

# Public Good Provision, Diversity and Distribution

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## Abstract

Diversity is a key issue in the provision of critical publicly provided goods such as clean drinking water and education. To develop institutions that address this issue, it is critical that we understand the mechanisms through which diversity and public goods are related. A simple model of public good provision is developed to demonstrate that there are potentially measurable differences between existing theories, particularly in the distribution of the public good to minority groups. These differences are then illustrated with respect to the distribution of drinking water, electricity and education across 18 countries of Sub-Saharan Africa. The results are consistent with ethnic diversity reducing access to all public goods, but the mechanism behind the effect varies depending on the nature of the public good.

**Keywords:** ethnic diversity, public good provision, Sub-Saharan Africa

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# 1 Introduction

The Millennium Development Goals recognize the importance of goods that are commonly provided through public intervention, with goals relating to education, drinking water, sanitation and health care. However, there is general consensus that the targets of the Millennium Development Goals are unlikely to be met in some regions of the world, notably Sub-Saharan Africa. One key factor may be ethnic diversity, which is generally very high in the region, both at the national and local levels. An extensive literature has developed over the past decade that focuses on the role of ethnic diversity in limiting effective governance. While this literature started at the national level, there has also been extensive research demonstrating the difficulty of providing public goods to diverse groups at sub-national scales.

This research raises an important question. If ethnic diversity is a problem, what is the solution? Not surprisingly, the answer will depend on the mechanism through which public good provision is related to diversity. If diversity has an effect through the demand for public goods, then lower public good provision in diverse communities is efficient and therefore does not need, nor permit, an institutional solution. In contrast, if diversity has an effect by reducing the effectiveness of particular forms of governance, then altering the governance structure may be warranted.

The literature on ethnicity and public good provision focuses on two main channels through which diversity could matter. First, in Alesina et al. (1999), different ethnic groups prefer different goods. The natural example of this is two groups that want their children educated in different languages. If education services involve economies of scale, the cost of provision in a diverse community will be higher than in a homogeneous one, resulting in lower rates of provision. This approach is also the basis of models in Alesina and La Ferrara (2000, 2005) along with Kimenyi (2006). With regard to a relatively neutral good such as water, segregated groups may disagree about the location of the main water supply to which households connect, or the location of a public tap. Or, as in Alesina and La Ferrara (2000), individuals may prefer to use a source that is not used by members of a different ethnic group. In any case, the underlying mechanism is that diversity affects the aggregate demand for particular goods.

In contrast to these demand-side effects, ethnic diversity could affect the ability of a group to act collectively. In Vigdor (2004) and Miguel and Gugerty (2005), collective action within an ethnic group is more efficient than collective

action between groups. As such, individuals in diverse communities are less willing to contribute to the public good, thus reducing its level in equilibrium. The specific mechanisms behind the effects are different, as Vigdor (2004) appeals to intra-ethnic altruism, while Miguel and Gugerty (2005) point to the role of social sanctions being effective within groups, but the overall impacts are indistinguishable.

Each of these mechanisms has the same collective result; diverse societies are likely to have lower levels of goods that are publicly provided. However, it is important to distinguish the relative importance of each mechanism. There is little that governments can, or possibly should, do about variation in public goods that is associated with ethnic diversity through demand effects. Improving efficiency in the face of a demand effect requires ethnic sorting, which is both morally difficult, and, if sufficiently important, will occur naturally. In contrast, if the effects of diversity demonstrate a vulnerability to collective action problems, then there may exist institutional changes that can improve the efficiency of public good provision.

This paper develops a theoretical framework within which to consider the question of the relative importance of these two effects. This model incorporates the primary features of each of the demand or supply effect mechanisms in order to determine the testable implications of each effect. While the two mechanisms have similar aggregate effects, they differ sharply on the distribution of benefits from the public good. If demand effect models reflect reality, then the negative impact of ethnic diversity should fall disproportionately on the minority groups in the community. In contrast, if the issue is the governance of contributions, then the effects will fall on everyone.

This key difference provides the theoretical support for the empirical section that follows. Using a household dataset including 140,000 households in 18 countries, I demonstrate that the correlation between diversity and public good provision is critically affected by the type of public good. Education, water and electricity differ significantly, as education may be tailored more or less to local ethnic groups, while water and electricity are not generally differentiated. I first demonstrate that there is a correlation between local diversity and the likelihood that a random household has access to each public good. Next I demonstrate that in the case of education, but not drinking water or electricity, that this is the result of differential access for locally dominant groups.

The literature connecting public good provision and ethnic diversity has al-

most exclusively been conducted at the aggregate level, whether national, as in papers by La Porta et. al. (1999) and Kuijs (2000). These papers find limited support for the notion that ethnic diversity directly affects public good provision. A much larger literature has focused on the relationship between ethnic diversity and economic growth, with Mauro (1995), Easterly and Levine (1997), Alesina et al (2003) and Fearon (2003) all demonstrating a negative correlation.

Focusing on sub-national analysis, Alesina et al.(1999) showed that ethnic diversity affected the level of public good spending at the city and country level in the US. Bardhan and Dayton-Johnson (2002), Khawaja (2009), Banerjee et al. (2005) and Banerjee and Somanathan (2007) extend this analysis to developing countries with broadly similar results. People in diverse communities are less likely to have access to a broad range of goods where collective provision is efficient.

As I do here, Besley et. al. (2004) focuses on the distributional effects of ethnic identity, and find that households that share an ethnic identity with a leader receive a greater proportion of publicly provided private goods, while those that are in close proximity to the leader receive a higher share of publicly provided public goods. However, they do not focus on the question of heterogeneity directly.

Most relevant to this analysis is the work of Miguel and Gugerty (2005), who assess the impact of ethnic diversity on the level of school funding, the quality of school facilities and the maintenance of water wells in rural western Kenya. In this environment, the authors find evidence linking these collective action failures to the ineffectiveness of local institutions at governing across ethnic lines. Habyarimana et al. (2007) provides further support from Uganda that supports the idea that social sanctions act to promote cooperation within ethnic groups, but are less effective across ethnic divisions.

While social heterogeneity may have an impact, the theoretical model presented here does not help in the defining how to measure social heterogeneity. In particular, I focus on the role of ethnic diversity, rather than religious diversity. Caselli and Coleman (2010) provide a theoretical justification for focusing on forms of social heterogeneity that are relatively expensive to change such as ethnicity. In addition, Alesina et al. (2003) finds no relationship between religious diversity and economic growth. In keeping with these results, I find no significant relationship between religious diversity and access to any of the public goods in the analysis.

## 2 Theoretical Analysis

The existing literature on ethnic diversity has considered a variety of mechanisms for how ethnic diversity could affect the provision of public goods. However these tend to fall into two categories. First, different ethnic groups could want different public goods. In the model of Alesina et al. (1999), this is the relevant source of conflict associated with diversity. Alesina and La Ferrara (2000) and Kimenyi (2006) also follow similar lines, where differential demand across ethnic groups reduces the ability of a single provider to meet all demands. The provision of public goods in diverse communities involves lower average satisfaction for any level of funding and therefore the optimal level of funding is lower. One specific instance of this would be a local majority directing public resources to be spent on the form of a public good that they would prefer, or placing other discriminatory controls on its distribution. This last feature highlights the fact that most publicly provided goods are not pure public goods, as it is possible to exclude some members of society from accessing the good.

Alternatively, the papers of Vigdor (2004) and Miguel and Gugerty (2005) develop models in which the inter-ethnic free-riding problem is highlighted. In each case the intra-ethnic free-riding problem is at least partially mitigated by the presence of an additional feature that operates within ethnicities. In the case of Vigdor (2004) this is altruism, whereas in Miguel and Gugerty (2005) it is an intra-ethnic sanctioning technology. This paper is not able to differentiate between these mechanisms, though evidence provided in Habyarimana et al. (2007) indicates that the presence of intra-ethnic sanctioning may be a vital factor. In either case, ethnic diversity is associated with lower provision of public goods because of the differential effectiveness of intra-ethnic institutions as opposed to inter-ethnic ones.

The model developed here embeds the simplest versions of these two mechanisms within a single reduced form model to investigate the potential effects of ethnic diversity at both the aggregate and individual levels. The model generates predictions related to aggregate provision of public goods and the distribution of public goods between majority and minority groups. In addition, the model provides direction as to how diversity affects the total level of spending on public goods and the efficiency of that spending.

## 2.1 The Community

A community provides a single public good funded by the contributions of local households. An alternative assumption is that funding from higher level governments is available but responsive to local lobbying efforts. For the results below it is sufficient that both the size and form of the public good provided are sensitive to local contributions. The population of the community is divided among a total of  $E$  ethnic groups with  $p_e$  defining the population share of ethnic group  $e$ . Households receive utility from private consumption and the public good:

$$u_i = W_i - x_i + \mu \ln X_i \quad (1)$$

where  $W_i$  is household wealth,  $x_i$  is the household's contribution to the public good and  $X_i$  is the benefit the individual receives from the public good. The parameter  $\mu$  captures demand and supply considerations including the local preference for the public good and the cost of installation and maintenance which could vary across communities. As a simplification, it is assumed that ethnic groups are able to fully overcome the internal free-riding problem and thus all individuals will make contributions to maximize group utility. This assumption is the result of the sanctioning model in MG, and with the voting model incorporated in ABE. Alternatively, it could be assumed that the institution governing intra-ethnic coordination is less than perfect. To the extent that the ability of groups to overcome the within-group public good problem is not affected by group size the solutions provided here would not be changed in any qualitative way. Individuals belonging to the same ethnic group face identical decisions and therefore I focus on solutions that are symmetric within groups. Therefore, define  $x_i = x_e$ .

## 2.2 The Public Good

The benefit received from the public good depends on the contributions of all other individuals but the contributions from one's own ethnic group may potentially have a greater effect.

$$X_e = p_e N x_e + \alpha \sum_{e' \neq e} p_{e'} N x_{e'} \quad (2)$$

The parameter  $\alpha \in [0, 1]$  captures the extent to which the preferences for a public good vary across ethnicities with  $\alpha = 1$  indicating no variation in prefer-

ences. This assumption is roughly consistent with the voting model developed in Alesina et al (1999) where the final allocation of funding on the public good is determined by majority vote. This parameterization provides a simplified reduced form while not detracting from the overall results.

In the absence of institutions, each ethnic group chooses their contribution level to maximize the aggregate welfare of the group. Inter-ethnic institutions alter the incentives facing each group, such that they place some weight on aggregate social welfare. The parameter  $\tau \in [0, 1]$  represents the effectiveness of local institutions in managing inter-ethnic coordination - with  $\tau = 1$  the equilibrium is identical to that that would be chosen by a social planner. Each group takes the contributions of other groups as given and chooses  $x_e \geq 0$  to solve:

$$U_e = \max_{x_e} \left[ (1 - \tau)p_e N(W - x_e + \mu \ln X_e) + \tau \sum_{j=1}^E p_j N(W - x_j + \mu \ln X_j) \right] \quad (3)$$

## 2.3 Extreme Cases

Before proceeding to the main propositions I present solutions to two extreme cases that demonstrate the effects of each mechanism. First, I define ‘ethnic goods’ as those where different groups have opposing preferences. Education may be a relevant example, in which people want their children educated according to their own belief structure. Second, ‘community goods’ are those where there are no differences in preferences across groups. Sanitation and drinking water systems are the logical examples that might be expected to be ‘community goods’. The example of sewers as a community good and education as an ethnic good demonstrates the non-trivial nature of this question. In their papers, Miguel and Gugerty consider education in an “institutions” model while Alesina et al analyzes the provision of sewer services in the context of a “preferences” model.

### 2.3.1 Ethnic Goods

In the event of completely divergent preferences ( $\alpha = 0$ ) there is no effect of the institution,  $\tau$ . Each group invests on their own behalf and each group invests until:

$$X_e = \mu p_e \quad (4)$$

Measured at the individual level, public good provision is only related to the size of one's own ethnic group, with the diversity in the remaining community is irrelevant.

Aggregating over individuals, the average benefit from the public good in the community is therefore:

$$\bar{X} = \mu(1 - F) \quad (5)$$

where  $F$  is local ethnic fractionalization. Notably, this result is not affected by the presence of inter-ethnic institutions. Diversity of this form has little to no policy implications regarding local institutional development. The reason for this is that contributions by one group have no impact on the welfare of any other group and hence inter-ethnic coordination has no effect.

Further, total spending is unrelated to the level of diversity. If one moves away from quasi-linear preferences, it is not even possible to sign the expected correlation between diversity and public good expenditures. The consequences of ethnic diversity for the provision of "ethnic" goods is entirely through the inefficiency of public spending and therefore it is critical that measurement of these effects occurs using outcome measures.

### 2.3.2 Community Goods

In contrast, with complete spillovers ( $\alpha = 1$ ) the results depend critically on the quality of inter-ethnic institutions. If inter-ethnic institutions are non-existent ( $\tau = 0$ ) only the largest group will contribute and all other groups will choose to not contribute further. The intuition for this result is that the largest group is willing to contribute until the public good reaches a level higher than any other group's optimal level. In doing so they eliminate the incentive for any other group to contribute. The benefits to all groups are the same and are determined by the size of the largest group.

$$X_e = \bar{X} = \mu p_1 N \quad (6)$$

However if inter-ethnic institutions are complete  $\tau = 1$  then all individuals contribute and:

$$X_e = \bar{X} = \mu N \quad (7)$$

In contrast to the case with ethnic goods, all spending on community goods is highly effective. It is therefore not important whether analysis of public good provision is conducted using spending or outcome variables.

## 2.4 General Case

In a general solution we must consider the non-negativity constraint on public good investment by each group. However, lemma 1 significantly restricts the set of possible cases that require analysis.

**Lemma 1.** *A member of a larger group will never contribute less than a member of a smaller group. They will contribute strictly more unless  $\alpha = 0$ ,  $\tau\alpha = 1$ , or they do not contribute at all. In addition, the largest group will always contribute.*

Proof - see appendix. The intuition for this result is similar to that mentioned above in the case of “community” goods. A larger group always has a higher incentive to contribute than a smaller group and therefore will contribute more.

The effect of this lemma is that one can order groups by size and restrict analysis to cases where groups 1 through  $K$  contribute and groups  $K+1$  through  $E$  do not. In all following results I assume that  $p_i \geq p_{i+1}, \forall i < E - 1$ .

For the next result I define average public good provision as the weighted average of group benefits:

$$\bar{X} = \sum_{e=1}^E p_e X_e \quad (8)$$

However, the proposition is qualitatively unchanged if we define public good provision as the weighted average of the utility from the public good,  $\bar{X} = \sum_{e=1}^E p_e \ln X_e$ .

**Proposition 1.** *If  $\tau\alpha < 1$  increasing the population share of the largest group (at the expense of any other group) will strictly increase average public good provision  $\left(\frac{\partial \bar{X}}{\partial p_1} > 0\right)$ .*

Proof - see appendix. In general there are two effects associated with a reduction in diversity. First, the individual(s) that move to the largest group receive a large direct benefit associated with improved access to public goods. Second, if the individual(s) were not previously contributing their contributions increase the total level of spending on the public good. The proof demonstrates that the result of these effects is unambiguously positive on the average level of public good provision. However, this is true regardless of the mechanism in effect, and is therefore no help in distinguishing between the effects of different mechanisms.

In general increasing the size of any group that was contributing at the expense of any smaller group will increase average public good provision. However, whether the second group is contributing depends on  $\alpha$ . If  $\alpha < \frac{p_2}{p_1}$  then the second largest group will also contribute. This leads to the following corollary:

**Corollary 1.** *If  $\alpha < \frac{p_2}{p_1}$  then increasing the population share of the second largest group (at the expense of a smaller group) will strictly increase average public good provision.*

Proof - the proof of proposition 1 does not depend on the identity of the group increasing in size. It is sufficient that the increasing group is contributing to the public good. This is the case when  $\alpha < \frac{p_2}{p_1}$ .

Thus if variation in preferences is high enough, then holding the size of the largest group constant and increasing the size of the second largest group should increase aggregate provision. Further, as  $\alpha$  is reduced, the number of groups that will contribute increases. For  $\alpha = 1$  the relevant measure of diversity (or homogeneity) is the size of the largest group. When  $\alpha = 0$  the relevant measure is fractionalization. In between these extremes the optimal measure is the fractionalization between contributing groups. In addition, while the local literature has focused on fractionalization a significant portion of the cross-country literature on diversity considers the effects of polarization (Montalvo and Querol (2002, 2005), Alesina et al. (2003)). However, these results point toward potentially positive impacts associated with polarization. In general, holding the size of the largest group constant, increases in polarization are generally associated with increasing the size of the second largest group and thus possibly increasing public good provision.

Following directly from the proof of lemma 1 is proposition 2.

**Proposition 2.** *If spillovers are less than complete an individual in the largest group will receive greater value from the public good than an individual in any other group. For  $\alpha < 1$ , if  $p_1 > p_j$ ,  $X_1 > X_j$ . For  $\alpha = 1$ ,  $X_1 = X_j$ .*

Proof - see appendix.

If there is a single largest group they always contribute more than any other group and therefore the public good is more closely aligned with their preferences. This proposition provides the primary difference between the “preferences” approach and the “institutions” approach. In the preferences model  $\alpha < 1$  and individuals in the largest group should receive a larger benefit from public goods than other individuals. Alternatively, if all individuals benefit equally

from the public good then any effect of ethnic diversity on public good provision must be due to poor institutions. While this result is apparent from the model set out in ABE it is not discussed as the empirical focus on government spending prevents the authors from testing for this effect. In MG, while there is some discussion of anecdotal evidence regarding the applicability of spending on education services to all ethnic group, there is no further analysis of this result.

## **2.5 Quantity vs. Quality of Spending**

As mentioned above in the extreme cases there is a definite advantage to measuring outcome variables in the case of public goods that have a strong ethnic component as the quantity of spending does not fully describe the impact of ethnic diversity. The empirical results in Kuijs (2000) indicates the variation in the effects of diversity on the quality of spending versus the quantity of spending, where, loosely speaking, quality is defined as the outcome measure divided by the spending measure. The model developed here provides one channel to explain why these effects would be different in specific cases. Diversity will therefore have a larger effect on the quantity of spending when variation in preferences are low and a larger effect on the efficiency of spending when there is great variation in preferences. In Kuijs (2000) spending on education is not affected by diversity but the efficiency of spending is significantly affected. This is therefore consistent with education being a good where ethnic groups have large variation in preferences. Alternatively, both spending and the efficiency of spending on public health programs were reduced by diversity - indicating that health outcomes may face lower variation in preferences. Thus if the public good is associated with high spillovers between groups then a negative effect of ethnic diversity will be caused by a reduction in the quantity of spending with no expected effect on the quality of spending. Conversely, low spillovers between groups would indicate the problem lies with the quality of spending and we should not necessarily anticipate a correlation between diversity and spending.

## **2.6 Empirical Implications**

The model provides two primary results. First, proposition 1 indicates that, if either mechanism has an effect, diverse communities will have lower rates

of public good provision than homogeneous communities. This can be tested at both the community level and the household level. Tests are initially conducted at the community level to provide results that are directly comparable to the existing literature. Additionally, proposition 2 implies that, unless spillovers between groups are complete, individuals that are part of a local majority will have greater access to the public good than members of minority groups. Using household data regarding access to the public good I exploit this proposition to determine the relative importance of preference variation in the negative relationship between diversity and the provision of the public good in question. Each of these results is illustrated in the empirical section that follows.

In addition there are a pair of secondary results. First, the size of the second largest group should have a positive effect if the “preferences” model is correct. However, the starkness of this result is due to the quasi-linear nature of preferences and does not generalize. With a more complex specification, this result would not significantly differentiate between the two mechanisms. And second, measurement should occur over outcomes rather than spending as we are unsure as to what extent the “preferences” model is correct. To the extent that variation in preferences is the cause of poor provision of public goods, this could be associated with spending in diverse communities being either higher or lower than in homogeneous communities, depending on the precise nature of preferences.

### **3 Empirical Specification and Data**

The empirical analysis of the paper tests the correlation between ethnic diversity, ethnic group size and access to piped drinking water and education in 18 countries of Sub-Saharan Africa. The primary data source for the analysis is the Measure DHS surveys conducted repeatedly in over 75 countries around the world. The country selection in this case is based on all countries in Sub-Saharan Africa for which the Measure DHS records the relevant information - particularly ethnicity data and data on the geographic location of each cluster. In most cases, there has only been a single acceptable survey in each country. In countries where there have been repeated surveys, I use only the last one.



Figure 1: Countries in Analysis

### 3.1 Empirical Specification

The ideal specification would therefore have the value that households receive from current public good spending as a dependent variable. Such a variable is not feasible, in multiple dimensions. As such, I will use access to the public good as a proxy for the value of the public good to the household. As long as there are alternative choices, that are independent of ethnic identity, the willingness of a household to access the public good does provide information about the underlying value received.

With drinking water access, the alternative to improved sources of water are surface water from lakes or rivers, or rainwater. For education, I focus on teenagers, for whom attending school implies an opportunity cost as they are not working. Access to alternative water sources, or to employment, is likely to be less responsive to ethnic identity than access to the publicly provided goods

of interest.

The primary specification of the paper focuses on the level of access that each household has, as a function of community diversity, and the size of one's own ethnic group. Additional controls include region dummies within each country, geographic controls, and economic controls at both the community and household level.

$$X_i = \beta_0 + \beta_1 * Div_c + \beta_2 * Own_i + \gamma_1 * Geog_c + \gamma_2 * Econ_c + \gamma_3 * House_i + \epsilon_i \quad (9)$$

For 'ethnic goods', one should expect that  $\beta_1 > 0$ , and  $\beta_2 = 0$ , while for 'community goods', one should expect that  $\beta_1 = 0$ , while  $\beta_2 > 0$ . For goods that lie between these two extremes, one should expect that both would be positive.

### **3.2 The Scale of Measurement**

I focus on the effects of ethnic diversity at the district level, as the lowest level of governance that can be consistently measured across the sample. In many cases, particularly for electricity, a higher level of government is technically responsible for the provision of the good. However, as the provision of improved drinking water, electricity or education may be varied across districts, either mechanism may generate a relationship between ethnic diversity and public good provision. Further, as long as the local government is active in lobbying higher levels of government for funding of local projects, the effectiveness of local government will be relevant.

### **3.3 Access to Improved Sources of Drinking Water, Electricity and Education**

Across the sample, 79% of households have access to improved sources of drinking water, 27% have access to electricity, and 51% of teenagers report that they are attending school. None of these goods is a pure public good, as it is possible for individuals to be excluded from accessing each one. However, each is affected by significant economies of scale, which generate a role for government involvement in their provision in both developed and developing countries. The assumption here is that household access to each good will depend on the nature and quantity of the good provided. For example, access to electricity requires that an electrical grid is operating in the area, that the provision

of electricity is sufficiently consistent to justify the costs of households being connected to the grid. Similarly, school attendance by teenagers will be affected by the perceived value of the education, which will depend on its overall level combined with how the education curriculum is defined.

### 3.4 Ethnicity Data

In the DHS survey each individual surveyed is asked for their ethnicity, chosen from a predefined list. These lists vary significantly across countries, but the correlations with national measures of ethnic diversity, such as in Alesina et al.(2003), are quite high. Where there is variation, the lists of ethnicities in the DHS data provide a slightly more detailed set of ethnicities to choose from than those reported at the national level.

The measure of diversity used throughout the empirical literature on public good provision is ethnic fractionalization, defined as:

$$F = 1 - \sum_{e=1}^E p_e^2$$

where  $p_e$  is the population share of ethnic group,  $e$ . This measure is drawn from the Herfindahl index that is used in assessing industrial concentration, however as shown above, it is the optimal measure of diversity under specific conditions. The model above predicts that the correct measure of diversity will depend on the extent of inter-ethnic spillovers associated with the public good, with measures varying from fractionalization to the population share of the largest group. While I report the results using the fractionalization measure, the choice is irrelevant as the correlation between the size of the largest group and the level of ethnic fractionalization is almost perfect at (-0.98).

Alternative forms of social heterogeneity, particularly religious or caste diversity, may be important in particular countries including some within our sample. However, aggregating across this sample of countries, the effects of religious diversity are not important. There are a variety of potential reasons for this. First, as shown by Caselli and Coleman (2010), as the result of an active choice, religious identity may not be as critical as more permanent forms of identity such as ethnicity. Second, the measures of religious observation in the DHS survey include only 5% of the population identifying with traditional forms of religion. This is much lower than that found by previous authors, and

this may represent an error that impacts the measured impact of religious diversity.

### **3.5 Geographic Controls**

The choice of a source of drinking water is likely to be strongly affected by geographic factors, including the extent of precipitation and the distance to rivers. Each would reduce both the cost of developing a piped water system, and the value of such a system. As such, the total effect is uncertain, but the two effects are controlled for in the regressions. Further geographic variables include elevation and the distance to the ocean, each of which could affect economic opportunities and the structure of the local economy. Finally, I control for country and province level fixed effects, to reduce the potential errors associated with uncontrolled geographic and institutional variation.

### **3.6 Ethnic Controls**

African countries tend to be heavily centralized and funding for water projects may be strongly affected by political affiliation in the community. For this reason the presence of a large number of individuals of a dominant national ethnicity may affect the viability of development projects. To control for this effect I include the fraction of households in the community belonging to each of the three largest ethnic groups in each country - totaling over half the population in every case.

In addition, I control for the ethnicity of the household to focus solely on the impact of ethnic diversity and the size of one's local ethnic group, rather than effects based strictly on ethnic identity. The result is to compare individuals or households from a particular ethnicity, where one is in a district where the ethnic group is large, while the other lives in a district where the ethnic group is smaller. Combined with the province level controls included above, this attempts to eliminate as much of the omitted variable bias as possible.

### **3.7 Economic Controls**

As there is a strong correlation between wealth and ethnic diversity, in this sample, as in most other surveys, it is critical to control for wealth in the analysis.

For each household surveyed, the DHS reports a measure of wealth, standardized for each country. Urbanization and population density will also potentially affect both the cost of public goods, and the value of receiving them. The DHS survey includes a measure of urbanization, while I use geographic data to extract the local population density from 1990.

A related concern is that diverse communities may be more likely to contain recent migrants or younger households, and therefore be less connected within the community. As such, I control for the average tenure and age of the household head in the community, and for each household.

In the regressions on school attendance, it is also necessary to control for other factors that would have an effect. Therefore, in these regressions I use dummy variables to control for gender, age, the maximum level of education in the household and the level of past educational attainment for the student.

## 4 Empirical Results and Discussion

The theoretical results suggest that the presence of ethnic diversity will result in lower public good provision of either community goods or ethnic goods, but that the distribution of benefits from those public goods will differ. To illustrate this result, table 1 shows the regression analysis for access to improved sources of drinking water, electricity, and education. In columns (1), (3) and (5), the results control for ethnic fractionalization in the district, and the other controls that are common in the literature. In all cases, households in diverse communities are less likely to access the public good, and the results are statistically significant, though borderline in the case of education.

In columns (2), (4) and (6), I report exactly the same regression, but also controlling for the size of the household's ethnic group in their district. The results in column (2) and (4) show that for water and electricity, the relationship between diversity and access to the public good does not change, and there is no significant relationship with the size of one's own ethnic group. In contrast, column (6) shows that there is no relationship between diversity and educational attendance, once one controls for the size of the ethnic group of each individual. The results are therefore perfectly consistent with the notion of drinking water and electricity as community goods, and education as an ethnic good.

The effects of the remaining control variables require some explanation. Household wealth and district wealth both have a positive relationship with the

presence of improved sources of water and electricity, though the relationship with household wealth is much larger for electricity. With education, household level wealth predicts school attendance positively, but district level wealth does not. This could be caused by differential demand for labour, in which teenagers in rich districts have a better alternative to school, and therefore attend less.

While the average tenure in the district does not have a significant effect, the effects of household tenure are small, but statistically significant, and positive for electricity and school attendance but negative for access to improved sources of water. This difference is interesting, though it may indicate that access to water is seen as a right gained immediately on entrance to the community, while access to education and electricity is more likely to be restricted. Further, it may be that households moving into a community choose where they live in part on their ability to access drinking water, while electricity and education are less important.

Finally, I report the coefficient on the distance to a local river. This is positively correlated with access to improved drinking water, which is consistent with a situation in which the alternative source of drinking water, the river, is further away and therefore more costly to access. Further, this variable has no significant correlation with access to electricity or education.

The unreported additional results on the educational attendance regression show expected effects. Females are roughly 5% less likely to attend school than males, attendance drops off as children age, and there appears to be a completion effect, in that students are more likely to drop out after finishing primary school or at the end of secondary school.

## **4.1 Alternative Specifications**

In the education results above, the size of one's own ethnic group in the local district is positively correlated with school attendance. This could be the result of the "preference" effect mentioned above. However, it could be that there is a distinct benefit to being a member of the largest local ethnic group, or being a member of a local group that forms a majority of the population. Either of these measures is highly correlated with the size of one's own ethnic group. Each is significant if included in the place of the size of one's own ethnic group, with a similar magnitude. Being a member of the largest ethnic group, or in the majority group, is associated with approximately a 2% increase in the probability of an individual attending school. The results are also robust to a variety of other

specifications, including discrete choice models such as logit or probit models.

## 5 Conclusion

While ethnic diversity has been shown to have an effect on the provision of public goods, the particular nature of these goods is rarely investigated in much detail. This paper demonstrates that the relationship between diversity and public good provision will depend critically on the nature of the public good that is provided.

For “community goods”, where the form of the public good is not easily directed toward one ethnic group, such as drinking water or electricity, then the overall diversity of the community may affect the willingness of community members to contribute to the provision of that good. If voluntary contributions by community members are critical to provision, this will lead to inefficiently low provision of the good in diverse communities. The policy implications of this sort of inefficiency are to either improve inter-ethnic cooperation, or to reduce the voluntary nature of contributions.

In contrast, “ethnic goods” are those that can be directed such that the benefits of access will be greater for some ethnic groups. In the example presented here, education, one must make a series of choices involving cultural practices, including but not limited to the language of instruction, and therefore some groups may derive greater benefits than other groups depending on those choices. While there may be a correlation between diversity and public good provision in this case, this may reflect the diversity in demand more than a problem of collective provision. In these cases, unless policy interventions affect the demand for ethnically oriented education, they will be ineffective at reducing the disadvantage facing students from minority groups.

This effect is then demonstrated using a large household sample from 18 countries of Sub-Saharan Africa. This statistical analysis is intended to illustrate the nature of the problem, by linking it to a critical issue in development economics; the low level of public good provision in Sub-Saharan Africa. The results suggest that levels of educational attainment, and access to electricity and piped water are lower in diverse communities, but with very different distributional effects. Access to water or electricity are not correlated with the size of one’s own ethnic group, as is consistent with each being a “community good”. In contrast, teenagers are more likely to attend school if they are in larger

groups in the local community.

Given the limited data, and particularly the cross-sectional nature of the data, the analysis does not permit a strong causal interpretation of the results. However, the analysis does suggest that the distribution of benefits across society is potentially a critical issue to be considered in future work relating diversity, public good provision and institutional development.

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## A Proofs

### A.1 Lemma 1

- Proof of Lemma 1

The FOC facing each group can be written as:

$$1 = \frac{\mu p_e N}{X_e} + \tau \alpha \mu N \sum_{j \neq e} \frac{p_j}{X_j} \quad (10)$$

$$1 - Q \geq (1 - \tau \alpha) \mu \frac{p_e N}{X_e} \quad (11)$$

$$Q = \tau \alpha \mu \sum_{j=1}^E \frac{p_j N}{X_j} \quad (12)$$

and  $Q$  is constant for all groups. If two groups contribute positive amounts the FOC holds with equality and thus:

$$\frac{p_e N}{X_e} = \frac{p_j N}{X_j} \quad (13)$$

$$p_e((1 - \alpha)p_j x_j + \alpha S) = p_j((1 - \alpha)p_e x_e + \alpha S) \quad (14)$$

$$\text{where } S \text{ equals total spending} \quad (15)$$

$$S = \sum_{k=1}^E p_k x_k \quad (16)$$

Rearranging equation 14 defines the difference between the contributions of two groups:

$$x_e - x_j = \frac{(p_e - p_j)\alpha S}{(1 - \alpha)p_e p_j} \quad (17)$$

This difference is positive if  $p_e > p_j$  unless  $\alpha = 0$ . Further, note that total spending is always positive as at least these two groups have made contributions. If  $\tau \alpha = 1$  then both groups face identical FOCs ( $Q = 1$ ) and their contributions are equal. Given the first part of the lemma it is obvious that the largest group must contribute. If no one else contributes the marginal value of their first dollar invested is infinite and if anyone else contributes then the largest group will as well.

### A.2 Proposition 2

- Proof of Proposition 2

Rearranging the equation defining the public goods for each of two groups

we have:

$$X_e = (1 - \alpha)p_e x_e + \alpha S > (1 - \alpha)p_j x_j + \alpha S = X_j \quad (18)$$

For  $\alpha < 1$  this inequality holds as  $p_e x_e > p_j x_j$ .

### A.3 Proposition 1

- Proof of Proposition 1

For any equilibrium define  $C$  as the number of ethnic groups that contribute positively and therefore  $J = E - K$  groups do not contribute. Further define the total share of all groups that contribute:

$$p_c = \sum_{k=1}^K p_e \quad (19)$$

$$(20)$$

For any group that contributes,  $\frac{p_e}{X_e} = \frac{p_c}{X_c} = \beta$ . We therefore have:

$$\sum_{k=1}^K X_k = \frac{p_c}{\beta} \quad (21)$$

$$= (1 + \alpha(K - 1)) \sum_{k=1}^K p_k x_k \quad (22)$$

$$= (1 + \alpha(K - 1)) * S \quad (23)$$

where  $S$  is total spending on the public good as defined above. For any group that does not contribute their public good is determined by the contributions of the other groups:

$$X_j = \alpha \sum_{k=1}^K p_k x_k \quad (24)$$

$$= \frac{\alpha \sum_{k=1}^K X_k}{(1 + \alpha(K - 1))} \quad (25)$$

$$= \frac{\alpha p_c}{(1 + \alpha(K - 1))\beta} \quad (26)$$

An ethnic group for whom the FOC holds with equality when they make precisely zero contribution can be considered contributing or not. Ethnic group  $K+1$  contributes if:

$$X_{K+1} = \frac{\alpha p_c}{(1 + \alpha(K - 1))\beta} = \frac{p_e}{\beta} = X_e \quad (27)$$

where  $p_c$  is the total share of all ethnic groups from 1 to  $K$ . Rearranging a group will not contribute if:

$$\frac{\alpha}{(1 + \alpha(K - 1))} p_c \geq p_e \quad (28)$$

The largest group always contributes and therefore we can write their FOC as:

$$1 = \mu N \frac{p_1}{X_1} + N\tau\alpha\mu \sum_{k=2}^K \frac{p_k}{X_k} + N\tau\alpha\mu \sum_{j=K+1}^E \frac{p_j}{X_j} \quad (29)$$

$$= \mu N\beta + N\tau\alpha\mu(K - 1)\beta + N\tau\mu(1 + \alpha(K - 1))\beta \frac{(1 - p_c)}{p_c} \quad (30)$$

Rearranging this equation results in:

$$\beta = \frac{p_c}{N\mu [p_c(1 - \tau) + \tau(1 + \alpha(K - 1))]} \quad (31)$$

$$= \frac{p_c}{N\mu [p_c(1 - \tau) + \tau Q]} \quad (32)$$

Having defined  $\beta$  in terms of parameters we are now able to measure the marginal effect of increasing the size of the largest group at the expense of any other single group. Average public good provision can be written as:

$$\bar{X} = \sum_{e=1}^E p_e X_e \quad (33)$$

$$= \sum_{k=1}^K \frac{p_k^2}{\beta} + \sum_{j=K+1}^E \frac{p_j p_c \alpha}{Q\beta} \quad (34)$$

$$= \frac{1}{\beta} \left[ \sum_{k=1}^K p_k^2 + \frac{\alpha}{Q} (1 - p_c) p_c \right] \quad (35)$$

with  $Q = 1 + \alpha(S - 1)$ . Increasing the size of the largest group has three consequences for group size. The largest group increases, some other group decreases and the share of the population that contributes may or may not increase.

- Case 1 -  $p_1 \uparrow, p_e \downarrow, p_c$  unchanged - the mass moving to the largest group comes from another group that was already contributing a positive amount.

In this case there is no change in  $\beta$  and therefore:

$$\frac{\partial \bar{X}}{\partial p_1} = \frac{1}{\beta} [2p_1 - 2p_e] \quad (36)$$

which is positive as  $p_1 > p_e$  by construction and  $\beta > 0$ .

- Case 2 -  $p_1 \uparrow, p_j \downarrow, p_c \uparrow$  - the group moving to the largest group comes from another group that was not contributing.

The key in this case is that the change in  $p_c$  alters  $\beta$ . Therefore:

$$\frac{\partial \bar{X}}{\partial p_1} = \frac{\beta I_1 - I \beta_1}{\beta^2} \quad (37)$$

where:

$$I = \left[ \sum_{k=1}^K p_k^2 + \frac{\alpha}{Q}(1-p_c)p_c \right] \quad (38)$$

$$I_1 = \frac{\partial I}{\partial p_1} \quad (39)$$

$$= 2p_1 - p_c Q + (1-p_c)Q \quad (40)$$

$$(41)$$

while  $\beta_1$  is defined in a similar way:

$$\beta_1 = \frac{\partial \beta}{\partial p_c} \quad (42)$$

$$= \frac{\tau Q}{\mu N [p_c(1-\tau) + \tau Q]^2} \quad (43)$$

$$= \frac{\beta^2 \tau \mu Q N}{p_c^2} \quad (44)$$

Substituting equations 32 and 44 into equation 37 results in:

$$\frac{\partial \bar{X}}{\partial p_1} = \frac{\mu N}{p_c} [p_c(1-\tau) + \tau Q] I_1 - I \frac{\tau \mu Q N}{p_c^2} \quad (45)$$

$$= p_c(1-\tau)I_1 + \tau Q I_1 - \frac{I \tau Q}{p_c} \quad (46)$$

The first term is positive if  $\tau < 1$ . I will therefore show that the second term is greater than the third. Factoring  $\tau Q$  leaves:

$$I_1 \geq \frac{I}{p_c} \quad (47)$$

$$2p_1 - 2\frac{\alpha}{Q}p_c + \frac{\alpha}{Q} \geq \frac{1}{p_c} \sum_{k=1}^K p_k^2 + \frac{\alpha}{Q}(1-p_c) \quad (48)$$

Collecting terms results in:

$$p_1 - \frac{1}{p_c} \sum_{k=1}^K p_k^2 + p_1 - \frac{\alpha}{Q}p_c \geq 0 \quad (49)$$

As:

$$p_1 \geq \frac{1}{p_c} \sum_{k=1}^K p_k^2 \quad (50)$$

$$\geq \frac{\alpha}{Q} p_c \quad (51)$$

while at least one of these is a strict relation if  $p_c < 1$  which is necessary to even consider this case.

Thus for  $\alpha\tau < 1$  increasing the size of the largest group will strictly increase average public good provision.

Table 1: Ethnic Diversity and Public Good Provision

|                        | Water1               | Water2               | Elec1                | Elec2                | Educ1                | Educ2                |
|------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                        | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| Fractionalization      | -.100***<br>(.024)   | -.101***<br>(.025)   | -.081***<br>(.017)   | -.089***<br>(.020)   | -.016*<br>(.009)     | .002<br>(.013)       |
| Own Group Size         |                      | -.002<br>(.010)      |                      | -.004<br>(.007)      |                      | .018**<br>(.008)     |
| HH Wealth              | .073***<br>(.005)    | .073***<br>(.005)    | .269***<br>(.006)    | .264***<br>(.007)    | .023***<br>(.003)    | .024***<br>(.003)    |
| District Wealth        | .088***<br>(.011)    | .088***<br>(.011)    | .068***<br>(.009)    | .069***<br>(.009)    | -.013***<br>(.005)   | -.015***<br>(.006)   |
| HH Tenure              | -.0001**<br>(.00005) | -.0001**<br>(.00005) | .0003***<br>(.00005) | .0002***<br>(.00005) | .0003***<br>(.00007) | .0004***<br>(.00008) |
| Avg. Tenure            | -.001<br>(.0008)     | -.001<br>(.0008)     | -.0005<br>(.0006)    | -.0004<br>(.0006)    | .001***<br>(.0004)   | .0007<br>(.0005)     |
| (ln) Distance to River | .021***<br>(.003)    | .021***<br>(.003)    | -.002<br>(.002)      | -.002<br>(.002)      | -.0007<br>(.001)     | -.001<br>(.002)      |
| Other Controls         | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Province Effects       | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Dominant Ethnic Groups | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Own Ethnic Group       | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Obs.                   | 142444               | 142444               | 143447               | 143447               | 116609               | 116609               |
| R <sup>2</sup>         | .349                 | .349                 | .665                 | .677                 | .591                 | .590                 |