.025)
Constant	-0.390**	-1.865***	1.165***	0.000	0.895**	0.649*
	(0.195)	(0.675)	(0.302)	(0.118)	(0.348)	(0.352)
Observations	17,672	12,794	12,794	12,794	12,794	17,896
R-squared	0.768	0.374	0.041	0.063	0.153	0.228

Notes: Each column includes distance to port city, individual control variables and district fixed effects. Sample is restricted to households. Standard errors in parentheses are clustered at the enumeration area level. *** p<0.01, ** p<0.05, * p<0.1