The Local Impact of Oil: Evidence from Nigeria (Preliminary draft: Please do not cite or circulate without the authors' permission)

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Abstract

Most contributions to the large literature on the natural resource curse focus on the country level. We study the development impact of oil deposits at the local level in Nigeria instead. We use geo-localized survey data to construct various development and wealth indicators for localities within and outside of oil regions. To establish causality we employ differences-in-differences estimators and exploit the rapid increase in the international price of oil from 2003 to 2008. We find that the price increase tends to harm communities in oil-producing regions relative to other regions, which is evidence for an oil curse at the local level in Nigeria. These negative effects do not spill over to neighboring regions. Rather, we find evidence for at least some positive spillovers of the oil price surge to neighboring regions, which are not traceable to fiscal redistribution of oil windfalls.

Keywords: Nigeria, natural resource curse, oil, spillovers.

JEL classification: H71, L71, O13, O55, Q32, Q33.

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1 Introduction

Following the influential work of Sachs and Warner (1995), the natural resource curse has attracted considerable attention in economics and political science.[1] So far, most contributions have used countries as units of observation. While some of these contributions study whether natural resources have a negative effect on economic development in an average country, others focus on factors explaining why natural resources seem to be a curse for some countries, but a blessing for others. These latter contributions find that natural resources tend to be a curse for countries characterized by high ethnic fractionalization (Hodler, 2006), weak political and economic institutions (Mehlum et al., 2006; Bhattacharyya and Hodler, 2010), and presidential systems (Andersen and Aslaksen, 2008). Nigeria is one of the world's largest oil exporters, ethnically highly fractionalized, weakly institutionalized with a presidential system, and has performed poorly over the last decades (Sala-i-Martin and Subramanian, 2003). Nigeria has thus become the prime example of a country cursed by natural resources.

In this paper, we move beyond the country level, and study the effects of oil production and oil revenues on economic development at the local level in Nigeria. We use geo-localized data from Demographic and Health Surveys (DHS) carried out in Nigeria in 2003, 2008 and 2013 to construct educational, health and wealth measures for clusters of households corresponding to villages or urban blocks. Further we use information on the location of oilfields from the U.S. Geological Survey to identify oil regions. As a regional breakdown we choose Local Government Areas (LGAs), corresponding to the lowest level of Nigerian government, and classify as oil regions those LGAs which host at least one oilfield. To establish causality we exploit the rapid increase in the international price for crude oil over a five-year period to 2008. In particular, we employ differences-in-differences estimators to study how this rise in the oil price implicates diverging development results for localities within and outside of oil regions. We focus our analysis on the southern states of Nigeria, because that is where all oilfields are located, and because Nigeria's Christian-dominated south differs in many respects from its Muslim-dominated north.

Our main finding is that the rise in the international price of oil tends to have negative effects on local development outcomes in oil regions as compared to non-oil regions. Hence, there is evidence for an oil curse at the local level in Nigeria. We fail to find similar negative effects for clusters located in non-oil LGAs that are direct neighbors of LGA with oilfields. Rather, we find evidence for at least some positive spillovers of the oil price surge to neighboring regions. We also examine whether there is evidence for local development effects through fiscal redistribution of oil windfalls. We divide neighboring LGAs into those that belong to

[1] See van der Ploeg (2011) for an excellent literature review.

an oil-producing state and those that do not belong to an oil-producing state, exploiting the fact that oil-producing states benefit from an allocation of 13 percent of oil revenues from the central government, by federal legislation. We find similar effects on both types of neighboring LGAs. Hence, there is no evidence for local development impacts through fiscal channels.

We contribute to the emerging literature on the developmental effects of oil and other natural resources at the local level. Papyrakis and Gerlagh (2007) find a negative effect of natural resources on economic development in a sample of U.S. states, while Michaels (2011) finds a positive long-run effect of oil production on economic development in a sample of U.S. counties. A main difference of our study is its focus on an ethnically highly fractionalized and weakly institutionalized developing country.

Several recent contributions study the effect of a federal law in Brazil that determines the allocation of royalties to municipal governments. Caselli and Michaels (2013) focus on the effects of royalties from offshore oil production to municipalities without onshore oil production. They find that these windfalls increase public spending on education, health, public infrastructure and transportation, but have no systematic effect on the actual provision of the corresponding public services. Similarly, Monteiro and Ferraz (2012) find no systematic effect of oil royalties on public service provision, but show that oil royalties increase the number of municipal employees and the mayors' reelection chances. Postali and Nishijima (2012) however present evidence for positive long-run effects of oil royalties on the provision of some public services and educational outcomes. Looking at Indonesia rather than Brazil, Olsson and Valsecchi (2012) study a country-wide reform that decentralized oil revenues from the federal government to provincial governments. Comparing districts in oil-rich provinces with neighboring districts in oil-poor provinces, they find that these windfalls had a small positive effect on the provision of some public goods in oil-rich provinces. Our paper differs in at least three respects: First, these studies focus on subnational administrative units that receive higher revenues, which happen to be related to oil production elsewhere, while we mainly focus on localities within administrative areas in which oilfields are actually located.[2] Second, for causal inference these studies exploit federal laws and changes thereof, while we exploit changes in the international price of oil. Third, we focus on Nigeria, which is more dependent on oil revenues and more ethnically fractionalized than Brazil and Indonesia, and its political and economic institutions are weaker as well.

By studying spillovers into neighboring regions, our study is also related to Aragón and Rud (2012). They find evidence for positive local spillovers from a gold mine in Peru. We

[2] Our exploration of differences between neighboring LGAs in oil states and non-oil states is however related to Olsson and Valsecchi's (2012) approach. Unlike Olsson and Valsecchi (2012), we find no evidence for positive effects of fiscal transfers.

do not find evidence for spillovers from oil production to localities in neighboring regions in Nigeria.

The remainder of the paper is structured as follows: Section 2 provides a short overview of oil production and the governance of the oil sector in Nigeria. Section 3 discusses our data, and Section 4 our empirical strategy. Section 5 presents our findings. Section 6 briefly concludes.

2 Oil in Nigeria

2.1 Nigeria's oil production and its implications for development

Oil was first discovered in commercial quantities in the Eastern Niger Delta in 1956, four years before Nigeria's independence from Britain. Shell-BP took up production for export in 1958, and other companies joined soon after independence. Oil production increased significantly in the early and mid 1960s as numerous new oilfields were developed. The Biafra war from 1966 to 1970, which arose from ethnic tensions and was fuelled by disputes over the distribution of oil revenues, implicated an abrupt drop in oil output, but production recovered quickly thereafter and escalated in the early 1970s. Nigeria became a member of the Organization of the Petroleum Exporting Countries (OPEC) in 1971. Ever since the first oil crisis in 1973, the petroleum industry has been the mainstay of Nigeria's economy. Production declined in the early 1980s as world oil demand contracted, and output only recovered in the early 1990s. Remaining at high levels with a slightly increasing trend over the last two decades, crude oil production was almost 2 billion barrels per day in 2010 (OPEC, 2013).[3]

Today, oil revenues constitute 90 percent of Nigeria's export revenues and 75 percent of its government revenues. Nigeria is the largest oil producer in Africa and ranks among the world's top ten oil-producing countries. It has 2,168 producing wells, and proven crude oil reserves are estimated at 37 billion barrels, making it one of the ten most petroleum-rich countries in the world (IMF, 2013a,b; OPEC, 2013).

However, oil exploration in Nigeria has been accompanied from the early stages by recurring cycles of unrest and conflict in the Niger Delta, where oilfields are primarily located. Local groups are seeking to increase their share of the oil wealth, with violent attacks on oil and gas infrastructure, sabotage of pipelines, and kidnapping of industry personnel. In addition to the humanitarian and social cost it involves for local communities, conflict and insecurity in the Niger Delta lead to lost revenue for government and oil companies, and increased operating costs have induced some international oil companies to pull out of oper-

[3]See Thurber et al. (2010) for a concise history of oil production in Nigeria.

ations from onshore oilfields (EIA, 2013).

Oil money inundating government accounts has also spurred rent seeking and corruption at all levels of government, and the oil sector has been sphered by a lack of transparency, notably throughout the era of military rule from 1980 to 1999. The Economic and Financial Crimes Commission of Nigeria, established in 2004, revealed that between 1960 and 1999 the country's rulers stole an estimated USD 400 billion in oil revenues, which is equal to all the foreign aid payments to Africa during the same period (Okpanachi, 2011).

Another adverse side-effect of oil exploitation in the Niger Delta Region is the severe damage it has caused to the local environment. Local communities have been exposed to hydrocarbon contamination of wells used for drinking water. They also face degradation of the natural resources that underpin their livelihoods, such as soil on agricultural lands and fish stocks. Air pollution from gas flaring and risk of fire accidents associated with oil spills have also lead to public health concerns.[4]

In light of these realities, it is not too surprising that to the present Nigeria has failed to translate its resource wealth into sustained economic growth and human development for its people. While it is classified as a lower middle income country with a GDP per capita of around USD 3,000 in 2013, Nigeria is branded by some of the gravest poverty records in the world. On the Human Development Index list, Nigeria ranks 153 among 186 countries. An average Nigerian has 5.2 years of schooling and a life expectancy of 52 years. More than two thirds of the population live on less than USD 1.25 per day (UNDP, 2013). Nigeria's infant mortality rate was 78 deaths per 1,000 live births in 2012, making it rank in the bottom ten out of 226 countries (World Bank, 2014). The sharp contradiction between the country's poor development outcomes and its resource wealth has been frequently cited as an infamous manifestation of the natural resource curse (e.g., Sala-i-Martin and Subramanian, 2003; Collier, 2007).

High ethnic fractionalization and weak political and economic institutions are often seen as pivotal factors that have hindered Nigeria from turning its oil wealth into prosperity. According to Alesina et al. (2003), the index of ethnic fractionalization, which measures the probability that two randomly selected individuals belong to different ethnic groups, is 0.85 for Nigeria. Hence, Nigeria is among the ten most ethnically fractionalized countries in the world, and more ethnically fractionalized than any other of the 25 largest oil exporters. The Polity2 indicator from the Polity IV project is one of the most often used measures of the quality of political institutions. It ranges from -10 to 10, with higher values implying better institutions. The value for Nigeria in 2003 is 4, so that it ranks in the third quartile in that

[4] See UNEP (2011) for detailed evidence on the nature, extent and impacts of oil-related contamination in a sub-region of the Niger Delta.

year.

2.2 Governance of the Nigerian oil sector

Nigeria is constituted as a Federal Republic with three layers of government. At the subnational level, there are 36 states and 775 local government areas (LGAs). According to the Nigerian Constitution, "the entire property in and control of all minerals, mineral oils and natural gas in, under or upon any land in Nigeria [...] shall vest in the Government of the Federation." Regulation of the Nigerian oil sector is overseen primarily by the Nigerian National Petroleum Corporation (NNPC), created in 1977.

Private sector operators are involved in crude oil and gas operations in Nigeria under various contractual arrangements. The standard basic agreement between the government and international oil companies is a joint venture in which the oil company is granted concession rights and operates the property, while the Government of Nigeria, represented through NNPC, holds a majority share of 55 to 60 percent. All joint venture parties contribute to operating costs and receive a part of the crude oil produced in proportion to their shareholding. In recent years, the government has increasingly found it difficult to meet its obligations from cash calls made by the operators to cover investment costs. As a response, alternative funding arrangements have been designated which allow for third party financing or loans from private joint venture partners to fill the financing gaps. In order to stimulate foreign investment in offshore oil production, notably in deepwater areas where exploration and operations involve higher cost, the government has offered production sharing contracts as an alternative arrangement. Under these contracts, international oil companies, while bearing the initial exploration risks, receive a greater share of revenue if oil is discovered and extracted. Crude oil shares under joint venture agreements and production sharing contracts constitute the largest part of government revenues. Other oil-related revenues include royalties, companies income taxes, value added taxes, petroleum profit taxes, signature bonuses, and penalties for gas flaring (NEITI, 2012). Figure 1 shows the development of government revenues from the oil (and gas) sector from 1999 to 2011.

There has been much controversial debate on how these revenues should be shared between different levels of government, and how much should flow back to oil-producing regions. The allocation formula has been frequently revised since independence.[5] The derivation principle enshrined in the 1999 Constitution states that 13 percent of the gross oil revenues must be distributed among the eight oil-producing states in proportion to their production vol-

[5] See Ahmad and Singh (2003) for a historical overview of oil revenue sharing regimes in Nigeria since independence.

umes.[6] The remaining pool of oil revenues is shared among the federal government (approx. 50 percent), state governments (approx. 26 percent), and local governments (approx. 21 percent).[7] For these transfers, the formula of distribution among states and LGAs includes a lump-sum component of almost 50 percent, and a variant component determined in large part by population and geographical area, and to a minor part by social development indicators like primary school enrolment, hospital beds and access to clean water. This regime leads to substantial disparities in the transfers from the federal government to state governments. In 2008, total transfers per capita were around 36,000 Naira (approx. USD 306) to oil-producing states, and around 10,000 Naira (approx. USD 85) to non-oil-producing states. Correspondingly, changes in the international price for oil have more pronounced effects on the government budget of oil-producing states than non-oil-producing states (Ahmad and Singh, 2003).

3 Data

Our units of observation are localities in both rural and urban areas in the southern states of Nigeria. We have survey data from the Demographic and Health Survey (DHS) carried out in 2003, 2008 and 2013, from a sub-sample of households within these localities. Summed over the three survey years, we have data from 1,373 localities, spread over 230 Local Government Areas. Since for every survey round a new set of localities and households is selected, our sample is a pooled cross-section of localities rather than a panel.

There are two reasons why we exclude northern states: First, all oilfields are located in southern states. Second, there are many differences between the Christian-dominated south of the country and the Muslim-dominated north, such that the oil-producing areas in southern states may develop differently than the non-oil-producing areas in northern states for reasons unrelated to oil production and oil revenues. We classify as northern states the 12 states in which sharia (i.e., islamic law) plays some role in the judicial system. We also exclude the Federal Capital Territory, which is surrounded by both northern and southern states, which may be affected differently by variations in federal oil revenues because of its special status. Hence we are left with 24 southern states.

Our dependent variables are constructed from Demographic and Health Surveys (DHS), which are a standard data source for tracking the Millennium Development Goals (MDGs) (IFC International, 2003-2008). These households surveys have been carried out in low-

[6] Oil extracted offshore also forms part of the 13 percent derivation in oil revenues since a legislative reform in 2004. Further, Anambra was officially added as a ninth oil-producing state in 2012.

[7] Small parts of the oil revenues are paid into the Ecological Fund and the Stabilization Reserve Fund.

income countries since the 1980s with funding from USAID.[8] Information is collected from women of childbearing age about their own health, their birth histories, the health of their children born in the past few years, and various household characteristics.[9] Despite occasional adjustments and amendments to the questionnaires, DHS follow a largely consistent methodology and structure across countries and years.

Standard DHS have been carried out in Nigeria in 1990, 1999, 2003, 2008 and 2013. For all rounds except for 1999, data are geo-referenced, which allows their use for the analysis of development outcomes at the local level. We restrict our analysis to the three most recent DHS rounds, since for the 1990 survey most of the variables that we use to construct our dependent variables are not available.

We construct commonly used education and health indicators, following MDG methodology where applicable. As main indicator for education, we calculate the net attendance ratio in primary education, which is the ratio of primary school age children who have attended primary school the previous year, to the total population of children of official primary school age (6 to 12 years in Nigeria). As a measure for child nutrition we use weight-for-age of children under five years of age. Children's weights are compared with the weights given in a WHO reference table of child weights for each age group. We take the standard deviations from the reference median as an indicator of nutritional status of individual children (adequate weight for a given age). We include two indicators of health-relevant facilities available to households, which are largely driven by public service provision, namely a household's access to an improved drinking water source and access to an improved sanitation facility. For distinguishing between improved and unimproved water and sanitation facilities, we follow the standard MDG classification[10]. Further, we look at a number of indicators of a household's wealth. Our main variables are whether the household has access to electricity, which is obviously in part driven by public infrastructure; whether the household owns electric media devices, i.e., radio and television; whether the household owns a motorcycle or a car; and whether the floor in a household's dwelling is made of any material that is not earth, sand or dung. We have selected these household characteristics as wealth indicators based on two criteria. The first is consistent data availability in the 2003, 2008 and 2013 DHS for Nigeria.[11] The second is that they allow for interpretation in the sense that acquiring these

[8]For further details on DHS methodology and data, see http://dhsprogram.com.

[9]Some surveys also include information from men of similar ages or the husbands/partners of women surveyed.

[10]Improved drinking water sources are piped household water connections, public standpipes, boreholes, protected dug wells or springs, or rainwater collection facilities. Improved sanitation facilities are flush toilet, ventilated improved pit latrines, traditional pit latrines with a slab, or composting toilets, if they are not shared with other households.

[11]For example, data for other dwelling characteristics commonly used as indicators of a household's wealth, such as material of roof or walls, were not available for the 2003 DHS round for Nigeria.

assets or access to services indisputably indicates an improvement from the households' point of view.

We also extract from the DHS data information on migration of households. The survey asks women for how many years they have been living in the place where the interview is taking place. If all interviewed women in a household state that they have moved less than five years ago, we conclude that the household migrated. This approach takes into account that a single respondent's move could mean that she married into the family.

DHS data are collected in clusters of households, which generally correspond to villages or urban blocks. In our dataset, the average number of households per cluster is 17 for 2003, 38 for 2008 and 31 for 2013. Figure 1 shows the distribution of 2003 and 2008 DHS clusters over our area of analysis. We aggregate our educational, health and wealth indicators at the level of clusters by taking the shares from all qualifying individuals within a cluster. The qualifying individuals are children at primary school age for the calculation of the net attendance ratio in primary school ($Schooling_{ijt}$), children under five years scaled by DHS survey teams ($ChildNutrition_{ijt}$), and all households for which the relevant variables are available for the calculation of all other health and wealth measures. These other measures are the share of households using an improved drinking water source ($Water_{ijt}$), the share of households using an improved sanitation facility ($Sanitation_{ijt}$), the share of households with access to electricity ($Electricity_{ijt}$), the share of households with a radio or TV ($EMedia_{ijt}$), the share of households with a motorcycle or car ($Motorvehicle_{ijt}$), the share of households with decent floors ($Floors_{ijt}$), and the share of households who presumably migrated in the last five years ($Migration_{ijt}$).

We construct measures of oil extraction at the level of LGAs based on U.S. Geological Survey (USGS) data by Persits et al. (2002), which provide a digitally compiled map of oil and gas field centerpoints in Africa. The GADM database of Global Administrative Areas provides information on subnational administrative regions and their boundaries. For Nigeria, regions at the first subnational level correspond to states, and regions at the second subnational level to LGAs. With ArcGIS software, we process the GADM shapefile of LGA boundaries and the USGS shapefile of oil and gas fields centerpoints to identify the number of oilfields within each LGA (figure 1). There are 76 LGAs that contain at least one oilfield, and the maximum number of oilfields within one LGA is 21. The dummy variable Oil_i is equal to one if and only if there is at least one oilfield in LGA i. We further use ArcGIS software to construct the dummy variable $Neighbor_i$, which is equal to one if and only if there is no oilfield in LGA i, but there are oilfields in at least one of the neighbouring LGAs. Further, we construct the dummy variable $Oilstate_i$, which is equal to one if and only if LGA i belongs to one of the eight oil states under the 13 percent derivation rule. A potential weakness of the USGS data for our purposes could be the lack of information on the oilfields' production volumes, including the years in which they were actually producing. In order to get a feel of how well oilfield locations as per the USGS data reflect actual oil production in a region, we have to resort to analysis at the state level. We look at the correlation between the number of oilfields from USGS data within a state, and the revenues under the 13 percent derivation rule among the eight oil states for the years 1999 to 2011. Remember that these revenues are proportional to the states' production volumes. The correlation coefficient is 0.74, which suggests that oilfield location from the USGS data can capture regional oil production reasonably well.

Table 1 provides summary statistics, and Figure 2 shows the distribution of DHS clusters and oilfields over LGAs in southern states of Nigeria.

4 Empirical Strategy

Figure 3 shows the development of the international price for crude oil from 1990 to 2012. We see that the oil price was rather constant for many years up to 2003. During the period from 2003 to 2008, the oil price increased constantly and considerably from USD 29 per barrel to USD 98 per barrel. The oil price started dropping in late 2008, but rebounded again soon thereafter. Figure 1 further shows that Nigeria's government revenues from the oil sector closely follow the oil price movements, and increased manyfold from 2003 to 2008. Fortunately, geo-localized DHS data for Nigeria are available for the year of the oil price peak, as well as 5 years before and 5 years after. We employ differences-in-differences estimators to study how the rise in the international price for crude oil in our observation period impacts differently on development indicators for localities in the southern states of Nigeria, depending on whether they are located in an oil region or not. Hence, localities within oil regions constitute the treatment group, and localities outside of oil regions the control group; and the rise in the oil price in the years just before 2008 is our treatment. Therefore, we estimate the following specification:

$$DHS_{ijt} = \alpha_j + \beta Post_t + \gamma(Post_t \times Oil_j) + \delta Urban_i + \epsilon_{ijt} \tag{1}$$

DHS_{ijt} represents the outcome variables based on the DHS data introduced above, where index i stands for cluster, index j for LGA, and index t for the survey year. The dummy variable α_j indicates the use of LGA fixed effects, and $Post_t$ is a time dummy variable that equals zero in 2003 and one in 2008, and in 2013 respectively. Oil_j is the dummy variable that is equal to one for LGAs with oilfields. In order to account for the different characteristics of urban and rural areas in our pooled cross-section of localities, we include the dummy variable $Urban_i$, which equals zero if a locality is a rural settlement and one if it is an urban block.

The coefficient of interest is γ, which corresponds to the difference between $DHS_{ij2008} - DHS_{ij2003}$ (or $DHS_{ij2013} - DHS_{ij2003}$, respectively) for clusters in oil regions, and those in non-oil regions. The key identifying assumption is that there would be common trends in both groups of clusters in the absence of the rise in the oil price. As discussed above we exclude observations from Muslim-dominated northern states exactly because trends are likely to be different in northern states than in (oil-producing) southern states. Moreover, we can use the geo-localized DHS data for 1990 to check for common trends for some outcome variables prior to 2003. To do so, we use specification (1) with data from 1990 and 2003, and redefine $Post_t$ to be equal to one in 2003.

We run the regression with observations from 2003 and 2008 to examine short-term effects of the oil price shock. To explore whether the price shock resulted in diverging development paths between oil regions and non-oil regions over the medium term, we run the same regression with observations from 2003 and 2013.

Further, we extend specification (1) to test whether effects from oil production and higher oil revenues spill over to localities in the neighborhood areas of oil regions. Therefore, we add dummy variables for clusters within LGAs where no oilfield is located, but where oilfields are located in any of the adjacent LGAs. We will further make use of different dummy variables for such clusters depending on whether they are located in an oil state or a non-oil state.

5 Empirical Findings

Table 2 presents our estimates of specification (1) for various development indicators for the years 2003 and 2008. Columns 1 and 2 show that the higher oil price had no different short-term effect on the net attendance ratio in primary school ($Schooling_{ijt}$) and on child nutrition, measured as weight-for-age standard deviations from a reference median for children under 5 years of age ($ChildNutritionijt$) in localities within oil regions than in other localities. Columns 3 to 5 look at the effects on relevant facilities and services, in particular the share of people using an improved drinking water source ($Water_{ijt}$), the share of people using an improved sanitation facility ($Sanitation_{ijt}$), and the share of households with access to electricity ($Electricity_{ijt}$). The coefficient of interest is in all cases negative and statistically significant for the latter two. These results suggest that higher oil prices tend to worsen access to these services in localities in oil regions, relative to other regions. Columns 6 to 8 look at the effects on various household assets. These are the share of households with a radio or TV ($EMedia_{ijt}$), the share of households with a motorcycle or car ($Motorvehicle_{ijt}$), and the share of households with decent floors ($Floors_{ijt}$). We find a negative and statistically significant effect of higher oil prices on how many households own media devices, and a weakly significant negative effect on how many own motor vehicles.

It does not come as a surprise that coefficient estimates on the $Urban_i$ dummy variable are significantly positive for most of our indicators. Urban areas are known to have better development outcomes than rural areas in most of the dimensions measured by our indicators. We also test for differential effects of an oil price increase in urban as opposed to rural areas, but find no significant differences. We therefore exclude the respective interaction term from all the specifications reported here in detail.

Table 3 presents regression results for the same specification, but with observations from 2003 and 2013, to check whether the short-term effects of the 2008 oil price peak persist over the medium term. It turns out that after a five-year period following the peak, during which the oil price fluctuated at a much higher level compared to before the peak, we still observe a similar pattern of diverging development outcomes in oil and non-oil regions. The coefficients on our infrastructure-related indicators are all negative and (at least weakly) significant. For ownership of household assets, coefficients are also negative, but weakly significant only for ownership of motor vehicles.

Overall these findings suggest that higher oil prices tend to have a negative effect on relevant development indicators in localities within oil regions as compared to other regions. The question arises why this is the case. One possible reason could be that higher oil prices lead to migration into oil-producing LGAs, with short-term overload on infrastructure capacity as a result. We test this possibility by looking at the effect of higher oil prices on the share of households which migrated to the place where the survey was taken.[12] We find a weakly significant positive coefficient on the migration variable for the short-term regression (table 2, columns 9). We interpret this as weak evidence that increased migration flows can explain the negative development effects at least partly. Unfortunately, no information on recent migration was collected in the 2013 survey, which is why we cannot examine migration patterns in the period following the oil price peak.

Table 4 adds the interaction term $Neighbor_i \times Post_t$ to specification (1) for observations from 2003 and 2008. This specification examines the short-term development effect on localities in non-oil regions that are adjacent to oil regions. The coefficient estimates on $Neighbor_i \times Post_t$ are positive (albeit in most cases not significant) for all of our development indicators, except $ChildNutrition_{ijt}$. For $Schooling_{ijt}$, $Sanitation_{ijt}$, $Electricity_{ijt}$ and $EMedia_{ijt}$, we find evidence that the effect of $Neighbor_i \times Post_t$ is either positive or less

[12] The DHS does not include questions on migration of the family, but asks women for how long they have been living in their current place of residence. We infer that a household migrated if all interviewed women within the household state that they moved to the place less than 5 years ago.

negative than the effect of $Oil_i \times Post_t$. This suggest that the negative development effects of a higher oil price on localities in oil regions does not extend to localities in neighboring regions. Column 9 shows that for neighboring regions we have no evidence of increased migration flows to neighboring regions.

Regions neighboring oil-producing LGAs might benefit due to positive economic spillovers from oil production or due to fiscal spillovers. In Table 5 we divide the localities in neighboring LGAs into two groups: those that belong to oil-producing states, which receive 13 percent of the federal oil revenues, and those that do not belong to an oil-producing state. We find that localities in neighboring LGAs in non-oil states do no worse than those in oil states. We even find significantly positive effects of $Neighbor_i \times Post_t \times (1 - Oilstate_j)$ on education and electricity access. Again, column 9 suggests that increased migration flows to oil regions within oil states could partly explain what we observe. We conclude that windfalls from oil production in oil states do not translate into better development outcomes through fiscal channels. Rather, there is evidence for at least some positive economic spillovers from increases in the oil price to regions neighboring oil regions.

Our results are robust to the following robustness exercises: First, we control for whether a locality is located in an oil state or not in specification (1). We find no significant effect of whether a locality lies within an oil state, but the effects of lying within an oil-producing LGA remain unchanged. Accordingly, results presented in Table 2 and 3 are robust to including only LGAs from oil-producing states. Second, we find the same overall patterns when we include observations from all survey rounds in the same regression, in other words, if we do not differentiate between short and medium term in our treatment. Further, results are robust to recoding LGAs with only one oilfield as non-oil-producing LGAs (and LGAs that border LGAs with only one oilfield in total as not being neighbors to oil-producing LGAs). Results are also robust to including LGAs from northern (sharia) states and the Federal Capital Territory.

6 Conclusions

[To be added]

References

Ahmad, E., Singh, R. (2003). Political Economy of Oil Revenue Sharing in a Developing Country: Illustrations from Nigeria. IMF Working Paper No. 03/16.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., 2003. Fractionalization. Journal of Economic Growth 8, 155–194.

Andersen, J.J., Aslaksen, S., 2008. Constitutions and the Resource Curse. Journal of Development Economics 87, 227–246.

Aragón, F.M., Rud, J.P. , 2013. Natural Resources and Local Communities: Evidence from a Peruvian Gold Mine. American Economic Journal: Economic Policy 5, 1–25.

Bhattacharyya, S., Hodler, R., 2010. Natural Resources, Democracy and Corruption. European Economic Review 54, 608–621.

Caselli, F., Michaels, G., 2013. Do Oil Windfalls Improve Living Standards? Evidence from Brazil. American Economic Journal: Applied Economics 5, 208–238.

Collier, 2007. The Bottom Billion. Oxford, Oxford University Press.

EIA, 2013. U.S. Energy Information Administration Country Analysis Brief Nigeria, available at http://www.eia.gov/countries/cab.cfm?fips=NI (accessed 11 September 2014).

Hodler, R., 2006. The Curse of Natural Resources in Fractionalized Countries. European Economic Review 50, 1367–1386.

ICF International, 2003-2008. Demographic and Health Surveys (various). Calverton, Maryland, ICF International (Distributor).

International Monetary Fund (IMF), 2013a. Nigeria 2012 Article IV consultation. IMF country report No. 13/116.

International Monetary Fund (IMF), 2013b. Nigeria: Financial Sector Stability Assessment. IMF Country Report No. 13/140.

Mehlum, H., Moene, K., Torvik, R., 2006. Institutions and the Resource Curse. Economic Journal 116, 1–20.

Michaels, G., 2011. The Long Term Consequences of Resource-Based Specialisation. Economic Journal 121, 31–57.

Monteiro, J., Ferraz, C., 2012. Does Oil Make Leaders Unaccountable? Evidence from Brazils Offshore Oil Boom. Unpublished working paper.

Nigeria Extractive Industries Transparency Initiative, 2012. Financial Audit: An Independent Report Assessing and Reconciling Financial Flows within Nigerias Oil and Gas Industry 2009 to 2011, available at http://www.neiti.org.ng/index.php?q=documents/audit-report-2009-2011 (accessed 8 September 2014).

Okpanachi, E., 2011. Confronting the Governance Challenges of Developing Nigerias Extractive Industry: Policy and Performance in the Oil and Gas Sector. Review of Policy Research 28, 25–47.

Olsson, O., Valsecchi, M, 2012. Resource Windfalls and Public Goods: Evidence from a Policy Reform. Unpublished working paper.

Organization of the Petroleum Exporting Countries (OPEC), 2013. Annual Statistical Bulletin 2013. Vienna, OPEC.

Papyrakis, E., Gerlagh, R., 2007. Resource Abundance and Economic Growth in the United States. European Economic Review 51, 1011–1039.

Persits, F., Ahlbrandt, T., Tuttle, M., Charpentier, R., Brownfield, M., Takahashi, K., 2002. Map Showing Geology, Oil and Gas Fields and Geologic Provinces of Africa, Version 2.0. U.S. Geological Survey.

Postali, F.A.S., Nishijima, M., 2013. Oil windfalls in Brazil and their long-run social impacts. Resources Policy 38, 94–101.

Sachs, J.D., Warner, A., 2001. The Curse of Natural Resources. European Economic Review 45, 827–838.

Sala-i-Martin, X., Subramanian, A., 2003. Addressing the Natural Resource Curse: An Illustration from Nigeria. NBER Working Paper 9804.

Thurber, M., Emelife, I., Heller, I., 2010. NNPC and Nigeria's Oil Patronage System. Stanford Program on Energy and Sustainable Development Working Paper No. 95.

United Nations Development Programme (UNDP), 2013. Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World. New York, UNDP.

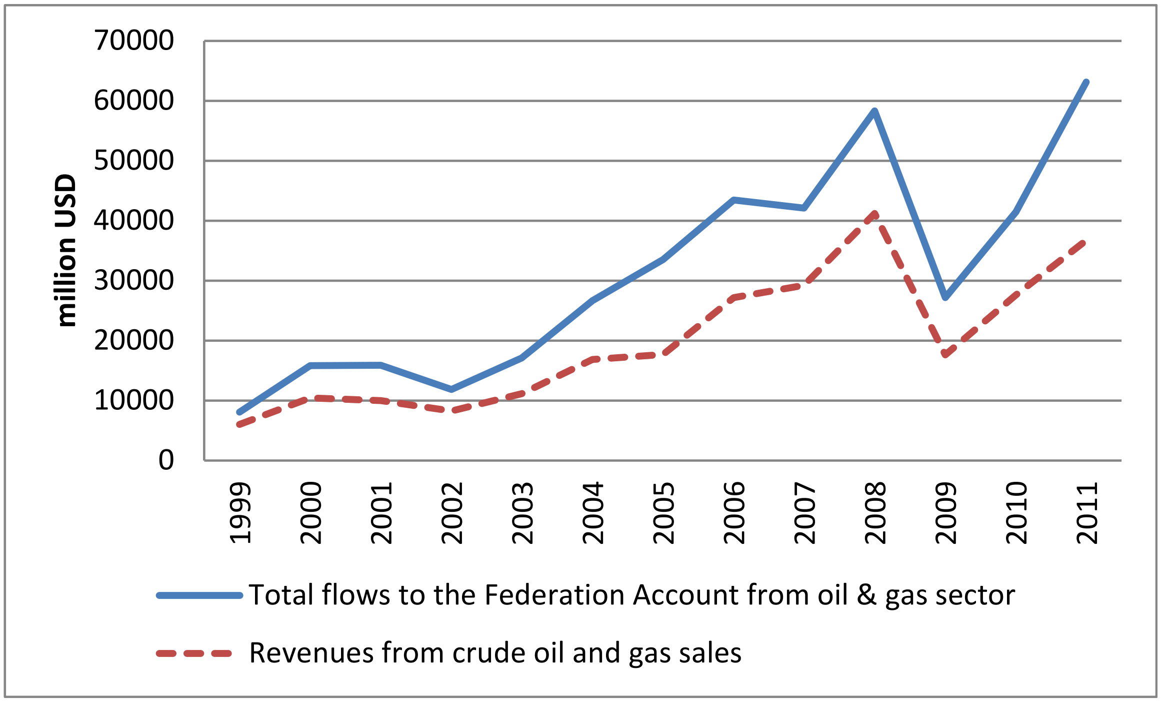
United Nations Environment Programme (UNEP), 2011. Environmental Assessment of Ogoniland. Nairobi, UNEP.

World Bank, 2014. World Development Indicators Online Database (data retrieved 8 September 2014).

van der Ploeg, R., 2011. Challenges and Opportunities for Resource Rich Economies. Journal of Economic Literature 49, 366–420.

Figures and Tables

Figure 1: Government revenues from oil and gas sector, Nigeria, 1999-2011

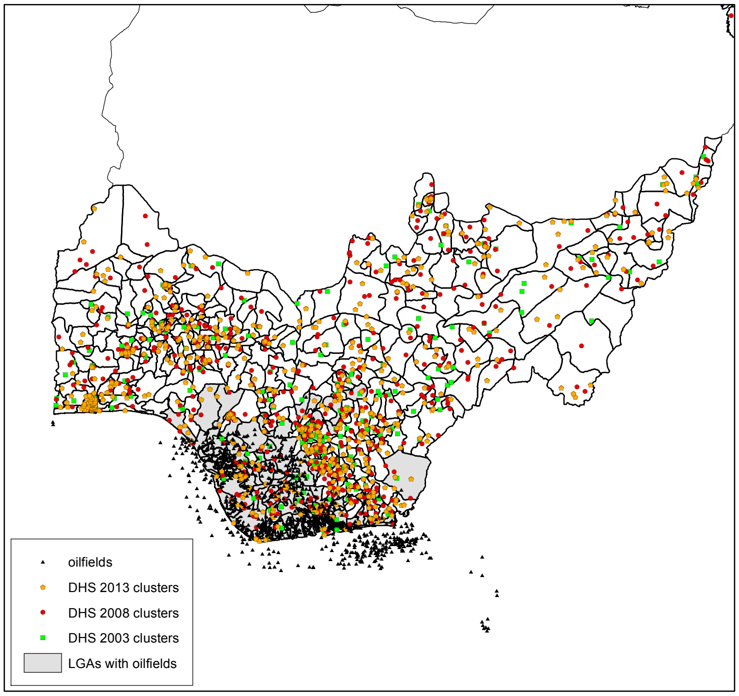


Note: This figure shows the annual flows of revenues from the oil and gas sector to the Nigerian Federation Account. Sales of crude oil and gas includes export and domestic crude. Total revenues includes sales of crude oil and gas, petroleum profit tax, royalty oil and gas, signature bonus, gas flaring penalties, concession rentals, companies income tax and value added tax.
Data source: Nigeria Extractive Industries Transparency Initiative (NEITI).

Table 1: Summary statistics, including observations for 2003, 2008 and 2013

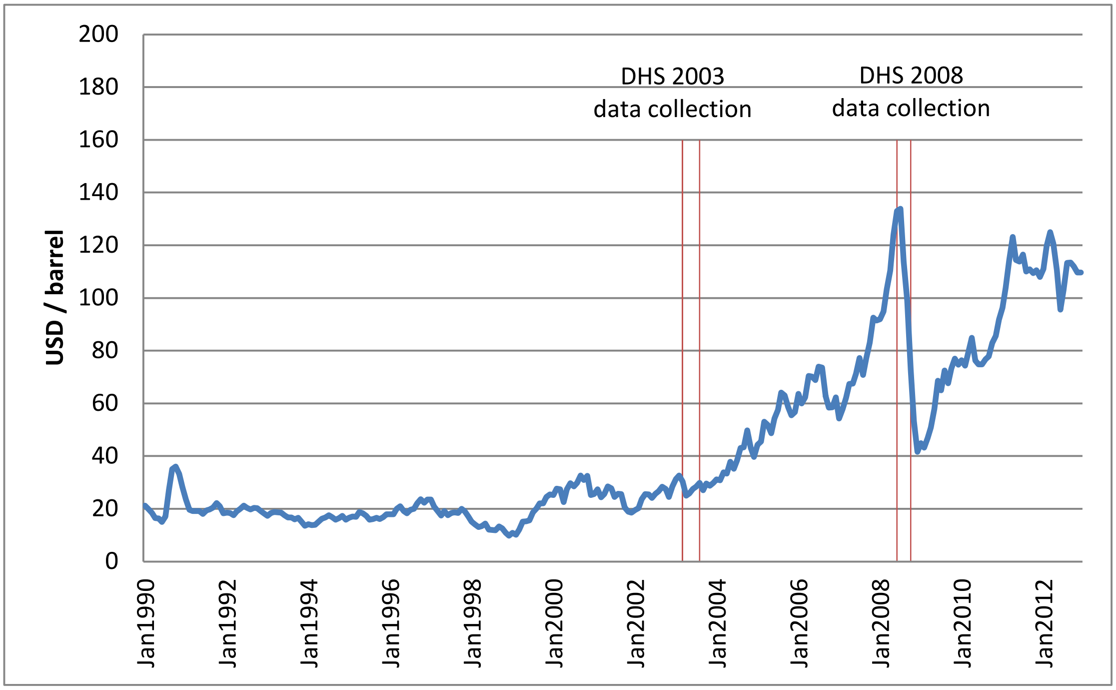
Variable	Observations	Mean	Std.Dev.	Min.	Max.
$Schooling_{ijt}$	1373	0.756	0.146	0	1
$ChildNutrition_{ijt}$	1372	-0.674	0.558	-2.631	2.14
$Water_{ijt}$	1358	0.557	0.460	0	1
$Sanitation_{ijt}$	1373	0.256	0.260	0	1
$Electricity_{ijt}$	1373	0.580	0.422	0	1
$EMedia_{ijt}$	1373	0.770	0.169	0.178	1
$Motorvehicle_{ijt}$	1373	0.326	0.173	0	0.953
$Floors_{ijt}$	1373	0.764	0.290	0	1
$Migration_{ijt}$	804	0.304	0.203	0	0.970

Figure 2: Distribution of DHS clusters and oilfields over LGAs in southern states of Nigeria



Note: This map shows boundaries of Local Government Areas (LGAs) in our area of analysis, the location of DHS clusters in 2003 (green squares) and 2008 (red circles), and the location of oilfields (black triangles). LGAs with oilfields are gray.
Data sources: GADM database of Global Administrative Areas (version 2.0); ICF International (2003–2008); Persits et al. (2002).

Figure 3: Crude petroleum price, 1990-2012



Note: This figure shows the price of crude petroleum (light Brent Blend, 38° API, spot, FOB UK ports) in USD per barrel in monthly data from Jan 1990 to Dec 2012, and the periods of data collection for the DHS in 2003 and 2008.
Data source: UNCTAD.

Table 2: Effects of oil price increase on development indicators in oil regions and non-oil regions, 2003-2008

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	$Schooling_{ijt}$	$ChildNutrition_{ijt}$	$Water_{ijt}$	$Sanitation_{ijt}$	$Electricity_{ijt}$	$EMedia_{ijt}$	$Motorvehicle_{ijt}$	$Floors_{ijt}$	$Migration_{ijt}$
$Oil_j \times Post_t$	0.0125	0.0427	-0.0462	-0.128**	-0.222***	-0.0856***	-0.0583*	0.0266	0.0800*
	(0.0350)	(0.138)	(0.109)	(0.0499)	(0.0786)	(0.0325)	(0.0349)	(0.0536)	(0.0428)
$Urban_i$	-0.00538	0.205***	0.131***	0.0888***	0.278***	0.0830***	0.0294*	0.213***	0.0819***
	(0.0158)	(0.0612)	(0.0499)	(0.0225)	(0.0355)	(0.0147)	(0.0157)	(0.0242)	(0.0193)
$Post_t$	-0.0318**	0.164***	0.0690	0.149***	0.0219	0.0309**	0.0619***	0.00271	0.0702***
	(0.0147)	(0.0569)	(0.0469)	(0.0210)	(0.0330)	(0.0136)	(0.0146)	(0.0225)	(0.0180)
Observations	804	803	789	804	804	804	804	804	804
R-squared	0.644	0.636	0.668	0.692	0.750	0.731	0.657	0.775	0.677
LGA Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Standard errors are reported in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 3: Effects of oil price increase on development indicators in oil regions and non-oil regions, 2003 and 2013

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	$Schooling_{ijt}$	$ChildNutrition_{ijt}$	$Water_{ijt}$	$Sanitation_{ijt}$	$Electricity_{ijt}$	$EMedia_{ijt}$	$Motorvehicle_{ijt}$	$Floors_{ijt}$	$Migration_{ijt}$
$Oil_j \times Post_t$	0.0301	-0.0223	-0.212**	-0.107*	-0.181**	-0.00650	-0.0758*	-0.0761	
	(0.0377)	(0.145)	(0.0940)	(0.0593)	(0.0816)	(0.0379)	(0.0422)	(0.0536)	
$Urban_i$	0.00720	0.176***	0.247***	0.0699***	0.268***	0.113***	0.0370**	0.190***	0.0281
	(0.0155)	(0.0589)	(0.0391)	(0.0244)	(0.0335)	(0.0156)	(0.0174)	(0.0220)	(0.0623)
$Post_t$	-0.0236*	0.0795	0.295***	0.200***	0.0829***	0.0155	0.123***	0.0521***	
	(0.0139)	(0.0526)	(0.0356)	(0.0218)	(0.0300)	(0.0139)	(0.0155)	(0.0197)	
Observations	801	800	786	801	801	801	801	801	232
R-squared	0.537	0.594	0.706	0.704	0.771	0.718	0.678	0.779	0.827
LGA Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Standard errors are reported in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 4: Effects of oil price increase on oil regions and neighboring regions, 2003-2008

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	$Schooling_{ijt}$	$ChildNutrition_{ijt}$	$Water_{ijt}$	$Sanitation_{ijt}$	$Electricity_{ijt}$	$EMedia_{ijt}$	$Motorvehicle_{ijt}$	$Floors_{ijt}$	$Migration_{ijt}$
$Oil_j \times Post_t$	0.0282	0.0328	-0.0412	-0.123**	-0.200**	-0.0853**	-0.0582	0.0408	0.0946**
	(0.0358)	(0.141)	(0.112)	(0.0513)	(0.0807)	(0.0334)	(0.0358)	(0.0550)	(0.0438)
$Neighbor_i \times Post_t$	0.0661*	-0.0421	0.0200	0.0211	0.0937	0.00113	0.000184	0.0602	0.0618
	(0.0342)	(0.133)	(0.108)	(0.0490)	(0.0770)	(0.0319)	(0.0342)	(0.0525)	(0.0418)
$Post_t$	-0.0474***	0.174***	0.0639	0.144***	-0.000233	0.0307*	0.0618***	-0.0116	0.0556***
	(0.0168)	(0.0651)	(0.0543)	(0.0240)	(0.0377)	(0.0156)	(0.0168)	(0.0257)	(0.0205)
$Urban_i$	-0.00551	0.205***	0.131***	0.0888***	0.278***	0.0830***	0.0294*	0.212***	0.0818***
	(0.0158)	(0.0613)	(0.0500)	(0.0225)	(0.0355)	(0.0147)	(0.0158)	(0.0242)	(0.0193)
Observations	804	803	789	804	804	804	804	804	804
R-squared	0.648	0.636	0.668	0.692	0.751	0.731	0.657	0.776	0.678
LGA Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Test for different coefficients on $Oil_i \times Post_t$ and $Neighbor_i \times Post_t$									
P-value	0.385	0.662	0.651	0.0212	0.00292	0.0341	0.181	0.772	0.539

Notes: Standard errors are reported in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 5: Effects of oil price increase in neighboring LGAs within oilstates and non-oilstates, 2003-2008

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	$Schooling_{ijt}$	$ChildNutrition_{ijt}$	$Water_{ijt}$	$Sanitation_{ijt}$	$Electricity_{ijt}$	$EMedia_{ijt}$	$Motorvehicle_{ijt}$	$Floors_{ijt}$	$Migration_{ijt}$
$Oil_j \times Post_t$	0.0277	0.0462	-0.0476	-0.132**	-0.200**	-0.0882***	-0.0631*	0.0384	0.103**
	(0.0360)	(0.142)	(0.113)	(0.0514)	(0.0807)	(0.0335)	(0.0360)	(0.0553)	(0.0438)
$Neighbor_j \times Post_t$	0.0376	0.0103	0.0654	0.0124	-0.0474	-0.0465	-0.000923	0.0121	0.110**
$\times Oilstate_j$	(0.0450)	(0.175)	(0.142)	(0.0642)	(0.101)	(0.0418)	(0.0449)	(0.0691)	(0.0546)
$Neighbor_j \times Post_t$	0.0964**	-0.101	-0.0223	0.0334	0.243**	0.0525	0.00295	0.112	0.00828
$\times(1 - Oilstate_j)$	(0.0461)	(0.179)	(0.144)	(0.0658)	(0.103)	(0.0428)	(0.0461)	(0.0708)	(0.0560)
$Post_t$	-0.0450**	0.125	0.0964	0.184***	0.00260	0.0435**	0.0827***	-0.00101	0.0176
	(0.0219)	(0.0854)	(0.0693)	(0.0313)	(0.0491)	(0.0204)	(0.0219)	(0.0336)	(0.0266)
$Urban_i$	-0.00121	0.137	0.177**	0.142***	0.287***	0.102***	0.0577**	0.228***	0.0287
	(0.0248)	(0.0967)	(0.0802)	(0.0354)	(0.0556)	(0.0230)	(0.0248)	(0.0381)	(0.0301)
Observations	804	803	789	804	804	804	804	804	804
R-squared	0.648	0.637	0.668	0.695	0.754	0.734	0.659	0.777	0.684
LGA Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Test for different coefficients on $Neighbor_i \times Post_t \times Oilstate_i$ and $Neighbor_i \times Post_t \times (1 - Oilstate_i)$									
P-value	0.328	0.633	0.640	0.807	0.0314	0.0768	0.949	0.279	0.166

Notes: Standard errors are reported in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.