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"Ethnic Diversity, Democracy, and Health: Theory and Evidence"

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Ethnic Diversity, Democracy, and Health: Theory and Evidence*

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Abstract

This paper examines the relationship between ethnic composition, political regimes, and the quality of public policy. Specifically, based on the citizen-candidate model, we assume individuals who have heterogeneous policy preferences and investigate how ethnic diversity affects selection of a politician and the resulting policy choices in democratic and dictatorial regimes. In the theoretical analysis, our model derives (1) a negative relationship between ethnic diversity and the quality of public policy, both in a democracy with a dominant group and in a dictatorship, and (2) a non-monotonic relationship in a democracy without a dominant group. In the empirical examination, using health outcomes as the proxy for the quality of public policy, our theoretical results are supported by evidence from the data of 154 countries.

Keywords: Citizen-candidate model; Ethnic fractionalization; Infant mortality.

JEL Classification: D72; H41; I18.

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1 Introduction

The government is required to achieve security, education, and health by public policies, but the quality of public policies across countries shows large differences. Ethnic diversity in a society can be considered as a factor causing those differences, and the relationship between ethnic heterogeneity and public goods provision is shown to be negative in many previous studies (e.g., Alesina et al., 1999; Alesina et al., 2003; Easterly and Levine, 1997; La Porta et al., 1999; Miguel and Guberty, 2005; Vigdor, 2004). Also, more public goods are provided in a democracy than in a dictatorship (e.g., Besley and Kudamatsu, 2006; Bueno de Mesquita et al., 2003; Deacon, 2009; Lake and Baum, 2001; Zweifel and Navia, 2000). In spite of the abundant research, few studies examine how political regimes affect the relationship between ethnic diversity and the quality of public policy. To fill this gap in the literature, the purpose of this paper is to examine this relationship from both theoretical and empirical viewpoints.

To analyze the relationship between ethnic composition, political regimes, and public policy, we construct a model with the following basic features. First, we assume that the allocation of the government budget can be targeted to a specific ethnic group. Second, there are two types of individuals who have different policy preferences. Type e people care only about the benefits of their own ethnic group, and type s people prefer to maximize the social welfare of the entire society. Third, applying the citizen-candidate model (Besley and Coate, 1997; Osborne and Slivinski, 1996), the model endogenously determines which type of individual is selected as a politician (and, therefore, policies are also endogenously determined).

In a democracy, all citizens can decide whether or not to run for election, and a politician is elected from among the candidates by sincere voting. Conversely, in a dictatorship, a specific ethnic group monopolizes political power, and only the members of this group have the right to run for election and right to vote. Since the candidates cannot commit campaign pledges during the election, the elected candidate will implement his/her favorite public policy. On the one hand, if a type s person is elected, he/she would distribute public goods evenly to all the ethnic groups. On the other hand, a type e person would distribute public goods only to his/her own ethnic group if elected. As a result, public goods are distributed unevenly between the politician's ethnic group and the others, and the social welfare is worse compared to the case in which a type s politician is elected. Furthermore, the smaller the size of the ethnic group to which a type e politician belongs, the worse the social welfare due to the exclusive policy by the type e politician.[1]

Analyzing the model, we derive the relationship between ethnic composition and social welfare in a democracy and a dictatorship. There are two crucial channels in which ethnic composition affects the social welfare. The first channel is the selection of a politician. Ethnic composition affects electoral outcome and policy payoff. Thus, individuals' incentive to run for election depends on ethnic composition. The second channel is the size of the ethnic group that turns out a type e politician. When a type e individual becomes a politician, the government's budget is monopolized by his/her ethnic group, and the size of the group affects the social welfare. We derive a negative relationship between ethnic fractionalization and the social welfare in a dictatorship and a democracy with a dominant group, which is defined as a group where type e individuals within the group make up a majority of the whole society. In a democracy without a dominant group, we derive a non-monotonic relationship between ethnic fractionalization and the social welfare.

In the empirical analysis to examine the predictions obtained from the model, we employ health outcomes as the proxy for the social welfare resulting from public policy. This proxy is used for the following reasons. First, the health of the citizens is improved/maintained mainly by public goods provision (public hospitals, water and sewage service, vaccination, sanitation and so on). Second, since many ethnically diverse countries are located in the world's poor regions, such as Sub-Saharan Africa, the health status of their citizens can appropriately represent the countries' social welfare status as well as or better than income. Thus, infant mortality, child mortality, and life expectancy can be considered as important indices for welfare.[2] Third, although some studies use the share of government expenditure to gross domestic product (GDP) as the proxy for the quality of public

[1] Our model evaluates the social welfare by the policy payoff function of the type s, as described later.

[2] The infant mortality rate is especially high among poor people (Gwatkin et al., 2007) and can be used as one of the indices measuring the poverty level.

policy, there can be a gap between expenditure and actual provision in corrupt countries, as pointed out by Rajkumar and Swaroop (2008).[3]

The following three testable predictions from our theoretical model are empirically tested. (1) In a democracy with a dominant group, an increase in ethnic fractionalization worsens the health outcomes. (2) In a democracy without a dominant group, an increase in ethnic fractionalization has a non-monotonic effect on the health outcomes. Specifically, when fractionalization is not sufficiently high, the health outcomes become worse as fractionalization increases. When fractionalization is sufficiently high, the health outcomes are good. (3) In a dictatorship, an increase in ethnic fractionalization worsens the health outcomes. The regression analysis using the data of 154 countries from 1960 to 2005 supports the above three predictions. These results are obtained in almost all cases in which infant mortality, child mortality, and life expectancy are used as health outcomes.

The remainder of this paper is structured as follows. In section 2, we provide the summary of the existing literature related to our study. In section 3, we present a model and derive testable predictions on the relationship between ethnic composition and the social welfare. In section 4, our theoretical predictions are empirically examined. The conclusion is provided in Section 5.

2 Related Literature

As mentioned in the previous section, a large number of studies show the negative relationship between ethnic diversity and public goods provision.[4] The prominent studies on the underlying mechanism of this relationship focus on ethnic preferences (Alesina et al., 1999; Alesina and La Ferarra, 2000; Luttmer, 2001; Vigdor, 2004) and social sanctions (Miguel and Gugerty, 2005). Alesina et al. (1999) argue that preferences for the type and the size of local public goods are divergent in an ethnically diverse society, and a large level of public goods is not supported by the majority. Luttmer (2001) finds that individuals' support for welfare spending depends positively

[3]Rajkumar and Swaroop (2008) empirically show that the improving effects of education and health expenditure on their corresponding outcomes become smaller as the corruption level increases.

[4]Along with the studies referred to in the previous section, see also Alesina et al. (2001), Dayton-Johnson (2000), Khwaja (2009), Okten and Osili (2004), and Poterba (1997), among others.

on the share of their own ethnic group in the entire beneficiaries. Vigdor (2004) examines similar effects and finds that individuals contribute less to public benefits in a more ethnically heterogeneous society. Miguel and Gugerty (2005) show that ethnic diversity leads to few public goods due to few social sanctions against free-riders.

This paper differs from previous studies as follows. First, we consider political selection as the mechanism through which ethnic diversity affects public policy. Second, as a public policy, our model considers allocation of an exogenous government budget among ethnic groups rather than the size of public goods provision or transfer. Finally, this paper shows a non-monotonic relationship between ethnic heterogeneity and policy outcomes in a democracy without a dominant group.

The model of this paper is related to the literature of political selection, which analyzes who will be selected as a politician from heterogeneous individuals (Acemoglu et al., 2010; Besley, 2005; Besley and Coate, 1997; Caselli and Morelli, 2004; Diermeier et al., 2005; Mattozi and Merlo, 2008; Messner and Polborn, 2004; Osborne and Slivinski, 1996).[5] This paper, however, differs from these studies in the sense that it analyzes the effect of ethnic composition on political selection. Banerjee and Pande (2009) study both political selection and the role of ethnicity in politics. While we focus on the effect of ethnic fractionalization on policy outcome, their focus is on the effect of "ethnicization" on the quality of politicians, which is the degree of importance that voters attach to candidates' parochialism. In their model, parties choose candidates' characteristics (quality and parochialism) to maximize vote share, and they analyze the effect of the increase in voter's ethnicization. By contrast, in our model, all individuals decide whether or not to run for election to realize their most preferred policy, and ethnic fractionalization affects individuals' incentives for running for election, the type of the elected politician, and policy outcomes.

To the best of our knowledge, the closest approach to the theoretical part of this paper is the model developed by Fernández and Levy (2008) that study the relationship between ethnic diversity

[5] Caselli and Morelli (2004) and Messner and Polborn (2004) analyze the quality of a politician based on the citizen-candidate model. Diermeier et al. (2005) and Mattozzi and Merlo (2008) demonstrate political selection in environments where experience in politics affects future payoff of politicians. Acemoglu et al. (2010) develop a dynamic model of political selection and analyze how low quality government persists.

and public policy in considering political selection. They analyze the model of endogenous party formation to examine the relationship between diversity and two types of income redistribution, one of which is general redistribution and the other is targeted goods to the poor in the interest groups. In one equilibrium, which always exists, a representative of the poor who do not belong to the interest groups wins and implements maximal general redistribution, but there is another equilibrium in which the rich and some interest groups of the poor form a minimum winning coalition and implement lower general redistribution and positive targeted redistribution. In the latter equilibrium, greater diversity leads to lower general redistribution and larger targeted redistribution. But this equilibrium disappears when diversity is high enough. This non-monotonic effect of diversity depends on the party formation and the cost of targeted goods that is increasing with the number of interest groups in the winning coalition. Therefore, the mechanism of the non-monotonic effect of diversity in their model is quite different from ours. Furthermore, while they study the conflict between the rich and the poor, our focus is on the condition under which the benevolent individual is selected as a politician. We also take into account the presence of a dominant ethnic group and political regimes and show that the effects of diversity in a democracy without a dominant group are different from those in a democracy with a dominant group and a dictatorship.

Furthermore, two types of evidence in previous studies are associated with our empirical analysis. First, regarding the ethnic fractionalization and health outcomes, many previous studies find the negative relationship between them (e.g., Alesina et al., 2003; La Porta et al., 1999). Second, regarding the effect of political regimes on health outcomes, some studies provide evidence that health outcomes are better in more democratic countries (e.g., Besley and Kudamatsu, 2006; Kudamatsu, 2011; Zweifel and Navia, 2000).[6]

Finally, while few studies have examined the effect of ethnic fractionalization both in a democracy and a dictatorship, the studies conducted by Collier (2000, 2001) and Bluedorn (2001) are notable exceptions. Collier (2000) theoretically and empirically shows that when income redistribution and

[6] Ross (2006) conducts the data imputation and employs the dataset that includes authoritarian nations with high performance. He finds that if global health trends and country-specific factors are controlled for, democracy has no influence on infant mortality.

economic growth have a trade-off relationship, the effect of ethnic diversity on economic growth depends on political regimes, and ethnic diversity hinders economic growth under limited political rights but does not affect the growth under a democracy. Bluedorn (2001) also provides empirical evidence that a democracy ameliorates a negative effect of ethnic diversity on economic growth. Collier (2001) considers the effect of the presence of a dominant ethnic group whose population size is large enough to make up a majority. However, our study differs from those previous studies in the following ways. For the theoretical part, unlike theirs, we consider the mechanism of political selection. For the empirical part, we examine the effect of ethnic composition on health outcomes, while Collier (2000, 2001) and Bluedorn (2001) investigate its effect on economic growth and civil war.[7]

3 Theory

3.1 The Model

Consider a society comprising N ethnic groups. Let S_i be the population size of group i. The entire population is normalized to unity; that is:

$$\sum_{i=1}^{N} S_i = 1.$$

The standard definition of ethnic fractionalization is the probability that two randomly selected individuals belong to different groups, which can be written as:

$$1 - \sum_{i=1}^{N} S_i^2. \tag{1}$$

There are two types of individuals. One comprises those who care only about their own benefit, which we call type e. The other comprises those who care about the welfare of the whole society, which we call type s. Type s individuals, therefore, have benevolent preferences. In each ethnic group, a fraction σ of individuals is assumed to be type s, and a fraction $1 - \sigma$ is assumed to be

[7] Alesina and La Ferrara (2005) also confirm that the negative effect of ethnic diversity on growth becomes smaller as a democracy matures.

type e. A plausible value of σ would be different among societies, and it may be very small in some societies. We assume that $\sigma \in (0,1)$.

The government has exogenous revenue T and distributes it to each group. Let g_i be the level of per capita transfer of group i, and let $g = (g_1, ..., g_N)$ be the policy vector. Therefore, the government budget constraint is given by:

$$\sum_{i=1}^{N} S_i g_i = T. \tag{2}$$

We can also interpret g_i as the level of local public goods of unit cost S_i if a geographical distribution of ethnic groups is highly segregated.[8]

Since type e individuals care only about their own benefit, the policy payoff of type e individuals in group i depends only on g_i. Let $U_i^e(g)$ be the policy payoff of type e individuals in group i from policy g. We assume that $U_i^e(g)$ is given by:

$$U_i^e(g) = g_i^{\alpha}, \quad \alpha \in (0,1). \tag{3}$$

Note that we can also interpret type e individuals as those who care only about the benefit of their own ethnic group. Type s individuals care about the welfare of the whole society, and we assume that their policy payoff, $U^s(g)$, is given by:

$$U^s(g) = \sum_{i=1}^{N} S_i g_i^{\alpha}. \tag{4}$$

Type s individuals prefer the policy that maximizes the social welfare function expressed in (4). We can interpret g_i^{α} as material benefit of individuals in group i from the policy. The policy payoff of type e individuals is their own material benefit. The policy payoff of type s individuals is not their own material benefit but the sum of the all individuals' material benefits. For example, we can interpret g_i^{α} as the health condition of children of each individual in group i. The health condition improves with the increase in per capita transfer, but the improving effect diminishes as per capita

[8] Alesina and Zhuravskaya (2011) point out that the degree of segregation of ethnic groups is higher in poor countries than in rich ones.

transfer increases. Then, function (4) represents the health condition of the average child in this society.

From (2) and (3), the most preferred policy of type e individuals in group i, $g^{e,i}$, is:

$$g_i^{e,i} = \frac{T}{S_i}, \quad g_j^{e,i} = 0 \text{ for all } j \neq i. \tag{5}$$

From (2) and (4), the most preferred policy of type s individuals, g^s, is:

$$g_i^s = T \text{ for all } i \in \{1, ..., N\}. \tag{6}$$

The political process is based on the citizen-candidate model (Besley and Coate, 1997; Osborne and Slivinski, 1996). In a democracy, all individuals can run for office, and the candidate who wins the election chooses the policy. In a dictatorship, the right to run for election and the right to vote are limited to a specific ethnic group, as we will explain later. The timing and the details of the political process are as follows:

1. Each individual decides whether or not to run for election. Entry cost is $\delta > 0$. The candidates cannot commit to which policy he/she will implement after winning the election.

2. A politician is chosen among the candidates by plurality rule voting. We assume sincere voting, which means that each individual votes for the most preferred candidate.

3. The winning politician chooses policy g.

We denote the psychological and pecuniary benefit the politician earns from holding office as υ, and, for simplicity, we assume $\upsilon = 0$. Candidates, therefore, run for election to choose their most preferred policies. Since a politician is chosen by plurality rule voting, the candidate who wins the most votes holds office. In the event of a tie where multiple candidates win the most votes, these candidates win with the same probability. When a voter has multiple most preferred candidates, he/she votes for one of them in a random manner. When there is only one candidate, the candidate wins with probability one. If no one runs for election, the status quo policy $\bar{g} = 0$ is implemented.

Since the politician holding office implements his/her most preferred policy, from (5) and (6), a type e voter has the following preference over the candidates:

$$\begin{aligned} &\text{type } e \text{ candidates of own group} \\ &\succ \text{type } s \text{ candidates} \\ &\succ \text{type } e \text{ candidates of other groups.} \end{aligned}$$

Type s voters prefer type s candidates to type e candidates. When the policy most preferred by a type e individual in group i is implemented, the policy payoff of a type s individual is $S_i^{1-\alpha}T^{\alpha}$. Therefore, a type s individual prefers a type e candidate in a larger group to a type e candidate in a smaller group.

The ultimate payoff of each individual is separable in the policy payoff and the entry cost, which he/she pays if running for election. We evaluate the social welfare resulting from policy g by the policy payoff function of type s, i.e., $\sum_{i=1}^{N} S_i g_i^{\alpha}$.[9] As mentioned above, the health condition of the average child in this society can be represented by this social welfare function.

3.2 Equilibria

We seek for subgame perfect equilibria of this game. In the equilibrium:

- The politician holding office chooses his/her most preferred policy because candidates cannot commit their campaign promise during an election.
- Since we assume sincere voting, each individual votes for the candidate who brings him/her the largest policy payoff among the candidates.
- Each individual's decision on whether or not to run for election is optimal given the other individuals' decisions.

There can be multiple equilibria in this game. When the number of candidates in equilibrium is x, we call it x-candidate equilibrium following previous studies.

[9] Including the entry cost δ into the calculation of social welfare does not change the subsequent argument.

Concerning the parameter of the model, we make the following assumption:

Assumption 1

$$T^{\alpha} > \delta.$$

The LHS in the inequality is type s' policy payoff from the most preferred policy, and the RHS is the cost of running for election. Assumption 1, therefore, means that running for election is optimal for a type s individual if no one runs for election.

In what follows, we examine three different situations for political regimes and for ethnic composition. Specifically, the first case is that a dominant group exists in a democracy; the second is that a dominant group does not exist in a democracy; and the third is a dictatorship.

3.2.1 Democracy with a Dominant Group

We first consider the case of democratic regime. In a democracy, all citizens have the right to vote and the right to run for election. Furthermore, concerning an ethnic composition, we assume that a dominant group exists. We say that there is a dominant group when:

$$(1-\sigma) S_i > \frac{1}{2} \quad \text{for some } i \in \{1, ..., N\}. \tag{7}$$

This means that type e individuals of the dominant group account for more than half of the population.[10] If σ is negligibly small, this case implies that the share of the most populous ethnic group is larger than 50 percent. For simplicity, we assume that the dominant group is group 1. Then, the following proposition holds.

Proposition 1 *Let Assumption 1 hold. Then, in the case of a democracy with a dominant group, a one-candidate equilibrium exists where a type* e *individual of the dominant group runs for election. Furthermore, when the condition*

$$\left(\frac{T}{S_1}\right)^{\alpha} - \delta > T^{\alpha} \tag{8}$$

[10] We exclude the infrequent case where $(1-\sigma) S_i = 1/2$ for some i to restrict the equilibria we must consider.

holds, this one-candidate equilibrium is the unique equilibrium. If condition (8) does not hold, there is also a one-candidate equilibrium where a type s individual runs for election.

Proof. We first show that a one-candidate equilibrium exists where a type e individual of the dominant group runs for election. It is the subgame perfect equilibrium if, anticipating the optimal policy choices of the winning candidate and sincere voting, each individual's decision on whether or not to run for election is optimal given the other individuals' decisions. From Assumption 1, it follows that $(T/S_1)^{\alpha} > \delta$. Therefore, given that other individuals do not run for election, it is optimal for the type e candidate of the dominant group to run for election. Since $\delta > 0$ and $\upsilon = 0$, given that there is one type e candidate of the dominant group, it is optimal for other type e members of the dominant group not to run for election, and, therefore, all type e members of the dominant group vote for the candidate. Since $(1-\sigma) S_1 > 1/2$, the type e candidate wins a majority vote in this case, and type s individuals and type e individuals of other groups cannot win the election even if they run. Therefore, given that there is one type e candidate of the dominant group, it is optimal for type s individuals and type e individuals of other groups not to run for election. Accordingly, each individual's decision on running for election is a best response to the other individuals' decisions, and a one-candidate equilibrium exists where a type e individual of the dominant group runs for election.

We next show that if condition (8) holds, the above one-candidate equilibrium is the unique equilibrium. When there is a type e candidate of the dominant group, type s individuals and type e individuals of other groups have no chance to win, and it is optimal for them not to run for election. This means that the above equilibrium is the only equilibrium where a type e individual of the dominant group runs for election. Under the assumption that $\delta > 0$ and $\upsilon = 0$, in equilibrium the pool of candidates does not include multiple type s candidates and multiple type e candidates of the same group. Thus, we must check the following three cases:

(i) the pool of candidates comprises some type e individuals of different groups other than the dominant group.

(ii) the pool of candidates comprises a type s individual and some type e individuals of different groups other than the dominant group.

(iii) the pool of candidates comprises a type s individual.

In case (i), a type e individual of the dominant group can increase his/her payoff by running for election since $(T/S_1)^{\alpha} > \delta$. Therefore, it cannot be an equilibrium. In case (ii), all type e individuals of the dominant group vote for the type s candidate; therefore, the type e candidates lose with probability one. Then, the type e candidates can increase their payoff by giving up running for election, and it cannot be an equilibrium.

Thus, only case (iii) can be an equilibrium. If condition (8) holds, given that only a type s individual runs for election, a type e individual of the dominant group can increase his/her payoff by running for election. Therefore, when condition (8) holds, case (iii) cannot be an equilibrium. On the other hand, when condition (8) does not hold, case (iii) is an equilibrium since each individual's decision on whether to run for election is a best response to the other individuals' decisions. ■

In the equilibrium where a type e individual becomes a politician, the government budget is exclusively allocated to the dominant group. On the other hand, in the equilibrium where a type s individual becomes a politician, all ethnic groups can equally receive the transfer. When some groups receive no government budget, health outcomes in these groups would be bad due to the lack of health infrastructure. The policy by a type e politician from group i causes $T^{\alpha}\left(1 - S_i^{1-\alpha}\right)$ of social welfare loss compared to the policy of a type s politician. Thus, as the group size S_i is smaller, the social welfare loss is larger.

When condition (8) holds, the one-candidate equilibrium where a type e individual of the dominant group runs for election is the unique equilibrium. When condition (8) does not hold, the game has multiple equilibria, and there is also another one-candidate equilibrium where a type s individual runs for election.[11] When the size of the dominant group S_1 is sufficiently large, condition

[11] Note that condition (8) implies Assumption 1 since $(1 - \sigma) S_1 > 1/2$.

(8) does not hold, and both of the two equilibria exist. When S_1 is small, type e individuals in the dominant group can substantially increase the policy payoff by allocating the government budget exclusively to the dominant group. Therefore, when S_1 is small, the one-candidate equilibrium of a type s candidate is hard to exist.

The size of the dominant group S_1 is positively related to the social welfare (and health outcomes) for the following two reasons:

- As S_1 is smaller, in the equilibrium where a type e individual becomes a politician, a larger share of the population receives no transfer, and the social welfare loss is larger.
- As S_1 is smaller, condition (8) is easier to be satisfied, and it is unlikely that the equilibrium exists where a type s individual becomes a politician.

Therefore, in the case of a democracy with a dominant group, if σ is negligibly small, the social welfare is worst when the share of the dominant group in the population is near 50 percent.

The smaller the size of the dominant group is, the larger ethnic fractionalization would be. The above argument, therefore, implies a negative relationship between ethnic fractionalization and health outcomes.

3.2.2 Democracy without a Dominant Group

We next consider the case of a democracy without a dominant group. We say that there is no dominant group when:

$$(1-\sigma)\, S_i < \frac{1}{2} \quad \text{for all } i \in \{1, ..., N\}. \tag{9}$$

In this case, the following proposition holds.

Proposition 2 *Let Assumption 1 hold. Then, in the case of a democracy without a dominant group, a one-candidate equilibrium where a type s individual runs for election always exists.*

Proof. We show that, when there is one type s candidate, each individual's decision on whether or not to run for election is optimal given the other individuals' decisions. From Assumption 1, given that all other individuals do not run for election, it is optimal for the type s candidate to run for election. Since $\delta > 0$ and $\upsilon = 0$, it is optimal for other type s individuals not to run for election. When there is one type s candidate, if a type e individual of group i runs for election, all type e members of group i vote for this type e candidate, and all other individuals in this society vote for the type s candidate. Since $(1-\sigma) S_i < 1/2$, this type e candidate will lose with probability one. Therefore, when there is one type s candidate, it is optimal for type e individuals not to run for election. Thus, a one-candidate equilibrium exists where a type s individual runs for election. ■

Unlike the case of a democracy with a dominant group, the one-candidate equilibrium where a type s individual becomes a politician always exists in a democracy without a dominant group. The equilibrium where type e individuals run for election may also exist in a democracy without a dominant group. In what follows, we first consider the case where the size of all groups is equal and then consider the case of different group sizes. The results derived in both cases are essentially the same. Although the assumption of equal group size is not realistic, this case is simple and clear. In the case of different group sizes, we can consider not only the number of groups but also the population share of small groups as the determinants of ethnic fractionalization.

3.2.3 Democracy without a Dominant Group: The Case of Equal Group Size

Concerning group size, we assume that:

$$S_1 = S_2 = ... = S_N = \frac{1}{N}, \quad N \geq 2. \tag{10}$$

Since the number of groups is more than one, $(1-\sigma) S_i < 1/2$ for all groups, and no dominant group exists. From Proposition 2, the one-candidate equilibrium where a type s individual runs for election exists in the case of equal group size. Since fractionalization is $1 - 1/N$ in this case, an increase in N causes high degree of fractionalization.

Concerning the parameter, we make the following assumptions in this section:

Assumption 2

$$T^{\alpha} - \delta > \left(\frac{1}{2}\right)^{1-\alpha} T^{\alpha}.$$

Assumption 3

$$(1-\sigma)\,\frac{1}{N} \neq \sigma.$$

Assumption 2 means that, for any $N \geq 2$, if a type s individual can win election with probability one, a type s individual prefers running for election to letting a type e individual hold office. Note that Assumption 2 implies Assumption 1. As we discuss in Appendix A, the main results derived below still hold even if Assumption 2 is replaced with Assumption 1. Assumption 3 means that the number of type e individuals in each group does not coincide with the number of type s individuals in the society. We make this assumption to exclude the equilibrium that exists only when the two numbers are equal.

In what follows, we will show that, in the case of equal group size, the other possible equilibrium is an N-candidate equilibrium where all groups turn out one type e candidate. While the one-candidate equilibrium where a type s individual runs for election always exists, this N-candidate equilibrium exists if and only if the following two conditions hold:

$$\left(\frac{1}{N}\right)^{1-\alpha} T^{\alpha} \geq \delta, \tag{11}$$

$$(1-\sigma)\frac{1}{N} > \sigma. \tag{12}$$

When the pool of candidates comprises N type e candidates from different groups, all of the candidates obtain the same votes and win with probability $1/N$. The LHS of condition (11) is, therefore, the expected policy payoff of the type e candidates in such case. Condition (11), therefore, means that when there are N candidates of type e individuals from different groups, it is optimal for each candidate to run for election. Condition (12) means that the number of type e individuals in each group is larger than the number of type s individuals in the society.

Proposition 3 *Let Assumptions 2 and 3 hold. We also assume equal group size as expressed in (10). Then, an N-candidate equilibrium where each group turns out one type e candidate exists if and only if conditions (11) and (12) both hold.*

Proof. Necessity: We prove by contradiction that if an N-candidate equilibrium exists where each group turns out one type e candidate, then both conditions (11) and (12) must hold. Suppose that condition (11) does not hold. If condition (11) does not hold, a type e candidate can increase his/her payoff by giving up running for election in the N-candidate equilibrium. This is contradiction. Next, suppose that condition (12) does not hold. If a type s individual runs for election when there are N type e candidates from different groups, he/she obtains σ votes from type s individuals. In such a case, the type e candidates obtain $(1-\sigma)\,1/N$ votes from type e individuals of their own group. Because condition (12) does not hold, from Assumption 3, we obtain $(1-\sigma)\,1/N < \sigma$. Therefore, given that there are N type e candidates from different groups, a type s individual can win the election with probability one if running for election when condition (12) does not hold. From Assumption 2, it is optimal for type s individuals to do so. This also contradicts the assumption that an N-candidate equilibrium exists where all groups turn out one type e candidate.

Sufficiency: We show that if both conditions (11) and (12) hold, an N-candidate equilibrium exists where there is one type e candidate in each group. From condition (11), it is optimal for the type e candidates to run for election. Given that each group turns out one type e candidate, if other type e individual in group i runs for election, the votes that were supposed to be obtained by the incumbent group i candidate are shared with the two candidates, and both of the candidates lose certainly. Thus, given that there are N type e candidates from different groups, it is optimal for other type e individuals not to run for election. If a type s individual runs for election when there are N type e candidates from different groups, the type s loses with probability one due to condition (12). Thus, it is optimal for type s individuals not to run for election. Therefore, an N-candidate equilibrium exists where there is one type e candidate in each group. ■

Furthermore, the following proposition holds.

Proposition 4 *Let Assumptions 2 and 3 hold. In the case of a democracy with equal group size, there is no equilibrium other than the one-candidate equilibrium in Proposition 2 and the N-candidate equilibrium in Proposition 3.*

Proof. We first show that the equilibrium where no type s individual runs for election must be the N-candidate equilibrium in Proposition 3. Consider that a pool of candidates comprises only type e candidates and that there is at least one group that turns out no candidate. In this case, a type s candidate can win the election with probability one if running for the election. This is because, while the type e candidates obtain votes of type e individuals of their own group, the type s candidate wins the votes of type e individuals in the group that does not turn out any candidate in addition to the votes of type s individuals. From Assumption 2, if a type s individual is certain to win an election, it is optimal for him/her to run for election. Therefore, in the equilibrium where no type s individual runs for election, all groups must turn out one type e candidate, and it is the N-candidates equilibrium in Proposition 3.

Since there cannot be multiple type s candidates in equilibrium, showing that the one-candidate equilibrium in Proposition 2 is the only equilibrium where the pool of candidates includes a type s candidate completes the proof. To do this, we show that the case where the pool of candidates includes both a type s candidate and some type e candidates cannot be equilibrium. To show the contradiction, assume that there is equilibrium where both a type s individual and type e individuals run for election. In such an equilibrium, all groups must turn out one type e candidate. If not, the type s candidate can win with probability one, and it is suboptimal for type e candidates to run for election. When all groups turn out one type e candidate and there is one type s candidate, the type e candidates obtain $(1-\sigma)\,1/N$ votes and the type s candidate obtains σ votes. In this case, from Assumption 3, either the type e candidates or the type s candidate lose with probability one. This is a contradiction to the assumption that such pool of candidates constitutes equilibrium. Therefore, the one-candidate equilibrium in Proposition 2 is the only equilibrium where the pool of candidates includes a type s candidate, and the proof is completed. ■

Condition (11) in the necessary and sufficient conditions in Proposition 3 can be written as:

$$N \leq \left(\frac{T^{\alpha}}{\delta}\right)^{\frac{1}{1-\alpha}}. \tag{13}$$

In the N-candidate equilibrium where each group turns out one type e candidate, each candidate wins the election with probability $1/N$. When N is sufficiently large, since the winning probability is sufficiently small, running for election does not pay the type e candidates, and the N-candidate equilibrium disappears.

Condition (12) in the necessary and sufficient conditions in Proposition 3 can be written as:

$$N < \frac{1-\sigma}{\sigma}. \tag{14}$$

Given that there are N type e candidates from different groups, if a type s individual runs for the election, each type e candidate obtains $(1-\sigma)\,1/N$ votes and the type s candidate obtains σ votes. When N is sufficiently large, the number of votes obtained by the type e candidates is small, the type s candidate can win the election, and it is optimal for the type s candidate to run for the election. Therefore, when N is sufficiently large, the N-candidate equilibrium disappears.

From Proposition 3, when the number of ethnic groups is sufficiently large such that:

$$N > \min\left\{\left(\frac{T^{\alpha}}{\delta}\right)^{\frac{1}{1-\alpha}}, \frac{1-\sigma}{\sigma}\right\}, \tag{15}$$

then the N-candidate equilibrium does not exist, and the one-candidate equilibrium where a type s individual runs for election is the unique equilibrium.

In the case of a democracy with equal group size, the relationship between ethnic fractionalization and the social welfare (or health outcomes) is as follows:

- When ethnic fractionalization is sufficiently large (N is sufficiently large), the one-candidate equilibrium is the unique equilibrium. In the equilibrium, the government policy is implemented to maximize the social welfare, and health outcomes would be good.

- When ethnic fractionalization is not sufficiently large (N is not sufficiently large), both the one-candidate equilibrium and the N-candidate equilibrium exist. In the N-candidate equilibrium, as N is larger, the size of each group is smaller and the welfare loss due to the policy implemented by a type e politician is larger (the share of people who cannot receive the government expenditure is larger). Therefore, when fractionalization is not sufficiently large, health outcomes become worse as fractionalization increases.

In Appendix A, we show that the relationship between N and the existence of the N-candidate equilibrium is preserved even if Assumption 2 is replaced with Assumption 1.

3.2.4 Democracy without a Dominant Group: The Case of Different Group Size

We divide N groups into the largest groups and the other groups. Let group $i \in \{1, ..., M\}$ be the major groups and let group $i \in \{M+1, ..., N\}$ be the small groups. Let $x \in (0,1)$ be the population share of the small groups. The major groups have equal group size; that is:

$$S_1 = ... = S_M = \frac{1}{M}(1-x), \quad M \geq 1.$$

The group size of the small groups satisfies the condition:

$$S_i < \frac{1}{M}(1-x) \quad \text{for all } i \in \{M+1, ..., N\}.$$

This means that the major groups have the largest group size. The groups classified in the major groups have the same group size. As will become clear later, this classification is useful because a type e candidate cannot beat another type e candidate whose group size is larger than that of the former candidate. Since the case with a dominant group is already considered in section 2.2.1, we consider the case where no dominant group exists, and, therefore, assume the following:

$$\frac{1}{M}(1-x)(1-\sigma) < \frac{1}{2}.$$

Note that this condition necessarily holds when $M \geq 2$. From Proposition 2, there is the one-candidate equilibrium where a type s individual runs for election. In this section, we make the following assumptions, which are the modified versions of Assumptions 2 and 3:

Assumption 2a

$$T^{\alpha} - \delta > \left(\frac{1-x}{M}\right)^{1-\alpha} T^{\alpha}.$$

Assumption 3a

$$(1-\sigma)\frac{1-x}{M} \neq \sigma(1-x) + x.$$

Similar to Assumption 2, Assumption 2a means that if a type s individual can win election with probability one, a type s individual prefers running for election to letting a type e individual in a major group hold office. Note that when $M \geq 2$, Assumption 2 implies Assumption 2a. We make this modification to take the case of $M = 1$ into consideration. Assumption 3a is a modified version of Assumption 3. The LHS is the number of type e individuals in each major group, and the RHS is the sum of the number of type s individuals in the major groups and the number of individuals in the small groups. Then, the following proposition holds.

Proposition 5 *Let Assumptions 2a and 3a hold. There is an M-candidate equilibrium where each major group turns out one type e candidate if and only if the following two conditions hold:*

$$\left(\frac{1}{M}\right)^{1-\alpha}\left(\frac{T}{1-x}\right)^{\alpha} \geq \delta, \tag{16}$$

$$(1-\sigma)\frac{1-x}{M} > \sigma(1-x) + x. \tag{17}$$

Furthermore, there is no other equilibrium other than the one-candidate equilibrium where a type s individual runs for election and this M-candidate equilibrium.

Proof. We can prove this proposition similar to the proof of Propositions 3 and 4. See Appendix A. ■

Condition (16) means that when each major group turns out one type e candidate, it is optimal for the candidate to run for election. Condition (16) can be written as:

$$x \geq 1 - \left(\frac{1}{M}\right)^{\frac{1-\alpha}{\alpha}} \frac{T}{\delta^{1/\alpha}} \equiv x^* (M), \tag{18}$$

and $x^* (M)$ is increasing in M and takes negative value when $M = 1$. As x is large, the group size of the major group is small, and the policy payoff which the type e candidate receives by implementing the most preferred policy is large. When there are M type e candidates from different major groups, each candidate wins with probability $1/M$, and larger M means lower winning probability.

When the pool of candidates comprises M type e individuals from different major groups and a type s individual, the type e candidate obtains $(1-\sigma)(1-x)/M$ votes, and the type s candidate obtains $\sigma(1-x)+x$ votes. Therefore, when condition (17) is satisfied, given that there are M type e candidates from different major groups, it is optimal for a type s individual not to run for election. When the pool of candidates comprises M type e individuals from different major groups and a type s individual, as x becomes larger, the type s candidate obtains more votes while the type e candidates obtain less. The votes obtained by the type e candidates are also decreasing in M. Condition (17) can be written as:

$$x < \frac{(1-\sigma)\, 1/M - \sigma}{(1-\sigma)(1+1/M)} \equiv x^{**} (M),$$

and $x^{**} (M)$ is decreasing in M and is smaller than 1.[12]

The M-candidate equilibrium where each major group turns out one type e candidate exists if and only if $x \in [\max\{0, x^* (M)\}, x^{**} (M))$. As M is large, this interval shrinks, and it is empty when M is sufficiently large. If M or x is sufficiently large, the M-candidate equilibrium does not exist, and the one-candidate equilibrium where a type s individual becomes a politician is the unique equilibrium. When M is sufficiently large, the M-candidate equilibrium does not exist due to low winning probability for each candidate, or a small vote share in the election which will arise

[12]Note that when there is no dominant group, condition (17) does not hold under $M = 1$.

in the history where M type e individuals from different major groups and a type s individual run for election. When x is sufficiently large, the M-candidate equilibrium does not exist due to the small vote share in such an election.

When M and x are large, fractionalization would be large. Therefore, when fractionalization is sufficiently large, the one-candidate equilibrium is the unique equilibrium, and health outcomes would be good. When $x \in [\max\{0, x^*(M)\}, x^{**}(M))$, both the M-candidate equilibrium and the one-candidate equilibrium exist. Large M or large x means small size of the major group and large welfare loss due to the policy by a type e politician. Therefore, when fractionalization is not sufficiently large ($x \in [\max\{0, x^*(M)\}, x^{**}(M))$), an increase in fractionalization (an increase in M or x) would lead to worse health outcomes.[13]

3.2.5 Dictatorship

We next consider the case of a dictatorship. We assume that a certain ethnic group exclusively seizes political power and that the right to vote and the right to run for election are limited to the members of this politically dominant group. Collier (2000) argues that, "The dictator draws his power base from his own ethnic group by recruiting the army only from this group" (p.229) and that he must acquire enough support from the army to prevent coups by the army. Collier further states that, "If the army is drawn randomly from the ethnic group, and if soldiers retain the interest of the household to which they belong, then this subjects the dictator to a constraint analogous to the median-voter rule within his own ethnic group" (p.229). Along with his argument, we consider that, in a dictatorship, the dictator is elected through political competition within his ethnic group. As for the assumption that a certain ethnic group necessarily seizes political power, the alternative assumption that a dictator is randomly drawn from the politicians who win the political competition within their own ethnic groups does not change the essence of the argument. We also assume that type e individuals make up a majority in each group, that is, $\sigma < 1/2$. Without loss of generality,

[13] When M is sufficiently large such that $x^*(M) > 0$ and x is sufficiently small such that $x < x^*(M)$, the M-candidate equilibrium does not exist. This makes the relationship between fractionalization and the existence of M-candidate equilibrium somewhat ambiguous compared to the case in Section 3.2.3.

let group 1 be the politically dominant group. Then, the following proposition holds.

Proposition 6 *Let Assumption 1 hold. In the case of a dictatorship, a one-candidate equilibrium exists where a type e individual in the politically dominant group runs for election. Furthermore, when condition (8)*

$$\left(\frac{T}{S_1}\right)^{\alpha} - \delta > T^{\alpha}$$

holds, this is the unique equilibrium in this case. When condition (8) does not hold, there is also a one-candidate equilibrium where a type s individual in the politically dominant group runs for election.

Proof. The proof is similar to the proof for Proposition 1. We first show that a one-candidate equilibrium exists where a type e individual in the politically dominant group runs for election. From Assumption 1, it is optimal for the type e candidate to run for election. Since $\delta > 0$ and $\upsilon = 0$, it is optimal for other type e individuals in the politically dominant group not to run for election. Since type e individuals make up a majority in the group, a type s individual loses with probability one even if he/she competes with the type e candidate in the election. Thus, it is optimal for type s individuals in the politically dominant group not to run for election, and a one-candidate equilibrium exists where a type e individual in the politically dominant group runs for election.

The other possible equilibrium is a one-candidate equilibrium where a type s individual in the politically dominant group runs for election. When condition (8) holds, given that there is one type s candidate, it is optimal for a type e individual in the group to run for election, and it cannot be an equilibrium. If condition (8) does not hold, when there is one type s candidate, the decision of each individual in the politically dominant group is a best response to the other members' decisions, and there is a one-candidate equilibrium where a type s individual in the politically dominant group runs for election. ■

The size of the politically dominant group is positively related with the social welfare due to the following two reasons. First, as the size of the politically dominant group is smaller, condition

(8) is easier to hold, and the equilibrium where a type s individual becomes a politician becomes less likely to exist. Second, as the size of the politically dominant group is smaller, in the one-candidate equilibrium where a type e individual becomes a politician, more people cannot receive the government resources, and the welfare loss due to the policy of the type e politician is larger.

When fractionalization is large, the group size of the politically dominant group tends to be small. For example, in the case of equal group size, as fractionalization is larger, the size of the politically dominant group is smaller. The above argument, therefore, implies a negative relationship between fractionalization and health outcomes.

3.3 Summary on the Theoretical Predictions

Summarizing the previous argument, our model derives the following three testable predictions (P1), (P2), and (P3) about the relationship between fractionalization and health outcomes.

(P1) In a democracy with a dominant group, an increase in fractionalization (a decrease in the size of the dominant group) leads to worse health outcomes.

(P2) In a democracy without a dominant group, the relationship between fractionalization and health outcomes is non-monotonic. When fractionalization is not sufficiently high, health outcomes worsen in fractionalization. When fractionalization is sufficiently high, health outcomes are good.

(P3) In a dictatorship, an increase in fractionalization causes worse health outcomes.

4 Empirical Evidence

4.1 Estimation Methodology

In this section, we empirically examine three testable predictions derived from our model. As discussed in the Introduction, we employ health outcomes as the proxy for the social welfare resulting from public policy. Due to the availability of the data, we assemble the dataset for 154 countries in every five years from 1960 to 2005.[14] The estimation equation for predictions (P1) and (P3) is specified as:

$$Health_{it} = \alpha + \beta Fractionalization_i + X_{it}\gamma + \mu_t + \varepsilon_{it},$$

where i stands for a country and t represents a time period. μ is year fixed-effects and ε is an error term. $Health$ is health outcomes such as infant mortality, child mortality, or life expectancy. $Fractionalization$ is ethnic fractionalization generated by Alesina et al. (2003). In our theoretical model, fractionalization and the size of a dominant ethnic group are interchangeably interpreted. Thus, as a robustness check, we also employ the size of a dominant ethnic group instead of fractionalization as an explanatory variable of interest in the case of a democracy with a dominant ethnic group. Given the constraint on the data availability and the fact that the magnitude of change of ethnic fractionalization in a country is very small, fractionalization and the size of a dominant group are regarded as time invariant in our dataset.[15] Year fixed-effects are used to control for global trends such as an improvement in medical technology and its diffusion. X includes other control variables such as the natural logarithm of real GDP per capita, government expenditure as a share of GDP, average years of secondary schooling as a proxy for human capital, the natural logarithm of total population, a dummy variable for an incidence of war, malaria ecology index, and two regional dummies of "Sub-Saharan Africa" and "Latin America and Caribbean."[16] We include income level in the estimation equation to capture the fact that health outcomes can be better in high-income countries. Because government revenue is exogenously given in our model, we control for government expenditures as a share of GDP. An increase in government spending is expected

[14]Employing cross-sectional data, constructed by taking the average of each variable over a specific period, can be considered as another approach for the estimation. However, our study does not adopt this strategy for the following reasons. First, the averaged data may not appropriately reflect the degree of democracy in a country if compared to the data in multiple years, which captures the evolution of political regime in a country more accurately. Second, if we use the averaged data, the sample size in the case of democracy without a dominant group is too small for the estimation.

[15]Alesina et al. (2003) state that, "The bottom line is that while we recognize that ethnic fractionalization could to some extent be endogenous, and that the previous literature has probably underplayed this point, we do not believe this is a very serious problem at the horizon of 20-30 years which characterizes our cross-country work" (p.161).

[16]In exploring the determinants of health outcome, Alesina et al. (2003), Besley and Kudamatsu (2006), and La Porta et al. (1999) consider the legal origins developed by La Porta et al. (1997, 1998) as control variables. However, we do not take legal origins into account, because, unlike previous studies, we divide the whole sample into three subsamples, and there may be multicollinearity problems.

to improve health outcomes. Human capital reflects basic medical knowledge, which can improve health outcomes. The effect of population may be somewhat ambiguous. While medical services in populous countries may be more efficient, congestion may cause worse sanitation. Incidence of war apparently worsens health outcomes. The malaria ecology index is defined as the potential intensity of malaria transmission, uncolored by clinical externalities. Malaria can be an important determinant of health outcomes. Finally, two regional dummies of "Sub-Saharan Africa" and "Latin America and Caribbean" are included because of more severe climate conditions and/or high income inequality, which affect health in theses areas.

According to the prediction (P2), in a democracy without a dominant ethnic group, health outcomes are high when fractionalization is low, and health outcomes become worse as fractionalization increases. When fractionalization rises to the sufficient level, health outcomes become high again. Therefore, the prediction (P2) suggests the (inverted) U-shaped relationship between health outcomes (mortality) and fractionalization. To test the prediction (P2), the squared term of fractionalization is added in the estimation equation to capture the possibility of the inverted U-shaped relationship; that is:

$$Health_{it} = \alpha + \beta_1 Fractionalization_i + \beta_2 Fractionalization_i^2 + X_{it}\gamma + \mu_t + \varepsilon_{it}.$$

As the estimation methodology, we employ the ordinary least squares estimation and report the robust standard errors clustered at the country level, because the fixed effects estimation cannot be applied due to the time invariance of fractionalization and the size of a dominant group.

Three datasets are created from the whole sample for testing our theoretical predictions (P1) to (P3). In order to make these subsamples, two criteria must be determined. One is whether a country is democratic or dictatorial, and the other is whether or not a dominant ethnic group exists in a country. First, as for a democracy and a dictatorship, the data in the Polity IV is employed (Marshall, 2010). Variable *polity*2 in the Polity IV database represents a level of a democracy annually. This variable is ranged from -10 to 10, and a larger value indicates more democratic.

Following Persson and Tabellini (2009), we define a country as democratic if *polity*2 is strictly positive and dictatorial otherwise. Next, a dominant ethnic group in our model is defined as (7). Although, in reality, a fraction of people who care for the whole society (σ) should be considered, in our empirical analysis, σ is assumed to be negligibly small in a benchmark case. In other words, a dominant group exists in a country if a fraction of the most populous ethnic group is larger than 0.5. In addition, as a robustness check, the estimation results in the case where σ is equal to 0.2 are also reported. This case is equivalent to the case where a dominant group exists if a fraction of the most populous ethnic group is larger than 0.625.

According to these two criteria, the first dataset for prediction (P1) comprises democratic countries with a dominant group. The number of countries categorized in this subsample is 85 out of 154 countries. In the second dataset for prediction (P2), 29 democratic countries without a dominant group are included. A third dataset for prediction (P3) comprises 109 countries that are dictatorial. It is noteworthy that since some countries move between dictatorship and democracy, they are included in these two subsamples at different years. The details on the countries in each sample are shown in Table A1 in Appendix B.

The expected signs of the estimated coefficients of fractionalization for the case of infant or child mortality are as follows. Prediction (P1) insists that, in the case of a democracy with a dominant group, an increase in fractionalization (a decrease in the size of a dominant group) worsens health outcomes. Thus, the coefficient of fractionalization (β) is expected to be positive. Next, prediction (P2) suggests the inverted U-shaped relationship between mortality and fractionalization in the case of a democracy without a dominant group. Specifically, when a level of fractionalization is not sufficiently high, infant mortality increases in fractionalization, and when a level of fractionalization is sufficiently high, infant mortality is lower. Therefore, the coefficient of fractionalization (β_1) is expected to be positive, and the coefficient of its squared term (β_2) is expected to be negative. Finally, in the case of prediction (P3), which states that a rise in fractionalization increases mortality under a dictatorship, the coefficient of fractionalization (β) is expected to be positive. If using life expectancy as a dependent variable, the expected signs of the coefficient of fractionalization are opposite to those in the case of mortality.

4.2 Data

The data used in our estimations are drawn from various databases. Our dataset is created from the annual data for 154 countries. The data of infant mortality, child mortality, and life expectancy is derived from the World Development Indicators provided by World Bank (2010b). Although the data on infant and child mortality are available in every year since 2005 in most countries, these data are available only in every five years before 2005. To ensure data consistency, we employ all the data for every five years between 1960 and 2005.

The data of ethnic fractionalization are obtained from Alesina et al. (2003). They create ethnic, linguistic, and religious fractionalization for approximately 190 countries, mainly based on the information available for the early to mid-1990s.[17] A fraction of each group for calculating fractionalization is also available from the authors' website.

Regarding other control variables, real GDP per capita and total population are taken from the Penn World Table 6.3 (Heston et al., 2009). The data of government expenditures are obtained from the World Development Indicators provided by World Bank (2010b). In addition, to control for an effect of human capital on health outcomes, the average years of secondary schooling created by Barro and Lee (2010) are employed. The data of incidences of war are obtained from the UCDP/PRIO Armed Conflict Dataset developed by Gleditsch et al. (2002) and Harbom and Wallensteen (2010). We create a dummy variable for war that is equal to one if there are at least 1,000 battle-related deaths in a given year and zero otherwise. Furthermore, we control for the malaria ecology index developed by Kiszewski et al. (2004). A larger value for this index means that malaria is more likely transmitted due to ecological factors. Regional dummies are constructed based on the World Bank's regional classification. The detailed definitions and sources of all the

[17] Fearon (2003) also creates ethnic and cultural fractionalization for about 160 countries. However, since the number of countries in the dataset developed by Alesina et al. (2003) is larger than that by Fearon (2003), this paper employs the data developed by Alesina et al. (2003).

data are summarized in Table A2 in Appendix B. Descriptive statistics of each variable are shown in Table A3 in Appendix B.

4.3 Results

4.3.1 Democracy with a Dominant Group

Table 1 presents the estimation results for prediction (P1), which insists that an increase in fractionalization worsens health outcomes in the case of a democracy with a dominant ethnic group. In column (1), where GDP per capita, regional dummies, and year dummies are controlled for, the coefficient of fractionalization on infant mortality is significantly positive, as predicted by our theoretical model. This result holds in column (2) even if we add additional control variables. From column (2), while an increase in population significantly decreases infant mortality, the impact of other control variables is not statistically significant. In columns (3) and (4), we utilize child mortality instead of infant mortality as the dependent variable. The signs and significances of the estimated coefficients are the same as those in the case of infant mortality.

[Table 1 here]

Columns (5) and (6) present the results when life expectancy is used as the dependent variable. By noting that, unlike infant and child mortality, a higher value in life expectancy means better health condition, the coefficient of fractionalization is expected to be negative from our theoretical model. Although columns (5) and (6) show that the estimated coefficient of fractionalization is not statistically significant, it is negative as predicted in our theoretical model.

For a robustness check, Table 2 illustrates the results when the size of a dominant ethnic group, instead of fractionalization, is an explanatory variable of interest. The correlation coefficient between the size of a dominant ethnic group and fractionalization is -0.984, indicating a negative correlation between them. Therefore, the signs of the estimated coefficient of a fraction of a dominant group are expected to be opposite to those of fractionalization in Table 1. The results in Table 2 support our theoretical prediction, which suggests that a decrease in the size of a dominant ethnic group worsens health outcomes in the case of a democracy with the existence of a dominant ethnic group. The size of a dominant group has significant impacts not only on infant and child mortality, but also on life expectancy.

[Table 2 here]

4.3.2 Democracy without a Dominant Group

Table 3 presents the estimation results in the case of a democracy without a dominant ethnic group. Prediction (P2) implies the inverted U-shaped relationship between fractionalization and mortality and the U-shaped relationship between fractionalization and life expectancy. In order to capture these relationships, we consider the term of fractionalization and its squared term. When the dependent variable is infant or child mortality, our theoretical model predicts that β_1 and β_2 are positive and negative respectively, and a calculated turning point of fractionalization is within the sample range from 0 to 1. In column (1) and (2), where the dependent variable is infant mortality, the coefficients of fractionalization and its squared term are significantly positive and negative respectively. Based on the result in column (2), a calculated turning point of fractionalization is 0.791. Therefore, the inverted U-shaped relationship between infant mortality and fractionalization is confirmed. Let us briefly examine some examples to illustrate this relationship, using the data in 2005. Specifically, Guyana, Trinidad and Tobago, Ecuador, and Peru are considered to be countries that have lower fractionalization and lower infant mortality. Fractionalization in Guyana, Trinidad and Tobago, Ecuador, and Peru is 0.619, 0.648, 0.655, and 0.657, and infant mortality is 32.9, 31.1, 23.5, and 25.5, respectively. Next, countries that are close to the turning point and have extremely high infant mortality are Guinea-Bissau and Sierra Leone. Fractionalization in Guinea-Bissau and Sierra Leone is 0.808 and 0.819, and infant mortality is 121.1 and 134.2, respectively. Finally, countries that have much higher fractionalization but lower infant mortality are Kenya and Madagascar. Fractionalization in Kenya and Madagascar is 0.859 and 0.879, and infant mortality is 59.3 and 49.7, respectively. These concrete examples support the inverted U-shaped relationship between fractionalization and infant mortality, as expected in our theoretical model.

[Table 3 here]

Columns (3) and (4) show the results when the dependent variable is child mortality. The inverted U-shaped relationship between child mortality and fractionalization is also supported. In columns (5) and (6), life expectancy is used as the dependent variable. In this case, our theoretical model predicts the U-shaped relationship between life expectancy and fractionalization. The effects of fractionalization and its squared term are negative and positive respectively. In addition, a calculated turning point of fractionalization is within the range from 0 to 1 in all columns. These findings support our theoretical prediction (P2).

4.3.3 Dictatorship

Table 4 illustrates the estimation results of the relationship between health and fractionalization in the case of a dictatorship. Our theoretical prediction (P3) suggests a positive relationship between fractionalization and mortality and a negative relationship between fractionalization and life expectancy. Columns (1) and (2) report the results in the case of infant mortality, and columns (3) and (4) illustrate the results in the case of child mortality. Columns (1) and (3) indicate that the effect of fractionalization is significantly positive. However, in columns (2) and (4), where several variables are controlled for, fractionalization does not have a significant impact on infant and child mortality. A possible explanation for this result is that the effect of government expenditures is excessively evaluated. This is because the coefficient of fractionalization is significant if we exclude government expenditures in columns (2) and (4). In dictatorial countries, corruption is a serious problem, and government revenues may be embezzled and/or used inefficiently.

In columns (5) and (6), the estimation results are presented in the case of life expectancy as the dependent variable. The effects of fractionalization on life expectancy are significantly negative in column (5). Although column (6) reports the insignificance of fractionalization, the sign of its estimated coefficient is negative. These results also support the negative relationship between life expectancy and fractionalization, as suggested by prediction (P3).

[Table 4 here]

4.3.4 Robustness Analysis

In the empirical analysis so far, a fraction of people who care for the whole society (σ) has been assumed to be negligibly small. However, in reality, more people may care about the whole society. Therefore, assuming that σ is equal to 0.2, we confirm the robustness of our main results. In this case, a dominant group exists if a fraction of the most populous ethnic group is above 0.625. Table 5 shows the estimation results in a democracy with a dominant group. The number of countries categorized in this subsample is 69. The specifications in Table 5 are similar to those in Table 1. In columns (1) to (4), where infant mortality and child mortality are used as the dependent variable, the effect of fractionalization is significantly positive, as in Table 1. However, in the case of life expectancy in columns (5) and (6), the coefficients of fractionalization are negative but are not statistically significant.

[Table 5 here]

Next, Table 6 presents the estimation in a democracy without a dominant group. In this case, a fraction of the most populous ethnic group is less than 0.625, and 45 countries are included in this subsample. Our main result holds in the case of infant mortality and child mortality in columns (1) to (4). The effects of fractionalization and its squared term are significantly positive and negative, respectively. In the case of life expectancy in columns (5) and (6), the coefficients of fractionalization and its squared term have expected signs but are not statistically significant.

In sum, in this robustness check, when infant mortality and child mortality are used as health outcomes, our main result is supported. On the other hand, the effects of fractionalization on life expectancy have expected signs but are not statistically significant. This result may be attributed from the fact that while infant and child mortality reflects the health status of the poor, life expectancy captures the "average" health condition in a county as a whole.[18]

[Table 6 here]

Finally, we confirm the validity of our specification as further robustness checks. We conduct the estimation using fractionalization (the size of a dominant group) and its squared terms for testing predictions (P1) and (P3) and using only the fractionalization term for testing prediction (P2). In the case of predictions (P2) and (P3), these terms do not have significant impacts. In the case of prediction (P1), fractionalization and its squared terms have significant effects on infant and child mortality in some specifications. However, these terms do not have significant impacts on life expectancy, and the size of a dominant group and its squared terms do not have significant impacts on health outcomes. Therefore, we can conclude that our results are robust.

5 Concluding Remarks

Many previous studies find that ethnic diversity affects the public goods provision. Also, political regimes are known to influence the quality of public policy. However, few studies analyze the relationship between ethnic diversity, political regimes, and the quality of public policy. This paper investigates the effects of ethnic diversity on the quality of public policy in different political regimes from both theoretical and empirical viewpoints.

Theoretically, we build a model based on the citizen-candidate model. Our model assumes individuals with heterogeneous policy preferences and considers how ethnic diversity affects selection of a politician and the resulting policy choice in a democracy and a dictatorship. Empirically, we examine the following three hypotheses obtained from our theoretical model. First, in a democracy with a dominant group, an increase in ethnic fractionalization decreases the social welfare. Second, in a democracy without a dominant group, an increase in ethnic fractionalization has a non-monotonic effect on the social welfare. Specifically, when fractionalization is not sufficiently

[18] Wigley and Akkoyunlu-Wigley (2011), who empirically examine the effect of electoral institutions on health status, report a similar result. They show that the impact of institutions on life expectancy is smaller than that on infant mortality because infant mortality can be improved more easily and less costly than adult mortality.

high, the social welfare becomes worse as fractionalization increases. When fractionalization rises to a sufficiently high level, the social welfare is enhanced. Finally, in a dictatorship, an increase in ethnic fractionalization decreases the social welfare. We employ the health outcomes as the proxy for social welfare resulted from public policy. The regression analysis using the data of 154 countries from 1960 to 2005 supports these three hypotheses. These results are obtained in almost all cases in which infant mortality, child mortality, and life expectancy is used as health outcomes.

Finally, we note a few caveats regarding our results. First, the model of this paper does not consider coalition formation among ethnic groups. The relationship between ethnic diversity and coalition among ethnic groups is studied in Fernández and Levy (2008). Second, in the empirical analysis, we assume that the fraction of people who care for the whole society (σ) is the same in all countries. This assumption does not necessarily reflect the reality and σ may be different across countries. Investigating the determinants of a fraction of people who care for the whole society and its effects on public policy are promising topics of future research. Third, while we treat political institutions as exogenous, Alesina and Glaeser (2004) discuss the possibility that political institutions are endogenously determined through intergroup conflicts. The analysis on the interaction between ethnic composition and political institutions can lead to further understanding of the relationship between ethnic diversity, political regime, and public policy. Despite these caveats, our results provide an insightful explanation of the relationship between ethnic fractionalization and public policy.

Appendix A. Theoretical Appendix

Democracy with Equal Group Size under Assumptions 1 and 3

We consider the case of a democracy with equal group size. While we made Assumptions 2 and 3 in Section 3.2.3, we replace Assumption 2 with Assumption 1 in this appendix. Under Assumptions 1 and 3, there are two possible equilibria other than the one-candidate equilibrium where a type s individual runs for election.

The first one is an N-candidate equilibrium where each group turns out one type e candidate. This equilibrium is the same as the N-candidate equilibrium in Proposition 3, but the necessary and sufficient conditions for existence of the equilibrium are different. Under Assumptions 1 and 3, this N-candidate equilibrium exists if and only if the following two conditions hold:

$$\left(\frac{1}{N}\right)^{1-\alpha} T^{\alpha} \geq \delta, \tag{A.1}$$

$$(1-\sigma)\frac{1}{N} > \sigma \quad \text{or} \quad T^{\alpha} - \delta \leq \left(\frac{1}{N}\right)^{1-\alpha} T^{\alpha}. \tag{A.2}$$

When Assumption 2 is replaced with Assumption 1, it is possible that a type s individual does not run for an election even if there are only type e candidates and the type s individual can certainly win the election if running for the election. Thus, condition (12) in Proposition 3 is modified to condition (A.2). Note that both conditions (A.1) and (A.2) are hard to hold, as N is large. The property that the N-candidate equilibrium disappears when N is sufficiently large is preserved in this case.

The second one is an M-candidate equilibrium ($M < N$) where the M candidates are type e individuals from different groups. This equilibrium exists if and only if the following three conditions hold:

$$\left(\frac{1}{M}\right)\left(\frac{T}{1/N}\right)^{\alpha} - \delta \geq 0, \tag{A.3}$$

$$\left(\frac{1}{M+1}\right)\left(\frac{T}{1/N}\right)^{\alpha} - \delta \leq 0, \tag{A.4}$$

$$T^{\alpha} - \delta \leq \left(\frac{1}{N}\right)^{1-\alpha} T^{\alpha}. \tag{A.5}$$

When there are M ($< N$) type e candidates from different groups, a type s individual can win the election certainly if running for the election. For this M-candidate equilibrium to exist, it is necessary that running for election does not pay type s individuals, and condition (A.5) assures it. Condition (A.3) means that it is optimal for the type e candidates to run for election. Condition (A.4) means that no more type e individuals want to run for election, given that there are M type

e candidates from different groups. From (A.3) and (A.4), the equilibrium number of candidates M must satisfy $M \leq (NT)^{\alpha} / \delta \leq M + 1$. When N is sufficiently large, condition (A.5) does not hold. In this case, the welfare loss due to the policy by a type e politician is very large, and it is suboptimal for a type s individual to let a type e candidate win the election.

From the above argument, even if Assumption 2 is replaced with Assumption 1, we can see that the equilibrium where a type e individual becomes a politician does not exist when N is sufficiently large. When N is not sufficiently large, there is the equilibrium where a type e individual becomes a politician, and large N leads to large welfare loss due to the policy by a type e politician as discussed in Section 3.2.3.

Proof of Proposition 5

Proposition 5 includes two claims, and we divide the proof into two parts to prove them separately.

(i) We first show that an M-candidate equilibrium exists where each major group turns out one type e candidate if and only if both conditions (16) and (17) hold.

Proof. The proof of the necessity is very similar to that of Proposition 3. We prove by contradiction that, if an M-candidate equilibrium exists where each major group turns out one type e candidate, then both conditions (16) and (17) must hold. Assume that condition (16) does not hold. Then, it is suboptimal for the type e candidates to run for election. It is a contradiction. Next, assume that condition (17) does not hold. Then it is suboptimal for a type s individual not to run for election. It is a contradiction. Therefore, if an M-candidate equilibrium exists where each major group turns out one type e candidate, then both conditions (16) and (17) must hold.

We next show that, if conditions (16) and (17) hold, an M-candidate equilibrium exists where each major group turns out one type e candidate. To show this, we will show that, when the pool of candidates comprises M type e individuals from different major groups, each individual's decision on whether to run for election is optimal given the other individuals' decisions. From (16), it is optimal for the candidate to run for election. When $M = 1$, since $\delta > 0$ and $\upsilon = 0$, it is optimal for other type e individuals of the major group not to run for election. When $M \geq 2$, if another type e individual in a major group runs for election, the two candidates in this major group will certainly lose. Thus, it is optimal for other type e individuals in the major groups not to run for election. From (17), given that M type e individuals from different major groups run for election, a type s individual will lose with probability one if running for election, and it is optimal not to run for election. When there is a type e candidate of the major group, a type e candidate of the small group loses with probability one. This is because the number of type e individuals in the major group is larger than that in the small group and type s individuals prefer a type e candidate of the major group to a type e candidate of the small group. Thus, it is optimal for type e individuals of the small groups not to run for election. Therefore, an M-candidate equilibrium exists where each major group turns out one type e candidate. ■

(ii) We next show that there is no other equilibrium than the one-candidate equilibrium where a type s individual runs for election and the M-candidate equilibrium where each major group turns out one type e candidate.

Proof. We first show that the one-candidate equilibrium where a type s individual runs for election is the only equilibrium where a type s individual runs for election.

Since a type e candidate of the small group can never beat a type e candidate of the major group, the pool of candidates that includes both a type e candidate of the small group and a type e candidate of the major group cannot be an equilibrium. Therefore, we have to check the following two cases:

(a) the pool of candidates comprises a type s individual and some type e individuals of the major groups.

(b) the pool of candidates comprises a type s individual and some type e individuals of the small groups.

To show a contradiction, assume that the pool of candidates in case (a) constitutes an equilibrium. Then, all major groups must turn out one type e candidate since, if not, the type s candidate will win certainly. In such a case, however, from Assumption 3a, either the type s candidate or the type e candidates will certainly lose, and there are some candidates whose choices are not optimal. This is a contradiction, and case (a) cannot be an equilibrium.

In case (b), while the type e candidates obtain votes from type e individuals of their own group, the type s candidate obtains votes of all individuals other than type e individuals of the small groups which turn out the type e candidates. This means that the type e candidates will lose with probability one and their strategy is not optimal. Thus, case (b) cannot be an equilibrium, and the one-candidate equilibrium where a type s individual runs for election is the only equilibrium where a type s individual runs for election.

Next, we show that the M-candidate equilibrium where each major group turns out one type e candidate is the only equilibrium where there is no type s candidate. To show this, we must show that the following two cases cannot be an equilibrium:

(a) the pool of candidates comprises only type e individuals in the small groups.

(b) the pool of candidates comprises only type e individuals in the major groups, and there are some major groups that do not turn out a candidate.

In case (a), if a type s individual runs for election, he/she can win with probability one. Thus, from Assumption 2a, it is suboptimal for a type s individual not to run for election, and case (a) cannot be an equilibrium. Similarly, a type s individual can certainly win an election if running for election in case (b), and case (b) cannot be an equilibrium. Therefore, the M-candidate equilibrium where each major group turns out one type e candidate is the only equilibrium where there is no type s candidate. ■

Appendix B. Data Description

[Table A1 here]

[Table A2 here]

[Table A3 here]

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Table 1: Health and fractionalization in democracy with a dominant group

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant mortality		Child mortality		Life expectancy	
Fractionalization	0.317**	0.307*	0.334**	0.311**	-0.028	-0.034
	(0.149)	(0.156)	(0.153)	(0.155)	(0.019)	(0.020)
GDP per capita	-0.774***	-0.751***	-0.819***	-0.793***	0.096***	0.091***
	(0.044)	(0.046)	(0.047)	(0.045)	(0.008)	(0.008)
Government expenditure		-0.008		-0.006		-0.002
		(0.005)		(0.005)		(0.001)
Education		-0.033		-0.034		0.006
		(0.034)		(0.035)		(0.004)
Population		0.054***		0.062***		-0.009***
		(0.020)		(0.018)		(0.003)
War		0.085		0.083		-0.002
		(0.110)		(0.121)		(0.019)
Malaria ecology		-0.013		-0.007		-0.002
		(0.015)		(0.016)		(0.003)
Sub-Saharan	0.470***	0.671***	0.589***	0.759***	-0.097***	-0.091***
Africa dummy	(0.112)	(0.165)	(0.121)	(0.170)	(0.025)	(0.031)
Latin America and	0.426***	0.402***	0.420***	0.404***	0.013	0.008
Caribbean dummy	(0.076)	(0.085)	(0.077)	(0.084)	(0.012)	(0.012)
Constant	9.763***	9.256***	10.377***	9.747***	3.377***	3.525***
	(0.435)	(0.515)	(0.461)	(0.497)	(0.080)	(0.075)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.89	0.90	0.90	0.91	0.79	0.82
No. of countries	85	80	85	80	85	80
Observations	504	478	504	478	511	483

Note: Infant mortality, child mortality, life expectancy, GDP per capita, and population are in the natural logarithm. The asterisks ***, **, and * indicate 1%, 5%, and 10% of significance levels, respectively. The numbers in parentheses are robust standard errors clustered at country level.

Table 2: Health and the size of a dominant group in democracy with a dominant group

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant mortality		Child mortality		Life expectancy	
Dominant group	-0.396**	-0.374*	-0.416**	-0.373*	0.045*	0.050*
	(0.190)	(0.189)	(0.200)	(0.193)	(0.024)	(0.027)
GDP per capita	-0.775***	-0.754***	-0.820***	-0.797***	0.096***	0.091***
	(0.045)	(0.046)	(0.047)	(0.045)	(0.008)	(0.008)
Government expenditure		-0.008		-0.006		-0.002
		(0.005)		(0.005)		(0.001)
Education		-0.031		-0.031		0.006
		(0.034)		(0.034)		(0.004)
Population		0.053**		0.062***		-0.009***
		(0.021)		(0.019)		(0.003)
War		0.092		0.089		-0.003
		(0.110)		(0.121)		(0.019)
Malaria ecology		-0.014		-0.007		-0.002
		(0.016)		(0.016)		(0.003)
Sub-Saharan	0.477***	0.683***	0.596***	0.772***	-0.097***	-0.092***
Africa dummy	(0.113)	(0.167)	(0.122)	(0.173)	(0.025)	(0.032)
Latin America and	0.429***	0.406***	0.424***	0.409***	0.014	0.008
Caribbean dummy	(0.075)	(0.083)	(0.077)	(0.083)	(0.012)	(0.012)
Constant	10.188***	9.675***	10.823***	10.169***	3.335***	3.476***
	(0.427)	(0.520)	(0.446)	(0.499)	(0.077)	(0.073)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.89	0.90	0.89	0.91	0.79	0.82
No. of countries	85	80	85	80	85	80
Observations	504	478	504	478	511	483

Note: Infant mortality, child mortality, life expectancy, GDP per capita, and population are in the natural logarithm. The asterisks ***, **, and * indicate 1%, 5%, and 10% of significance levels, respectively. The numbers in parentheses are robust standard errors clustered at country level.

Table 3: Health and fractionalization in democracy without a dominant group

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant mortality		Child mortality		Life expectancy	
Fractionalization	54.065***	39.338***	60.775***	45.582***	-9.921***	-8.101**
	(12.706)	(7.059)	(12.384)	(6.931)	(2.804)	(3.155)
Fractionalization squared	-35.119***	-24.880***	-39.549***	-29.029***	6.439***	5.333**
	(8.081)	(4.699)	(7.923)	(4.612)	(1.805)	(2.055)
GDP per capita	-0.589***	-0.354***	-0.657***	-0.404***	0.091***	0.065***
	(0.109)	(0.046)	(0.100)	(0.041)	(0.010)	(0.020)
Government expenditure		-0.007		-0.007		0.003
		(0.009)		(0.008)		(0.003)
Education		-0.330***		-0.337***		0.028
		(0.082)		(0.079)		(0.019)
Population		0.064*		0.086**		0.009
		(0.037)		(0.034)		(0.013)
War		0.208**		0.150*		0.007
		(0.079)		(0.085)		(0.016)
Malaria ecology		0.003		0.009*		-0.001
		(0.005)		(0.005)		(0.003)
Sub-Saharan	0.502	0.383	0.658**	0.527**	-0.190***	-0.172***
Africa dummy	(0.321)	(0.257)	(0.300)	(0.218)	(0.046)	(0.029)
Latin America and	0.729**	0.808***	0.753**	0.887***	-0.081**	-0.050
Caribbean dummy	(0.329)	(0.188)	(0.313)	(0.169)	(0.039)	(0.041)
Constant	-12.171**	-8.820***	-13.866***	-10.716***	7.195***	6.502***
	(4.795)	(2.639)	(4.685)	(2.599)	(1.070)	(1.125)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.81	0.91	0.85	0.93	0.80	0.82
No. of countries	29	24	29	24	29	24
Observations	109	91	109	91	115	95

Note: Infant mortality, child mortality, life expectancy, GDP per capita, and population are in the natural logarithm. The asterisks ***, **, and * indicate 1%, 5%, and 10% of significance levels, respectively. The numbers in parentheses are robust standard errors clustered at country level.

Table 4: Health and fractionalization in dictatorship

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant mortality		Child mortality		Life expectancy	
Fractionalization	0.293*	0.362	0.375**	0.408	-0.088*	-0.042
	(0.173)	(0.233)	(0.187)	(0.247)	(0.046)	(0.044)
GDP per capita	-0.353***	-0.341***	-0.396***	-0.375***	0.066***	0.057***
	(0.051)	(0.080)	(0.053)	(0.083)	(0.011)	(0.012)
Government expenditure		-0.012		-0.012		0.002*
		(0.010)		(0.010)		(0.001)
Education		-0.136		-0.165*		0.035***
		(0.089)		(0.094)		(0.013)
Population		-0.011		-0.007		0.010
		(0.041)		(0.044)		(0.007)
War		0.026		0.014		-0.040
		(0.110)		(0.122)		(0.035)
Malaria ecology		-0.014		-0.011		0.001
		(0.012)		(0.013)		(0.003)
Sub-Saharan	0.347***	0.398*	0.503***	0.517**	-0.151***	-0.148***
Africa dummy	(0.107)	(0.213)	(0.116)	(0.225)	(0.032)	(0.039)
Latin America and	0.063	0.047	0.077	0.065	0.024	0.023
Caribbean dummy	(0.184)	(0.169)	(0.195)	(0.175)	(0.032)	(0.023)
Constant	6.761***	7.088***	7.367***	7.628***	3.584***	3.488***
	(0.417)	(0.795)	(0.439)	(0.861)	(0.098)	(0.155)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.63	0.68	0.68	0.72	0.68	0.73
No. of countries	107	81	107	81	109	82
Observations	595	417	595	417	638	433

Note: Infant mortality, child mortality, life expectancy, GDP per capita, and population are in the natural logarithm. The asterisks ***, **, and * indicate 1%, 5%, and 10% of significance levels, respectively. The numbers in parentheses are robust standard errors clustered at country level.

Table 5: Robustness analysis on health and fractionalization in democracy with a dominant group

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant mortality		Child mortality		Life expectancy	
Fractionalization	0.463**	0.414*	0.482**	0.453**	-0.018	-0.037
	(0.226)	(0.230)	(0.223)	(0.215)	(0.033)	(0.032)
GDP per capita	-0.797***	-0.761***	-0.838***	-0.804***	0.097***	0.089***
	(0.049)	(0.054)	(0.051)	(0.052)	(0.009)	(0.009)
Government expenditure		-0.007		-0.006		-0.002*
		(0.006)		(0.006)		(0.001)
Education		0.004		0.003		0.003
		(0.040)		(0.038)		(0.004)
Population		0.060**		0.067***		-0.013***
		(0.023)		(0.020)		(0.003)
War		0.136		0.130		-0.007
		(0.107)		(0.119)		(0.019)
Malaria ecology		0.035*		0.038*		-0.008**
		(0.020)		(0.020)		(0.004)
Sub-Saharan	0.477***	0.540***	0.542***	0.589***	-0.091***	-0.083**
Africa dummy	(0.116)	(0.139)	(0.133)	(0.148)	(0.030)	(0.032)
Latin America and	0.367***	0.438***	0.348***	0.422***	0.020	0.000
Caribbean dummy	(0.090)	(0.110)	(0.090)	(0.107)	(0.015)	(0.015)
Constant	9.961***	9.144***	10.547***	9.660***	3.371***	3.598***
	(0.472)	(0.626)	(0.496)	(0.587)	(0.089)	(0.087)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.89	0.90	0.89	0.91	0.77	0.81
No. of countries	69	64	69	64	69	64
Observations	423	397	423	397	429	401

Note: Infant mortality, child mortality, life expectancy, GDP per capita, and population are in the natural logarithm. The asterisks ***, **, and * indicate 1%, 5%, and 10% of significance levels, respectively. The numbers in parentheses are robust standard errors clustered at country level.

Table 6: Robustness analysis on health and fractionalization in democracy without a dominant group

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant mortality		Child mortality		Life expectancy	
Fractionalization	12.817**	11.017**	14.608**	12.927***	-1.053	-1.019
	(6.270)	(4.102)	(6.554)	(4.268)	(1.179)	(0.979)
Fractionalization squared	-8.435*	-7.317**	-9.769**	-8.749***	0.676	0.702
	(4.300)	(2.933)	(4.513)	(3.044)	(0.879)	(0.751)
GDP per capita	-0.575***	-0.497***	-0.637***	-0.544***	0.083***	0.065***
	(0.077)	(0.057)	(0.072)	(0.057)	(0.009)	(0.012)
Government expenditure		-0.014**		-0.014**		0.003**
		(0.006)		(0.006)		(0.002)
Education		-0.162***		-0.172***		0.020**
		(0.037)		(0.040)		(0.008)
Population		0.011		0.019		0.009*
		(0.026)		(0.024)		(0.005)
War		0.080		0.035		0.003
		(0.069)		(0.088)		(0.013)
Malaria ecology		-0.015**		-0.012		0.001
		(0.007)		(0.007)		(0.002)
Sub-Saharan	0.538***	0.638***	0.744***	0.814***	-0.178***	-0.175***
Africa dummy	(0.197)	(0.152)	(0.196)	(0.157)	(0.031)	(0.026)
Latin America and	0.565***	0.454***	0.598***	0.487***	-0.021	-0.004
Caribbean dummy	(0.120)	(0.101)	(0.123)	(0.108)	(0.016)	(0.015)
Constant	3.498	3.995***	3.648	3.930**	3.870***	3.815***
	(2.454)	(1.404)	(2.500)	(1.454)	(0.410)	(0.308)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.85	0.91	0.87	0.92	0.82	0.84
No. of countries	45	40	45	40	45	40
Observations	190	172	190	172	197	177

Note: Infant mortality, child mortality, life expectancy, GDP per capita, and population are in the natural logarithm. The asterisks ***, **, and * indicate 1%, 5%, and 10% of significance levels, respectively. The numbers in parentheses are robust standard errors clustered at country level.

Table A1: Countries in the sample

Afghanistan (4)	Chile (1, 2, 4, 5)	Gambia (3, 4, 6)	Kyrgyz Rep. (1, 2, 4, 6)	Nigeria (3, 4, 6)	Sudan (4)
Albania (1, 2, 4, 5)	China (4)	Georgia (1, 2, 5)	Lao PDR (4)	Norway (1, 2, 5)	Swaziland (4)
Algeria (1, 2, 4, 5)	Colombia (1, 2, 6)	Germany (1, 2, 5)	Latvia (1, 2, 6)	Oman (4)	Sweden (1, 2, 5)
Angola (4)	Comoros (1, 2, 4, 5)	Ghana (1, 2, 4, 6)	Lebanon (1, 2, 4, 5)	Pakistan (3, 4, 6)	Switzerland (1, 2, 5)
Argentina (1, 2, 4, 5)	Congo, Dem. Rep. (3, 4, 6)	Greece (1, 2, 4, 5)	Lesotho (1, 2, 4, 5)	Panama (1, 2, 4, 5)	Syria (4)
Armenia (1, 2, 5)	Congo, Rep. (3, 4, 6)	Guatemala (1, 2, 4, 6)	Liberia (3, 4, 6)	Papua New Guinea (1, 2, 5)	Tajikistan (4)
Australia (1, 2, 5)	Costa Rica (1, 2, 5)	Guinea (4)	Libya (4)	Paraguay (1, 2, 4, 5)	Tanzania (4)
Austria (1, 2, 5)	Cote d'Ivoire (3, 4, 6)	Guinea-Bissau (3, 4, 6)	Lithuania (1, 2, 5)	Peru (3, 4, 6)	Thailand (1, 2, 4, 6)
Azerbaijan (4)	Croatia (1, 2, 4, 5)	Guyana (3, 4, 6)	Macedonia, FYR (1, 2, 5)	Philippines (1, 2, 4, 5)	Togo (4)
Bahrain (4)	Cuba (4)	Haiti (1, 2, 4, 5)	Madagascar (3, 4, 6)	Poland (1, 2, 4, 5)	Trinidad and Tobago (3, 6)
Bangladesh (1, 2, 4, 5)	Cyprus (1, 2, 4, 5)	Honduras (1, 2, 4, 5)	Malawi (3, 4, 6)	Portugal (1, 2, 4, 5)	Tunisia (4)
Belarus (4)	Czech Rep. (1, 2, 5)	Hungary (1, 2, 4, 5)	Malaysia (1, 2, 6)	Qatar (4)	Turkey (1, 2, 4, 5)
Belgium (1, 2, 6)	Denmark (1, 2, 5)	India (1, 2, 5)	Mali (3, 4, 6)	Romania (1, 2, 4, 5)	Turkmenistan (4)
Benin (3, 4, 6)	Djibouti (3, 4, 6)	Indonesia (3, 4, 6)	Mauritania (4)	Russia (1, 2, 5)	Uganda (3, 4, 6)
Bhutan (4)	Dominican Rep. (1, 2, 4, 5)	Iran (1, 2, 4, 6)	Mauritius (1, 2, 5)	Rwanda (4)	Ukraine (1, 2, 5)
Bolivia (3, 4, 6)	Ecuador (3, 4, 6)	Iraq (4)	Mexico (1, 2, 4, 6)	Saudi Arabia (4)	United Arab Emirates (4)
Botswana (1, 2, 5)	Egypt (4)	Ireland (1, 2, 5)	Moldova (1, 2, 6)	Senegal (3, 4, 6)	United Kingdom (1, 2, 5)
Brazil (1, 2, 4, 6)	El Salvador (1, 2, 4, 5)	Israel (1, 2, 5)	Mongolia (1, 2, 4, 5)	Sierra Leone (3, 4, 6)	United States (1, 2, 5)
Bulgaria (1, 2, 4, 5)	Equatorial Guinea (4)	Italy (1, 2, 5)	Morocco (4)	Singapore (1, 2, 4, 5)	Uruguay (1, 2, 4, 5)
Burkina Faso (4)	Eritrea (4)	Jamaica (1, 2, 5)	Mozambique (3, 4, 6)	Slovak Rep. (1, 2, 5)	Uzbekistan (4)
Burundi (1, 2, 4, 5)	Estonia (1, 2, 5)	Japan (1, 2, 5)	Namibia (1, 2, 6)	Slovenia (1, 2, 5)	Venezuela (1, 2, 5)
Cambodia (1, 2, 4, 5)	Ethiopia (3, 4, 6)	Jordan (4)	Nepal (1, 2, 4, 6)	Solomon Islands (1, 2, 4, 5)	Vietnam (4)
Cameroon (4)	Fiji (1, 2, 6)	Kazakhstan (4)	Netherlands (1, 2, 5)	Somalia (4)	Zambia (3, 4, 6)
Canada (3, 6)	Finland (1, 2, 5)	Kenya (3, 4, 6)	New Zealand (1, 2, 5)	South Africa (3, 6)	Zimbabwe (1, 2, 4, 5)
Central African Rep. (3, 4, 6)	France (1, 2, 5)	Korea, Rep. (1, 2, 4, 5)	Nicaragua (1, 2, 4, 5)	Spain (1, 2, 4, 5)	
Chad (4)	Gabon (4)	Kuwait (4)	Niger (1, 2, 4, 6)	Sri Lanka (1, 2, 5)	

Note: The numbers in parentheses indicates the number of tables (1 to 6) in which a country is included for the estimation.

Table A2: Data definitions and sources

Variable	Description	Source
Infant mortality	The number of infants dying before reaching age one, measured as per thousand live births per year.	World Bank (2010b)
Child mortality	The number of children who die by the age of five, measured as per thousand live births per year.	World Bank (2010b)
Life expectancy	Life expectancy at birth.	World Bank (2010b)
Fractionalization	Ethnic fractionalization	Alesina et al. (2003)
Dominant group	A fraction of the most populous ethnic group in total population.	Alesina et al. (2003)
GDP per capita	Real GDP per capita.	Heston et al. (2009)
Government expenditure	General government final consumption expenditure as a share of GDP.	World Bank (2010b)
Education	Average years of secondary schooling of the population over age 15.	World Bank (2010a) (Original source: Barro and Lee, 2010)
Population	Total population in the unit of thousands.	Heston et al. (2009)
War	Dummy variable which is equal to one if there are at least 1,000 battle-related deaths in a given year and zero otherwise.	UCDP/PRIO Armed Conflict Dataset (Version 4-2010)
Malaria ecology	The potential intensity of malaria transmission, uncolored by clinical externalities.	Kiszewski et al. (2004)
Democracy	Democracy index reflecting the competitiveness of political participation, the openness and competitiveness of executive recruitment, and the constraints on the chief executive.	Marshall (2010)

Table A3: Descriptive statistics

Variables	Observations	Observations	Mean	Std. Dev.	Min.	Max.
Infant mortality	154	1208	63.039	48.682	2.200	217.900
Child mortality	154	1208	95.005	83.061	2.900	417.900
Life expectancy	154	1264	61.279	11.701	29.100	81.925
Fractionalization	154	1264	0.466	0.263	0	0.930
Dominant group	154	1264	0.647	0.242	0.178	1
GDP per capita	154	1264	8312	10462	153	97813
Government expenditure	151	1119	15.287	6.659	2.736	63.778
Education	131	1113	1.669	1.309	0.014	7.468
Population	154	1264	33788	116697	169	1306314
War	154	1264	0.052	0.223	0	1
Malaria ecology	153	1257	4.323	7.123	0	31.548