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ACCESS TO ELECTRICITY AND DRINKING WATER IN THE PRESENCE OF ETHNIC DIVERSITY: EVIDENCE FROM NIGERIA

Adewara Sunday
Department of Economics, Landmark University, Omu-Aran, Nigeria

Oyenubi Adeola
Department of Economics, University of Witwatersrand, South Africa

Adewara Sunday Olabisi, Agba Domnic Zaan, Adama Joseph, Rasak Bamidele, Oloni Elizabeth
Lecturing at Landmark University, Omu-Aran, Nigeria

ABSTRACT

The study analysed the effects of ethnic diversity on access to drinking water and electricity in Nigeria. Our analysis indicates that ethnic diversity at the sub-national level has reduced households' access to safe drinking water, but increased provision of electricity. The implication of the finding is that provision of targeted public goods are more prone to negative effects of ethnic diversity than non-targeted public goods. Ethnic diversity will increase provision of public goods due to increased lobbying by the various ethnic groups. The study recommends that the national government should provide targeted public goods in heterogeneous countries.

Keywords: Public Goods, Safe Drinking Water, Electricity, Ethnic Diversity, Democracy.

JEL Classification: H5; H7; Q5

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1. INTRODUCTION

There is a growing interest among economists in the effects of ethnic diversity on the provision of public goods (Kimenyi, 2006; Kimenyi and Meagher, 2004). Theoretical and also a few empirical studies have attempted to link ethnic diversity with increased corruption (Lederman *et al*., 2005; LaPorta *et al*., 1998; Shleifer and Vishny, 1993), lower economic growth (Easterly and Levine, 1997; Mauro, 1995), and a reduction in the provision of public goods (Miguel and Gugerty, 2004; Harris *et al*., 2001; Goldlin and Katz, 1999; Alesina *et al*., 2000, 1999). Differences in ethnic groups' tastes and preferences are some of the reasons advanced for the negative relationship between ethnic diversity and provision of public goods. In addition, it is also believed that corruption increases with ethnic diversity due to rivalry among various ethnic groups for their shares of the 'national cake'. In some cases, ethnic diversity may lead to conflicts and war such as the Nigerian civil war, Kenya's post-election violence and the Rwandian genocide.

Therefore, we examine the effects of ethnic diversity at the sub-national levels of government on the provision of drinking water (pipe and borehole water) and electricity in Nigeria. We depart from previous studies by using households' access to drinking water and electricity as our measure of provision of public goods, instead of allocation of public expenditure.

The novelty of this paper lies in three contributions: In the first place, as far as we know, this is the first attempt to use actual household access to public goods as a measure of provision of public goods in studying the relationship between ethnic diversity and public goods provision. We chose this method to overcome the problem of leakages between allocation of public funds and actual delivery of basic needs, created by of rent seeking in most of the developing countries[5]. Nigeria had consistently ranked as one of the most corrupt countries since 1985[6]. Measuring provision of public goods with public expenditure will not be applicable when corruption such as this is pervasive, especially in developing countries. This study is an answer to the recent call by the World Bank to depart from the use of public expenditure as measure of service delivery to citizens (World Bank, 2008).

Secondly, we are not aware of any study on the effects of ethnic diversity on the provision of public goods, especially at the sub-national governments, either in Sub-Saharan Africa or in Nigeria, though many of these countries are both highly heterogeneous and decentralized.

An important characteristic of the sub-national units in Nigeria is their ethnic polarization. Nigeria is highly ethnically polarized with over 374 ethnic groups in the country[7]. Ethnic-based politics in Nigeria date back to the country's pre-independence era. The struggle for independence historically has been ethnically based, since the country was adminstratively divided along ethnic groups. Moreover, Nigeria's independence was delayed untill 1960 due to disagreements among the various ethnic groups and the divisions persist even after independence. Politics in Nigeria since 1960 can not be separated from ethnic polarization even under military rule, at all levels of government, whether national or sub-national levels.

2. LITERATURE REVIEW

Access to basic needs such as drinking water and electricity affects citizens' health, poverty reduction, growth, and environmental protection. Provision of these basic needs is beyond the ability of the poor due to the relatively high cost and their non-excludability in consumption. However, these basic needs are not readily available in developing countries, partly due to bad governance. In the past, most economists have given little attention to how ethnic diversity affects economic policies and outcomes (Alesina, *et al*., 2004). Theoretically, there are three basic mechanisms whereby ethnic diversity can influence economic outcomes. The first mechanism is through individual preferences. Individuals may attribute preferential positive

utility to the wellbeing of their own ethnic group, but negative utility to the members of other ethnic groups. Tajfel *et al*., (1971) pioneered this theory in their work "Social Categorization and Intergroup Behavior". Alesina and La Ferrara (2000) further formalized this theory in their work "Participation in Heterogeneous Communities", showing that the utility an individual derives from joining a group is a positive function of the share of that individual's own ethnic members in that group, but a negative function of the share of other ethnic members within the group.

The second theory links ethnic diversity with individual participation in social activities and its effects on economic outcomes. In heterogeneous societies, individual participation in social activities is lower than in homogeneous societies. The effect of lower participation is diminishing social capital and weak institutions, which eventually lead to failure of collective action. When social sanctions cannot be imposed effectively due to ethnic diversity, corruption and rent seeking will be pervasive, therefore provision of public goods is negatively affected (Alesina and La Ferrara, 2004; La Ferrara, 2003; Fearon and Laitin, 1996). For instance, in Nigeria, the Economic and Financial Crime Commission (EFCC) has been accused repeatedly of targeting politicians from the incumbent president and governors' rival ethnic groups in its efforts to fight against looting of public funds in the country. Such accusations have the tendency to weaken the effectiveness of the fight.

The third theory explains how ethnic diversity correlates positively with an individual's production function by providing a variety of individual skills that eventually leads to an increase in total output. The costs of ethnic diversity in a production function arise through difficulties in communication between people due to differences in languages, preferences and culture. Controlling for the cost of ethnic diversity will lead to an increase in total production, while the reverse will be the case if difficulties in communication due to ethnic diversity cannot be effectively managed (Alesina, Spolaore and Wacziarg, 2000; Lazear, 1999).

There is limited empirical evidence about the effects of ethnicity on the provision of public goods (Kimenyi, 2006). As noted by Kimenyi and Meagher (2004), failure to incoporate ethnic diversity into institutional design may be one of the reasons for the failure of ethnically polarized countries. Easterly and Levin (1997) likewise argue that negative trends of economic outcomes in Sub-Saharan Africa may be connected with a series of ethnic conflicts in the region. Even in the U.S. ethnic diversity has been linked with lower secondary school expansion, lower levels of social capital, and lower funding for schools and other local public goods (Goldin and Karz, 1997; Alesina *et al*., 1999; Alesina and Laferrara 2000; and Poterba, 1997). O' Reilly et al.., (1997) empirical work shows that ethnic diversity leads to greater levels of conflict and less communication, but that after controlling for these effects, it led to an increase in productivity in a study of 32 projects. Ethnic diversity is a major issue when collective action is required especially in the provision of public goods. Ethnic diversity may lead to a failure in collective action due to differences in tastes and distribution of public goods benefits (Vigdor, 2004; Khwaja,2000; Wade, 1994). However, though sub-Saharan Africa is highly ethnically heterogeneous, the effects of ethnic diversity remain largely unexplored empirically in the sub-region and we are not aware of such study on Nigeria.

3.EMPIRICAL MODEL SPECIFICATION

We divide our empirical specification into i) a household-level analysis and ii) a state-level analysis. Equation 8) below is the model specification for the household-level analysis of access to safe drinking water and electricity in Nigeria, using DHS pooled data sets for 1999 and 2003. Access to public goods is a measure of actual provision of public goods by the government. The data set for 1999 provides information on the level of access to the two public goods at the

tail end of military rule in the country, while the dataset for 2003 provides information on access to these public goods under democratic rule:

$$g_{s,t} = a + \beta_1 HH_{s,t} + \beta_2 Dem_{s,t} + \beta_2 Comp_{s,t} + \beta_3 ELF_{s,t} + \beta_4 Control_{s,t} + \epsilon_{s,t} \quad (8)$$

where: $g_{s,t}$ is a binary variable for household access to drinking water (piped and borehole water) and electricity (both are measures of provision of public goods at the households level). It takes the value of one (1) if the household does have access to the specific basic service being analysed and zero (0) if not. Subscripts s and t denote state and time respectively. We specify the model covariates as follows: $HH_{s,t}$ is a vector of household-level variables. $Dem_{s,t}$ is a dummy variable for democracy, indicating that Nigeria was subject to military rule in 1999 and under democratic rule in 2003. $Comp_{s,t}$ is an index of executive and legislative competition respectively and it takes values ranging between 1 and 7. $ELF_{s,t}$ is the Ethnic Linguistic Fractionalization (ethnic diversity index) of the state. It ranges from 0 for a perfectly homogeneous state to 1 for a perfectly heterogeneous state. $Control_{s,t}$, represent other variables that may affect households' access to public goods and $\epsilon_{s,t}$ represents the error term.

For ii) the state-level model specified in equation 9, we constructed a panel using mean (average) state-level data to estimate access to drinking water and electricity in 1990, 1999, 2003, 2006 and 2008. The model specification is similar to equation 8, which is as follows:

$$G_{s,t} = a + \beta_1 Dem_{s,t} + \beta_2 Comp_{s,t} + \beta_3 ELF_{s,t} + \beta_4 Control_{s,t} + \epsilon_{s,t} \quad (9)$$

but in this case *G* represents access to a specific public good measured by state mean (average) access to electricity (electricity) and water (pipe and borehole water) respectively. Subscripts s and t stand for state and time respectively. There are three variables of interest in the above model. *Dem* is a dummy variable for democracy; it takes the value of 0 under military rule and 1 under democratic rule (it takes the value of 0 in 1990 and 1999, but 1 in 2003, 2006 and 2008). The variable *Comp* is the measure of the inclusiveness of executive and legislative power in each state. We used the popular Legislative (LIEC) and Executive (EIEC) Indices of Electoral Competition based on the *database of political institutions* (Beck, et al. 2002).[8] The indices range from a minimum of 1 for totally autocratic rule to a maximum of 7 under the most competitive rule. The DHS datasets used for this study contain information about the ethnic composition of the states. $ELF_{s,t}$ is ethno-linguistic fractionalization of state s, at time t. This ethnic fractionalization index ranges from a minimum of 0 (zero) for a perfectly homogenous state to a maximum of 1 (one) for a perfectly heterogeneous state. The $Control_{s,t}$ is a set of additional exogenous variables such as the state mean wealth index, population density, rural fraction of the state population, sex of households head, average size of the households and education for each of the years under consideration, $\epsilon_{s,t}$ is the error term.

4. ESTIMATION CONCERNS

We used survey probit regression and the standard probit regression for our household-level analysis of access to drinking water and electricity. Survey regressions control for the effects of sample design used in the primary data collection procedure. It takes care of important sample characteristics such as sampling weights, clustering and stratification (Stata 11...2010). Failure to account for sampling weights according to Kabubo-Mariara *et al*. (2008) will affect the standard errors and also yield biased estimators. In addition, observations in a cluster are not independent because of the sampling design, and using ordinary least squares may result in very small standard errors. The DHS data collection method is not a purely random sampling, because of the fact that different groups of clusters are separately sampled. The solution to this problem is to apply survey regression techniques to the data in order to produce the correct standard errors (Kabubo-Mariara *et al*., 2008). This is what we have done here but we also used the standard probit regression methods with robust standard errors to check the robustness of our results. For the sake of simple explanation, we estimate the marginal effects of the independent variables on the dependent variable for both probit regressions.

For the state-level analysis of provision of public goods of interest, we used panel data constructed from the mean access to drinking water and electricity in each of the states for 1990, 1999, 2003, 2006, and 2008. We used the panel data to analyse the effects of ethnic diversity on the provision of electricity and drinking water in the 37 states including FCT, between 1990 and 2008. We used random-effects estimates with the robust standard error option for the panel data analysis.

Since public goods may not respond immediately to inclusiveness within the elections year, we measured electoral competition based on the political regimes preceding the year of observation. We also used a wealth index instead of state income due to non-availability of reliable per capita income for the states covering the years included in our analysis. The wealth index is a measure of the economic strength of the state.

Lastly, we account for the effects of unobservable characteristics of the state by including robust standard error estimates in our cross sectional and panel analysis.

5. SOURCES OF DATA AND MEASUREMENT

Environmental and Health Improving Public goods: We are interested in the provision of basic services that promotes sustainable development of natural resources, but also provides the opportunity for sustainable livelihoods through provision of clean drinking water and energy within households. Lack of these basic needs will affect the environment negatively, makes life more difficult and poses a danger to citizens' health in general. For the panel analysis described above, we measured the state mean access to safe drinking water (piped water within and outside the dwelling as well as borehole water), and state mean access to electricity. We source these variables from the National Bureau of Statistics Core Welfare Indicators (CWI) of 2006 and the National Demographic and Health Surveys (DHS) datasets on Nigeria for 1990, 1999, 2003 and 2008. For our probit regressions, we measured these public goods as a binary variable indicating whether households have access to a specific public good of interest or not, taking a value of 1 for YES and 0 for NO. Access to environmental public goods is a measure of the commitment of different regimes to environmental protection as well as to household poverty reduction.

We measured ethnic diversity i as the ethno-linguistic fractionalization (ELF) of the state at a point in time. It therefore takes into cognisance changes in the state ethnic diversity due to migration. Ethnic diversity (ELF)[9] is the probability that two people choosing at random from a state will not belong to the same ethnic group. The DHS datasets contains the ethnic composition of each state at the time of the observation.

Population density is the state population at any given time divided by the area of that state, providing a combination of the effects of population and the size of the state on the provision of public goods. The effect of population density depends on the type of good in question. We sourced data on the population size and the area of each state from the National Bureau of Statistics (NBS). Education is a binary variable in the prob it regression analysis, indicating whether the head of a household is educated or not. For the panel analysis, we calculated education as the mean state household educational level at a point in time.

Finally, we measured wealth index as the state mean household assets index from the DHS datasets for the panel analysis. The state wealth index is a measure of the state income capacity over the years and is directly related with provision of public goods from the theoretical model. Wealth index also directly and positively affects state tax revenue. We therefore expect this variable to be positive and significantly related to the provision of public goods by the states. We expect the household wealth index to have a positive relationship with access to public goods at the household level. Wealthy households are generally located where public goods are available, due to their ability to afford the cost of living in the urban areas. They can also form a powerful interest group and have the ability to influence provision of public goods by the government.

6. DESCRIPTIVE ANALYSIS

In table 1 and 2, we present the descriptive analysis for average houshold access to safe drinking water and electricity respectively. From Table 1, a reduction in mean access to safe drinking water between 1990 and 1999 can be observed for ten of the states. Between 1999 and 2003, there was a decrease in access to safe drinking water in 23 out of the 37 states, including Federal Capital Teritory(FCT). This shows that there was a reduction in

Notes:

[5] For instance, in one of the states in Nigeria, a former Local Government Chairman and the Treasurer converted the sum of N6 million into their personal pockets out of the N7 million mobilisation fees for the construction of a borehole. The contractor was only paid N1 million to execute the project (ICPC, 2009) .

[6] Transparency international corruption perception index shows that the country is one of the most corrupt in Sub-Saharan Africa.

[7] The final reports of the Nigeria Demographic and Health Surveys of 1990, 1999, 2003 and 2008 specify the total number of identifiable ethnic groups in the country to be 374.

[8] LIEC and EIEC is an initiative of the Development Research group of the World Bank. It is an objective and entirely transparent measure of executive and legislative competitiveness. It includes scaling of government both under democratic and military rules, which is the most appropriate for our study. We used the 2005 criteria for our measure of executive and legislative indices in this study. See appendix for further explanation of the criteria.

[9] ELF= 1- (Racei)2 Where Racei is a proportion of ethnic group i in total population. The DHS datasets contain information about ethnic linguistic characteristics of each respondent.

TABLE 1 Descriptive Statistics of States Mean Access To Safe Drinking Water In Nigeria

						POOLED	
DATA SOURCE:-	**DHS**	**DHS**	**DHS**	**NBS**	**DHS**	**SAMPLE**	
STATES/YEAR	**1990**	**1999**	**2003**	**2006**	**2008**	**MEAN**	**SD**
ABIA	53.6	48.1	**19**	53	79.5	50.64	21.53
ADAMAWA	30	21.1	**13.9**	23	**19**	21.4	5.89
AKWA IBOM	33.3	28.1	**15**	37.9	54.6	33.78	14.45
ANAMBRA	30.4	31.2	**17**	26.3	59.6	32.9	15.96
BAUCHI	10.5	12.3	14.3	25	25.1	17.44	7.08
BAYESA	19.3	48.3	**13.9**	30	**17.5**	25.8	13.93
BENUE	10.4	12.1	16.5	10	**6.6**	11.12	3.61
BORNO	44.1	41.9	**29.9**	29.1	**36.1**	36.22	6.8
CROSS RIVER	35.2	40.7	**12.2**	13.7	**22.6**	24.88	12.73
DELTA	64.7	47.4	**22.7**	39.3	48.9	44.6	15.31
EBONYI	2.8	56.6	**15**	37.1	**48.9**	32.08	22.68
EDO	38.7	29.6	**19.6**	28.6	48.5	33	11
EKITI	7.4	14.1	19.5	30	41.4	22.48	13.43
ENUGU	20.7	26	35.7	26.4	**14.3**	24.62	7.9
GOMBE	27.6	26.7	**14.7**	22	**18.1**	21.82	5.52
IMO	22	22.8	22.8	37.2	54.3	31.82	14.08
JIGAWA	19.1	35.6	**20.4**	53.6	66.1	38.96	20.62
KADUNA	43.4	25.7	36.2	30.3	**19**	30.92	9.4
KANO	36.5	45	45.8	34.3	**40.6**	40.44	5.07
KATSINA	6.9	21.5	28.1	16.8	21.8	19.02	7.88
KEBBI	0.7	1.2	50	34.4	27.3	22.72	21.5
KOGI	0.54	42.2	**30.3**	12	**16.4**	20.29	16.23
KWARA	64.2	71.4	**62.3**	49.5	**46.7**	58.82	10.41
LAGOS	56	80.1	**30**	32.5	**57.1**	51.14	20.57
NASSARAWA	18.9	11.4	**8.3**	14.1	25.5	15.64	6.75
NIGER	18.7	46.6	**24.9**	25.8	**25.5**	28.3	10.64
OGUN	54.4	46.2	**24.5**	38.7	56.5	44.06	13.02
ONDO	31.9	41.6	**21.2**	44.7	**25.1**	32.9	10.17
OSUN	42.1	56.9	**41.9**	21.9	**28**	38.16	13.68
OYO	58.9	27.5	**25.2**	30.6	34.4	35.32	13.63
PLATEAU	2.9	15	23.7	17.6	**12.3**	14.3	7.64
RIVERS	36.8	61.1	**15.8**	41.6	**57.8**	42.62	18.21
SOKOTO	15.6	18.1	29.6	16	**16.6**	19.18	5.9
TARABA	0.5	31.4	**21.9**	18.2	**13**	17	11.41
YOBE	5.7	41.4	43	41.1	42.5	34.74	16.25
ZAMFARA	0.7	19.9	27.9	34.1	**19.8**	20.48	12.58
FCT-ABUJA	11.1	25.3	50	49.4	59.1	38.98	2

Source: calculated from DHS and NBS datasetsof 1990, 1999. 2003, 2008 and 2006 respectively.

TABLE 2 Descriptive Statistics of State Mean Access To Electricity In Nigeria

DATA SOURCE:-	***DHS***	***DHS***	***DHS***	***NBS***	***DHS***	**POOLED SAMPLE**	
STATES/YEAR	*1990*	*1999*	*2003*	*2006*	*2008*	*MEAN*	*SD*
ABIA	*37.1*	*45.38*	*53.42*	*69*	*69.03*	*54.79*	*14.21*
ADAMAWA	*19*	*17.02*	*32*	*27.7*	*32.45*	*25.63*	*7.24*
AKWA IBOM	*22*	*52.51*	*32.77*	*46*	*57.65*	*42.19*	*14.63*
ANAMBRA	*39.8*	*71.96*	*77.87*	*80.2*	*83.03*	*70.57*	*17.68*
BAUCHI	*27.6*	*11.04*	*33.05*	*30.1*	*17.68*	*23.89*	*9.22*
BAYESA	*26.6*	*55.17*	*39.22*	*58.2*	*50.83*	*46*	*13.02*
BENUE	*10*	*33.92*	*30.18*	*23.1*	*14.16*	*22.27*	*10.19*
BORNO	*35.6*	*20.83*	*48.54*	*37*	*22.62*	*32.92*	*11.4*
CROSS –RIVER	*35.2*	*28.44*	*62.9*	*54.3*	*31.82*	*42.53*	*15.17*
DELTA	*60.5*	*65.61*	*60.12*	*74.7*	*61.61*	*64.51*	*6.1*
EBONYI	*5.6*	*18.18*	*25.3*	*28.6*	*41.31*	*23.8*	*13.18*
EDO	*51.5*	*45.99*	*76.8*	*79.7*	*74.52*	*65.7*	*15.71*
EKITI	*48.5*	*39.62*	*48.78*	*68.8*	*62.87*	*53.71*	*11.85*
ENUGU	*32.3*	*8.22*	*34.3*	*50.3*	*48.38*	*34.7*	*16.86*
GOMBE	*10*	*19.8*	*39.76*	*35.2*	*30.61*	*27.07*	*12.08*
IMO	*28.4*	*60.71*	*69.52*	*69*	*60.78*	*57.68*	*16.91*
JIGAWA	*10*	*8*	*12*	*18.1*	*19.35*	*13.49*	*5*
KADUNA	*44.8*	*30.34*	*50.58*	*50.7*	*53.31*	*45.95*	*9.26*
KANO	*22.8*	*57.08*	*79.11*	*53.1*	*48.75*	*52.17*	*20.16*
KATSINA	*22*	*40.26*	*54.32*	*33.8*	*30.19*	*36.11*	*12.13*
KEBBI	*6*	*10*	*11.11*	*34.7*	*38.33*	*20.03*	*15.22*
KOGI	*25*	*79.57*	*69.19*	*56.1*	*52.29*	*56.43*	*20.64*
KWARA	*79.9*	*71.56*	*95.9*	*71.1*	*53.2*	*74.33*	*15.5*
LAGOS	*95.9*	*95.74*	*98.51*	*98.5*	*90.64*	*95.86*	*3.21*
NASSARAWA	*17.3*	*28.21*	*22.22*	*36.5*	*27.11*	*26.27*	*7.18*
NIGER	*12*	*49.27*	*44.6*	*45.8*	*34.62*	*37.26*	*15.13*
OGUN	*18.7*	*65.81*	*43.56*	*69.3*	*66.35*	*52.74*	*21.64*
ONDO	*41.2*	*47.98*	*33.33*	*65*	*49.74*	*47.45*	*11.75*
OSUN	*67.4*	*80*	*88.13*	*67*	*66.6*	*73.83*	*9.78*
OYO	*58.4*	*58.52*	*55.56*	*76.4*	*61.13*	*62*	*8.29*
PLATEAU	*73.9*	*26.53*	*36.25*	*31.8*	*14.3*	*36.56*	*22.43*
RIVERS	*20.3*	*64.74*	*76.85*	*53.2*	*52.36*	*53.49*	*21.07*
SOKOTO	*32*	*7.55*	*16.46*	*27.5*	*22.79*	*21.26*	*9.59*
TARABA	*12*	*40.8*	*17.22*	*14.8*	*15.85*	*20.13*	*11.71*
YOBE	*12*	*27.92*	*61.08*	*34.8*	*23.23*	*31.81*	*18.35*
ZAMFARA	*13*	*24*	*32.47*	*24*	*18.03*	*22.3*	*7.31*
FCT-ABUJA	*85.2*	*86.67*	*100*	*86.6*	*71.96*	*86.09*	*9.93*

Source: calculated from DHS and NBS datasets of 1990, 1999. 2003, 2008 and 2006 respectively.

average household welfare immediately after transition from military rule to democratic rule. In 21 states, mean access to drinking water in 2008 is still less than mean access to drinking water in 1999, even after 10 years of democracy. Table 2 indicates that mean access to electricity declined in eight of the states between 1990 and 1999. After transition from military rule to democratic rule, mean access to electricity in eleven of the states had declined in 2003 compared to 1999 levels. When we compare mean access to electricity between 1999 and 2008, there was a further reduction in mean access in about sixteen states in the country.

The magnitude and number of states with reduced access to electricity (Table 2) spanning the period 2003 to 2008 is, however, less than the magnitude and number of states with reduced access to safe drinking water (table 1) for the same period. This shows that access to drinking water is still a chronic problem in the country.

7. REGRESSION RESULTS

As earlier specified, we divided the regression analysis into two parts. In the first part, we analysed the effects of democracy and ethnic diversity on access to safe drinking water and electricity at the household levels by using a pooled sample of the 1999 and 2003 DHS data sets for Nigeria. We used a combination of the survey probit regression method and the standard probit regression method. Both probit regressions explained the effects of ethnic diversity on households' access to drinking water and electricity between 1999 and 2003. In the second part, we used random-effects panel estimates to analyse the effects of ethnic diversity on the states' provision of safe drinking water and electricity between 1990 and 2008. The panel estimates explained the effects of ethnic diversity on the provision of drinking water and electricity for a period of twenty years, consisting of ten years apiece under military and democratic rule.

We present the results of our analysis in Table 3 and 4 below. We concurrently explain both the probit regression results and the panel regression results. Table 3 shows that being in a large household reduces the probability of having access to safe drinking water by 0.002 percentage points, compared to being in a smaller household. However, the size of the household is not a significant determinant of access to safe drinking water. Households headed by males are likely to have significantly less access to safe drinking water according to our results. The marginal effect shows that being in a household headed by a male reduced the probability of having access to safe drinking water by about 0.04 percentage points. This might be due partly to female concerns for availability of water in their choice of residence relative to their male counterparts, since females are most often responsible for carrying water if located outside the household. The result is also in agreement with Akramov and Asante (2006) in their study on Ghana. However, our panel estimates show that provision of drinking water is positive and significantly related with the average number of households headed by males for the twenty years of our panel analysis.

Table 3 Democracy, Ethnic diversity and access to safe drinking water

Independent Variables	**Survey: Probit regression**	**Marginal Effects**	**Probit Regression**	**Marginal effects**	**Random effect panel Estimates**
	1999-2003	1999-2003	1999-2003	1999-2003	1990-2008
Household size	-0.00497	-0.00165	-0.00366	-0.00123	0.899
	(0.00347)		(0.00321)		(0.853)
Head Male	-0.117**	-0.03994	-0.119**	-0.0410	0.335*
	(0.0564)		(0.0571)		(0.190)
Rural	-0.822***	-0.2894	-0.840***	-0.294	-0.0917
	(0.0212)		(0.0234)		(0.0633)
Education	0.0745	0.0248	0.0640	0.0215	0.00177
	(0.0475)		(0.0499)		(0.0878)
Log density	0.0726***	0.0242	0.0850***	0.0285	6.122***
	(0.0142)		(0.0165)		(2.296)
Ethnic diversity	**-0.331*** **	**-0.1102995**	**-0.265*** **	**-0.0891**	**-0.0895**
	(0.0396)		**(0.0477)**		**(5.401)**
Wealth index	0.619***	0.2061293	0.631***	0.212	47.21***

Independent Variables	Survey: Probit regression	Marginal Effects	Probit Regression	Marginal effects	Random effect panel Estimates
	(0.0656)		(0.0606)		(16.49)
Legislative competition	**0.0977*** **	**0.0325362**	**0.105*** **	**0.0354**	**1.587**
	(0.0207)		**(0.0227)**		**(2.173)**
Executive competition	**-0.0275**	**-0.0091622**	**-0.0124**	**-0.00415**	**-1.605**
	(0.0212)		**(0.0205)**		**(1.207)**
Democracy indicator	**-0.762*** **	**-0.2499273**	**-0.908*** **	**-0.298**	**2.390**
	(0.0944)		**(0.102)**		**(10.04)**
North indicator	0.247***	0.0814332	0.237***	0.0791	-2.805
	(0.0271)		(0.0322)		(5.352)
Constant	-0.296***		-0.395***		-30.23
	(0.101)		(0.118)		(21.39)
Observations	15,144		15,144	15,144	185
Number of id					37

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 indicates coefficient significant at 1%, 5% and 10% respectively. Dependent variable is a binary indicating whether households have access to drinking water (piped or borehole water) or not for our probit regressions. Mean state access to piped and borehole water is the dependent variable used for our panel regression.

Rural households are significantly disadvantaged in access to safe drinking water compared to urban households. The coefficient at 0.12 is both negative and significant at the 1 per cent level of significance in our probit regressions. The marginal effects also indicate that the probability of access to safe drinking water is 29 percentage points for rural compared to urban households. Our panel estimates further show that, on average, rural households have less access to provision of drinking water. Provision of water is likely to be concentrated in urban areas due to proximity to centres of governance. Education is a positive determinant of households' access to safe drinking water from both our probit and panel estimates. However, the relationship between access to safe drinking water and education levels of household heads is not significant in all the models. High rates of unemployment and underemployment in the country may be responsible partly for the weak relationship between education and provision of drinking water observed here. There is a positive and significant relationship between the log of population density and households' access to safe drinking water. The variable is significant at the 1% level in all models. The marginal effects also indicate that the probability of access to drinking water is about 0.02 percentage points higher in a densely populated state. This is not surprising since it is cost efficient to provide public goods in a densely populated state. Our panel estimate confirms this, indicating that provision of drinking water is significant (at the 1% level) and positively related with the log of the state population density.

As expected, the households' wealth index is significant at the 1% level and positively related with access to safe drinking water in all our models. A unit increase in the wealth index will increase households' access to safe drinking water probit index by 0.62. The marginal effect shows that wealthy households have about a 21 percentage greater probability of having access to drinking water than poor households. This is a clear indication that provision of safe drinking water significantly favours richer households over poorer households, even under democratic rule in the country. In line with this, the coefficient of the state's wealth index (47.21) in our panel model is positive and significantly related with provision of safe drinking water.

One of the core variables, legislative competition, is positive and significantly related (at the 1% level) with access to safe drinking water, indicating that a vibrant legislative environment is an added advantage under democratic rule. The marginal effects from our probit regression result shows that the probability of access to safe drinking water has increased by approximately 4 percentage points between 1999 and 2003, due to an increase in legislative competition. The panel result, although not significant, further shows that legislative competition has increased provision of drinking water for the period under consideration. This result may be due to lack of a credible electoral system in the country since the inception of the present democratic rule. It provides further confirmation of the likely negative impacts of political capture on the provision of public goods as predicted in the literature.

Executive competition has no significant relationship with access to drinking water based on our probit and panel results. Rather than improving access to drinking water, executive competition reduced households' access to drinking water due to lack of maintenance of dams constructed under military rule. While this result may be in conflict with our earlier hypothesis regarding the link between democracy and access to basic services, it is in accord with the argument posed in previous studies that the politics of Sub-Saharan Africa is rife with corruption and non-credible electoral processes (Keefer and Khemani, 2004, Ross, 2006). Corrupt democracies in that sense can be worse for social welfare than military rule. Our result pertaining to executive competition also points to the fact that political capture at local level often has negative impacts on the provision of basic needs mostly needed by the poor (Bardhan and Mookherjee, 2000), especially if competition for executive power by politicians dilutes efforts and resources intended for the provision of basic services.

The coefficient of the marginal effect for our democracy dummy clearly shows that the shift in government from military rule in 1999 to democratic rule in 2003 has reduced the probability of a household having access to safe drinking water by over 25 percentage points. This is a confirmation of the descriptive analysis from table 1 above, where average access to drinking water in about 20 states in 2003 was lower than the average in 1999. The panel estimate also indicates that there has been no significant improvement in the provision of drinking water in the ten years of democratic rule in the country. However, the relationship between the democracy indicator and provision of drinking water is positive for the panel. Hence it may be that if the electoral system is reformed and becomes more credible, citizens may in fact start to enjoy the long-awaited dividends of democracy.

Our second core variable, ethnic diversity, has a negative and significant (at the 1% level) effect on the likelihood that a household will have access to safe drinking water**.** The coefficient of the marginal effects indicates that ethnic diversity is responsible for an 11-percentage point reduction in the probability of access to drinking. The result corroborates previous empirical studies indicating that ethnic diversity has a negative impact on access to public goods (Akramov, 2006; Alesina, Baqir and Easterly, 1999; Miguel and Gugerty, 2004; Harris *et al*., 2001; Miguel, 2000; Goldin and Katz, 1999; Alesina *et al*., 1999). High levels of corruption and conflict associated with ethnically heterogeneous societies are some of the reasons advanced in the literature for the inverse relationship between ethnic diversity and access to public goods. At the state level, however, the negative effects of ethnic diversity lost its significance on the provision of drinking water. However, the effects of the variable remained negative.

The North-South indicator variable suggests that households in the northern part of the country are more likely to have access to safe drinking water in 2003 than their southern counterparts. We attributed the disparity between the north and the south to the spill over of the uneven distribution of public goods under military rule. Virtually all the Nigerian heads of state from 1979 to 1999 are from the northern part of the country. Most of the governors in the

southern states under military rule are military officers from the north. These governors are therefore not responsible to the citizens, especially in an ethnic polarized country such as Nigeria. Our panel result shows that a shift occurred after 2003, rendering the southern part better off in terms of provision of drinking water. Moreover, the geographical advantage of the south in terms of rivers and higher average rainfall should reduce the average costs of providing drinking water in the south.

In Table 4, we examine the effects of ethnic diversity on households' access to electricity. Unlike the case of drinking water, household size is positive and significantly related with access to electricity, according to our probit regression. This result is due partly to the high cost of providing alternative sources of energy in large households. Similar to access to drinking water, households headed by males have a negative probability of having access to electricity. Rural households are about 50 percent less likely to have access to electricity compared to the urban households (significant at the 1% level), as indicated by the probit marginal effects. This is an indication of a significant disparity between urban and rural households in access to electricity, as observed in the case of drinking water. Analysis at the state level from the panel result also show that the provision of electricity is poor in the rural areas compared to urban areas. As expected, it is costly to distribute electricity to the rural areas from the urban areas, where most of the transmission centres are located.

Education is a positive determinant of households' access to electricity, according to our probit regressions. The coefficient of education is significant at the 10% level and the marginal effect is about 0.04 percentage point higher in a household headed by an educated person than in a household without education. Similarly, the level of education in the state is also significant (at the 5% level) and positively related to the provision of electricity. As might be expected, households in more densely populated areas have significantly greater access to electricity, since governments prioritize such areas. The variable is significant at the 1% level and the probability is about 17 percentage points higher.

Table 4 Democracy, Ethnic diversity and access to Electricity in Nigeria

independent variables	**Survey: Probit Regression 1999-2003**	**Marginal Effects 1999-2003**	**Probit Regression 1999-2003**	**Marginal effects 1999-2003**	**Random effects panel estimates**
					1990-2008
Household size	0.0140***	0.0055859	0.0135***	0.00540***	-1.156
	(0.00375)		(0.00331)		(0.828)
Head male	-0.00162	-0.0006452	-0.0415	-0.0166	0.0412
	(0.0621)		(0.0613)		(0.188)
Rural	-1.464***	-0.5169447	-1.372***	-0.499***	-0.0917
	(0.0205)		(0.0254)		(0.0617)
Education	**0.0659**	**0.0262722**	**0.0919***	**0.0366***	**0.207****
	(0.0528)		**(0.0534)**		**(0.0859)**
Log density	0.420***	0.1673921	0.371***	0.148***	4.508*
	(0.0148)		(0.0179)		(2.352)
Ethnic diversity	**0.296*****	**0.1179939**	**0.284*****	**0.113*****	**2.696**
	(0.0350)		**(0.0476)**		**(5.376)**
Wealth index	0.755***	0.3010619	0.672***	0.268***	112.7***
	(0.0711)		(0.0656)		(16.20)
Legislative competition	**0.123*****	**0.0492192**	**0.0361***	**0.0144***	**3.004**

independent variables	Survey: Probit Regression 1999-2003	Marginal Effects 1999-2003	Probit Regression 1999-2003	Marginal effects 1999-2003	Random effects panel estimates
	(0.0123)		**(0.0202)**		**(2.112)**
Executive competition	**-0.0372*** **	**-0.0148297**	**-0.0477** **	**-0.0190** **	**-0.598**
	(0.0127)		**(0.0201)**		**(1.169)**
Democracy indicator	**-0.309*** **	**-0.122891**	**-0.00870**	**-0.00347**	**-12.56**
	(0.0750)		(0.0926)		(9.754)
North indicator	**-0.121*** **	**-0.0483732**	**-0.103*** **	**-0.0412*** **	**-0.358**
	(0.0248)		**(0.0310)**		**(5.421)**
Constant	-1.676***		-1.371***		1.235
	(0.0985)		(0.122)		(21.38)
Observations	14,882		14,882	14,882	185
Number of id					37

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 indicates coefficient significant at 1%, 5% and 10% respectively. Dependent variable is a binary indicating whether households have access to electricity or not for our probit regressions. Mean state access to electricity is the dependent variable used for our panel regression.

Wealth is clearly a major determinant of access to electricity. Access to electricity is 27% higher for households with a high wealth index and this is significant at the 5% level. The result is not that surprising, as wealthy households typically cluster in wealthy neighbourhoods, with better infrastructure and a greater ability to pay levies. At the state level, the average wealth index is also significant (at the 1% level) and positively related to the provision of electricity.

Our finding pertaining to democratic governance is similar to that for access to water, including the indicator for democracy (which distinguishes between the military period of 1999 and the democratic period in 2003). Legislative competition has a positive relationship with households' access to electricity. Our household-level analysis shows that an increase of about 0.04 percentage points in the probability of access to electricity is due to an increase in the legislative competitive index. The effect is significant at the 1% and 10% levels respectively, from the survey and non-survey probit regression. However, legislative competition is not a significant determinant of electricity provision at the state level, though it has a positive impact. The result is consistent with that of access to drinking water both for the household-level analysis and for the state-level analysis. Legislatures are closer to the electorates than the executives are and can therefore be monitored and made responsible more readily than the executives. However, it is worrisome that legislative competition is not a significant determinant of provision of both drinking water and electricity in the country.

Once again, the relationship between executive competition and access to electricity from our household-level analysis is both negative and significant (at the 1% level). Households are significantly worse off in terms of access to electricity under democratic rule in 2003, compared to military rule in 1999. This is a confirmation of the negative effects of political capture at the local levels of government on the provision of public goods, especially when elections are not credible. A credible electoral process as observed in the literature is a necessary condition for ensuring accountability of elected leaders in the sub-region and subsequently the delivery of basic services. The panel result also indicates that executive competition has not improved provision of electricity; instead, provision of electricity has deteriorated in the country since 1999.

The effects of the ethnic diversity index which is our main variable of interest is positive and significant (at the 1% level) on households' access to electricity in the country. An increase in the probability of access to electricity at the household level of about 12 percentage points is due to ethnic diversity. State-level analysis from the panel estimates also indicates that ethnic diversity has a positive relationship with electricity provision. This result contradicts our earlier finding, which indicated a negative relationship between access to water and ethnic diversity. This contradiction generates important questions that require further empirical and theoretical study of other countries. The first question relates to the sensitivity of ethnic diversity to targeted vs. non-targeted public goods. Provision and distribution of water, especially boreholes, can be targeted, unlike the provision and distribution of electricity. It is therefore easier to isolate a particular community due to ethnic bias in the provision and distribution of water. In the case of electricity, it is difficult to isolate a particular community on the grounds of ethnic bias, because electricity generation and distribution via electric poles and cables makes it difficult to exclude members of a rival ethnic group. Therefore, willingness to provide electricity to a favourable ethnic group will increase provision of electricity to all members of the society.

It is easier for the governors to exclude rival ethnic groups in the provision of water, unlike the provision of electricity, because drinking water is a targeted public good under the exclusive jurisdiction of the state governments. In fact, there are cases where state governments used water tankers to supply drinking water to targeted ethnic groups within the same area. The combination of the targeted nature of drinking water and its provision at the state level provides explanation for why access to drinking water has a negative relationship with ethnic diversity in the states. Therefore, when it is possible to target public goods provision, equitable provision is much more likely at the national level, especially when the sub-national government is ethnically heterogeneous. When provision of public goods are untargeted in nature (such as for electricity), provision is not subject to negative effects of ethnic diversity, irrespective of whether the national government or sub-national government is responsible for the provision of such public goods.

Overall, the effects-of-democracy indicator for both our household- and state-level analysis of access to and provision of electricity is negative. Presently in the country, access to electricity is at its lowest level. Most households depend on power-generating sets, while electricity interruption has become a normal occurrence.

The north-south indicator shows that the northern part of the country is significantly disadvantaged in the access to electricity. The variable is significant at the 1% level and the marginal effect shows that the north has a 4-percentage point lower probability of access to electricity compared with the southern part. The result of the panel estimates also suggests that provision of electricity is lower in the north than in the south.

8. CONCLUSION AND POLICY IMPLICATIONS

We have examined the effects of ethnic diversity on the provision of safe drinking water and electricity in Nigeria, using access to these basic needs both at the household level and at the state level. We used probit regressions and panel regressions for the household- and state-level analysis respectively. The results of our analysis suggest that transition from military to democratic rule is not synonymous with an immediate increase in households' welfare in the case of access to safe drinking water and electricity. Households' access to safe drinking water and electricity significantly reduced during the first four years of democratic rule in the country. The panel analysis also shows that access to drinking water has not improved significantly in the past ten years, while access to electricity is even worse under democratic rule so far.

The two measures of electoral competition have conflicting effects on the provision of drinking water and electricity. Our result shows that the legislative competition index has increased the provision of drinking water and electricity in the country. We interpret this as the advantage of a vibrant legislature under democratic rule. Legislatures are closer to the citizens than the executives are; they are therefore more accountable to the electorates. Surprisingly, executive competition has a negative effect on the provision of public goods from both our probit and panel results. We attribute this to the problem of political capture at the level of sub-national governments, due to weak electoral systems that encourage rigging and manipulation of election results. The executives are more loyal to the few members of their political interest group than to the general needs of the citizens.

The effects of ethnic diversity on public goods depend on the nature of such public goods. When it is possible to target public good provision such as drinking water, ethnic diversity will reduce its provision due to ethnic bias. Therefore, the national government and not the sub-national governments should provide such public goods when the society is ethnically heterogeneous. When public good provision is non-targeted in nature, ethnic diversity will increase its provision due to the combination of non-excludability in provision and an increase in lobbying by the various ethnic groups. Provision of such public goods is not prone to the negative effects of ethnic diversity, irrespective of the tiers of government that are responsible for their provision.

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