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GSSP Background Paper 16

Decentralization and Local Public Services in Ghana: Do Geography and Ethnic Diversity Matter?

Ghana Strategy Support Program (GSSP)

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November 15, 2008

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Decentralization and Local Public Services in Ghana: Do Geography and Ethnic Diversity Matter?

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November 15, 2008

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Summary

This paper explores disparities in local public service provision between decentralized districts in Ghana using district and household level data. The results show that districts' geography plays a major role in shaping disparities in access to local public services in Ghana. The findings also suggest that ethnic diversity has significant negative impact on access to local public services, including drinking water. This negative impact is significantly higher in rural areas. However, the negative impact of ethnic diversity in access to local public services, including drinking water, decreases as average literacy level increases. The paper relates these results to the literature and discusses policy implications.

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1. Introduction

The decentralization of authority and responsibility for public services provision to local governments is an essential part of the overall governance reform and development strategy in many developing countries around the world. The argument is that decentralization will increase economic efficiency and allow greater differentiation in the provision of public services due to improved preference matching and government accountability (Lockwood, 2006). This reflects the belief that since local governments are 'closer to the people' than the central government: (1) they will be better informed about the preferences and circumstances of the residents, and (2) local people might be better informed about the actions of local government, thus they will be in better position to hold government accountable. Thus, decentralization is thought to improve allocative efficiency, in the sense that the services provided by local governments will be better matched to the preferences of their populace.

However, some authors argue that the benefits of decentralization are not as obvious as proponents of decentralization suggest, and that there could be serious shortcomings that policymakers should be aware of in designing decentralization policies (Prud'homme, 1995; Breton, 2002). One of the potential risks with decentralization is that it can lead to greater interjurisdictional disparities due to the differences in socioeconomic potential and expenditure needs of sub-national governments. The argument is that sub-national governments with better factor endowments and potential will have larger revenue bases than other, poorer sub-national governments and therefore will be able to provide more local public services. This may cause disparities in economic opportunities and create gaps in income and public service delivery between various jurisdictions. Prud'homme (1995) considers in his work the "pure" decentralization as viewed in earlier fiscal federalism theory, that is, local governments fund local public services with their own local revenues without transfers from the central government. However, evidence suggests that intergovernmental transfers, such as equalization grants, can play an important role in overcoming imbalances between revenue capacities and expenditure needs of local governments (Martinez-Vazquez and Searle, 2007).

Whether advantages or disadvantages of decentralization will prevail is an empirical question. There are several studies that examine the relationship between decentralization and regional disparity in both developed and developing countries (Ahmad, Brosio and Tanzi, 2008; Bardhan and Mookherjee, 2005; Bonet, 2006; Kanbur and Zhang, 2005; Kim et al, 2003; etc.). These studies mostly focus on Asia and Latin America. This problem in the context of Sub-Saharan African countries is studied very rarely despite the fact that many countries in the region are pursuing serious decentralization programs. In fact, there is some evidence that within country regional disparities in development – such as those between the North and South of Ghana - can be attributed to changes in spatial disparities between administrative regions, agro-ecological zones and rural-urban divides (Vanderpue-Orgle 2002). However, there are significant gaps in existing research. Few studies focus specifically on the main administrative unit of decentralization – the district in Ghana's case – and thus fail to take into account inter-

district disparities in economic opportunities and local public service provision in explaining regional trends.

The aim of this study is to contribute new empirical insights to this question, derived from district and household level quantitative analysis. For a district-level analysis, we create a unique cross-sectional data at the district level for 110 districts of Ghana. Our household-level analysis is based on the Core Welfare Indicators Questionnaire Survey conducted in 2003. We focus on the following specific research questions: What is the extent of inter-district disparities in local public service provision in Ghana? What are the determinants of observed disparities in services between decentralized districts? What is the impact of spatial disparities on access to local public services at the household level?

The remainder of the paper is structured as follows. Section 2 provides a brief overview of Ghana's decentralization policy. Section 3 reviews the literature and then develops a simple theoretical framework to examine the potential sources of disparities between decentralized districts. Section 4 describes data sources and discusses empirical methodology. Section 5 reports the empirical results of the district-level and household-level analyses. Section 6 provides conclusions and implications of the results.

2. Overview of Decentralization in Ghana

Ghana's current program of decentralization was started in 1988 under the Rawlings' government with the introduction of the Local Government Law (Law 207). The initiative for the program was motivated by the ruling government's populist political philosophy, and its broader reform agenda, which concerned the role and responsibilities of the various levels of government and private sector for economic development (Ayee, 2003a, Ayee, 2003b). The decentralization process in Ghana led to the establishment of 85 districts in ten regions of the country in 1988. In 1992, the number of districts increased to 110.[3]

The 1992 Constitution, which marked Ghana's transition to a multi-party democracy, endorsed the 1988 reforms by consolidating the principles of decentralization within the overall context of a liberal democratic constitution. This constitution laid out the principles of the autonomous role of local government and its downward accountability to the populace. A three-tier structure of sub-national government was created at regional, district and sub-district levels. This includes ten Regional Coordinating Councils, 110 District Assemblies, and two bodies at the sub-district level: the urban, zonal, town or area council and the unit committee. However, the District Assembly (DA) is the key local government institution. As the Article 241 of the Constitution states they are the "the highest political authority in the district … with deliberative, legislative and executive power." DAs include both elected and appointed members. Seventy percent of DA members are elected by universal adult suffrage in local government elections that are held every four years. The central government appoints 30 percent of DA members and the District Chief Executive (DCE) who is an ex-officio member of the respective DA. The Members of Parliament whose constituency falls within a district are also non-voting members of the DA.

[3] Additional districts have been created in more recent years. The number of districts increased to 138 in 2004 and 162 in 2007. However, this study is based on 110 districts due to lack of data for newly created districts.

The DAs are mandated to hold three general meetings each year, during which they act as the district legislature. The main administrative and executive functions of the DAs are undertaken by the Executive Committee of the Assembly, which are responsible for general policy and overall development planning in a given district. They are the principal authority in their respective districts for development activities, inclusive of coordinating and integrating of other development partners. The districts are responsible for a delivery of various public goods and services, including such significant areas as feeder roads, agricultural extension, primary and secondary education, health, water and sanitation. Part of these public service delivery functions are devolved to district governments, while others are simply deconcentrated to district offices of the central Ministry, which operate in parallel to the DA.

Devolved public services entail full responsibility residing in the hands of district governments, including legislative (adopting bye-laws), fiscal (revenue-raising and expenditure allocation) and administrative discretionary power. Examples of such devolved services in Ghana include construction and maintenance of feeder roads, delivery of relief and sanitation services, and development planning. Delegated public services include those services provisions of which are delegated to districts by the central government ministry and agency. In this case, the DAs act as agents of central government without significant discretionary power in these services. Examples of delegated services in Ghana are: the provision of public health services in consultation with the Ministry of Health; the delivery of primary and secondary education under guidance of the Ministry of Education; and water supply in conjunction with the Ghana Water and Sewerage Corporation in urban areas and the Community Water and Sanitation Agency in rural areas.

Article 252 of the 1992 Constitution of Ghana mandated the transfer of at least 5 percent of total national fiscal revenues to district governments through a District Assembly Common Fund (DACF), which was implemented in 1994. Starting from 2008, the size of these transfers was increased to 7.5 percent of total national revenues. On average, in 2004, transfers from the central government accounted over 80 percent of total local revenues. The DACF grants are allocated between districts based on a special formula, which is approved by the National Parliament every year. This formula considers various social and economic factors, such as “Need”, “Responsiveness”, “Service Pressure”, and “Equality”, in allocation of DACF funds between districts (for a detailed discussion of the DACF and the allocation formula, see Banful, 2008).

3. Theory

In this section, we briefly review the literature and develop a simple theoretical framework which helps to organize our thoughts and focus on potential sources of cross-district differences in local public service provision. The model will also help us in developing specifications for the empirical analysis.

3.1. The literature

The case for decentralization is fundamentally based on accountability and efficiency considerations. Decentralization may help to improve accountability in two ways: via yardstick competition and by strengthening the link between policy choices and re-

election chances of local politicians (Hindricks and Lockwood, 2006). With respect to efficiency considerations, Oates (1972 and 1985) suggested that centralization should be naturally superior to decentralization so long as returns are increasing to scale. Thus, any case for decentralization on efficiency grounds should evoke counterbalancing sources of efficiency in which decentralized governments have an advantage.

As Lockwood (2006) summarizes, there are two broad approaches to the problem: the 'standard' model and political economy approach. The 'standard' model assumes that both central and local governments are benevolent, i.e., they maximize total welfare in their respective jurisdictions. This approach developed the so-called decentralization theorem, which results in the following general statements: (1) if jurisdictions are identical and there are no spillovers between them, then centralized and decentralized provision of public services are equally efficient; (2) if jurisdictions are not identical and there are no spillovers between them, then decentralized provision is more efficient; (3) if jurisdictions are identical and there are spillovers between them, then centralized provision is more efficient (Oats, 1972; Lockwood, 2006). However, these results rest largely on the assumption of policy uniformity, which is problematic, especially for developing countries. Another disadvantage of the 'standard' approach is that it does not consider the accountability argument at all.

The political economy approach, which systematically models the behavior of government taking into account political and institutional context, shifts the policy uniformity restriction. In these models, political processes and institutions, not a benevolent social planner, determine the choice of public policies in practice. There are various threads within the political economy approach to decentralization, such as legislative, strategic delegation and electoral accountability models (Lockwood, 2006). Our aim here is not to extensively review all those models but rather to highlight that the political economy approach can give a rigorous account of the efficiency (preference-matching) and accountability benefits of decentralization.

For example, Besley and Coate (2003) provide a political economy (legislative) model to examine centralized versus decentralized provision of local public goods. In this model, they assume that elected representatives in national legislature bargain over public goods provision in multiple districts. Similar to the 'standard' model, if districts are not identical, they find that decentralized provision of local public services continues to be welfare superior in the absence of spillovers. However, contrary to the 'standard' approach, they find that centralization is no longer superior when spillovers are present. Moreover, they find that higher heterogeneity reduces the relative efficiency of centralization for any level of spillovers as heterogeneity creates conflicts of interest between citizens of different districts. Thus, in the presence of heterogeneity between districts, strategic choice of delegates by voters may cause centralization to be less efficient by reducing 'preference matching'. Faguet (2004) uses a similar framework to examine whether decentralization increases the responsiveness of public investment to local needs in Bolivia. Ahmad and Brosio (2005) also use an analogous framework to evaluate outcomes of decentralization in Ghana and find mixed results.

Another group of studies analyze the relationship between decentralization (and fiscal federalism), regional disparities and economic development. Theoretically, the relationship between decentralization and spatial disparity is ambiguous. McKinnon (1995) and Qian and Weingast (1997) focus on the incentive effects of decentralization

on sub-national governments and suggest that regional disparities may be related to the efficiency of public services. Fiscal centralization and redistribution of resources from central government to ex-post poor districts may soften their budget constraints and distort their ex-ante incentives to escape from poverty. In this regard, decentralization might help to reduce regional disparities.

However, decentralization might lead to horizontal fiscal imbalances between decentralized districts because of the different fiscal capacities and expenditure needs of these districts. It might also lead to vertical imbalances in favor of the central government because of the same reason. In many countries an intergovernmental transfer system exists to overcome these imbalances (Martinez-Vazquez and Searle, 2007)[4]. Some authors question the effectiveness of such equalization transfers. On the one hand equalization transfers could give disadvantaged districts the scope they need for investments in public infrastructure and services. On the other hand, it is not clear whether they use these transfers effectively (Feld and Dede, 2005). It is also possible that instead of investing in public services, these transfers are used for consumption and rent seeking activities.

There are a number of empirical studies on the impact of decentralization on spatial disparity (Kim at al., 2003; Bonet, 2006; Kanbur and Zhang, 2005 and 2006; Zhang and Zou, 1998). For example, Kanbur and Zhang (2005) show that decentralization led to higher regional inequalities in Chinese provinces in the period of 1952-1999. Similarly, Zhang and Zou (1998) find that a higher degree of fiscal decentralization in government spending is associated with lower provincial economic growth over the period from 1978 to 1992. Contrary to these findings, Bonet (2006) finds a negative impact of fiscal decentralization on regional income distribution. Ahmad et al (2008), reviewing theoretical and empirical literature, suggest that links between decentralization and convergence are tenuous.

3.2. The model

Our empirical analysis is based on a simple analytical framework for decentralized provision of local public services, which is developed using insights from Besley and Coate (2003), Faguet (2004) and Ahmad and Brosio (2005). However, differently from these studies, our focus is not centralized versus decentralized provision of public goods, but differences between decentralized districts in local public service provision.

A country is made up of K decentralized districts, with a population size of N_k each where subscript k identifies district. We assume that districts are not identical and they provide certain local public services to their constituents. Preferences of all individuals have the same linear form

$$u_i = x_i + \mu_i b(g_k), \qquad (1)$$

where x_i is a private good consumed by an individual i and g_k is the amount of local public service available in district k. The preference of individual i for local public service g_k *is* denoted by μ_i.

In most developing countries, local public goods are financed by both a proportional local tax on income and transfers from a central government and donors. However, for the sake

[4] Examples of developing and transition countries that use intergovernmental equalization transfers are: Nigeria, Ghana, Kyrgyzstan, Pakistan, and India among others. Many developed nations, such as Canada, Germany, Japan, Australia, and the United Kingdom also use fiscal equalization schemes.

of simplicity, we assume that districts rely only on a local tax (a head tax), t_k, to finance local public services. Therefore, utility of an individual i in district k is

$$u_{ik} = y_{ik}(1 - t_k) + \mu_{ik} b(g_k) \qquad (2)$$

where $x_{ik} = y_{ik}(1 - t_i)$ and y_{ik} indicates the income of individual i in district k. We can define local welfare as a median utility,

$$u_{mk} = y_{mk}(1 - t_k) + \mu_{mk} b(g_k) \qquad (3)$$

where *m* used to denote the median individual in district k, and y_{mk} and μ_{mk} are the local median income and preference for local public service in district k, respectively.
The budget constraint for district k can be defined as

$$t_k N_k = \frac{g_k}{\gamma_k} \qquad (4)$$

where γ_k indicates the potential cost disability[5] of a given district k. This cost disability factor should not be confused with economies of scale, i.e., cost advantage due to size, which is represented by the district population (N_k). This cost disability factor captures the differences in the cost of local service delivery across districts relative to the average of all districts. A district may have a cost disadvantage for provision of local public service for a variety of reasons. For example, it may have a geographically dispersed population and have to provide services in remote locations. This means that ceteris paribus a unit cost of a particular service in this district may have a higher cost than the average cost across all districts. Other factors contributing to differences in cost of service provision might include the composition (rural versus urban, sex, age, etc.) of the population. Further, the differences in the cost of service provision could be related to differences between districts in government accountability, bureaucratic slack, managerial capabilities, and technical knowledge of local governments.
By solving (4) for tax rate, we get the required tax rate to provide g_k level of local public service in district k

$$t_k = \frac{\gamma_k g_k}{N_k} \qquad (5)$$

by substituting the tax rate from (5) into (3), we rewrite the utility of median individual in district k as

$$u_k = y_k - \frac{y_k \gamma_k g_k}{N_k} + \mu_k b(g_k) \qquad (6)$$

where for simplicity we drop all subscripts m. Thus, local government's welfare maximization problem in district k is

$$\max_{g_k} \left[y_k - \frac{y_k \gamma_k g_k}{N_k} + \mu_k b(g_k) \right] \qquad (7)$$

Taking first-order conditions and re-arranging yields, we get the optimum choice of local public service as

[5] Assuming there are only two districts, this cost disability factor can be defined as $\gamma_k = 2c_k / (c_1 + c_2),\ k = 1,2$ and c_k is the cost local service provision in district k. So defined, if $\gamma_k > 1$, then district k is relatively high cost provider of the local public service (has a cost disability) and if $\gamma_k < 1$, it is a relatively low cost provider.

$$b'(g_k) = \frac{y_k \gamma_k}{\mu_k N_k} \quad (8)$$

This suggests that the level of local public service provided by a district k is an implicit function of the income (y_k), the cost disability factor (γ_k), the median preference (μ_k) for the local public good, and the size (N_k) of the district. This also implies that local governments are more likely to provide different levels of public services to their constituents as these factors tend to vary across districts.

So far we have focused on potential sources of disparities between districts in local public service provision. The important question is how these factors impact access to local public services at the household level. Similar to Ahmad and Brosio (2005), extending the insights of the above analysis to individual level, we can determine the consumer surplus for a given individual i from a given district k as:

$$CS_i(g_k) = \mu_{ik} b(g_k) - \frac{\gamma_k g_k}{N_k} \quad (9)$$

The equation (9) suggests that, other things being equal, the well-being of individuals will be higher in districts where the local government can determine the preferences for local public goods more precisely, the cost-efficiency of district government and the district size.

Several empirical hypotheses emerge from this model:

1. Districts with higher income levels are likely to have stronger revenue bases than districts with lower income levels. The expected relationship between the average income level in the district and the level of local public services provided is positive.
2. As the preferences for local public services become more diverse the supply of individual local public services likely to decline, ceteris paribus. The level of local public services also depends on how districts correctly assess local preferences.
3. The likely impact of the cost disability factor on local service provision is negative.
4. Economies of scale exist in the provision of public services because average costs decline as the number of recipients of the services increases. Thus, more populous districts are likely to have an advantage in local service provision.

We can empirically test these hypotheses. But one has to be careful in interpreting such relationships because these variables are themselves endogenous and the relationships might have two-way effects. This prevents us from giving the equation (8) any straightforward causal interpretation. For example, to the extent that local public service provision is driven by other fundamental determinants, not directly captured in the model, the causality may well run backwards, from local public services to income instead of the other way around. For these reasons it is best to think of these factors as proximate determinants of local public service provision.

We posit that the deeper determinants of service delivery disparities are geography and ethnic diversity. Ethnic diversity relates to ethnic, linguistic and religious heterogeneity of districts' population. Geography relates to the advantages and disadvantages created by districts' physical location and agro-ecological conditions. Each of these variables and their potential direct and indirect (through proximate determinants) impact on local public services warrants some discussion.

In recent years, there has been increasing interest in economic consequences of ethnic diversity. The existing literature focuses on two principal channels through which local ethnic heterogeneity impacts the local public services. First, different ethnic groups might have different tastes and preferences for local public services, and heterogeneity of preferences across ethnic groups in a jurisdiction is likely to influence the amount and type of public goods the jurisdiction supplies (Alesina, Baqir and Easterly 1999; Vigdor 2004). Second, Alesina and La Ferrara (2000) show that participation in social activities is significantly lower in more fragmented localities leading to lower social capital and weak local institutions. Further, an incapability of weak local institutions to impose social sanctions in diverse communities leads to collective action failures (Miguel and Gugerty 2005). Diverse communities thus face higher coordination costs in provision of local public services. Hence, ethnic diversity may influence local public services through its impact on two variables in our model: the preferences for local public goods and the cost disability factor.

Geography directly influences the demand for and supply of local public services. Different types of countryside might have advantages for different types of local public goods. For example, supply of drinking water is highly dependent on the availability of surface and ground water sources in a given geographic area. Climate and environment play important roles in shaping the public health environment (the inhabitants' proclivity to debilitating infectious diseases such as malaria) and the need for public health care. Geography also influences local public services through other factors such as institutions, income, and population density. As Engerman and Sokoloff (2000) and Sokoloff and Engerman (2000) have shown, the initial factor endowments for large part explain income, human capital and political power inequalities; these inequalities in turn explain the structure and functioning of institutions which insure the persistence of inequalities. Geography may also influence ethnic diversity in the long run via migration. In the simplest story migrants from unfavorable regions may be drawn to regions with favorable conditions and this in-migration may increase ethnic diversity in receiving regions. Thus, ethnic diversity is only partly exogenous and geography is arguably the only exogenous factor in our framework. Given the insights of the model and follow-up discussion, the important empirical question is: what impact do geography and ethnic diversity have on local public services? The next section describes data and explains how we plan to empirically examine this question.

4. Empirical methodology and data

4.1. Empirical model specifications

Our theoretical discussion above suggests that geography and ethnic diversity are two potentially deep determinants of cross-district disparity in local public service delivery.

Thus, the main question for our empirical analysis is whether geography and ethnic diversity have any effect on local public services after controlling for observable variables at the district and household levels. To address this question, we have divided the analysis into three stages.

The first stage analyzes the evidence of cross-district differences in access to local public services and to what extent these differences had been shaped by local geographic endowments and ethnic diversity. This analysis is based on standard OLS methodology. To test the robustness of the OLS results to spatial dependence, we also estimate our models by using spatial econometric techniques.

At the district level, to examine the impact of geography and ethnic diversity in access to local public services, we estimate the model

$$Y_k = \alpha + \beta_g G_k + \beta_e EFI_k + \varphi D_k + \varepsilon_k \qquad (10)$$

where G_k is a matrix of geographic location variables including distance to district from the nation's capital (Accra), distance to district from a respective regional capital and agro-ecological zone, EFI_k is a vector of district level ethnic fractionalization, and D_k is a matrix of district characteristics including population density, share of rural population, average literacy level, per capita public expenditures, and internal revenue generation. We use a composite index of access to local public services as a dependent variable (Y_k).[6] We include each group of independent variables incrementally, and lastly we estimate the full model.

Additionally, we use spatial econometric techniques to explore the importance of the effects of neighboring districts for robustness of the results. The motivation for this is that unobserved effects may spillover across districts and hence result in spatially correlated errors. As a result, standard OLS estimates are no longer efficient but they are still unbiased. The most common choice to model such spatial dependence is a spatial autoregressive process such as

$$\begin{aligned} Y_k &= \alpha + \beta_g G_k + \beta_e EFI_k + \varphi D_k + \varepsilon_k \\ \varepsilon_k &= \lambda W \varepsilon_k + \epsilon \end{aligned} \qquad (11)$$

with λ as the autoregressive parameter, $W\varepsilon$ as a spatially correlated error, and ϵ as a well behaved random error term (Anselin, 2006).

In the second stage, to formally answer whether geography and ethnic diversity have impact in determining household-level access to local public services, we estimate series multi-level random intercept logistic models for access to drinking water. For this analysis our dependent variable is a binary measure of whether a household has access to drinking water. The responses are coded as 1 or 0, where 1 is interpreted as the household has access to drinking water and 0 as not. We use two types of information as indicators of access to drinking water: (1) access to any source of drinking water (from now on drinking water) and (2) access to an improved source of drinking water (from now on improved drinking water). A natural model to consider for estimating the effects of district and household characteristics on access to drinking water is a standard logistic regression model. Standard logistic regression modeling usually assumes that the error terms have zero mean and are mutually independent. However, in nested cross-sectional data, we would expect that measurements within the same districts are correlated. In this

[6] The details of this composite measure of access to local public services are given in next section.

case, standard logistic regression estimates are still consistent, but the estimated standard errors of the regression coefficients are no longer valid.

One way of addressing this problem is to use multilevel modeling, which explicitly models the dependence by decomposing the total residual or error term into error components: permanent error component, which varies between districts and a transitory error component, which varies between households as well as districts. The permanent error component represents the combined effects of omitted district characteristics or unobserved heterogeneity. Since it is shared by all households for the same district, it induces within-district dependence. Another advantage of using multilevel modeling is that multilevel models allow us to test whether within-level or cross-level interactions are significant in determining the dependent variable.

We specify a two-level random-intercept logit model for access to drinking water with household i nested in district k :

$$Y_{ik} = \alpha + \beta_h HH_{ik} + \beta_g G_k + \beta_e EFI_k + \varphi D_k + \xi_k + \varepsilon_{ik} \qquad (12)$$

where HH_{ik} is a vector containing all household-level covariates, D_k is a vector containing all district-level covariates, ξ_k is a random intercept varying over districts (level 2), and ε_{ik} is well behaved error term that has a logistic distribution with variance $\pi^2/3$. Y_{ik} is a binary variable for household having access to a drinking water. This two-level random-intercept model can be viewed as a regression model with a district specific intercept $\alpha + \xi_k$. Here ξ_k can be considered as a random parameter that is not estimated along with parameters $\alpha, \beta_h, \beta_g, \beta_e,$ and φ , but whose variance is estimated together with the variance of the ε_{ik}.

Similar to (12), we specify a three-level random-intercept logit model for access to drinking water with household i nested in district k which is nested in region j :

$$Y_{ikj} = \alpha + \beta_{hh} HH_{ikj} + \beta_g G_{kj} + \beta_e EFI_{kj} + \varphi D_{kj} + \xi_{kj} + \xi_j + \varepsilon_{ikj} \qquad (13)$$

where HH_{ikj} is a vector containing all household-level covariates, D_{kj} is a vector containing all district-level covariates, ξ_{kj} is a random intercept varying over districts (level 2), ξ_j is a random intercept varying across regions, and ε_{ikj} is well behaved error term that has a logistic distribution with variance $\pi^2/3$. Y_{ikj} is a binary variable for household having access to a drinking water. Obviously, the random intercepts (ξ_{kj} and ξ_j) are assumed to be independent.

In stages 1 and 2 (equations 10 to 13), the main coefficients of interest are β_h and β_g. Following the argument in section 3.2, we expect that unfavorable geography impacts local public service provision negatively. Similarly, we expect that ethnic diversity negatively impacts the provision of local public services. The variables in D and HH are not included in specifications 10 to 13 as mere controls, however. The coefficients of variables in D are interest insofar as they help to explain district level institutional and socio-economic determinants of local public service provision, and so constitute indirect tests of the predictions of our theoretical model. The coefficients of variables in HH are interest to the extent that they play a role in reducing negative effects of an adverse geography and ethnic diversity. For example, we expect that education and income positively impact households' access to local public services.

In the third stage to explore the potential interaction effects of ethnic diversity with district and household level variables, we extend the specification (13) with interaction terms. First, we examine the interaction of ethnic diversity with districts' average literacy

level, considering the literacy level as a proxy for human capital and managerial capacity in the district. Our hypothesis is that the negative impact of ethnic fractionalization on local public service provision will be mitigated as literacy level increases. Second, we investigate the specific impact of ethnic fractionalization on local public services in rural areas by interacting it with rural household variable. We expect that negative impact of ethnic fractionalization on local public services will be higher for rural households.

4.2. Data and descriptive statistics

The empirical analysis utilizes district and household level data collected from different sources, including the 2000 Ghana Population and Housing Census and the 2003 Ghana Core Welfare Indicators Questionnaire (CWIQ) Survey. The description of these variables is provided in Table 1 in Appendix.

Dependent variables

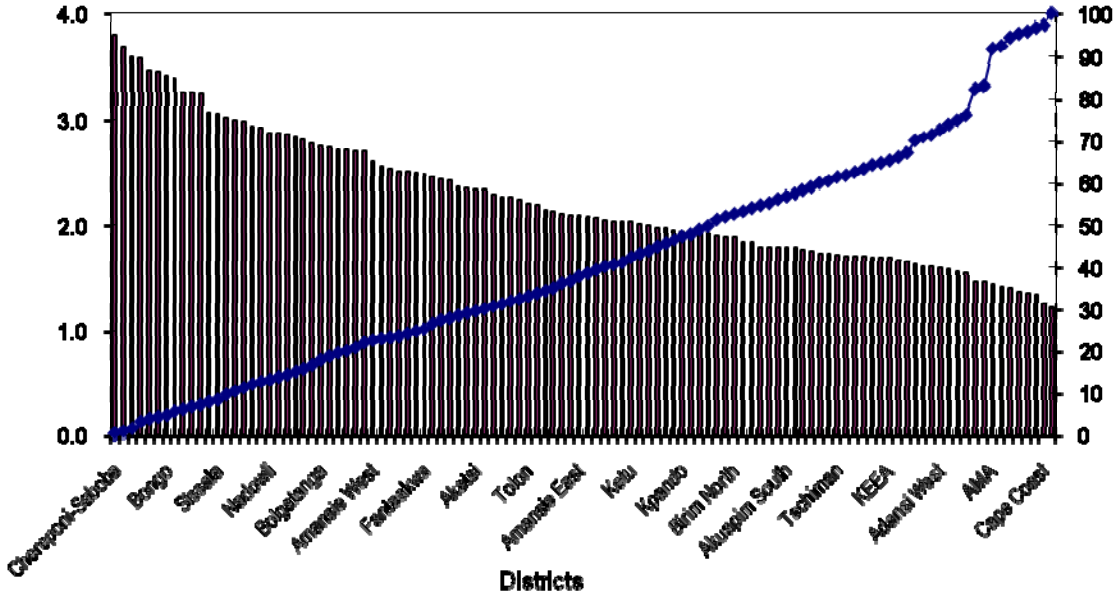
We use CWIQ (2003) data to measure access to local public services. The dataset provides measures of access to seven public services, including drinking water, public food markets, public transportation, primary and secondary school, health care and communication. This national survey, which is representative at the district level, was conducted in 2003 and includes over 49,000 households. The survey asked households the following question: how long in minutes does it take from here to reach the nearest service facility, with five possible choices: 0-14 minutes – score 1; 15-29 minutes – score 2; 30-44 minutes – score 3; 45-59 minutes score 4; over 60 minutes – score 5. Thus, the higher the score the longer is the time to reach nearest service facility.

Descriptive statistic analysis shows that these measures of access to different local services are highly correlated across all households, with correlation coefficients ranging from 0.6 to 0.9. This suggests that any randomly selected household is likely to have similar levels of access to different local public services. To facilitate analysis, and in order to obtain a meaningful average rate of access to seven local public services covered by CWIQ (2003) at the district level, we construct a composite index of access to local public services. We do so by using principal components analysis, which captures the most of the variance in access to different local public services for each district.[7] This is our dependent variable (*access*) for district level analysis.

Figure 1 shows the distribution of access to local public services across Ghana's decentralized districts. The index is constructed in a way that lower scores associates with better access to local services and vice versa. It varies between 1.2 for Tema Municipal district where about 2.7% of Ghana's total population live and 3.8 for Chereponi-Saboba district where only 0.5% of Ghana's population reside.

[7] This process is explained in detail in the Appendix.

Figure 1. Distribution of access to services in Ghana: Composite index of access to services (left axis) and cumulative percentage of Ghana's population (right axis)



Data source: CWIQ (2003), GSS, & authors' calculations

For household-level analysis of access to drinking water we use two types of dependent variables. Our first dependent variable (*water_ac*) shows whether a household has a reasonable access (water source within 15 minutes) to any supply of drinking water. About 82 percent of all households reported having access to any source of drinking water. By area of residence, urban households have considerably higher (91.4%) access than rural households (77.3%). The alternative dependent variable (*impr_water*) shows whether a household has access to improved drinking water sources, including piped water in the dwelling, public outdoor tap, borehole and protected well. Overall, about 72 percent of all Ghanaian households have access to improved water sources. Again, by area of residence, urban households (almost 88%) have significantly higher access to improved drinking water than rural households (63%). However, this gap is much higher compared to access to any source of drinking water. Data also suggests that there are significant variations in access to any and improved drinking water across regions and districts.

Independent variables

Our independent variables include geography, ethnic diversity, district and household level socioeconomic indicators. Ghana is located in the tropics, but because of variations in relief, soil texture and rainfall, it comprises different microclimates. These differences have potentially important impacts on the productivity of land and economic development. The evidence shows that the development pattern in Ghana is characterized by a north-south divide in which north lags far behind south. The evidence also suggests that these regions are heterogeneous internally. Reasons often put forward include unfavorable geography and economic conditions among other, such as history and post

independence political neglect (Shepherd and Gyimah-Boadi 2004, ODI and CEPA 2005).

We use two types of variables to measure the districts' geography: (1) distances from Accra (national capital) and regional capitals; and (2) agro-ecological zones. From GIS sources, we collected latitudes and longitudes for all districts, and then using the great circle distance formula[8], computed the distances between Accra and all Ghanaian districts (*adistrict*), and between respective regional capitals and all districts in that region (*rdistrict*).

Data on agro-ecological zoning classifies districts in Ghana to forest, coastal and savannah zones[9]. Main characteristics of these agro-ecological zones are provided in Table 2 in Appendix. The forest and coastal zones have a bi-modal rainfall pattern with major and minor rainy seasons. In contrast, the rainfall pattern is uni-modal in the Savannah zone. The average annual rainfall ranges from 800 mm in the coastal to 1600 mm in the forest zone. The forest zone specializes in industrial crops such cocoa, which is the source of income and livelihood for about 25 percent of Ghana's population (ISSER, 2003). The cocoa industry contributes more than one-quarter of Ghana's total export earnings. The savannah zone mainly specializes in cereals, such as millet, sorghum and rice. The coastal zone is home to the nation's capital, and it is more urbanized than other parts of the country.

Following the existing literature (Alesina et al, 1999; Miguel 2005; etc.), we use ethno-linguistic fractionalization (*elf*) as the measure of ethnic diversity. This allows us to compare our results with these studies. Ethno-linguistic fractionalization is the probability two people randomly drawn from the population are from different ethnic groups. It is closely related to a Herfindahl index and formally defined as

$$ELF_k = 1 - \sum_{i=1}^{N} P_i$$

where P_i is a proportion of group i in total population. This index was calculated using the 2000 Ghana Population and Housing Census. It varies across Ghana's districts between 0.07 and 0.81.

In addition, we include in the empirical models such district level variables as population size, population density, share of rural population, poverty indicators, literacy level and per capita public expenditures. The data to measure these variables are obtained from the publications of the Ghana Statistical Service. Further, from the 2003 CWIQ data we obtained such household characteristics as income (welfare quintiles), whether household's community was easily accessible by road all year around, whether the head of household was literate, male or female, and whether household lived in rural area.

Correlations

Figure 1 provides the partial associations of the access to local public services index against measures of geography and ethnic diversity. These partial correlations show strong positive relation between the geographic variables and the composite index of

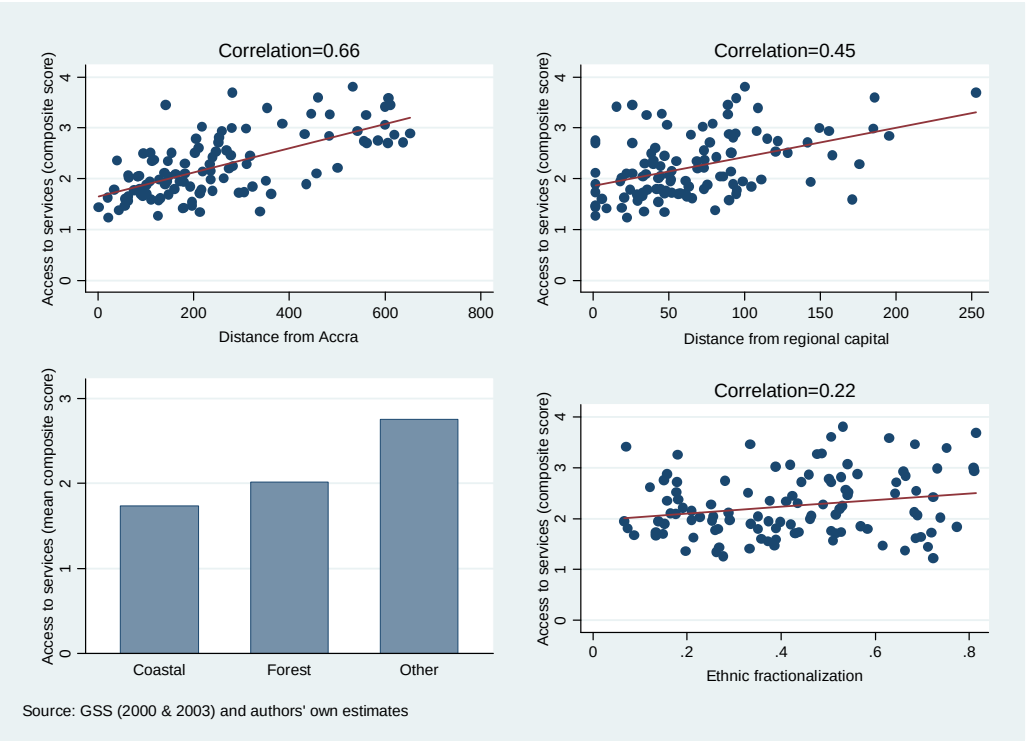
[8] The great-circle distance is the shortest distance between any two points on the surface of an earth measured along a path on the surface of the sphere (since the earth is a sphere).

[9] These agro-ecological zones can further be divided into smaller zones. For example, the Forest Zone can be divided into rain forest and deciduous forest zones.

access to local public services. Since the index is constructed in a way that lower scores associates with better access to local public services and vice versa, the farther the districts' location from Accra and the respective regional capitals the lower is the access to local public services. Also districts located in coastal and forest zones are likely to have better access to local public services. On the other hand, the disparities in local public service provision can also be attributed, at least in part, to a significant dispersion in ethnic fractionalization. The more diverse the districts population the lower is the access to local public services.

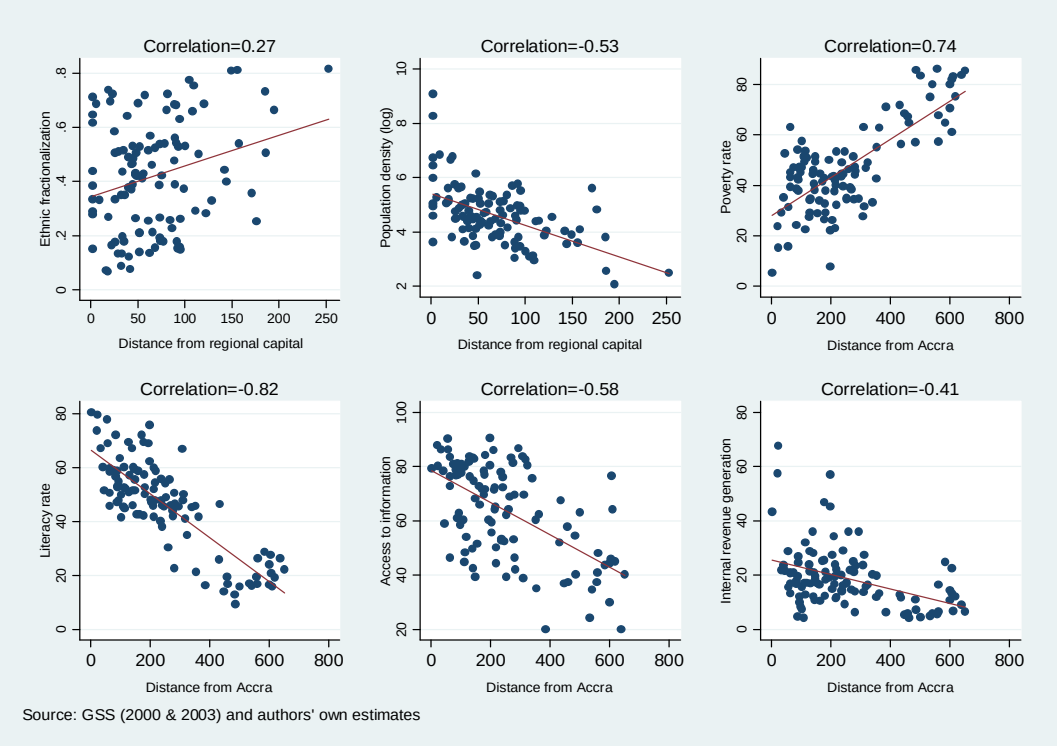
At the same time, geographic variables appear to have considerable correlations with other independent variables (Figure 2). First, the districts that are located farther from the regional capitals appear to have relatively higher ethnic fractionalization. Second, the districts' geography is strongly correlated with district characteristics such as average literacy and poverty rate. Third, geography has significant associations with the districts' population density, access to information and fiscal capacity. Further, as expected, access to local public services is correlated with its proximate determinants such as population density, poverty, literacy, fiscal capacity, and share of rural population. For example, there is significant correlation (0.62) between access to local public services and poverty rate. At the same time we observe no significant correlations between access to local public services and per capita public (both total and capital) expenditures. However, since correlation measures only a linear relationship, to have correlation close to or equal to zero does not mean that there is no relationship between these variables.

Figure 1. Partial associations between the dependent variable (access to local public services) and the key independent variables (geography and ethnic diversity)



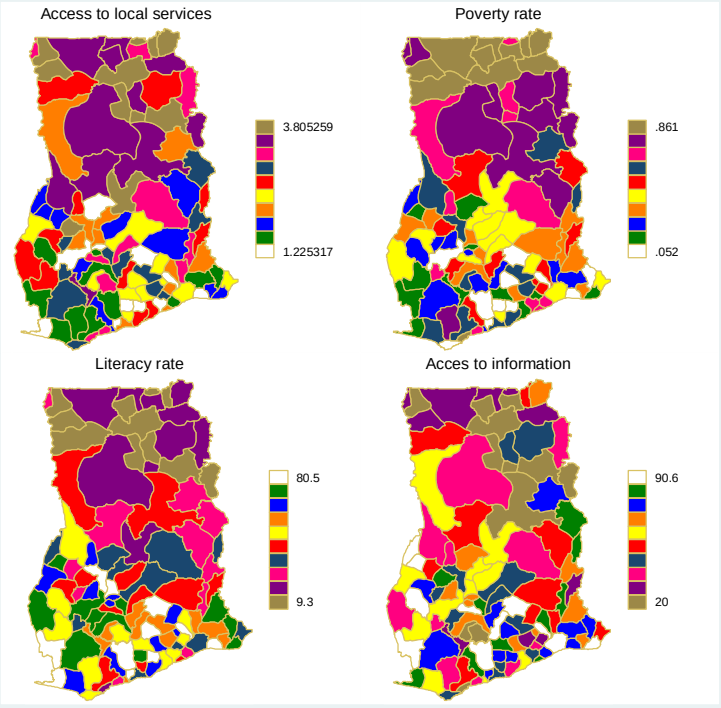
Source: GSS (2000 & 2003) and authors' own estimates

Figure 2. Partial associations between geography, ethnic diversity, and proximate determinants of access to local public services



The importance of district's geography suggests that there could be spatial clustering in the data. Figure 3 shows the spatial patterns of access to local public services and some of its highly spatially correlated determinants. Districts showing better access to local public services tend to be clustered in the south (coastal zone), while districts with lower access to public services tend to be clustered in the north (savannah zone) with some exceptions. Similarly, districts in the north are more likely to be poor and have low literacy levels and access to information. Table 1 confirms the graphical analysis showing high and statistically significant spatial autocorrelations for these and some other variables. Some variables do not show a clear spatial pattern. One variable – districts' per capita public (both total and capital) expenditures - deserves special attention. Per capita public expenditures do not show any statistically significant spatial pattern measured by the Moran's I. This could be a result of the national governments fiscal equalization policy.

Figure 4. Spatial patterns of access to local public services and its determinants



Source: GSS (2003 and 2005) and authors' own calculations

The results of descriptive analysis seem to agree with predictions of the theoretical model. However, these relationships are much more complicated and we need to use multivariate econometric analysis, rather than simple correlations, to better understand them. The results of such analyses are provided in the following section.

Table 1. Spatially correlated variables in the data

	Moran's I*	Z-value	p-value**
Access to local services	0.44	12.265	0.000
Poverty	0.61	16.841	0.000
Literacy	0.67	18.348	0.000
Road density	0.40	11.241	0.000
Information access			
Newspaper	0.25	7.011	0.000
Radio	0.37	10.289	0.000
Ethnic fractionalization	0.19	5.495	0.000
Internal revenue generation	0.13	3.858	0.000
Share of rural population	0.13	3.863	0.000

Note: * Distance band (0-1); **Probability to reject null hypothesis (absence of spatial dependence)
Source: Authors' own estimates

5. Regression results

5.1 District level analysis

Table 2 shows the results of district level econometric analysis. We used a composite index of access to local public services, which is a combined measure of access to seven specific local services, as a dependent variable. The models 1-4 are OLS estimates of the specification 10. The model 5 is the first degree spatial error regression estimate of the specification 11.

As can be seen in Table 2, when only geographic variables are included in the model, all of them prove to be statistically significant. In particular, the districts that are father away from Accra as well as from a regional capital tend to have lower access to local public services. Similarly, the districts located in coastal and forest zones are likely to have better access to local public services. When we add the ethnic fractionalization, which is likely to encompass the heterogeneity of preferences for public services and social capital, geographic variables (except the coastal dummy) remain significant but their negative impact diminishes considerably. This effect can be seen as demonstrating the importance of ethnic diversity for local public services. Further, when we add additional proximate variables (which are correlated with geography) into the model the importance of geographic variables continues to diminish while the importance of ethnic fractionalization continues to increase.

The full specification of the model (model 4) explains more than three quarters of the cross-district variation in access to local public services in Ghana. The results suggest that ethnic fractionalization is the most important determinant of access to public services. Geography remains important. Districts that are located in coastal and forest zones are likely to have better access to local public services. Although distance from regional capital is statistically significant but its practical importance (magnitude of estimated coefficients) is very limited. Distance from Accra is both statistically and practically insignificant. Among proximate determinants of access to local public services share of rural population, literacy, internal fiscal capacity and access to information are statistically significant at an acceptable level. All of these variables, excluding internal fiscal capacity, have the expected sign.

It is important to note that with addition of all measures of deep and proximate determinants of access local public service at hand, the spatial dependence (autocorrelation) of residuals reduced significantly. Nevertheless, model 5 in table 2 displays the results implemented by considering possible spatial dependence between observations. The coefficients of the spatial error term appear sizable in magnitude and statistically significant. According to this model, ethnic fractionalization is even more important in determining the access to local public services. The coefficient associated with this variable is increased up to 0.79 from 0.54. The coefficients associated with the coastal dummy and internal fiscal capacity are no longer statistically significant at acceptable significance levels. In contrast, the coefficient associated with per capita district public expenditures turns out to be statistically significant. The positive sign of the coefficient suggests that the higher the per capita district public expenditures the lower is the access to local public services. How can we explain this result? One possible explanation could be the central governments equalization policy. Finally, we would like

to emphasize the results associated with literacy rate. As mentioned above, we are not trying to isolate the effect of literacy skills on access to local public services but rather to test the use of literacy as a proxy for human capital and managerial capacity in the district. The estimated coefficients suggest that the higher the literacy level the higher is the access to local public services.

5.2 Household-level analysis

To further examine effects of geography, ethnic fractionalization, and other district and household level characteristics on access to local public services, we use household level data from the 2003 CWIQ survey. At this stage of analysis, we estimate a series of multilevel random intercept logit models of access to drinking water based on (12) and (13). Our two binary dependent variables measure whether a household have access to a drinking water: (1) access to drinking water and (2) access to improved drinking water. Maximum likelihood estimates of a two- and three-level random-intercept logit models were obtained using Generalized Linear Latent and Mixed Models (GLLAMM) framework, which uses adaptive quadrature (Rabe-Hesketh et al, 2004 and 2005). The goodness of fit of estimated models are measured by using deviance and information criteria (AIC and BIC), which indicates that three-level random-intercept models are superior in describing the reality of access to drinking water in Ghana.

Table 3 reports coefficients estimated for determinants of access to drinking water. Model 1 in Table 3 reports results for a model that includes only household and community characteristics. These results suggest that households whose head is literate are more likely to have access to drinking water. In the same way, households that reside in communities with all season access to roads are likely to have better access to drinking water. In contrast, rural and poorer households are likely to have significantly lower access to drinking water. Surprisingly, ceteris paribus, households with male head are less likely to have access to drinking water. On the other hand, analogous to district level analysis, when only geographic variables are included in the model (not reported here), the negative impact of distance from Accra and regional capitals prove to be statistically significant in explaining household level access to drinking water. Similarly, ethnic fractionalization has significant negative impact on access to drinking water.

It is interesting to see whether household and community characteristics counterbalance the adverse effects of geography and ethnic diversity. Model 2 in Table 3 reports the results of logistic regression, which includes household, community and district characteristics. The next two columns in Table 3 provide the results of two- and three- level random-intercept models, respectively. These results show that the negative impact of distance from Accra and regional capitals disappear. In fact, coefficients for these variables are practically very small. However, the impact of agro-ecology persists or even gets stronger suggesting that households that reside in forest and coastal zones are significantly more likely to have better access to drinking water as compared to households from other zones. Likewise, the negative impact of ethnic fractionalization continues to be significant. The results also suggest that, other things being equal, households that reside in districts with higher levels of human capital (literacy) and access to information are more likely to have access to drinking water. The share of rural population and per capita district public expenditures appear to be insignificant. Comparing the results of model 1 and model 4, we can see that returns to private

(education and income) assets in terms of access to drinking water diminishes considerably when observable district characteristics (geography, ethnic diversity, human capital, public expenditures, etc.) are included in the model, and unobserved heterogeneity at district and region levels are controlled for. However, return to public assets (access to roads) in terms of access to drinking water is robust to changes in model specification.

Table 4 reports the results of the model for access to improved drinking water. These results are substantially different in many ways from the results in Table 3. First, positive household (education and income) and community characteristics (access to roads) seem counterbalance the effects of adverse geography to greater extent. In fact, coefficients estimated for a three-level random-intercept logit model suggest that the negative effect of adverse geography is virtually insignificant in determining household level access to improved drinking water. At the same time, estimated coefficients for income quintiles, household head's literacy and access to roads are robust to changes in model specification. Also, rural households seem to have greater disadvantage than their urban counterparts. Second, the negative impact of ethnic fractionalization turns out to be extremely significant, however. In fact, the magnitude of estimated coefficient (Model 4 in Table 4) is twice as much as compared to the model for access to drinking water (Model 4 in Table 3). Third, differently from our previous model (Table 3), the results suggest that per capita district public expenditures have positive impact on access to improved drinking water. The magnitude and sign of the estimated coefficients are robust to changes in model specifications. The results for district characteristics such as share of rural population, average literacy level and access to information are similar for both models.

5.3 Interactions

In this section we address two important questions. First, does the investment in human capital mitigate the negative impact of ethnic diversity on local public services? If so, then the negative impact of ethnic diversity on access to local public services should be lower in districts with higher literacy. Second, is the negative impact of ethnic diversity on local public services equal for urban and rural households? Table 5 reports estimates of the interaction effects of ethnic diversity with literacy and rural households. The marginal effect of ethnic fractionalization, in these models, depends on the values of the literacy and rural variables, respectively, involved in the interactions. In particular, the marginal impact of a one-unit change in ethnic diversity on access to water depends on the level of average literacy in the district or whether a household is urban or rural.

One of our key findings is that the negative impact of ethnic fractionalization diminishes as average literacy level increases. The marginal impact of ethnic fractionalization on drinking water and improved drinking water is equal to

$$(-1.0616 * (ethnic\ fractionalization) + 0.0235 * (ethnic\ fractionalization * literacy))$$

and

$$(-1.0155 * (ethnic\ fractionalization) + 0.0103 * (ethnic\ fractionalization * literacy))$$

, respectively. The sizes and signs of the coefficients for the main and interaction terms illustrate how the relative impact of ethnic fractionalization vary by literacy level.

The second important finding is that net impact of ethnic fractionalization is different for urban and rural households. In fact, for urban households (where rural dummy is zero), the marginal impact of ethnic fractionalization is either virtually zero (drinking water) or positive (improved drinking water). In contrast, for rural households (where rural dummy is one), the marginal impact of ethnic fractionalization is significantly negative. The magnitudes of the coefficients for the main and interaction effects suggest that differences in the marginal impact of ethnic fractionalization between urban and rural areas is even greater in case of improved drinking water.

It is worth to note that the introduction of interaction terms in model specifications did not result in significant changes in the estimated coefficients of other variables compared to our earlier estimations. This provides additional evidence of the robustness of the results.

6. Conclusions

In this paper we develop a simple framework that explains disparities in local public services between decentralized districts within a country. Our framework suggests that fundamental differences in geography and in the ethnic composition of populations have important effects on local public service provision. We hypothesize that these effects are either direct or via other basic socioeconomic variables, such as income, population density, local institutions, etc.

We use this framework to examine observed differences in local public services between Ghana's decentralized districts. We find that geography and ethnic diversity are important determinants of access to local public services. We also find that access to private and community level public assets can diminish the effects of adverse geography. Our findings also suggest that district characteristics, such as literacy level, share of rural population, access to information and district public expenditures, have marginal effect on access to local public services. These results are robust to changes in model specification and across levels of analysis.

In econometric as well as policy terms, the most interesting feature of the results is that no variable other than ethnic fractionalization is consistently, both in statistical and practical terms, significant across the levels and types of analysis. Relationships of ethnic fractionalization are robust and insensitive to changes in empirical specifications. Overall, the higher the ethnic fractionalization the lower is the level of access to local public services, including drinking water. The negative impact of ethnic fractionalization is especially severe in rural areas.

Our results highlight difficulties in local public service provision in ethnically diverse jurisdictions and are consistent with evidence elsewhere (Alesina et al 1999, Vigdor 2004, Miguel 2004 and 2005). What explains the negative relationship between ethnic diversity and local public services is an important area for future work. Promising hypotheses to be tested from the literature include ethnic differences in tastes and preferences over the types of local public goods, weak social capital, and local institutions that manage inter-ethnic relations. As Miguel (2005) underlines one promising approach for addressing adverse effects of ethnic diversity is advancing policies that promote successful cooperation across ethnic groups. The results of this paper point to the important role that education and literacy may play in this regard.

The data presented in this paper are from one of the most decentralized countries in Sub-Saharan Africa and took some time to collect, clean and organize. Its quality is sufficient to obtain relevant results. This process proved that data, especially at district level, regarding local public services is very scarce in Ghana. The government of Ghana and development partners should pay more attention to collecting and distributing appropriate data consistently and in timely manner. Without such data it will be very difficult to make coherent and efficient policies at national as well as district levels.

Table 2. Determinants of access to local services (district level data)

	Model 1	Model 2	Model 3	Model 4	Model 5
Distance from Accra	0.0015*	0.0014*	0.0010*	0.0005	0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Distance from Region's capital	0.0041*	0.0024*	0.0022*	0.0018**	0.0016**
	(0.0003)	(0.0007)	(0.0007)	(0.0007)	(0.0008)
Forest	-0.3919*	-0.2718*	-0.2454*	-0.2291*	-0.2638*
	(0.1034)	(0.0876)	(0.0861)	(0.0837)	(0.0844)
Coastal	-0.4701*	-0.1485	-0.1641	-0.2318**	-0.2086
	(0.1146)	(0.1057)	(0.1074)	(0.0976)	(0.1377)
Ethnic fractionalization		0.5840*	0.5984*	0.5436*	0.7926*
		(0.1730)	(0.1657)	(0.1683)	(0.1980)
Share of rural population		0.0112*	0.0106*	0.0113*	0.0132*
		(0.0016)	(0.0022)	(0.0024)	(0.0021)
Literacy			-0.0064***	-0.0095**	-0.0115**
			(0.0038)	(0.0038)	(0.0048)
Population density (log)			0.0268	0.0220	0.0969***
			(0.0598)	(0.0617)	(0.0510)
Per captia district expenditures (log)				0.1561***	0.1364*
				(0.0832)	(0.0508)
Internal revenue generation				0.0098**	0.0074
				(0.0048)	(0.0046)
Access to information (radio)				-0.0065**	-0.0066**
				(0.0030)	(0.0027)
Lambda					-0.2882*
					(0.0678)
Constant	1.8588	0.8468	1.1566	0.1959	0.1443
	(0.1341)	(0.1694)	(0.4540)	(0.8846)	(0.2594)
Adj. R-squared	0.621	0.7301	0.7358	0.7661	0.7550
F-statistics	45.45	44.75	34.81	31.32	-
N	110	110	110	110	110

Note: Models 1-4 are the OLS estimates with robust standard errors in parentheses. Model 5 is the estimates of the spatial error regression model by maximum likelihood: log-likelihood=-14.2; variance ratio=0.762; Wald test of lambda=0: Chi2(1)=18.083 (p-value=0.000); LR test of lambda=0: Chi2(1)=18.786 (p-value=0.000).
*p < 0.01; **p < 0.05

Table 3. Determinants of access to drinking water (household-level)

Dependent variable: Binary variable indicating whether a household has an access to any drinking water source

	Model 1	Model 2	Model 3	Model 4
Household characteristics				
If head of household is male	-0.4136*	-0.2138*	-0.2018*	-0.1863*
	(0.0309)	(0.0322)	(0.0330)	(0.0331)
If head of household is literate	0.5389*	0.2964*	0.2981*	0.2911*
	(0.0280)	(0.0298)	(0.0305)	(0.0305)
Rural	-0.6911*	-0.5904*	-0.6314*	-0.6179*
	(0.0324)	(0.0370)	(0.0373)	(0.0373)
Income quintile 1	-0.6720*	-0.1916*	-0.1418*	-0.1451*
	(0.0380)	(0.0418)	(0.0428)	(0.0429)
Income quintile 2	-0.4094*	-0.1993*	-0.1189*	-0.1115*
	(0.0389)	(0.0404)	(0.0416)	(0.0417)
Income quintile 3	-0.2108*	-0.1315**	-0.0756	-0.0705
	(0.0412)	(0.0422)	(0.0433)	(0.0434)
Income quintile 4	-0.1245*	-0.0940**	-0.0585	-0.0551
	(0.0409)	(0.0417)	(0.0427)	(0.0428)
Community characteristics				
Access to roads	0.4279*	0.3432*	0.3254*	0.3651*
	(0.0259)	(0.0268)	(0.0283)	(0.0282)
District characteristics				
Distance to Accra		0.0010*	0.0013*	0.0016*
		(0.0001)	(0.0002)	(0.0002)
Distance regional capital		0.0011**	0.0006	0.0029*
		(0.0003)	(0.0004)	(0.0003)
Forest		0.6592*	0.4287*	1.0576*
		(0.0365)	(0.0424)	(0.0495)
Coastal		0.6248*	0.5346*	0.7993*
		(0.0540)	(0.0690)	(0.0647)
Ethnic fractionalization		-0.4354*	-0.8720*	-0.6571*
		(0.0730)	(0.0852)	(0.0861)
Share of rural population		-0.0005	0.0007	-0.0040*
		(0.0009)	(0.0011)	(0.0011)
Literacy level		0.0151*	0.0194*	0.0111*
		(0.0016)	(0.0019)	(0.0020)
Per capita total expenditures		-0.0227	0.1635*	0.0303
		(0.0297)	(0.0317)	(0.0335)
Access to information (radio)		0.0126*	0.0158*	0.0133*
		(0.0009)	(0.0011)	(0.0011)
Constant	2.1726	0.1483	-1.5409	-0.1972
	(0.0463)	(0.3366)	(0.3598)	(0.3978)
Variances and covariances of random effects				
District			0.2699*	0.2512*
			(0.0155)	(0.0135)
Region				0.0620*
				(0.0179)
Pseudo R-squared	0.0749	0.1076	NA	NA
Log likelihood	-20922.4	-20183.1	-19295.1	-19293.7

Note: Models 1 and 2 are standard logistic regression models and Models 4 and 5 are two- and three-level random-intercept models, respectively. The number of level 1 observations is 49000, with 110 level 2 units (districts) and 10 level 3 units (regions). Logits for income quintiles are calculated with reference to quintile 5.

*p < 0.01; **p < 0.05

Table 4. Determinants of access to improved drinking water (household-level)

Dependent variable: Binary variable indicating whether a household has an access to improved drinking water

	Model 1	Model 2	Model 3	Model 4
Household characteristics				
If head of household is male	-0.3367*	-0.3203*	-0.3142*	-0.3138*
	(0.0259)	(0.0273)	(0.0288)	(0.0289)
If head of household is literate	0.3162*	0.3240*	0.3601*	0.3648*
	(0.0235)	(0.0252)	(0.0264)	(0.0264)
Rural	-1.1122*	-0.9032*	-0.9061*	-0.8872*
	(0.0273)	(0.0313)	(0.0319)	(0.0317)
Income quintile 1	-0.3110*	-0.3384*	-0.3826*	-0.3727*
	(0.0332)	(0.0368)	(0.0392)	(0.0388)
Income quintile 2	-0.3536*	-0.3435*	-0.3193*	-0.3206*
	(0.0327)	(0.0342)	(0.0360)	(0.0360)
Income quintile 3	-0.2261*	-0.2315*	-0.1984*	-0.2155*
	(0.0339)	(0.0351)	(0.0370)	(0.0370)
Income quintile 4	-0.1304*	-0.1427*	-0.1394*	-0.1478*
	(0.0334)	(0.0344)	(0.0363)	(0.0364)
Community characteristics				
Access to roads	0.5738*	0.5202*	0.6460*	0.6586*
	(0.0222)	(0.0233)	(0.0249)	(0.0251)
District characteristics				
Distance to Accra		0.0033*	0.0049*	0.0045*
		(0.0001)	(0.0002)	(0.0002)
Distance to regional capital		-0.0033*	-0.0017*	-0.0044*
		(0.0003)	(0.0003)	(0.0003)
Forest		0.5040*	0.4923*	0.1479*
		(0.0313)	(0.0336)	(0.0357)
Coastal		0.0101	0.0592	-0.0240
		(0.0447)	(0.0473)	(0.0531)
Ethnic fractionalization		-0.8767*	-0.3698*	-1.2174*
		(0.0632)	(0.0725)	(0.0755)
Share of rural population		-0.0083*	-0.0093*	-0.0121*
		(0.0008)	(0.0009)	(0.0009)
Literacy level		0.0116*	0.0128*	0.0077*
		(0.0014)	(0.0015)	(0.0015)
Per capita total expenditures		0.3763*	0.3372*	0.3876*
		(0.0261)	(0.0286)	(0.0297)
Access to information (radio)		0.0094*	0.0158*	0.0044*
		(0.0008)	(0.0009)	(0.0011)
Constant	1.6926	-3.0158	-3.7686	-2.5347
	(0.0387)	(0.2960)	(0.3194)	(0.3358)
Variances and covariances of random effects				
District			0.3767*	0.3239*
			(0.0127)	(0.0123)
Region				0.4519*
				(0.0264)
Pseudo R-squared	0.0907	0.1361	NA	NA
Log likelihood	-26292.6	-24980.5	-22823.2	-22791.5

Note: Models 1 and 2 are standard logistic regression models and Models 4 and 5 are two- and three-level random-intercept models, respectively. The number of level 1 observations is 48921, with 110 level 2 units (districts) and 10 level 3 units (regions). Logits of income quintiles are calculated with reference to quintile 5.

*p < 0.01; **p < 0.05.

Table 5. Determinants of access to drinking water (household level, interactions)

	Drinking water		Improved drinking water	
	Model 1	Model 2	Model 3	Model 4
Household characteristics				
If head of household is male	-0.1807*	-0.2075*	-0.3296*	-0.3248*
	(0.0330)	(0.0330)	(0.0289)	(0.0289)
If head of household is literate	0.2923*	0.3125*	0.3717*	0.3810*
	(0.0304)	(0.0304)	(0.0264)	(0.0265)
Rural	-0.6367*		-0.9075*	
	(0.0374)		(0.0319)	
Income quintile 1	-0.1203*	-0.1413*	-0.3481*	-0.3841*
	(0.0428)	(0.0428)	(0.0389)	(0.0393)
Income quintile 2	-0.1066**	-0.1091*	-0.2951*	-0.3116*
	(0.0417)	(0.0416)	(0.0361)	(0.0360)
Income quintile 3	-0.0647	-0.00608	-0.1885*	-0.1966*
	(0.0433)	(0.0433)	(0.0371)	(0.0370)
Income quintile 4	-0.0545	-0.0452	-0.1310*	-0.1288*
	(0.0427)	(0.0427)	(0.0365)	(0.0364)
Community characteristics				
Access to roads	0.3527*	0.3554*	0.6546*	0.6637*
	(0.0278)	(0.0280)	(0.0252)	(0.0249)
District characteristics				
Distance to Accra	-0.0028*	-0.0009*	0.0025*	0.0032*
	(0.0002)	(0.0002)	(0.0001)	(0.0002)
Distance to regional capital	0.0031*	0.0012*	-0.0022*	-0.0064*
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Forest	1.0566*	0.4611*	0.5466*	0.7752*
	(0.0456)	(0.0431)	(0.0331)	(0.0340)
Coastal	0.9669*	0.4537*	0.1313*	0.0222*
	(0.0616)	(0.0625)	(0.0501)	(0.0493)
Ethnic fractionalization	-1.0616*	0.0176	-1.0155*	0.8590*
	(0.1374)	(0.1033)	(0.1446)	(0.0922)
Ethnic fractionalization*literacy	0.0235*		0.0103*	
	(0.0028)		(0.0027)	
Ethnic fractionalization*Rural		-1.1305*		-1.8460*
		(0.0747)		(0.0655)
Share of rural population	-0.0011	-0.0008	-0.0158*	-0.0047*
	(0.0012)	(0.0011)	(0.0009)	(0.0009)
Literacy level		0.0175*		0.0116*
		(0.0019)		(0.0017)
Per capita total expenditures	-0.1781*	0.0896*	0.4760*	-0.4181*
	(0.0315)	(0.0331)	(0.0296)	(0.0323)
Access to information (radio)	0.0192	0.0147	0.0063*	0.0089*
	(0.0011)	(0.0010)	(0.0009)	(0.0010)
Constant	2.2574	-1.0656	-3.2948	-4.7200*
	(0.1193)	(0.3800)	(0.3091)	(0.3584)
Variances and covariances of random effects				
District	0.2611*	0.2506*	0.2894*	0.2749*
	(0.0140)	(0.0141)	(0.0115)	(0.0111)
Region	0.0769*	0.1434*	0.4364*	0.1508*
	(0.0125)	(0.0387)	(0.0256)	(0.0148)
Log likelihood	-19290.5	-19325.8	-22775.4	-22802.0

Note: All models are three level random-intercept logistic regressions. Logits of income quintiles are calculated with reference to quintile 5.

*p < 0.01; **p < 0.05.

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APPENDIX

Table 1. Descriptive statistics of variables

Variable	*N*	*Min*	*Max*	*Mean*	*SD*
District-level					
Access to services	110	1.2253	3.8053	2.2410	0.6226
Distance from Accra	110	1.84	652.4	250.1	171.9
Distance from regional capital	110	1.82	252.9	67.4	48.5
Agro-ecological zone					
Forest	110	0	1	0.45	0.50
Coastal	110	0	1	0.17	0.38
Ethnic fractionalization	110	0.0666	0.8146	0.4199	0.2029
Share of rural population	110	0	100	70.1	21.6
Population density (log)	110	2.1	9.1	4.6	1.1
Literacy rate	110	9.3	80.5	46.2	17.0
Headcount ratio	110	5.2	86.1	46.9	17.5
Poverty gap	110	1.2	47.0	18.4	10.4
Per capita total expenditures (log)	110	8.27	10.31	9.51	0.37
Per capita capital expenditures (log)	110	7.55	10.16	9.10	0.43
Internal revenue generation	110	4.4	67.6	18.9	11.3
Access to information					
Radio	110	20.1	90.6	63.7	17.5
Newspaper	110	1.3	52.4	17.9	11.1
Household-level					
Access to water	49003	0	1	0.8264	0.3788
Access to improved water	48923	0	1	0.7220	0.4480
Gender	49000	0	1	0.7072	0.4551
Household head’s literacy	49004	0	1	0.4671	0.4989
Rural household	49003	0	1	0.6269	0.4836
Income quintile 1	49003	0	1	0.1718	0.3772
Income quintile 2	49003	0	1	0.1708	0.1763
Income quintile 3	49003	0	1	0.1700	0.3756
Income quintile 4	49003	0	1	0.1936	0.3951
Income quintile 5	49003	0	1	0.2937	0.4554
Access to road	49003	0	1	0.6408	0.4798

Table 2. Main characteristics of agro-ecological zones

	Area (km^2)	Mean annual rainfall (mm)	Rainfall pattern	Major rainy season	Major crops grown
Forest	83900	1600	Bi-modal	March-July	Tree crops (cocoa, citrus, oil-palm)
Coastal	4500	800	Bi-modal	March-July	Cereals, starchy & tree crops
Other (Savannah)	150100	1000	Uni-modal	May-September	Cereals, legume and vegetables

Construction of the access to local public services index

The quantitative measurement of district-level access to local public services that we construct is a composite access to local public services index comprised accessibility of households to service facilities. Data is obtained from the Core Welfare Indicators Questionnaire (CWIQ) Survey on standardized welfare indicators. The survey comprised over 49000 households and representative at district level. The survey covered over 49000 households, including 30719 rural and 18284 urban households. All 110 districts of Ghana that existed in 2003 were sampled.

The survey asked households the following question: how long in minutes does it take from here to reach the nearest service facility, with five possible choices: 0-14 minutes – score 1; 15-29 minutes – score 2; 30-44 minutes – score 3; 45-59 minutes score 4; over 60 minutes – score 5. Thus, the higher the score the longer is the time to reach nearest service facility. The constructed index combines scores for the following basic social and infrastructure services: (1) supply of drinking water, (2) food market, (3) public transportation, (4) primary school, (5) secondary school, (6) health care facility (clinic or hospital), and (7) telecommunication facility.

We used the Cronbach's alpha to test the measurement properties and internal consistency of the 7 individual items proposed for the access to services index. The literature on scale measurement suggests that a Cronbach's alpha of 0.70 to 0.80 is acceptable and anything above is considered very good (De Vellis, 1991). Table 3 below shows the item-test, item-rest and average inter-item correlations for each of the 7 items and the alpha that would exist if each of the 7 items were removed individually from the scale. The average inter-item correlations are significant for all of the 7 items. This specification results in an overall Cronbach's alpha of 0.869, which appears acceptable using the criteria above. Table 3 also shows that the removal of any of the items would not substantially improve the Cronbach's alpha.

We then conducted principal components analysis to determine whether the set of items assessed a single construct of access to local public services. The result is consistent with that of the Cronbach's alpha. This analysis retained two factor loadings (table 4) and showed that the set of items provide a one-dimensional measure of access to local public services. These two factor loadings explain more than 70 percent of total variances.

Table 3. Cronbach's alpha for 7-item access to services standardized scales

Distance to nearest	Item-test correlation	Item-rest correlation	Average inter-item correlation	Alpha
Supply of drinking water	0.530	0.371	0.564	0.886
Food Market	0.814	0.731	0.465	0.839
Public transportation	0.805	0.719	0.468	0.841
Primary school	0.651	0.519	0.522	0.867
Secondary school	0.795	0.706	0.471	0.843
Health facility	0.827	0.750	0.460	0.836
Telecommunication facility	0.820	0.740	0.463	0.838
Cronbach's alpha				0.869

Table 4. Factor loadings

Indicators	Factor 1	Factor 2
Supply of drinking water	0.233	0.830
Food Market	0.411	0.002
Public transportation	0.404	0.076
Primary school	0.312	0.315
Secondary school	0.405	-0.296
Health facility	0.422	-0.225
Telecommunication facility	0.418	-0.260
Eigenvalue	4.03	0.87
Percent of total variance explained	57.5	12.4