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ARTICLE

Measuring social diversity in economic literature: An overview for cross-country studies

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Abstract

Over recent decades, the growing research on social diversity at country level has striven to explain several outcomes such as the differences in income across countries and the origins of civil conflicts. The literature employs a wide range of indices to measure social diversity that hinders the comparison of the results with respect to their effects on socio-economic performance. This paper intends to disentangle such a variety of indices and their applications. To achieve this goal, we have collected the social diversity indices used in cross-country studies, and have ascertained not only their similarities and differences, and the relationships between them, but also their main applications. Studies at country level have been selected that construct their own indices and that make their databases available. We show that the dimension and the index chosen to measure social diversity, the level of disaggregation of the social groups, and the geographical unit of analysis explain the tangle of indices and the mixed results achieved by the literature focused on socio-economic outcomes of social diversity. This paper enables the suitable evaluation and comparison of the effects of social diversity and the selection of the appropriate index depending on the analysis to be carried out.

KEYWORDS
conflicts, economic growth, fractionalization, polarization, social diversity indices

1 | INTRODUCTION

A quick look at income data worldwide shows that the gap in mean income across countries has continued to widen in recent decades. The GDP per capita of 10 of the richest countries in 1970 was 34.3 times the GDP per capita of 10 of the poorest at that time, but, by 2010, this difference had risen to a multiple of 104.9 (see Table A1 in Appendix I). Explaining why some countries are trapped in poverty while others are steadily growing constitutes one of the most highly studied topics in the growth and development area of economics, and remains the most crucial and challenging issue for economists in the field.

A relevant strand of the literature aims to explain this issue based on social[i] diversity as one of the main causes that may be underlying these differences in economic performance. From a theoretical point of view, the effects of social diversity on economic growth can be both positive and negative. Alesina and La Ferrara (2005) summarize the pros and cons[ii] involved. On the one hand, they point out that heterogeneity gives rise to a diversification in abilities and skills due to the variety in experiences and cultures. This may encourage innovation and creativity, which foster productivity, and, in turn, may boost economic growth. The benefits of diversity enter their model through the production function of private goods.

On the other hand, diversity could give rise to conflicts of preferences regarding the provision of public goods that cause social unrest and economic damage, thereby harming economic growth. In the same vein, by focusing on ethnolinguistic diversity as a dimension of social diversity, Mauro (1995), Alesina et al. (2003), Alesina and Zhuravskaya (2011), and Papyrakis and Mo (2014), among others, assert that institutions in heterogeneous societies tend to be of lower quality by arguing that ethnic favoritism encourages corruption. If politicians and bureaucrats intend to favor certain groups, or to receive favors from such groups, then an inefficient allocation of resources is induced, which, in turn, affects economic growth. Alesina and La Ferrara (2005) introduce these costs in the model through the utility function. They consider that utility depends on the consumption of private and public goods. As mentioned above, private goods include the positive effects of heterogeneity. However, public goods may bring about the negative effects due to the conflicts that may arise from the different preferences shown by the various groups on the type of public goods that should be provided. As the number of groups increase, the utility from the consumption of public goods decreases.

The fact that one effect prevails over another depends on several elements, which explain why the literature achieves conflicting results with respect to the impact of social diversity on social and economic outcomes, such as civil conflicts and economic growth. These issues are addressed in detail in Section 5.

The first task to be tackled involves the definition of the category "social", because it can be considered from different perspectives, such as language, race, religion, culture, and birthplace. In this respect, since the influential contribution of Easterly and Levine (1997), the dimension related to ethnicity has attracted special attention in the empirical literature at country level. Easterly and Levine (1997) strive to show that ethnolinguistic diversity may help explain why

certain countries choose the correct policies to promote growth, while others fail. This result can be illustrated with the so-called African growth tragedy. To measure ethnolinguistic diversity, Easterly and Levine (1997) employed a fractionalization index, which is defined as the probability that two individuals randomly drawn from a population belong to a different ethnolinguistic group, that is, the higher the index, the more diverse the society. At first glance, according to this index, low-income countries are more than twice as diverse as are high-income countries. In fact, from the 29 low-income countries for which the fractionalization index is available, 23 are African countries with a fractionalization index over 0.5 (see Table A2, Appendix I). This evidence has triggered growing interest in the effects of ethnolinguistic heterogeneity on socio-economic performance.

The question that immediately arises involves the criteria that have to be employed to delimit the ethnic groups. For instance, the main differentiating criterion between ethnicities in the index used by Easterly and Levine (1997) is that of language. However, other criteria, such as race, religion, and place of birth (Horowitz, 1985), can also be employed. Moreover, social diversity can be regarded from dimensions other than ethnicity. In this vein, we refer to genetics, and also to culture due to its significance achieved in the literature. As discussed in Section 5, several alternative perspectives towards defining social diversity give rise to different social and economic outcomes.

Second, there are social outcomes that can be explained from a number of the aforementioned dimensions of social diversity. In fact, the negative impact of ethnolinguistic fractionalization on economic growth found in the literature (Alesina et al., 2003; Easterly & Levine, 1997; Montalvo & Reynal-Querol, 2005b, among others) has been interpreted as a result of the fact that conflicts are more likely in highly fractionalized societies which, in turn, harm economic growth. However, while the negative relationship between ethnolinguistic fractionalization and growth is widely supported by various studies, the ethnolinguistic fractionalization does not appear as a significant element in the explanation of civil conflicts (Collier & Hoeffler, 1998, 2004; Fearon & Laitin, 2003; Montalvo & Reynal-Querol, 2005a, 2005b). Nevertheless, this cannot lead to the conclusion that ethnicity is not one of the possible sources of conflict, but rather indicates that fractionalization is not the appropriate index to measure the ethnic divisions that can generate conflict (Esteban & Ray, 1999; Esteban et al., 2012; Montalvo & Reynal-Querol, 2005a). Instead, the polarization index, initially developed by Esteban and Ray (1994) and Wolfson (1994), appears capable of collecting those aspects of ethnolinguistic diversity that can explain civil war and civil conflict: A polarized society with two ethnic groups of the same size shows a low index of fractionalization but is more prone to conflicts than a society with many small ethnic groups, that is, with a high fractionalization index.

In short, the choice of the appropriate indicator to measure social diversity, depending on the socio-economic result to be analyzed, appears as a second key task.

Furthermore, there are two additional issues that have to be taken into account in the empirical analysis. On the one hand, the level of aggregation selected to delimit the groups determines the value of the diversity index and hence its potential ability to explain socio-economic outcomes (Desmet et al., 2012). On the other hand, following Alesina and La Ferrara (2005) and Montalvo and Reynal-Querol (2020), the level of spatial disaggregation at which the analysis is performed can change the effects of diversity. For instance, the negative effects of ethnolinguistic fractionalization on economic growth found by the literature at country level are less intense in studies across localities, to such an extent that a positive association can be found between ethnolinguistic heterogeneity and economic performance (see, for example, Alesina and La Ferrara (2005) and Sparber (2010) for US cities).

Therefore, the way in which social diversity is defined, the appropriate index for its measurement, the level of disaggregation of the groups, and the geographical unit of analysis, all contribute towards the tangle of indices and the various results achieved in the literature on the socio-economic effects of social diversity. This paper is intended to untangle the variety of indices and their applications. We aim to collect these social diversity indices employed in cross-country studies, and to show their similarities and differences, and the main applications of each index. The present paper enables a suitable evaluation and comparison of the effects of social diversity and the selection of the appropriate index depending on the analysis to be carried out.

Since this paper is focused on the literature on the socio-economic impacts of social diversity at country level, and in order to achieve our goals, we have chosen those aspects of social diversity that have attracted the most attention in this literature: diversity due to the various dimensions of ethnicity (ethnolinguistic, religious, and birthplace); and genetic and cultural diversity. We have also chosen two main indices to measure diversity: fractionalization and polarization. With respect to socio-economic results, our focus is on economic growth and conflicts. Studies at country level have been selected that construct their own indices and that make their database available.

In an increasingly heterogeneous and complex world, the proper assessment of the impacts of diversity and their management have become key issues in guiding and designing policies that make it possible to take advantage of their beneficial effects while mitigating the possibly adverse effects.

The paper is organized as follows. Section 2 is devoted to the simple fractionalization index, widely employed in the literature. This index considers a discrete distance between groups, that is, whether the individual either belongs to a group or not. Moreover, this section addresses the criteria to characterize a group, and considers classifications based on one dimension (ethnolinguistic, religion, and birthplace) and those based on a set of characteristics (genetic and cultural groupings). However, the simple fractionalization index fails to take into account that there are certain groups that can be closer to each other than can others. In other words, it could be considered that two ethnicities that share a religion and employ a language with the same roots are more similar to each other than two groups with different religions and a totally different alphabet (Fearon, 2003). The measure of a continuous distance as the degree of similarity between groups is analyzed in Section 3. The polarization indices with discrete and continuous distances are described in Section 4. Section 5 aims to clarify the main applications at a country level of the indices described in the economic literature, and pays special attention to endogeneity issues. Finally, conclusions are drawn and further lines of research are outlined in Section 6.

2 | FRACTIONALIZATION INDICES WITH DISCRETE DISTANCE

The fractionalization indices describe the variety in a society. As mentioned in the Introduction, when referring, for example, to ethnicity, this variety is measured as the probability that two individuals, randomly drawn from a population, belong to different ethnicities. In order to obtain the fractionalization indices, let us consider that a population T can be divided into several I groups. Denote t_i as the population of group i, and $\pi_i = t_i/T$ as the share of population of group i. Therefore $1\text{-}\ \pi_i$ is the probability that an individual of population T does not belong to group i. To calculate the probability that two randomly selected individuals do not belong to the same group, we obtain

the weighted average:

$$FRAC = \sum_{i=1}^{I} (1 - \pi_i)\,\pi_i = 1 - \sum_{i=1}^{I} \pi_i^2 \tag{1}$$

From (1), the usual expression of the fractionalization indices can be obtained, which can also be interpreted as a Herfindahl index. This index is a measure of market concentration. It calibrates the degree of competition between the firms in an industry as the sum of the squares of the market shares of each firm with respect to the industry. The index ranges from 0 (maximum degree of competition) to 1 (monopoly). For the fractionalization index, the market share would be the share of population of a group within the total population, and is defined as one minus the Herfindahl index. This measure therefore varies from 0, which corresponds to the monopoly situation (i.e., there is only one ethnicity in the whole population), to 1, which is the maximum degree of fractionalization.

Expression (1) is a measure of diversity that can be applied to any field of study depending on the type of I groups considered.

Broadly speaking, an exogenous and an endogenous way can be regarded to distinguish between the groups. As far as social diversity is concerned, the former could be characterized through ethnicity and then, once the classification of groups is made, individuals are assigned to each of them. In this case, what matters are the variables selected to capture diversity across ethnicities. According to Horowitz (1985), an inclusive interpretation of ethnicity requires linking ethnicity to race, language, religion, or some other dimension of common origin such as place of birth. As Reynal-Querol (2002) points out, it is necessary to analyze which of these attributes are more appropriate in explaining the specific social and/or economic outcome under study, since each dimension can have different effects. In this respect, she considers religion as the main feature causing social conflicts, while Bove and Elia (2017) focus on birthplace as the relevant characteristic to explain differences in economic growth.

On the other hand, that which Arbatli et al. (2020) denote as interpersonal population diversity can be used, where groupings are based on a set of individual characteristics. In this vein, Bossert et al. (2011) provide a theoretical foundation for a generalized fractionalization index, of which the ethnolinguistic fractionalization index is a particular case. In order to obtain the index, information regarding several characteristics of the individuals is employed. Among these characteristics, such as income, employment, and education, ethnicity can also be included. Therefore, individuals are not pre-assigned to a precise group, since groups are formed endogenously depending on the characteristic selected.

Table 1 summarizes the most relevant aspects of the country-level fractionalization indices with discrete distance analyzed: type of diversity, level of disaggregation (number of groups), databases used, year, and number of countries for which they are available. Each aspect is described below, both for the indices that use exogenous groupings based on one dimension, and for those that are based on a set of individual characteristics.

2.1 | Grouping based on one dimension

The exogenous grouping previously requires the definition of the groups in order to later assign the individuals. This task has to be carried out carefully since the delimitation made in each database

TABLE 1 Fractionalization indices with discrete distance

$FRAC = 1 - \sum_{i=1}^{I} \pi_i^2$ (π_i = share of population of group i)					
Paper	**Diversity (Type)**	**Groups (Number)**	**Countries**	**Data source**	**Years**
Taylor and Hudson (1972)	Ethnic-linguistic	$i = 1....1600$	93	Atlas Narodov Mira (1964)	Early 60s
Alesina et al. (2003)	Linguistic	$i = 1....1055$	201	Encyclopedia Britannica (2001)	Early to mid-1990s
	Ethnic	$i = 1...650$	190	Encyclopedia Britannica (2001); CIA (2000); Levinson (1998); Minority Rights Group International (1997); National Census	Early to mid-1990s
	Religious	$i = 1...294$	215 (including dependencies)	Encyclopedia Britannica (2001)	Early to mid-1990s
Fearon (2003)	Ethnic	$i = 1...822$	160	CIA's World Factbook (main source). Encyclopedia Britannica; Library of Congress Country Study; Country-specific sources; Minority at Risk; Scarrit and Mozafar (1999)	Early 1990s
Montalvo and Reynal-Querol (2005a, 2005b)	Ethnic-linguistic	Vanhaven's ethnolinguistic families	138	World Christian Encyclopedia (main source). Vanhaven (1999) and World Factbook	1980-1990
	Religious	$i = 1...12$	138	L'Etat des Religions Dans le Monde (main source). The Statesman's Yearbook	1970-75-80
Desmet et al. (2012)	Linguistic	$i = 1...691215$ disaggregation levels	103	Ethnologue Database (2005; 15th edition)	2005
Esteban et al. (2012)	Linguistic	$i = 1...6912$	137	Ethnologue Database (2005; 15th edition)	2005
Alesina and Zhuravskaya (2011)[1]	Linguistic	$i = 1....1055$	92	Country/regionally-specific sources	Close to 2000
	Ethnic	$i = 1...650$	97	Country/regionally-specific sources	Close to 2000
	Religious	$i = 1...294$	78	Country/regionally-specific sources	Close to 2000

(Continues)

TABLE 1 (Continued)

$FRAC = 1 - \sum_{i=1}^{I} \pi_i^2$ (π_i = *share of population of group* i)					
Paper	**Diversity (Type)**	**Groups (Number)**	**Countries**	**Data source**	**Years**
Desmet Ortuño-Ortín, and Wacziarg (2017)	Ethnic-linguistic identity	i = (max 20-min 2)	76	Integrated World Values Survey - European Values Survey	1981 to 2008
Alesina, Harnoss, and Rapoport (2016)	Birthplace	$i = 1 \ldots 195$	195	Artuc et al. (2015)	1990 and 2000
Bove and Elia (2017)	Birthplace	$i = 1 \ldots 230$	230	World Bank (data on migrant stocks); Ratha et al. (2016)	1960-70-80-90-2000-10
Ashraf and Galor (2013a)	Genetic	i = Variants of a particular gene or DNA locus(averaged over 783 loci)	21 (*Observed genetic diversity*) 145 (*Predicted genetic diversity*)	Human Genome Diversity Cell Line Panel (HGDP-CEPH) (53 ethnic groups/21 countries) Ramachandran et al. (2005); World Migration Matrix (Putterman & Weil, 2010)	1500 and 2000
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes	i = Different answers to questions on values	76	Integrated World Values Survey - European Values Survey (WVS-EVS): 175 questions (answers: 49 binary, 26 unordered, 100 scale)	1981 to 2008

Notes: [1] National fractionalization is calculated by aggregating the regional fractionalization indices.

and the level of aggregation chosen may have significant implications. Let us consider the example of religion as a dimension of social diversity. If we deem the group "Christians" as unique, we will be including Catholics, Anglicans, and the various branches of Protestantism, which would hide the relevant religious diversity in regions such as Northern Ireland. The same argument can be applied to languages and ethnic groups. Likewise, another problem to consider is that the definition of groups and the self-identification of individuals with the groups change over time as a function, among others, of economic, social, or political factors (this issue is discussed in Section 5).

Moreover, the dimension chosen to identify social groups also has important implications, as discussed below. We have selected three dimensions of ethnicity that are widely studied in the literature (ethnolinguistic, religious, and birthplace) and focus especially on the first dimension since it has attracted special attention among researchers.

2.1.1 | Ethnolinguistic groups

In this case, we consider those indices that use language and/or racial dimensions to delimit ethnicity. As shown in Table 1, we can distinguish between ethnic-linguistic groups (Desmet, Ortuño-Ortín, & Wacziarg., 2017; Montalvo & Reynal-Querol, 2005a, 2005b; Taylor & Hudson, 1972), ethnic groups (Alesina & Zhuravskaya, 2011; Alesina et al., 2003; Fearon, 2003), and linguistic groups (Alesina & Zhuravskaya, 2011; Alesina et al., 2003; Desmet et al., 2012; Esteban et al., 2012).[iii]

One of the first and most widely used measurements of ethnolinguistic diversity was provided by Taylor and Hudson (1972). They computed an ethnic-linguistic fractionalization index (*ELF*), which employed the Narodov Mira Atlas (1964), in which the delimitation of ethnicity is based on language as the main differentiating criterion. This criterion has been widely criticized since language is only one of the many features that anthropologists and ethnologists employ to define ethnicity. Alesina et al. (2003) exemplify certain problems of *ELF* by showing the existence of groups that speak the same language and have different racial origins or different skin color (e.g., in the US, if only language is taken into account, then black people and white people could be in the same group, that is, English speakers). Alesina and his co-authors constructed two indices to overcome these shortcomings. On the one hand, they computed one based exclusively on language using the Encyclopedia Britannica. On the other hand, they calculated a broad ethnicity index, combining linguistic aspects with racial aspects of physical characteristics. To this end, they employed several primary databases and carried out in-depth fieldwork in order to determine, in each case, which delimiter element was the most relevant. Fearon (2003) developed similar work but based it on different databases, which allow a higher level of disaggregation of ethnic groups (822 vs. 650). In contrast, Montalvo and Reynal-Querol (2005a, 2005b) computed a new index by employing the World Christian Encyclopedia (WCE) and by disaggregating only the ethnolinguistic families of Vanhanen (1999) (see Table 1). As Montalvo and Reynal-Querol (2005b) point out, they follow Vanhaven (1999) in order to identify the relevant level of disaggregation, while Alesina et al. (2003) strive to capture the most disaggregated level (for a thorough review of the advantages and disadvantages of each database, see Montalvo and Reynal-Querol (2005a, 2005b). Regardless of the database used, the correlation between the indices computed by Alesina et al. (2003) and Montalvo and Reynal-Querol (2005a, 2005b) is high (over 0.7 for our sample, see Table A4, Appendix I).

A debate on the implications of the level of aggregation or degree of coarseness of ethnolinguistic classifications was opened from the aforementioned research. In this respect, the work carried out by Desmet et al. (2012) was conclusive. They computed linguistic diversity measures at vari-

ous levels of aggregation, by exploiting the information of language trees (15 levels of aggregation are available in Ethnologue, with level 15 being integrated by 6912 languages). Their results confirm that the level of aggregation is an important factor that also enables the historical dimension to be introduced. High levels of aggregation describe cleavages that go back thousands of years, while finer divisions are the result of cleavages of a more recent nature. In fact, the changes in the level of aggregation markedly affect the value of the diversity indices. For our sample, the correlation between the index with the highest and lowest level of aggregation is only 0.43, and even lower (below 0.33) on examining the correlation between the former and the indices proposed by Alesina et al. (2003) and Montalvo and Reynal-Querol (2005a, 2005b).

In a later work, Desmet, Ortuño-Ortín and Wacziarg (2017) calculate an ethnolinguistic fractionalization index supported by self-reported ethnic and/or linguistic identity by individuals, based on data from the integrated World Values Survey—European Values Survey (1981–2008). The groups were defined according to race and/or self-reported language based on the previous literature and on the territory considered. Thus, most ethnographers agree that language is decisive in determining groups in many African countries, while race is a more decisive factor in Latin America.[iv]

More recently, with the aim of introducing possible long-term changes in the ethnic composition of countries, Dražanová (2020) builds the Historical Index of Ethnic Fractionalization dataset. This dataset provides annual ethic fractionalization estimates for 162 countries for the years 1945−2013, based on the Cline Center for Democracy Composition of Religious and Ethnic Groups.

2.1.2 | Religious groups

Religious diversity has also been measured as an aspect that, in certain cases, constitutes an element of differentiation between ethnicities (Alesina & Zhuravskaya, 2011; Alesina et al., 2003; Montalvo & Reynal-Querol, 2005a, 2005b). According to Montalvo and Reynal-Querol (2005b), the main sources for the classification of religious groups are Barret's (1982) World Christian Encyclopedia, Encyclopedia Britannica, and, in particular, the Britannica World Data, L'Etat des Religions Dans le Monde, The Statesman's Yearbook, and The World Factbook. These differ mainly in their inclusion of Animist and Syncretic cults.

Two of the most widely used religious fractionalization indices are those of Alesina et al. (2003) and of Montalvo and Reynal-Querol (2005a, 2005b). The former construct their index using the information from the *Encyclopedia Britannica*, and the latter construct their index using L'Etat des Religions Dans le Monde as a primary source and The Statesman's Yearbook as a secondary source (Table 1).

Moreover, Alesina and Zhuravskaya (2011) compute the fractionalization index for ethnic, linguistic, and religious groups for both national and subnational levels. From the comparison of the two indices, the relationship between ethnicity and geographical distribution can be addressed, in an effort to analyze whether the different groups are located in separate territories. This issue can be measured by the segregation indices (see Reardon and Firebaugh (2002) for a review). As Alesina and Zhuravskaya (2011) note, the cross-country literature barely touches on this issue due to the scarcity of available data. These authors calculate a segregation index at a national level, by employing one of the six indices reported by Reardon and Firebaugh (2002). The index is based on the difference between fractionalization indices at regional and national levels.

By denoting $m = 1 \ldots M$ as the number of regions, t_m as the population of region m in the country, and π_{mi} as the share of group i in total population of region m, the segregation index employed by

Alesina and Zhuravskaya (2011) can be defined as follows:

$$SEG = \frac{1}{I-1}\sum_{i=1}^{I}\sum_{m=1}^{M}\frac{t_m}{T}\frac{(\pi_{mi}-\pi_i)^2}{\pi_i^2} \quad (2)$$

This index varies from zero to one. If the fractionalization index of each region is equal to that of the country, there is no segregation and the groups are homogeneously distributed across the territory. If each group lives within a single region, then there is complete segregation and the index achieves its maximum value 1.

Alesina and Zhuravskaya (2011) present a new dataset on the composition of ethnic, linguistic, and religious groups at the subnational level: 97 for ethnicity, 92 for language, and 78 for religion. When available, the data is drawn from the census closest to the year 2000. With this data, indices of segregation and fractionalization at the national level are computed as well as an index of fractionalization at the subnational level. Those authors find a positive correlation between the segregation and the national fractionalization index when considering the same dimension (ethnicity, language, and religion). This positive correlation holds for the most used fractionalization indices described above: see Table A6, Appendix I.

2.1.3 | Birthplace or migration groups

Bove and Elia (2017) point out that the research on the socio-economic consequences of ethnolinguistic diversity suffers from a major drawback because they use time-invariant measures based on language and ethnicity.[v] In contrast, the ethnic, linguistic, and religious composition of actual societies is increasingly changing due to mass migration. Thus, Bove and Elia (2017) use birthplace as one of the main characteristics to be taken into account in social diversity.

However, although, as mentioned above, authors such as Horowitz (1985) regards the birthplace as a dimension of ethnicity, it should be noted that, as argued by Alesina, Harnoss, and Rapoport (2016, p. 102), "Conceptually, ethnolinguistic, genetic, and birthplace diversity also differ as people born in different countries are likely to have been educated in different school systems, learned different skills, and developed different cognitive abilities. Intuitively, this may not be the case for people of different ethnic or genetic origins who were born, raised, and educated in the same country".[vi] In fact, birthplace diversity is not correlated with the aforementioned fractionalization indices nor with those indices discussed in the next section (see Table A4, Appendix I). Moreover, birthplace diversity works in different ways when explaining economic outcomes, as discussed in Section 5.

The main advantage of the birthplace dimension is the objectivity of their data and the ease of obtaining and updating the censuses and data on migration stock, which enables the calculation of dynamic indicators. In fact, these indicators are the most commonly employed in the analysis of diversity at subnational level (regions, municipalities, and even neighborhoods), where no other information is available. At a national level, the birthplace diversity indices provided by Alesina, Harnoss, and Rapoport (2016) and Bove and Elia (2017) deserve mention (Table 1).

2.2 | Groupings based on a set of individual characteristics

One strand of the literature considers diversity between individuals, instead of assigning individuals to a pre-defined group, as per the measures described in Section 2.1. The first attempts in

this approach are in contributions that use genetic data. Moreover, the cultural diversity index also measures diversity across individuals but uses responses to surveys on norms, attitudes, and preferences. As Ashraf and Galor (2018) point out, not only does the measurement of interpersonal diversity capture inter-group differences, as already carried out by the measures described in the section above, but it also captures intra-group differences, which allow us to explain both inter-group and intra-group conflicts.

2.2.1 | Genetic diversity

In this respect, one of the most relevant contributions is that of genetic diversity proposed by Ashraf and Galor (2013a).

As a starting point, these authors take the measurement of the extent of diversity in genetic material (expected heterozygosity) across individuals of 53 ethnic groups from data of the Human Genome Diversity Cell Line Panel compiled by the Human Genome Diversity Project and the Centre d'Etudes du Polymorphisme Humain. The expected heterozygosity is calculated as the probability that two individuals selected at random differ genetically from one another with respect to a given spectrum of traits. This Panel includes data on allelic frequencies for 783 loci (i.e., the frequency with which a variant of a particular gene or DNA locus occurs in the population). By using the traditional fractionalization index (expression 1b), the probability that two randomly selected individuals differ with respect to the gene in question is calculated. The process is then repeated and averaged over multiple genes or DNA loci (783) to estimate the overall expected heterozygosity for the relevant population.

The disadvantages of this source include: the limitation on the number of countries (21) for which the genetic diversity can be calculated, and the generation of endogeneity problems. The following strategy was therefore designed. Ashraf and Galor (2013a) confirm an inverse linear relationship between the genetic diversity of the 53 ethnic groups and migratory distance from East Africa to the settlements of these groups; that is, genetic diversity decreases with migratory distance. Supported by this finding and using both the observed genetic diversity data and the migratory distances (Putterman & Weil, 2010), Ashraf and Galor (2013a) predict genetic diversity for 145 countries in the world and avoid endogeneity problems (see Table 1). Thus, the econometric strategy followed by Ashraf and Galor (2013a) in the calculation of predicted genetic diversity was inspired by both the Out-of-Africa hypothesis (Ramachandran et al., 2005) and the historical migratory patterns known as the serial founder effect (SFE). A SFE implies that successive divisions of an original population into various subpopulations generate a loss of diversity in intergenerationality. The SFE generated by the dispersal of anatomically modern humans out of East Africa more than 60,000 years ago implies that diversity decreases along migratory routes from East Africa. Recent findings on ancient DNA (see Reich (2018) among others) have cast doubt on this hypothesis, and have opened an ongoing debate on the specific location of where the expansion of modern humans started. In this new line, Chan et al. (2019) suggest a South African origin. Despite this, the migratory distance to East Africa continues to be widely used both to predict genetic diversity and to avoid problems of causality (Ager & Brüeckner, 2018; Arbatli et al., 2020; Depetris-Chauvin & Özak, 2020). These authors rely on the results of their own econometric analysis in which they test the negative statistically and economically significant predictive power of the migratory distance from East Africa for diversity.[vii]

In addition, Ashraf and Galor (2013b) provide empirical evidence on the existence of a significant and positive causal relationship between predicted genetic diversity and a wide panel of con-

temporary ethnoliguistic fragmentation indices. In this way, they establish that genetic diversity is an underlying cause of ethnic and cultural diversity.[viii]

More recently, Depetris-Chauvin and Özak (2020) and Arbatli et al. (2020) have constructed new world datasets of measures of genetic diversity at ethnicity level. Unlike the country-level indices previously analyzed, these researchers construct indices of diversity at ethnicity level, which enables the capture of intra-group diversity. The strategy for calculating these intra-ethnic diversity indices is similar to that described above for the indices of genetic diversity of Ashraf and Galor (2013a). First, a measure of genetic diversity based on the expected heterozygosity is constructed for each ethnicity (observed intra-ethnic diversity indices). The variations in the pre-historical migratory distance to East Africa are subsequently exploited in order to generate the predicted intra-ethnic diversity for an expanded sample of ethnicities.[ix]

2.2.2 | Cultural diversity

Desmet, Ortuño-Ortín, and Wacziarg (2017) captures diversity across the cultural features of individuals using the responses to selected questions of the Integrated World Values Survey—European Values Survey (WVS-EVS) related to norms, values, attitudes, and preferences (see Table 1). They provide a cultural fractionalization index defined as the probability that two randomly drawn individuals from a population give different answers to a question:

$$CUF = \frac{1}{Q}\sum_{q=1}^{Q}\left(1-\sum_{r(q)=1}^{R(q)}\pi_{q,r(q)}^{2}\right) \tag{3}$$

where $q = 1\ldots Q$ are the questions selected from the WVS-EVS, $r(q) = 1\ldots R(q)$ are the possible answers to each question q, and $\pi_{q,r(q)}$ is the percentage of the overall population that gives answer $r(q)$ to a question q.

Although genetic and cultural fractionalization indices are conceptually linked (see Desmet, Ortuño-Ortín, & Wacziarg (2017, p. 2499), for details), they capture diversity along two different dimensions: culture versus genes. Thus, they give rise to different relations with socio-economic outcomes (see Section 5) and the correlation between them is low. Furthermore, the correlation between genetic and cultural fractionalization and the indices described in Section 2.1 is also negligible (Table A4, Appendix I).

The fractionalization indices discussed above offer the advantage of their simplicity of calculation. However, they fail to reflect the magnitude of the differences between groups. In order to overcome this disadvantage, certain authors have included the degree of similarity between groups. Section 3 describes this issue. Furthermore, the appropriateness of fractionalization indices to suitably reflect conflictive situations is also questioned. This topic will be discussed in Section 4.

3 | FRACTIONALISATION: MEASURING DISTANCE BETWEEN GROUPS

The simple fractionalization index described in Section 2 assumes a binary distance between groups, that is, groups are either equal, and the distance is zero, or they are different, and the

distance between them is one. However, this discrete distance between groups does not reflect the fact that there are ethnolinguistic groups that are more similar to each other since they share cultural features.[x] In this respect, Fearon (2003) provides many examples. For instance, he calculates the simple fractionalization index for Belarus and Cyprus and obtains 0.37 and 0.36, respectively. These results hide the fact that the groups coexisting in Belarus are much closer than those in Cyprus. When Fearon (2003) introduces the cultural distance, the fractionalization for Belarus falls to 0.26, while for Cyprus it stays at the same level. Nevertheless, this fractionalization index with cultural distance is highly correlated with those of Alesina et al. (2003) and Montalvo and Reynal-Querol (2005a, 2005b) with discrete distance; for our sample, these correlations are approximately 0.7 (see Table A4, Appendix I).

The cultural distance used by Fearon (2003) is defined using the characteristics of the languages spoken by the groups and is based on the seminal paper by Greenberg (1956), in which the degree of similarity between linguistic groups was taken into account, and a resemblance factor based on the language tree was proposed. Subsequent studies have used a modified version of this factor to approximate the cultural distance, and have employed the Ethnologue database as the main source for the construction of the language tree (Desmet et al., 2009, 2012; Esteban et al., 2012; Fearon, 2003).

In order to obtain the fractionalization index with continuous distance, let us denote $s_{i,j}$ as the similarity between two languages. Fearon (2003) defines $s_{i,j}$ as the ratio of the number of common branches (cb) to the maximum possible number of branches (m), which, according to Ethnologue, stands at 15:

$$s_{ij} = \left(\frac{cb}{m}\right)^{\delta} \tag{4}$$

where δ is a positive parameter that accounts for the relevance given to similarities.

Therefore, the distance between two groups i and j is:

$$d_{ij} = 1 - \left(\frac{cb}{m}\right)^{\delta} \tag{5}$$

Assigning a value to δ is not an easy task. For example, Fearon (2003) gives a value of *0.5* to δ, while Desmet et al. (2012) compute the index for a value of 0.05 and Esteban et al. (2012) calculate it for both values. As Esteban et al. (2012, p. 1325) assert, "None of these choices is satisfactorily motivated" (see Esteban et al. (2012, pp. 1325–1328)), for further discussion). As δ increases, more importance is given to small differences. In fact, if δ tends to infinity, a small difference in the number of common branches ($cb = m\text{-}1$) becomes as relevant as the biggest difference ($cb = 0$), and d_{ij} is equal to one in both cases. In other words, in this limited case, the distance is the binary measure considered by the simple fractionalization index.

Once the distance between groups is introduced, the fractionalization index with continuous distance can be obtained:

$$CDFRAC = \sum_{i=1}^{I} \sum_{i \neq j} \pi_i \pi_j d_{ij} \tag{6}$$

where π_i *and* π_j are the share of the population of group i and j, respectively. It is easy to observe that, for a binary distance, expression (6) reduces to (1).

As can be observed, *CDFRAC* is rooted in the theory of inequality measurement. In fact, it is a Gini index where the distance between groups i and j is measured with the cultural distance. In the same vein, the fractionalization index with discrete distance can also be interpreted as a Gini index with binary distance (0,1).

Moreover, following a procedure similar to that described above, Alesina, Harnoss, and Rapoport (2016) calculate two birthplace fractionalization indices with continuous distance. One of these indices introduces the genetic distance between inmigrant and natives and the other index measures the distance between groups with the differences in the GDP per capita of the country of origin and that of destination.

Finally, it is also worth noting that for those measures that employ several attributes (see Section 2.2), the issue of measuring distances across groups is less relevant given that the groups are not taken as given, but are formed endogeneously. However, for the cultural fractionalization index, Desmet, Ortuño-Ortín, and Wacziarg (2017) do take distance into account, by considering the distances between responses. They argue that if a question of the WVS-EVS is ordered on a scale, for instance, from 1 to 4, then the distance between those who choose responses 1 and 4 is greater than for those who choose responses 2 and 3.

Table 2 summarizes the main features of the country-level fractionalization indices with continuous distance discussed above: type of diversity, level of disaggregation (number of groups), dimension used to assess the distance between groups, databases, year, and number of countries for which they are available.

4 | POLARISATION INDICES

As mentioned in the Introduction, there is a wide range of literature that strives to explain conflicts from ethnic divisions but fails to find strong evidence (Collier & Hoeffler (1998, 2004) and Fearon and Laitin (2003) are seminal references). As Esteban et al. (2012) state, the concept itself of ethnic "division" arises as a key issue. It has usually been measured with the fractionalization index that reflects the variety of ethnic groups in a society, but how this variety can capture the ethnic divisions that give rise to conflict remain unexplained. Instead of fractionalization, Reynal-Querol (2002) proposed religious polarization as a cause underlying conflicts and Montalvo and Reynal-Querol (2005a) find a relationship between ethnic polarization and conflicts.

The literature[xi] on polarization draws from to the alienation framework of Esteban and Ray (1994), where individuals feel antagonism towards people whose characteristics differ from their own. The characteristic considered by Esteban and Ray is that of income. When applied to ethnicity, it could be said that an individual feels antagonism towards another individual who belongs to a different ethnic group. Therefore, there is a key distinction from the fractionalization indices that simply capture one dimension of the real world: people differ in numerous ways, one of which could be ethnolinguistic variety, but only antagonism between groups captured by polarization can explain conflicts.

The concept of polarization introduced by Esteban and Ray (1994) strives to measure the effective antagonism (EA_{ij}) experienced by an individual of group i when facing another individual of group j. This effective antagonism has two components. On the one hand, an individual of group i can feel antagonism (a) towards an individual of group j due to differences in the characteristics of the two groups ($a = a(d_{ij})$), where d_{ij} is the difference in income between groups i and j. On

TABLE 2 Fractionalization index with continuous distance

Fractionalization index with continuous distance

$$CDFRAC = \sum_{i=1}^{I} \sum_{i \neq j} \pi_i \pi_j d_{ij} d_{ij} = 1 - (\frac{cb}{m})^{\delta} (d_{ij} = distance\, i - j;\ cb = common\ branch\, i - j; \delta = parameter\ relevance\ similarities)$$

Paper	Diversity(Type)	Correction(d_{ij})	Groups(No.)	Countries	Data source(Diversity)	Data source(Correction)	Years
Fearon (2003)	Ethnic	Structural distance between languages $m = 15$ (max); $\delta = 0.5$	i and j = 1-822 (ethnic groups)	160	CIA'S World Factbook (main source). *Encyclopedia Britannica*; Library of Congress Country Study; Country-specific sources; Minority at Risk; Scarrit and Mozafar (1999)	Ethnologue	Early 1990
Esteban et al. (2012)	Ethnic	Structural distance between languages $m = 15$ (max); $\delta = 0.05$	i and j = 1-822 (ethnic groups)	138	Fearon (2003)	Ethnologue Database (2005; 15th edition)	2005
Esteban et al. (2012)	Linguistic	Structural distance between languages $m = 15$ (max); $\delta = 0.5$ and $\delta = 0.05$	i and j = 1-6912(linguistic groups)	137	Ethnologue Database (2005; 15th edition)	Ethnologue Database (2005; 15th edition)	Early 1990
Alesina , Harnoss, and Rapoport (2016)	Birthplace	(1) Genetic distance immigrants-natives (2) GDPpc at origin $\theta = -10$ to 10	i and j = 1-195	195	Artuc et al. (2015)	(1) Spolaore and Wacziarg (2009); Cavalli-Sforza et al. (1994)(2) PWT 8.0	1990 and 2000
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes	Distance between responses $m = 4$ (max); $\delta = 0.05$	i and j = Answers to questions on values	76	Integrated World Values Survey - European Values Survey (WVS-EVS).	WVS-EVS	1981 to 2008

the other hand, this antagonism can be enhanced by a feeling of identification of the individual within the group of individuals of similar characteristics. These authors introduce the identification function $I = I(\pi_i)$, where the higher the number of members there are in the group, the greater the identification that exists between them. The interpersonal antagonism $EAij$ is therefore the joint result of the sense of identification of individual i with their own group, which depends on the size of group i, and the feeling of alienation towards members of group j as captured by the distance d_{ij}:

$$EA_{ij} = T\left(I\left(\pi_i\right), a\left(d_{ij}\right)\right) \tag{7}$$

Therefore, the societal antagonism is the sum of all effective antagonism:

$$SA = \sum_{i=1}^{n}\sum_{j=1}^{n}\pi_i\pi_j T\left(I\left(\pi_i\right), a\left(d_{ij}\right)\right) \tag{8}$$

A particular measure of polarization is yielded once a specific functional form for T(·), I(·), and a(·) is selected. Esteban and Ray (1994) derive the concept of polarization of a distribution from three axioms and obtain the following measure of polarization:

$$POL = \beta\sum_{i=1}^{I}\sum_{j\neq i}\pi_i^{1+\alpha}\pi_j d_{i,j} \tag{9}$$

Expression (9) is a specific measure of societal antagonism. The identification function is $I = I(\pi_i) = \pi_i{}^{\alpha}$, where parameter α is defined as the degree of "polarization sensitivity". This is a positive parameter that should lie between zero and an optimum value, which Esteban and Ray (1994) show to belong to the interval (0,1.6]. The more α increases, the greater the importance given to identification between individuals. This parameter α is what makes the polarization measure significantly different from fractionalization. β is a positive parameter used for population normalization.

The application of this concept of polarization to dimensions such as religion or ethnicity is not straightforward. As pointed out by Montalvo and Reynal-Querol (2008), the polarization index developed by Esteban and Ray (1994) measures distance between groups using a continuous dimension such as income. However, when considering religious, linguistic, or ethnical aspects, the way in which the distance across groups can be measured remains unclear. On the one hand, this distance can be discretized, as shown in Section 4.1. On the other hand, the concept of distance between groups described in Section 3 has also been used for polarization indices, as discussed in Section 4.2. Furthermore, Table 3 summarizes the main features of the country-level polarization indices with discrete and continuous distance.

4.1 | Polarization indices with discrete distance

Following Montalvo and Reynal-Querol (2008), several reasons justify the use of discrete distance to construct ethnolinguistic and religious polarization indices. On the one hand, no measures are yet available and generally accepted regarding distance across ethnolinguistic and religious groups. On the other hand, the attempt to measure distances may give rise to larger measurement

TABLE 3 Polarization index

Polarization index with discrete distance $POLRQ = 4\sum_{i=1}^{I}\sum_{j\neq i}\pi_i^2\pi_j(\pi_i$ **and** $\pi_j =$ **population share of groups i and j)**					
Paper	**Diversity (Type)**	**Groups (No.)**	**Countries**	**Data source**	**Years**
Montalvo and Reynal-Querol (2005a, 2005b)	Ethnic-linguistic	Vanhaven's ehnolinguistic families	138	*World Christian Encyclopedia* (main source). Vanhaven (1999) and World Factbook	1970-75-80
	Religious	$i = 1\ldots12$	138	*L'Etat des Religions Dans le Monde* (main source). *The Statesman's Yearbook*	1970-75-80
Desmet et al. (2012)	Linguistic	$i = 1\ldots6912$ 15 disaggregation levels (L1…L15)	103	Ethnologue Database (2005; 15th edition)	2005
Esteban et al. (2012)	Ethnic	$i = 1\ldots822$	138	Fearon (2003)	Early 1990s
Esteban et al. (2012)	Linguistic	$i = 1\ldots6912$	137	Ethnologue Database (2005; 15th edition)	2005
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Ethnic-linguistic identity	$i =$ (max 20-min 2)	76	Integrated World Values Survey–European Values Survey (WVS-EVS)	1981 to 2008
Bove and Elia (2017)	Birthplace	$i = 1\ldots230$	230	World Bank (data on migrant stocks) Ratha et al. (2016)	1960-70-80-90-2000-10
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes	$i =$ Answers to questions on values	76	Integrated World Values Survey–European Values Survey (WVS-EVS): 175 questions (answers: 49 binary, 26 unordered, 100 scale)	1981 to 2008

(Continues)

TABLE 3 (Continued)

Polarization index with discrete distance $POLRQ = 4\sum_{i=1}^{I}\sum_{j\neq i}\pi_i^2\pi_j(\pi_i \text{ and } \pi_j = \text{population share of groups } i \text{ and } j)$					
Paper	**Diversity (Type)**	**Groups (No.)**	**Countries**	**Data source**	**Years**
Polarization index with continuous distance $CDPOL = \sum_{i=1}^{I}\sum_{j\neq i}\pi_i^2\pi_j d_{i,j}$ $d_{ij} = 1-(\frac{cb}{m})^{\delta}$ (d_{ij} = distance *i-j*; *cb* = common branch; δ = parameter relevance similarities)					
Esteban et al. (2012)	Ethnic (d_{ij} = Distance linguistic; $m = 15$; $\delta = 0.5$ and 0.05)	i and $j = 1\ldots822$	138	Diversity: Fearon (2003) Correction: Ethnologue Database (2005; 15th edition)	Early 1990s
	Linguistic (d_{ij} = Distance linguistic; $m = 15$; $\delta = 0.5$ and 0.05)	i and $j = 1\ldots6912$	137	Diversity and Correction: Ethnologue Database (2005; 15th edition)	2005

errors than those of the discrete measures. In fact, as pointed out by Duclos et al. (2004), for certain dimensions, such as religion (Reynal-Querol, 2002), the simple criterion belong/not belong can accurately reflect the interest of the individuals (the same reasons could be applied analogously for fractionalization indices considered in Section 2).

Moreover, Montalvo and Reynal-Querol (2008) stress the endogeneity problems that can arise when, for example, the strength of the sentiment of identity is employed to measure the distance between groups, since it may be the conflict itself that is causing that sentiment of identity.

Therefore, there are arguments in favor of using the index of polarization with discrete distance. In this vein, Reynal-Querol (2002) proposed the following index[xii]:

$$POLRQ = 1 - \sum_{i=1}^{N} (0.5 - \pi_i)^2 \frac{\pi_i}{0.25} \tag{10}$$

which achieves its maximum value when there are two groups of the same size, as in Esteban and Ray (1994) and Wolfson (1994), and fulfills the usual properties of these kinds of indices (see Reynal-Querol (2002, p. 53), for details).

Moreover, we can relate the polarization index with discrete distance with the polarization measure in (9). If we consider a discrete distance in the polarization measure of Esteban and Ray (1994), then $d_{ij} = 0$ if $i = j$, and $d_{ij} = 1$ if $i \neq j$, and therefore, from expression (9), we obtain:

$$DPOL = \beta \sum_{i=1}^{I} \sum_{j \neq i} \pi_i^{1+\alpha} \pi_j \tag{11}$$

Montalvo and Reynal-Querol (2008, p. 1841) show that the only value of α for which *DPOL* fulfils the basic properties of a discrete polarization index is 1, and β should be equal to 4 for *DPOL* to lie between 0 and 1, which gives the *POLRQ* index in expression (10):

$$\begin{aligned} POLRQ &= 1 - \sum_{i=1}^{N} (0.5 - \pi_i)^2 \frac{\pi_i}{0.25} = 1 - \sum_{i=1}^{N} \left(0.25 + \pi_i^2 - \pi_i\right) \left(\frac{\pi_i}{0.25}\right) \\ &= 1 - \sum_{i=1}^{N} \pi_i + 4 \sum_{i=1}^{N} \pi_i^2 (1 - \pi_i) = 4 \sum_{i=1}^{I} \sum_{j \neq i} \pi_i^2 \pi_j \end{aligned} \tag{12}$$

It is worth remarking that this does not signify that this is the only discrete polarization measure. In other words, what Montalvo and Querol (2008) are showing is that this precise index is one of those that fulfills the properties of a polarization index.

Furthermore, if $\beta = 1$ and $\alpha = 0$ in *DPOL* is considered, then the discrete fractionalization index (*FRAC* in expression 1)[xiii] is obtained. As can be observed, *FRAC* increases with the number of groups, while the maximum for *POLRQ* is attained when there are two groups. In fact, in the case of two groups, both indices *FRAC* and *POLRQ* attain the same value, but this is no longer true when the number of groups increases. This is due to the fact that, for *POLRQ*, the probabilities of two individuals belonging to different groups are weighted by the relative size of each group, while for *FRAC* they are not. Furthermore, the *FRAC* index does not account for the effect of group size on the sense of identity ($\alpha = 0$), while the *POLRQ* does, by assuming that identification increases with the size of the group.

Several authors have calculated various polarization indices at country level by employing different databases and different delimitations of ethnicity (see Table 3). Thus, Montalvo and

Reynal-Querol (2005a, 2005b) provide an ethnolinguistic polarization index by using the ethnolinguistic families described in Vanhanen (1999), and a religious polarization index by using the *L'Etat des Religions Dans le Monde* as their main source. Desmet, Ortuño-Ortín, and Wacziarg (2017) calculate a polarization index using the self-reported ethnic and/or linguistic identity by individuals based on surveys on values. As for the fractionalization index, Desmet et al. (2012) compute linguistic polarization measures at different levels of aggregation. Furthermore, Bove and Elia (2017) also obtain a birthplace polarization index.

Empirically, Montalvo and Reynal-Querol (2005a, 2005b) show the relationship between *POLRQ* and *FRAC* for their own data. They obtain a positive correlation for low levels of fractionalization, zero for the medium range, and negative correlation for high levels of fractionalization. Moreover, Desmet et al. (2012) show that the correlation between *FRAC* and *POLRQ*, at the same levels of aggregation, decreases as the level of disaggregation increases. Thus, for our sample, the correlation between the two indices rises from 0.43, at the highest level of disaggregation, to 0.78 at a medium level, and reaches a value of 0.98 at the lowest level. The intuition behind these results is that, for lower disaggregation, fewer groups remain, and, therefore, the distinction between the two indices vanishes. When the levels of disaggregation differ, the correlation is even lower. For instance, between *FRAC* and *POLRQ* for the lowest (highest) and highest (lowest) level of disaggregation respectively, the correlation is 0.3 (0.43) (see Table A8, Appendix I).

4.2 | Polarization indices with continuous distance

Based on Esteban and Ray (1994) and Duclos et al. (2004), Esteban and Ray (2011) derive a polarization measure with continuous distance for discrete distributions:

$$CDPOL = \sum_{i=1}^{I} \sum_{j \neq i} \pi_i^2 \pi_j d_{i,j} \tag{13}$$

Using this index, Esteban et al. (2012) obtain an ethnic polarization index that utilizes the grouping of Fearon (2003) and a linguistic polarization index from the Ethnologue Database (see Table 3). From the above expression, they calculate both ethnic and linguistic polarization indices for $\delta = 0.5$ and $\delta = 0.05$ in $d_{i,j}$ (see expression (5)).

Moreover, Esteban and Mayoral (2011) construct both ethnic and religious polarization indices with continuous distances measured from the intensity in the ethnic and religious attitudes, which is derived from the answers to a set of questions that refer to religious or ethnic feelings collected by the World Values Survey.[xiv] This way of measuring distance enables the capture of the fact that a significant number of individuals in a group may feel no antagonism towards individuals belonging to another group, and hence belonging to different groups generates no social polarization. Therefore, in this case, a polarization index with discrete distance or with a continuous distance in the spirit of Fearon (2003), instead of that proposed by Esteban and Mayoral (2011), can reflect antagonism that is not actually taking place in society.

Finally, it is also worth noting that, using the polarization index in expression (9), Desmet, Ortuño-Ortín, and Weber (2017) propose the peripheral heterogeneity index to analyze the ethnolinguistic conflicts arising from the existence of a central dominant group and several minority groups. Considering that there are $i = 1 \ldots I$ minority groups and a dominant group denoted by 0,

the peripheral heterogeneity index can be defined as:

$$PH = \sum_{i=1}^{I} \pi_i^{1+\alpha} d_{0i} + \sum_{i=1}^{I} \pi_i \pi_0^{1+\alpha} d_{0i} \tag{14}$$

where d_{0i} is the distance between the dominant group and each minority group, which Desmet, Ortuño-Ortín, and Weber (2017) compute using the Dyen et al. (1992) distance matrix.

In expression (14), the first addition is the effective antagonism from the minorities to the dominant group and the second addition is the effective antagonism from the dominant group to the minorities. From the set of axioms established by Desmet, Ortuño-Ortín, and Weber (2017), they derive that α can be either positive or negative. When α is positive, the larger the group, the greater the sense of identification. However, as Desmet, Ortuño-Ortín, and Weber (2017) point out, the reverse could also be true, that is, the larger the group, the smaller the sense of identification and hence α becomes negative. They show that for negative values of α, the *PH* index is a measure of variety (fractionalization) and for positive values, it can be interpreted as a polarization measure.

5 | SOCIAL DIVERSITY AND SOCIO-ECONOMIC OUTCOMES

In addition to constructing the social diversity indices described in previous sections, most of the papers cited employ them to carry out empirical analyses with the aim of assessing the effects of diversity on social and economic outcomes, especially economic performance and conflicts. Tables 4 and 5 summarize the main results obtained in the literature on the relationship between social diversity and these outcomes (Tables A9 and A10 in Appendix I include detailed information on the variables used in the empirical analysis).

As can be observed from these tables, the social and economic implications differ in certain cases depending on the indices. These can be due to any of the several reasons discussed in greater detail below:

1. The different ways of grouping. On the one hand, as addressed in Section 2, distinction is made between exogenous and endogenous groups, which itself has consequences since the former only capture inter-group differences while the latter also capture intra-group diversity (Arbatli et al., 2020). On the other hand, each dimension chosen to delimit the groups may have different consequences. For instance, religious and ethnolinguistic fractionalization exert diverse effects on growth.
2. The level of disaggregation when considering the definition of the groups. According to Desmet et al. (2012), the level of aggregation of the groups is a significant factor which allows the historical dimension to be introduced.
3. The level of spatial disaggregation for which the analysis is made. Although this paper is focused on contributions at country level, differences in the results are also considered when a more disaggregated geographical level is observed.
4. The selection of the accurate index, fractionalization versus polarization, to explain certain issues, such as conflicts.

TABLE 4 Applications of fractionalization indices

Indices	Diversity	Growth and Income	Conflicts
Fractionalization with discrete distance			
Taylor and Hudson (1972)[1]	Ethnic-linguistic	(- Sig.): GDPpc Growth	
Alesina et al. (2003)	Linguistic	(- Sig.): GDPpc Growth	
	Ethnic	(- Sig.): GDPpc Growth	
	Religious	(No correlation)	
Fearon (2003)[2]	Ethnic		(+ Sig.): Conflict Variables
Montalvo and Reynal-Querol (2005a, 2005b)	Ethnic-linguisticReligious	(- Sig): GDPpc Growth(No correlation)	No correlation: Civil Wars(- NS): Civil Wars
Desmet et al. (2012)	Linguistic	(- Sig.): Growth (L6 to L15)	(+ Sig.): Onset Civil Wars (L1) (NS): Onset Civil Wars(L6 to L15)
Esteban et al. (2012)	Linguistic		(+ NS): Conflict Variables
Alesina and Zhuravskaya (2011)	Linguistic		
	Ethnic		
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Ethnic-linguistic identity	(+ NS): GDPpc	(- NS): Civil Conflict
Alesina, Harnoss, and Rapoport (2016)	Birthplace	(+ Sig.): GDPpc(inverse U-Shaped)	
Bove and Elia (2017)	Birthplace	(+ Sig.): GDPpc	
Ashraf and Galor (2013a)[3]	Genetic	(+ Sig.): GDPpc(inverse U-Shaped)	(+ Sig.): Civil Conflict
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes	(+ Sig.): GDPpc	(- Sig.): Civil Conflict
Fractionalization with continuous distance			
Fearon (2003)[2] *(Linguistic distance $\delta = 0.5$)*	Ethnic		(- Sig.): Conflict Variables
Esteban et al. (2012)*(Linguistic distance $\delta = 0.05$)*	Ethnic		(- Sig.): Conflict Variables
Esteban et al. (2012)*(Linguistic distance $\delta = 0.5$ and $\delta = 0.05$)*	Linguistic		(- NS): Conflict Variables
Alesina, Harnoss, and Rapoport (2016)*(Genetic and GDP distances)*	Birthplace	(+ Sig.): GDPpc	
Desmet, Ortuño-Ortín, and Wacziarg (2017)*(Distance values)*	Cultural attitudes		(- Sig.): Civil Conflict

Notes: (1) The results for Growth were obtained by Easterly and Levine (1997) and those for Corruption by Mauro (1995). Both studies used the Taylor and Hudson (1972) index. (2) The results were obtained by Esteban et al. (2012) using the Fearon (2003) index. (3) The results for conflicts were obtained by Arbatli et al. (2020) using the Ashraf and Galor (2013a) index.
(+Sig.): positive and significant results, (-Sig.): negative and significant results, (NS): not significant, (Mix): mixed results, (No correlation): coefficients are positive and negative in different specifications and non-significant in all cases.

TABLE 5 Applications of polarization indices

Indices	Diversity	Growth and Income	Conflicts
Polarization with discrete distance			
Montalvo and Reynal-Querol (2005a, 2005b)	Ethnic-linguistic Religious	(+NS): GDPpc Growth (+NS): GDPpc Growth	(+ Sig.): Civil Wars (+ Sig.): Civil Wars
Desmet et al. (2012)	Linguistic	(- NS): Growth (L1 to L15)	(+ Sig.): Onset Civil Wars (L1) (- NS): Onset Civil Wars (L6 to L15)
Esteban et al. (2012)	Ethnic		(+ Sig.): Conflict Variables
	Linguistic		(NS): Conflict Variables
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Ethnic-linguistic identity		(- NS): Civil Conflict
Bove and Elia (2017)	Birthplace	(+ Sig.): GDPpc	
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes		(- Sig.): Civil Conflict
Polarization with continuous distance			
Esteban et al. (2012) (*Linguistic distance*. $\delta = 0.5$ and $\delta = 0.5$)	Ethnic Linguistic		

Notes: (+Sig.): positive and significant results, (-Sig.): negative and significant, (NS): not significant, (Mix): mixed results.

Moreover, the empirical literature on social diversity faces several problems of endogeneity. With regard to grouping based on one dimension as described in Section 2.1, two main problems arise with respect to ethnolinguistic groups.

On the one hand, ethnolinguistic diversity evolves endogenously in the very long-term for a variety of reasons. First, high ethnic diversity in developing countries could be the result of a legacy of colonialism and the artificial mapping of borders. In this vein, Leeson (2005) concludes that colonial policy in Africa was often purposely designed to increase ethnic heterogeneity while Ahlerup and Olson (2012) find that the length of the colonial period is positively associated with ethnic fractionalization. They argue that this result could be indicative of the consequences of the colonial policies of "divide-and-rule", which was deliberately implemented to maintain control of colonies. Second, these authors find that the timing of the initial settlement by modern humans constitutes a key factor in explaining much of the current ethnic diversity.

Third, Ahlerup and Olson (2012) also point out the relevance of the history of the modern state. They argue that the length of statehood is negatively associated to ethnic diversity since states might have incentives to actively design policies aimed at achieving populations of a more homogenous nature. If this argument is followed while using the present national borders as the units within which ethnic diversity is measured, then certain endogeneity problems may arise since we would be mixing, for instance, African countries that have gained their independence since 1950, with Western European and North American countries with a much longer history. If this is the case, then the former could be more ethnically fragmented because these nations have had very little time to impose homogenizing policies as did Western European and North American countries back in the 1800s. Furthermore, the wars and genocides that have been perpetrated against certain ethnic groups throughout the process of consolidation of nation states should also be borne in mind. In fact, there could be countries that might seem ethnically more homogeneous

today (consider, for instance, Australia with a fractionalization index of 0.09 (Alesina et al., 2003) due to the genocide against the natives at the time of conquest).

Finally, Michalopoulos (2012) stresses the role of geographic variability, captured by the variation in the terrain and differences in land endowments in explaining the changes of ethnolinguistic diversity over time

On the other hand, changes in social, economic, and political variables can, in turn, generate changes in the definitions of ethnolinguistic groups and the self-identification of individuals with these groups. Alesina et al. (2003) cite Somalia as an example of this latter concern. Before the 1991 civil war, this country could be considered as ethnically homogeneous, with 85% of the population identified as Somalis. Nevertheless, during and after the civil war, Somalia has become in a highly fragmented society since the population no longer self-identifies with the Somali ethnicity but instead with the multiple clans that existed prior to the war.

However, despite these two problems, the literature focused on the social and economic outcomes of ethnolinguistic fractionalization takes fractionalization indices as exogenous in cross-country regressions (Alesina et al., 2003; Bluhm & Thomsson, 2020; Desmet et al., 2012; Montalvo & Reynal-Querol, 2005a, 2005b). As Alesina et al. (2003, p. 160) argue, this statement is based on the assumption that ethnolinguistic diversity is historically determined before any of the outcomes intended to be explained arise. Thus, they deem it reasonable to assume that ethnolinguistic diversity is persistent in a 30-year horizon, which is the usual horizon in cross-country analysis[xv]. Nonetheless, this assumption might not hold for religious diversity indices since this type of diversity might apparently change in a shorter horizon. For instance, the transition from a democracy to an authoritarian regime could lead religious diversity to a spurious decrease since it would be impossible to count individuals belonging to non-authorized religions. Likewise, it has to be taken into account that religion can be considered as a dynamic process. In fact, the ways of interpreting and practicing by the religious groups may change over time, as well as the individual's sense of belonging to a precise group. Therefore, whenever data became available, the accurate measurement of religious diversity would require dynamic indices.

Furthermore, when focusing on conflicts, another problem of endogeneity arises since the antagonism captured by the polarization index can be due to previous conflicts. This issue is addressed in Section 5.2.

As far as birthplace diversity is concerned, this is a more frequently changing index due to the increasing migratory flows. In this case, the endogeneity problems cannot be left aside. The positive relationship with economic performance found by Alesina, Harnoss, and Rapoport, (2016) and Bove and Elia (2017) can be due to the good performance of the high-income destination that encourages immigration and not the other way around. To tackle these issues, both papers use an instrumental variable approach. These studies specify a gravity model to predict the size and diversity of a country's immigration by employing bilateral geographic/cultural variables. They construct instruments for birthplace diversity using the predicted bilateral migration shares estimated from gravity models. The robustness of their initial findings is subsequently confirmed in IV-regressions.

With respect to groupings based on a set of individual characteristics, endogeneity problems have also been taken into account. In fact, potential endogeneity is a problem that has repeatedly preoccupied researchers dealing with the effects of genetic diversity on both economic development (Ashraf & Galor, 2013a; Depetris-Chauvin & Özak, 2020) and conflict (Arbatli et al., 2020). Genetic diversity could reflect historical processes such as interregional migrations that were, in turn, determined by historical patterns of comparative development. Thus, in the course of human history, both economic growth differences and conflicts have plausibly altered the observed levels

of genetic diversity. In surmounting these potential issues of endogeneity, most of the research on this topic has implemented one of several empirical strategies based mainly on the Out-of-Africa hypothesis and on the serial founder effect, as analyzed in Section 2.2. On the one hand, the predicted genetic diversity (precolonial and contemporary) is estimated by exploiting the explanatory power of migratory distance from Africa for observed genetic diversity. Since the migratory distance of a country's prehistorically indigenous population from East Africa has no direct effect on current development or contemporary conflicts, potential endogeneity problems are mitigated. On the other hand, once the exogeneity of the migratory distance has been tested, this variable is used as an instrument in the estimates of the relationships between genetic diversity and economic development or conflicts.

Moreover, research into the effects of genetic diversity on the contemporary era addresses the possible endogeneity bias that can generate the impact of great cross-country migrations in the post-1500 era. In order to tackle this problem, empirical investigations carry out regressions for restricted samples, from which those countries that can cause disturbances are eliminated. The models for panels centered on a subsample of countries in the Old World are thereby estimated, since while post-1500 population flows exerted a marked effect on the genetic diversity of national populations in the Americas and Oceania, the diversity of populations in Africa, Europe, and Asia remained largely unaltered. These strategies towards addressing potential endogeneity have also been employed in the study of the relationships between genetic diversity and other measures of fragmentation (Ashraf & Galor, 2013b).

On the other hand, Desmet, Ortuño-Ortín, and Wacziarg (2017) are also aware of a potential problem of endogeneity, whereby the cultural diversity index may change when the population suffers civil conflicts since these can lead people to change their values, beliefs, and preferences, and, therefore, to modify their responses to the questions from the World Values Survey. In order to address this endogeneity concern, they rerun the regressions while performing two strategies. First, they include cultural indices that select only the questions with a higher degree of persistence, as these tend to be less influenced by external events such as conflicts. Second, they limit the sample, on the one hand, to the post-1970 period and, on the other hand, to respondents born before 1950 and to the post-1970 sample. In the two cases, if endogeneity were an issue, then there would be major changes in the results of the estimations with the restricted samples in comparison with those of the full sample. The results obtained after applying these approaches remain similar to those of the previous approaches.

The most relevant economic and social results that can be explained through the social diversity indicators included in this work can now be discussed. Our focus is mainly on two outcomes that have attracted the most attention in the empirical literature on social diversity: economic growth and conflicts.

5.1 | Diversity, economic growth, and income

A first look at the descriptive statistics and simple correlations for our sample can help illustrate the relationship between diversity and income. For ethnolinguistic fractionalization and segregation, the mean of the indices decreases from low-income countries to high-income countries, while the correlation with the income per capita remains negative. More precisely, it is above 0.33 in absolute values for the indices computed by Alesina et al. (2003), Montalvo and Reynal-Querol (2005a, 2005b), and Desmet et al. (2012) for the highest level of disaggregation and also for ethnic and linguistic segregation indices constructed by Alesina and Zhuravskaya (2011) (see Tables A2

and A5, Appendix I). However, the results differ for other fractionalization indices and polarization indices (see Table A3 for the former and Table A7 for the latter). In fact, for birthplace and cultural fractionalization indices, the relationship is positive.

With respect to grouping based on one dimension, as shown in Table 4, all the studies reviewed conclude that there is a statistically significant negative relationship between *ethnolinguistic fractionalization* and economic growth at country level. This result holds for both the several specifications of the index (ethnic: Alesina et al. (2003); linguistic: Alesina et al. (2003), Desmet et al. (2012); ethnic-linguistic: Easterly and Levine (1997), Montalvo and Reynal-Querol (2005b)) and for the different models estimated by including various control variables (initial income, education, population, openness, institutional quality, conflicts, and regional dummies). Nevertheless, Alesina and La Ferrara (2005) argue that ethnolinguistic heterogeneity can be beneficial in high-income countries since they have the tools to capture the positive effects of the diversification of the production process due to the variety of skills generated by ethnic diversity. In addition, highly developed countries contain institutions that are more capable of overcoming the costs of heterogeneity in terms of conflicts and social unrest. Therefore, these arguments explain why the negative relation between income and ethnic heterogeneity for cross-country studies could vanish in richer countries.

Desmet et al. (2012) computed measures of diversity at different levels of linguistic aggregation, and achieved results that introduced relevant nuances. Although ethnolinguistic fractionalization and growth bear a negative relationship at all levels, it is only significant for the most disaggregated groups (level 6 to level 15). These authors argue that economic growth is affected by finer linguistic divisions since it requires ethnolinguistic groups to possess the ability to coordinate and interact in networks of production, knowledge, and trade. The ability to form those networks is hampered when language differences hinder group interaction.

Furthermore, Montalvo and Reynal-Querol (2005b) conclude that there is a direct link between ethnolinguistic fractionalization and economic growth. They introduce investment, public consumption, and wars as channels and find them non-significant.

It is also worth noting that Alesina and la Ferrara (2005) and Montalvo and Reynal-Querol (2020) stress the role of spatial disaggregation in explaining the relationships between ethnolinguistic fractionalization and growth. In fact, Montalvo and Reynal-Querol (2020) show that this relationship is positive at a very high degree of geographical disaggregation. As mentioned in the Introduction, fractionalization exerts positive and negative effects on economic performance and, according to these authors, the dominance of one of the two effects depends heavily on the level of spatial disaggregation at which the analysis is performed. The positive effects through productivity dominate at higher levels of disaggregation, where the issues related to conflicts on the provision of public goods and the low quality of institutions are less relevant (cities or neighborhoods). These problems start to take center stage as the level of disaggregation decreases. This explains why, in many studies at a country level, the negative effects on economic growth outweigh the positive effects of ethnolinguistic diversity, while studies across localities find a positive association between ethnolinguistic heterogeneity and economic performance. Along these lines are found the results achieved, for example, by Alesina and La Ferrara (2005) and Sparber (2010) for US cities, Nathan (2011) for the UK, Suedekum et al. (2014) for Germany, and Bakens et al. (2013) for the Netherlands.[xvi] Related to this issue, Desmet et al. (2020) argue that the social antagonism between groups reflected by the ethnic fractionalization index at country level may be mitigated or enhanced by local interaction between members of different groups. Therefore, the incidence of ethnic fractionalization on outcomes at country level can change when this local interaction is taken into account.

As far as *religious fractionalization* is concerned, both Alesina et al. (2003) and Montalvo and Reynal-Querol (2005b) find that it has no effect on growth. To explain this different result with respect to ethnolinguistic fractionalization, Alesina et al. (2003, p. 167) argue that religious fractionalization is "more endogenous" than ethnic or linguistic fractionalization, since individuals can change their religion for social or economic reasons but not their ethnicity or mother tongue. In addition, as mentioned above, religious fractionalization can be a signal of a more tolerant and democratic society. In repressive regimes, the population may be forced to hide their true religion and join the official cult, thereby changing the religious composition and reflecting a deceptive religious homogeneity. This is much more difficult for racial origin, especially if it relates to skin color.

This difference in the results when considering religious fractionalization instead of ethnolinguistic fractionalization is also found, for instance, by Bluhm and Thomsson (2020). These authors show that, in a society with weak institutions, ethnolinguistic fractionalization lengthens economic declines because coordination and agreements between groups become more difficult. However, this effect vanishes if, instead, religious fractionalization is included in the estimations.

The results for birthplace fractionalization are in complete contrast to that above. Alesina, Harnoss, and Rapoport (2016) and Bove and Elia (2017) conclude that *birthplace fractionalization* has a positive and significant link with economic performance that holds for all specifications, and it is robust when potential problems of reverse causality are taken into account. More precisely, Alesina, Harnoss, and Rapoport (2016) find that this positive link is stronger for skilled immigrants in richer countries, and those from countries at intermediate levels of cultural distance. The positive association between birthplace fractionalization and economic development, unlike the negative association found for ethnicity, is based on the fact that birthplace fractionalization allows for complementarity of skills, since immigrants have different backgrounds, which enhances productivity (Lazear, 1999). Nevertheless, different ethnolinguistic groups do not necessarily imply different skills if they share the country of birth. In fact, as mentioned in Section 3, birthplace fractionalization is not correlated with the other fractionalization indices[xvii] considered in this work (see Table A4 in Appendix I). On the other hand, Bove and Elia (2017) find that this positive and significant relationship is stronger for longer periods of time and that it is maintained when polarization indices are used. However, when they analyze developing and developed countries separately, they find that the relationship is only significant for the panel of developing countries. Another interesting study that analyses the effects of cultural diversity (approximated by birthplace) on output growth is carried out by Ager and Brückner (2013) for the US during the age of mass migration. They illustrate the importance of including fractionalization and polarization jointly in the regression model since each type of index captures different effects. When these indices are introduced together, they find a positive and significant relationship between birthplace fractionalization and economic growth, while the relationship with polarization is negative and also significant.

With respect to *genetic fractionalization*, Ashraf and Galor (2013a) showed that observed and predicted genetic diversity generates a persistent hump-shaped influence on development outcomes in both historical and contemporary time periods (population density in 1500 and income per capita in 2000, respectively), once institutional, cultural, and geographical factors are considered. The economic performance of ethnic groups, countries, and regions that are characterized by intermediate levels of genetic diversity is documented to be higher than that associated with extremely homogenous or heterogeneous societies. Moreover, they estimated the optimal levels of diversity, and concluded that the level of diversity most conducive to economic development is found to be higher in the contemporary period, relative to the pre-industrial era. The

hump-shaped relationship reflects a fundamental trade-off between beneficial and detrimental effects of diversity on productivity at the societal level. In this respect, the authors provide evidence of a positive and significant relationship between genetic diversity and scientific production (as a proxy for innovation) and a negative relationship with interpersonal trust.

The initial empirical analysis by Ashraf and Galor (2013a) has been confirmed and extended by extensive ongoing research.[xviii] The hump-shaped results also hold when contemporary comparative development is measured by the cross-country variation in per-capita-adjusted night-time luminosity (Ashraf et al., 2014) or when different levels of aggregation are considered (Ager & Brüeckner (2018) for US counties; Cook and Fletcher (2018) for high schools from Wisconsin). Furthermore, Depetris-Chauvin and Özak (2020) provides prima-facie empirical evidence consistent with the upward sloping side of the Ashraf and Galor's hump-shaped results, by documenting a significant and causal positive relationship between intra-ethnic diversity (approximated through measures of genetic and linguistic diversity at ethnicity level) and economic specialization in pre-industrial times.

Therefore, the relationship between economic growth and genetic and ethnolinguistic fractionalization differs. As pointed out by Arbatli et al. (2020), these different results may be due to the fact that the former is based on individual characteristics and hence it captures not only heterogeneity in inter-groups as fractionalization, but also captures heterogeneity in intra-groups.

Moreover, several of the revised studies also analyze the relationship between growth and ethnolinguistic diversity measured by polarization indices (Desmet et al., 2012; Montalvo & Reynal-Querol, 2005b), and conclude that this link is not significant (Table 5). According to Montalvo and Reynal-Querol (2005b), this result may be caused by *ethnolinguistic polarization* harming economic growth through channels of a more indirect nature: it fosters rent-seeking mechanisms and gives rise to problems in the design and performance of policy measures on public investment and education. With respect to *religious polarization*, Montalvo and Reynal-Querol (2005b) also find no association with growth. However, Bove and Elia (2017) find that the positive effect of *birthplace* fractionalization on economic growth holds for *polarization*, and obtain coefficients of very similar magnitude for the two indices.

Finally, the contribution of Desmet, Ortuño-Ortín, and Wacziarg (2017) on the relationship between ethnicity and culture deserves to be highlighted.[xix] They find that ethnolinguistic and *cultural diversity* are not related. Therefore, it cannot be assumed that ethnolinguistic diversity involves cultural heterogeneity, as is commonly assumed in the economic literature. This research empirically demonstrates that most cultural heterogeneity occurs within groups rather than between groups. However, although the cultural differences between ethnolinguistic groups are small, they are relevant in explaining political economy outcomes (income, public goods provision, and conflicts). Ethnic divisions matter for those outcomes, but only when they overlap with cultural cleavages. In fact, Desmet, Ortuño-Ortín, and Wacziarg (2017) find that the relationship between ethnolinguistic fractionalization and GDP per capita is not significant, but that the measures of overlap between culture and ethnicity have a robust negative effect on income. Thus, in societies where individuals differ from each other in both ethnicity and culture, economic outcomes are worse.

The indices employed by Desmet, Ortuño-Ortín, and Wacziarg (2017) to analyze the overlap between ethnicity and culture can be applied to other dimensions, such as the level of education achieved and the level of income. If belonging to an ethnicity predicts either or both of these characteristics, then it may reveal that antagonism between ethnolinguistic groups could be due, not specifically to race, but to the differences in other features. In this vein, it is also worth highlighting the ethnic inequality index developed by Alesina, Michalopoulos, and Papaioannou (2016), which

captures the differences in the mean income across ethnic groups. They obtain a strong negative association of their index with economic development. This negative association holds when the fractionalization indices are incorporated, while the effects of the fractionalization indices on GDP vanish.

5.2 | Diversity and conflicts

The literature on the effects of diversity on conflicts is mainly focused on civil wars. This poses two previous issues: the definition of civil war; and whether to use the onset or the incidence of the conflict. Following Esteban and Mayoral (2011, p. 10) "A country is at war when one of the parties is the government and the number of human casualties goes beyond a threshold level within a given time period. This definition admits different specifications depending on the threshold level of the dead and the length of the time period (1 year, 5 years, or the duration of the armed conflict)". Therefore, the empirical contributions use several indices for measuring civil conflicts. On the other hand, we have to distinguish between conflict onset and the incidence of the conflict. According to the former, being in conflict is the transition from peace to conflict, while the incidence thereof refers to the time period in which the country remains in conflict.[xx] This distinction could matter since, at least theoretically, the reasons that explain the beginning of a conflict may differ from those that cause the conflict to last. Nonetheless, the impact of ethnolinguistic and religious polarization holds for both distinctions. In this vein, Desmet et al. (2012) focus on conflict onsets, but their results are robust to incidence, while Esteban et al. (2012) consider the incidence of the conflicts, and verify whether their findings hold for conflict onset.

The seminal papers by Collier and Hoeffler (1998, 2004) address the economic causes of civil war and pose the question of whether conflicts are motivated by greed and/or grievance. Ethnic identification within the group may fuel greed because it facilitates cooperation to achieve economic goals, while inter-group antagonism exacerbates grievance. Thus, according to this argument, ethnic homogeneity could enhance conflicts, but Collier and Hoeffler (2004) later argued that this is not supported by their data. Therefore, grievances caused by ethnic diversity could feature in the origins of the conflicts.[xxi]

As can be observed from Tables 4 and 5, although most of the studies conclude that *ethnolinguistic diversity* is positively related to different indicators of conflicts, the results are more robust using polarization indices than fractionalization indices. In this vein, Montalvo and Reynal-Querol (2005a) and Esteban et al. (2012) found no significant relationship with a fractionalization index, as in the seminal papers of Collier and Hoeffler (1998, 2004) and Fearon and Laitin (2003), but when introducing a polarization index, the results achieved are positive and statistically significant for all the estimated specifications. This difference between the effects of ethnolinguistic fractionalization and polarization on conflicts can be due to the fact that fractionalization is not the appropriate index to capture potential ethnic conflict (see Esteban & Ray, 2011; Montalvo & Reynal-Querol, 2005a; Reynal-Querol, 2002; and Esteban et al., 2012). In fact, according to Horowitz (1985), highly homogeneous and highly heterogeneous societies are less likely to experience conflicts than societies where a large ethnic minority faces an ethnic majority. This relation cannot be captured by a positive relationship between fractionalization and conflict, since it implies that the probability of a conflict is increasing with the number of ethnic groups. In the same respect, Collier and Hoeffler (1998) argue that the threat of a civil war is much greater when societies are polarized into two groups than when they are highly fractionalized since, in this latter case, the coordination costs of rebellion are higher. Therefore, as pointed out by Reynal-Querol

(2002), Montalvo and Reynal-Querol (2005a), and Esteban and Ray (1999), the polarization index seems to be the appropriate index to measure the ethnic divisions that can originate conflicts.

Moreover, Desmet et al. (2012) only find that the relationship between ethnolinguistic diversity and various indicators of conflict is significant at the most aggregated levels of the linguistic heterogeneity indices. They find that deep cleavages lead to better predictors of civil conflict since they better explain the differences in the preferences of the individuals who are usually those behind said conflicts. Esteban et al. (2012) carry out a complete analysis of the relationships between ethnolinguistic diversity and conflicts, by jointly using a fractionalization index, a polarization index, and introducing distances between groups. They distinguish between conflicts over public and private goods and find polarization to correlate positively with conflict on the former, and fractionalization to correlate positively with the latter. Thus, ethnic polarization will influence conflict if the prize is public (and group cohesion is high), and ethnic fractionalization will influence conflict if the prize is private (and group cohesion is also high). Finally, the results are robust when the distance described in expression (5) is used.

With respect to the incidence of *religious diversity* on conflicts, Collier and Hoeffler (2004) and Montalvo and Reynal-Querol (2005a, 2005b) find that religious fractionalization is not significant in explaining conflicts, or is even negative in certain specifications. This can be a reflection of the fact pointed out by Alesina et al. (2003). These authors argue that high religious fractionalization is a signal of a more tolerant society; if this is the case then tolerance may help towards preventing conflicts. Moreover, Montalvo and Reynal-Querol (2005b) show that religious polarization does increase the likelihood of a civil conflict. Along the same lines, Esteban and Mayoral (2011) show that a religious polarization index with continuous distance, instead of the *POLRQ* of discrete polarization employed by Montalvo and Reynal-Querol (2005b), also bears a positive relationship with conflicts.

On the other hand, Arbatli et al. (2020) provided evidence that interpersonal population diversity (measured through *genetic diversity* at both country level and ethnicity level) represents a strong predictor of historical and contemporary civil conflicts. A positive, highly significant, and robust reduced-form causal influence of population diversity on various conflict outcomes is documented. Moreover, the research provides empirical evidence that their findings reflect the contribution of population diversity to the non-cohesiveness of society (as reflected partly in the prevalence of mistrust, the divergence in preferences for public goods and redistributive policies, and the degree of fractionalization and polarization across ethnic, linguistic, and religious groups). These results hold when endogeneity is addressed.

Furthermore, Desmet, Ortuño-Ortín, and Wacziarg (2017) conclude that ethnolinguistic diversity per se has no effect on civil conflicts. These conflicts become more likely when differences in culture coincide with ethnic differences. By contrast, when *cultural diversity* exerts an effect, then it is in a reduction of conflict. The authors interpret these findings in the same way as do Alesina et al. (2003), that is, they deem cultural diversity as a sign of tolerance of a society towards a multiplicity of values and preferences, which reduces the probability of civil conflicts.

Finally, depending on the way in which distance across groups is measured, endogeneity problems might arise when polarization indices with continuous distance across groups are employed to explain conflicts. If the sentiment of identity or affinity in attitudes and values are employed to measure distance, then conflicts are being used to explain conflicts, since previous conflicts are likely to increase distances in attitudes and to strengthen the sentiment of identity. In order to avoid this problem of endogeneity, Montalvo and Reynal-Querol (2008) advocate the use of discrete distance and Esteban et al. (2012) employ the linguistic distance between groups (see

Section 3), which, at the same time, can be regarded as exogenous to conflict[xxii] and, to a certain extent, can enhance antagonisms between groups.

As mentioned in Section 4.2, Esteban and Mayoral (2011) incorporate distance measured as the intensity of the ethnic and religious feelings, which, in turn, can be both the cause and the result of conflicts. In order to tackle this potential issue of endogeneity, these authors carry out an instrumental variable analysis and, in the spirit of Fearon (2003), employ the language distance as an instrument for the polarization indices with continuous distance. Their results on the significance of ethnic and religious polarization in explaining conflicts hold in regressions with instrumental variables.

6 | CONCLUDING REMARKS

This paper aims to disentangle the complex issues that arise from measuring social diversity, in order to shed some light on the effects of diversity on socio-economic variables at country level.

To this end, we have analyzed fractionalization and polarization indices, and distinguished between those calculated with discrete distance and those of continuous distance. For each index, we have delved into their main features: the theoretical concepts underlying each measure, the type of diversity chosen (ethnic, linguistic, ethnic-linguistic, religious, birthplace, or grouping based on a set of individual characteristics), the database selected, the level of group disaggregation, and the years and number of countries for which the indices are available.

Once the similarities and differences between indices have been discussed, we have focused on their relationships with economic performance and conflicts, since these are the socio-economic outcomes that have been most analyzed by the scientific literature. Furthermore, special attention has been paid to the issue of endogeneity. In this vein, one of the main problems concerning the social diversity measures reviewed in the present paper is that they change over time. This issue may represent a drawback in the analysis of the relationships between social diversity and socio-economic outcomes. Thus, whenever the availability of primary data allows, the construction of dynamic indices is recommended.

From a theoretical point of view, the effects of social diversity on these socio-economic outcomes remain mixed. On the one hand, social diversity has a positive impact since, when translated into a diversity of abilities and skills, it may foster innovative activity and creativity, boost specialization, and promote faster adaptation to changing environments, which, in turn, can lead to improvements in productivity and economic growth. In contrast, negative effects can also arise from social diversity because it may erode interpersonal trust and social cohesion, which generate inefficiencies in the provision of public goods and hamper economic coordination, thereby explaining a greater risk and intensity in civil conflicts and adverse effects on economic performance.

As documented in the paper, the fact that certain effects prevail over others depends largely on how social diversity is measured. In this work, significant differences have been found that are largely based on: (1) the type of social diversity considered and the way of grouping; (2) the type of index chosen; and (3) the level of disaggregation for which the analysis is performed.

(1) Different ways of grouping lead to different socio-economic outcomes. When social diversity is approximated through indices of ethnolinguistic fractionalization, the studies analyzed find a negative and significant relationship with economic growth (Alesina et al., 2003; Desmet et al., 2012; Easterly & Levine, 1997; Montalvo & Reynal-Querol, 2005b). However, these results are not significant when the focus is placed on religion (Alesina et al., 2003; Montalvo & Reynal-Querol,

2005b), and they become positive and significant when considering birthplace diversity (Alesina, Harnoss, & Rapoport, 2016; Bove & Elia, 2017). In the case of groupings based on individual characteristics (genetic and cultural diversity), the results are different from those previous since these indices capture, in addition to the diversity inter-groups, the diversity intra-groups. In this respect, research on genetic diversity documents a persistent hump-shaped effect on comparative economic development (Ashraf & Galor, 2013a; Ashraf et al., 2014), while cultural diversity is positively associated to economic performance (Desmet, Ortuño-Ortín, & Wacziarg, 2017).

The way of grouping is also important in explaining the different results concerning the effects of diversity on conflicts. In this case, while the studies that use fractionalization indices based on one dimension (ethnolinguistic, religion, and birthplace) find no significant results (Desmet et al., 2012; Desmet, Ortuño-Ortín, & Weber, 2017; Esteban et al., 2012; Montalvo & Reynal-Querol, 2005b), those that are based on genetic diversity report positive and significant causal results on conflicts (Arbatli et al., 2020).

(2) The results of the reviewed literature differ when fractionalization or polarization indices are considered, for both economic performance and conflicts (Esteban et al., 2012; Montalvo & Reynal-Querol, 2005b). Although most of the studies find that the relationship between ethnolinguistic diversity and economic growth is negative and significant when diversity is measured with fractionalization indices, this relationship is no longer significant when polarization indices are used. In contrast, the relationship between ethnolinguistic diversity and conflicts is significant only for polarization indices. As has been discussed throughout the paper, these results are due to the fact that each type of index enables the capture of different dimensions of diversity.

(3) Regarding disaggregation, on the one hand, we can consider the level of disaggregation when defining the groups. In this respect, the findings of Desmet et al. (2012) are conclusive: the relationship between diversity and growth is only significant at the most disaggregated levels of the index, while the relationship between diversity and conflicts is only significant for the most aggregated levels. The most aggregated levels capture deep cleavages, originating thousands of years ago, which lead to better predictors of conflict. In contrast, growth is more influenced by finer divisions that condition the ability to coordinate.

On the other hand, the level of spatial disaggregation at which the analysis is performed also appears as a major issue. As shown by Montalvo and Reynal-Querol (2020), the positive effects of social diversity on economic growth through productivity dominate at higher levels of spatial disaggregation, where the issues related to conflicts on the provision of public goods and the low quality of institutions are less significant. This explains why studies across localities find a positive association between ethnolinguistic heterogeneity and economic performance, while, in most of the studies at country level reviewed in the present paper, the negative effects of ethnolinguistic diversity on economic growth prevail.

The work carried out in this paper contributes to the research on the effects of social diversity. In an increasingly heterogeneous world, where xenophobic attitudes are spreading, this research has become highly relevant. It is necessary to precisely ascertain the consequences of diversity and the mechanisms that can take full advantage of their effects. This task will provide a suitable guide to social and economic policies.

In further research, it is worth continuing research into ascertaining which dimensions of social diversity do indeed generate antagonism between individuals. Diversity is necessary and will always exist, and hence specifying which of its dimensions lead to that feeling of antagonism that may trigger negative socio-economic effects constitutes a relevant and challenging question, since those dimensions that arouse rejection among individuals change both over time and across geographical areas. In this respect, the overlapping indices employed by Desmet, Ortuño-Ortín,

and Wacziarg (2017) to analyze the relation between ethnicities and culture might well be inspiring because they can be applied to other crucial dimensions in today's societies, such as the level of education achieved, sexual orientation, and political ideology.

Moreover, the ability of each society to manage diversity is also crucial for the positive effects to outperform the negative effects. Van Staveren and Pervaiz (2017) stress social cohesion as a tool to handle diversity successfully. In this vein, Buitrago et al. (2019) highlight tolerance as a key issue in achieving social cohesion in an ethnically diverse society, since it contributes to the integration of all members of a community, which helps overcome frictions caused by diversity. Likewise, Caraballo and Buitrago (2019) point out the decisive role of education in promoting social cohesion since it facilitates social networks and fosters tolerance and cooperativeness. In fact, they show that education enhances the positive effects of diversity and calculate the level of education required to reverse the possible adverse effects of ethnolinguistic diversity on income.

Future research should therefore be focused on a deeper exploration of these and other possible mechanisms, with the aim of guiding the implementation of educational and socio-political institutions towards successfully addressing diversity.

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ENDNOTES

[i] The term "social" diversity is used instead of "population" diversity in order to leave aside the diversity between individuals due to purely economic reasons.

[ii] Alesina and La Ferrara (2005) focus on ethnolinguistic diversity as a dimension of social diversity. However, their arguments can be applied in general to the broader concept of social diversity.

[iii] In order to avoid confusion, we use the terms ethnic, ethnic-linguistic, and linguistic to classify diversity depending on whether the criteria to delimit ethnicity are based, respectively, mainly on racial aspects of physical characteristics, mainly on language, or only on language. When we employ ethnolinguistic diversity, we refer to any (or all) of these categories.

[iv] Many Latin American countries are relatively homogeneous in terms of the language spoken (often that of a former colonizer), but heterogeneity increases when factors related to ethnicity such as skin colour and race are considered. For instance, in Bolivia, Alesina et al. (2003, p. 159) identified the following groups based on race: Whites (10.13%), Aymara (30.38%), Quechua (30.38%), mestizos (25.32%), and other groups (3.80%), and that 87.65% of the population speaks Spanish. Thus, in Latin America, the ethnic fractionalisation index computed by Alesina et al. (2003) is much higher (0.42) than that computed for linguistic fractionalization (0.16). In contrast, they also find the highest linguistic heterogeneity is in Africa (e.g., Liberia (0.903) and Cameroon (0.889)).

[v] In this regard, Alesina et al. (2003, pp. 161) argue that the stability of ethnic fractionalization data at country level poses no problem for a 20- to 30-year horizon. Nevertheless, as we have already pointed out, Dražanová (2020) makes a first attempt in offering a historical index of ethnic fractionalization.

[vi] It is worth noting that this argument holds when it is assumed that country borders are fixed. However, depending on when the birthplace diversity is measured, there could be cases where people born in different countries (e.g., Slovenia and Croatia) could have received their education in the same school system (Yugoslavia).

[vii] Depetris-Chauvin and Özak (2020) find that the migratory distance to East Africa alone explains 72% of the variation in intra-ethnic diversity. Moreover, they test the robustness to origin of serial founder effect by considering alternative origins located in South Africa (as suggested by Chan et al., 2019). The research concludes that the effect of distance from the origin of the SFE on intra-ethnic diversity is practically identical for all origins.

[viii] Ashraf and Galor (2013b) estimate the relationship between genetic diversity and the following measures of ethnoliguistic fragmentation: the log number of ethnic groups, ethnic fractionalization indices of Fearon (2003)

and Alesina et al. (2003); linguistic fractionalization and polarization indices of Desmet et al. (2012) to level 1; and ethnolinguistic polarization indices of Esteban et al. (2012) and Montalvo and Reynal-Querol (2005a). The authors test the robustness of the results by considering a large number of control variables and they address potential endogeneity problems through two strategies: using a panel from Old World countries, and using the instrumental variable migratory distance from East Africa.

[ix] Depetris-Chauvin and Özak (2020) construct intra-ethnic diversity indices by combining geocoded linguistic and genetic data. Specifically, they use the Ethnographic Atlas and the World Atlas of Language Structures to achieve an index of observed intra-ethnic diversity for 116 ethnic groups and a predicted intra-ethnic diversity index for 1265 ethnicities. Arbatli et al. (2020), using a geo-referenced genetic dataset, construct an observed genetic diversity index for 207 ethnic groups and a predicted index for 901 ethnicities.

[x] However, as discussed in Section 4.1., there are arguments in favor of discrete distance instead of continuous distance to measure ethnolinguistic and religious diversity (Montalvo and Reynal-Querol, 2008).

[xi] The first attempts of providing a precise definition of polarization are due to Esteban and Ray (1994) and Wolfson (1994). The latter focuses on the difference between inequality and polarization and constructs a theoretical measure of polarization that can be interpreted using the Lorenz curve. We focus on the contribution of Esteban and Ray (1994) due to its relevance in research on social polarization.

[xii] Montalvo and Reynal-Querol (2005b, pp. 302-304) argue that the rent-seeking models also justify the use of this index to explain conflicts. They obtain the POLRQ index from a simple model of rent-seeking.

[xiii] As noted by Esteban and Mayoral (2011, p. 6), both indices are conceptually closely related. FRAC is the probability that two people drawn randomly belong to different groups, while POLRQ is the probability that, out of three people, two belong to the same group and the third to any other group.

[xiv] Esteban and Mayoral (2011) are aware of the endogeneity problems that this way of measuring distance may involve. This is addressed in Section 5.

[xv] Regarding the case of Somalia, they argue that "While the example of Somalia is interesting, in our sample period, such examples are rare and ethnic fractionalization displays tremendous time persistence" (Alesina et al., 2003, p. 161).

[xvi] However, the comparison between the results obtained by studies at local level with those at country level should be carried out cautiously, since studies at local level often use data on nationalities or birthplace, and, if this is the case, the literature at the country level also finds a positive relationship (See Alesina, Harnoss, & Rapoport, 2016 and Bove and Elia, 2017).

[xvii] The birthplace fractionalization index is also uncorrelated with segregation and polarization indices (see Tables A6 and A8 in Appendix I).

[xviii] See Ashraf and Galor (2018) for a full discussion of the relationship between genetic diversity and development.

[xix] A brief description of the indices used by Desmet, Ortuño-Ortín, & Wacziarg (2017) to analyze the overlap between ethnicity and culture is included in Appendix II.

[xx] Conflicts are usually measured as a binary variable, although there are continuous indices to measure the level of social unrest. See Sambanis (2004), Montalvo and Reynal-Querol (2005a), and Esteban and Ray (2012) for details.

[xxi] More recently, Huber and Mayoral (2019) have found a robust relationship between income inequality within ethnic groups and the severity of civil war.

[xxii] As Esteban and Mayoral (2011, p.9) argue "Distance measures based on linguistic differences appear to be reasonably free from endogeneity as the possible tensions that lead to the split took place hundreds, if not thousands, of years ago. This helps to substantiate a causality relationship between the independent and dependent variables. Yet, this potential causality is, by the nature of the measure quite remote and cannot be directly taken as an immediate cause of the onset of a conflict. Linguistic distances have always been there, but only in some historical instances and in some countries these differences have become activated and developed into a relevant social cleavage".

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APPENDIX I

TABLE A1 Descriptive statistics. GDP per capita

	GDPpc1970	GDPpc1980	GDPpc1990	GDPpc2000	GDPpc2010
LOW-INCOME COUNTRIES					
Mean	692.48	629.10	472.26	410.32	492.63
Median	602.46	531.43	474.97	421.02	429.59
Maximum	1624.33	1461.13	668.33	553.58	896.57
Minimum	265.22	279.95	329.15	228.24	231.19
Observations	10	10	10	10	10
HIGH-INCOME COUNTRIES					
Mean	23760.06	30538.86	38342.90	47136.70	51697.20
Median	23969.42	29264.47	36400.84	43930.94	47910.68
Maximum	32267.08	48538.24	60268.66	81709.66	87770.27
Minimum	17934.19	21865.13	28691.29	35576.77	38893.02
Observations	10	10	10	10	10

Notes: GDPpc1970, GDPpc1980, GDPpc1990, GDPpc2000, and GDPpc2010: gross domestic product per capita, in PPP (purchasing power parity) in constant 2011 international dollars, taken from the World Bank for the years 1970, 1980, 1990, 2000, and 2010, respectively. The classification of the countries by income level has been made in accordance with the criteria of the World Bank. We have selected ten countries that have always featured in the categories of low income and high income during the period for which the classification of the World Bank has been available: 1987–2020. Low-income countries: Burkina-Faso, Central African Republic, Chad, the Democratic Republic of the Congo, Liberia, Madagascar, Mali, Niger, Togo, Sierra Leone. High-Income countries: Australia, Canada, Denmark, Finland, Germany, Japan, Sweden, Norway, the United Kingdom, the United States of America.

APPENDIX II

The overlap between ethnicity and other features, such as income and culture, enables an analysis to be carried out into whether belonging to an ethnic group yields additional information regarding the characteristics of an individual. The overlap is also a way of measuring antagonism, since individuals feel antagonism towards other individuals belonging to different ethnic groups not due to the ethnicity itself, but because different ethnic groups involve different incomes and/or different cultures.

In this vein, Desmet, Ortuño-Ortín, and Wacziarg (2017) study whether different ethnicities do in fact imply different cultures, and therefore different preferences, which is the assumption underlying the negative economic effects of ethnolinguistic diversity. In order to address this issue, they focus on the cultural features extracted from the answers to selected questions of the World Values Survey related to norms, values, attitudes, and preferences (see Table 2). They use two indices. The first index measures the social antagonism (SA) with a χ^2 index. When the

TABLE A2 Descriptive statistics and correlations: Ethnolinguistic fractionalization indices

	ALE	ALL	ETFRAC	ELF1	ELF6	ELF15	SRELF	CDFRAC
TOTAL SAMPLE								
Mean	0.48	0.41	0.48	0.16	0.39	0.50	0.38	0.32
Median	0.52	0.40	0.50	0.06	0.40	0.54	0.37	0.32
Obs.	108	108	108	108	108	108	74	108
LOW-INCOME COUNTRIES								
Mean	0.73	0.69	0.70	0.16	0.54	0.75	0.57	0.47
Median	0.75	0.79	0.75	0.05	0.62	0.83	0.66	0.54
Obs.	24	24	24	24	24	24	5	24
LOWER-MIDDLE-INCOME COUNTRIES								
Mean	0.52	0.48	0.56	0.15	0.45	0.59	0.49	0.33
Median	0.53	0.46	0.60	0.034	0.50	0.69	0.54	0.28
Obs.	25	25	25	25	25	25	18	25
UPPER-MIDDLE-INCOME COUNTRIES								
Mean	0.48	0.33	0.48	0.20	0.28	0.37	0.40	0.27
Median	0.54	0.33	0.48	0.12	0.26	0.32	0.38	0.29
Obs.	25	25	25	25	25	25	21	25
HIGH-INCOME COUNTRIES								
Mean	0.26	0.23	0.26	0.12	0.32	0.34	0.27	0.23
Median	0.16	0.16	0.21	0.04	0.20	0.31	0.16	0.18
Obs.	34	34	34	34	34	34	30	34
LOW POLITICAL STABILITY								
Mean	0.57	0.48	0.55	0.18	0.46	0.57	0.47	0.37
Median	0.65	0.55	0.63	0.12	0.50	0.66	0.49	0.43
Obs.	65	65	65	65	65	65	38	65
HIGH POLITICAL STABILITY								
Mean	0.34	0.30	0.36	0.12	0.29	0.40	0.28	0.24
Median	0.25	0.25	0.35	0.04	0.15	0.36	0.16	0.18
Obs.	43	43	43	43	43	43	36	43
CORRELATIONS								
GDPpc00	−0.50	−0.36	−0.46	−0.21	−0.17	−0.28	−0.25	−0.27
GDPpc10	−0.51	−0.37	−0.47	−0.19	−0.18	−0.32	−0.27	−0.28
PS	−0.44	−0.31	−0.36	−0.21	−0.33	−0.33	−0.43	−0.31

Notes: ALE and ALL: ethnic and linguistic fractionalization indices, respectively, obtained by Alesina et al. (2003); ETFRAC: ethnolinguistic fractionalization index provided by 2005aMontalvo and Reynal-Querol (2005a, 2005b); ELF1, ELF6 and ELF 15: linguistic fractionalization indices computed by Desmet et al. (2012) disaggregated by levels 1, 6, and 15 respectively, available in Ethnologue; SRELF: ethnolinguistic fractionalization index based on self-reported ethnic and/or linguistic identity by individuals obtained by Desmet, Ortuño-Ortín, and Wacziarg (2017); CDFRAC: ethnolinguistic fractionalization index with continuous distance computed by Fearon (2003); GDPpc00 and GDPpc10: gross domestic product per capita, in PPP (purchasing power parity) in constant 2011 international dollars, taken from the World Bank for years 2000 and 2010 respectively. The classification

(Continues)

TABLE A2 (Continued)

of the countries by income level has been made in accordance with the criteria of the World Bank (2016). PS: political stability index taken from the World Governance Indicators. This index varies from −2.5 (minimum political stability) to 2.5 (maximum political stability. We have considered countries below (over) 0 as countries of low (high) stability.

ethnic groups reflect the population distribution of answers, then the index takes low values, while higher values indicate an increasing group-specificity.

In order to obtain the SA index, let us consider $i = 1 \ldots I$ ethnic groups, $q = 1 \ldots Q$ questions selected from the WVS, and $r(q) = 1 \ldots R(q)$ possible answers to each question q. Desmet, Ortuño-Ortín, and Wacziarg (2017) define the antagonism felt by an individual belonging to group i who gives an answer $r_j(q)$ to a question q. The individual feels antagonism when the members of their group i give an answer that differs from $r_j(q)$ to a question q. Social antagonism for a given question q and a reply $r_j(q)$ is therefore defined as the antagonism felt by an individual when the members of any ethnic group give an answer different from $r_j(q)$ for a question q (see Table A11 for the definitions of these two measures). Finally, the SA index captures the antagonism arising from the different answers given to the same question, and it is defined as a weighted average of the social antagonism for a given question q:

$$SA = \frac{1}{Q} \sum_{q=1}^{Q} \sum_{i=1}^{I} \sum_{r(q)=1}^{R(q)} \frac{\pi_i (\pi_i^{q,r(q)} - \pi^{q,r(q)})^2}{\pi^{q,r(q)}}$$

where $\pi^{q,r(q)}$ is the percentage of the overall population that gives answer $r(q)$ to a question q, and $\pi_i^{q,r(q)}$ is the percentage of individuals of ethnic group i that give answer $r(q)$ to a question q.

The second index is a fixation index that captures the share of the total variation in culture due to the differences between ethnic groups. It ranges from zero, which indicates that the ethnic group of an individual gives no information regarding the answers, to one, which indicates that the ethnic identity can accurately predict the answers. Desmet, Ortuño-Ortín, and Wacziarg (2017) consider the within-cultural diversity (CUF^W) for all ethnic groups as the weighted average of the cultural fractionalization within a group I (see Table A11). Finally, the Fixation Index is the cultural fractionalization that cannot be explained by the within-cultural diversity across ethnic groups:

$$F_{ST} = \frac{CUF - CUF^W}{CUF}$$

Desmet, Ortuño-Ortín, and Wacziarg (2017) conclude that ethnic diversity is not a good proxy of cultural diversity, given the low values of SA and the Fixation Index obtained in their study.

TABLE A3 Descriptive statistics and correlations: Religious, birthplace, genetic and cultural fractionalization indices

	ALR	RFRAC	MIG00	MIG90	PDIV	CUF
TOTAL SAMPLE						
Mean	0.44	0.31	0.12	0.13	0.72	0.52
Median	0.43	0.30	0.04	0.05	0.73	0.53
Observations	108	108	108	108	108	74
LOW-INCOME COUNTRIES						
Mean	0.47	0.46	0.05	0.08	0.74	0.52
Median	0.54	0.52	0.03	0.05	0.74	0.54
Observations	24	24	24	24	24	5
LOWER-MIDDLE-INCOME COUNTRIES						
Mean	0.43	0.35	0.06	0.08	0.72	0.50
Median	0.42	0.36	0.02	0.02	0.74	0.50
Observations	25	25	25	25	25	18
UPPER-MIDDLE-INCOME COUNTRIES						
Mean	0.38	0.31	0.06	0.07	0.70	0.53
Median	0.31	0.29	0.03	0.02	0.71	0.53
Observations	25	25	25	25	25	21
HIGH-INCOME COUNTRIES						
Mean	0.46	0.17	0.26	0.24	0.72	0.54
Median	0.42	0.05	0.19	0.12	0.73	0.54
Observations	34	34	34	34	34	30
LOW POLITICAL STABILITY						
Mean	0.39	0.35	0.08	0.10	0.72	0.51
Median	0.37	0.36	0.02	0.04	0.73	0.52
Observations	65	65	65	65	65	38
HIGH POLITICAL STABILITY						
Mean	0.51	0.24	0.19	0.17	0.72	0.54
Median	0.55	0.10	0.11	0.10	0.73	0.54
Observations	43	43	43	43	43	36
CORRELATIONS						
GDPpc00	0.04	−0.43	0.48	0.38	0.00	0.34
GDPpc10	0.05	−0.45	0.46	0.37	−0.01	0.34
PS	0.18	−0.26	0.29	0.23	−0.13	0.45

Notes: ALR religious fractionalization index obtained by Alesina et al. (2003); RFRAC: religious fractionalization index provided by Montalvo and Reynal-Querol (2005a, 2005b); MIG00 and MIG90: birthplace diversity indices for years 2000 and 1990 respectively, computed by Alesina , Harnoss, and Rapoport (2016); PDIV: predicted genetic diversity provided by Ashraf and Galor (2013a); CUF: cultural fractionalization index. GDPpc00 and GDPpc10: gross domestic product per capita, in PPP (purchasing power parity) in constant 2011 international dollars, taken from the World Bank for years 2000 and 2010 respectively. The classification of the countries by income level has been made in accordance with the criteria of the World Bank (2016). PS: political stability index taken from the World Governance Indicators. This index varies from −2.5 (minimum political stability) to 2.5 (maximum political stability. We have considered countries below (over) 0 as countries of low (high) stability.

TABLE A4 Ethnolinguistic, religious, birthplace, genetic, and cultural fractionalization indices: Correlations

	ALE	ALL	ETFRAC	ELF1	ELF6	ELF15	SRELF	CDFRAC	ALR	RFRAC	MIG00	MIG90	PDIV
ALE	1.00												
ALL	0.69	1.00											
ETFRAC	0.81	0.76	1.00										
ELF1	0.33	0.33	0.26	1.00									
ELF6	0.49	0.57	0.45	0.49	1.00								
ELF15	0.71	0.86	0.69	0.43	0.76	1.00							
SRELF	0.74	0.67	0.72	0.42	0.57	0.69	1.00						
CDIV	0.73	0.72	0.68	0.60	0.69	0.76	0.59	1.00					
ALR	0.26	0.32	0.30	0.10	0.01	0.28	0.12	0.20	1.00				
RFRAC	0.53	0.48	0.53	0.33	0.36	0.53	0.34	0.49	0.54	1.00			
MIG00	−0.03	0.02	−0.12	0.05	0.21	0.12	−0.02	0.13	0.14	−0.09	1.00		
MIG90	0.02	0.06	−0.07	0.09	0.25	0.16	0.06	0.17	0.12	−0.05	0.97	1.00	
PDIV	0.19	0.27	0.08	−0.14	0.08	0.30	0.06	0.09	0.27	0.06	0.16	0.17	1.00
CUF	−0.13	−0.03	−0.07	0.04	−0.34	−0.23	−0.06	−0.02	0.35	−0.16	0.13	0.07	−0.09

Notes: ALE and ALL: ethnic and linguistic fractionalization indices, respectively, obtained by Alesina et al. (2003); ETFRAC: ethnolinguistic fractionalization index provided by Montalvo and Reynal-Querol (2005a, 2005b); ELF1, ELF6 and ELF 15: linguistic fractionalization indices computed by Desmet et al. (2012) disaggregated by levels 1, 6, and 15, respectively, available in Ethnologue; SRELF: ethnolinguistic fractionalization index based on self-reported ethnic and/or linguistic identity by individuals obtained by Desmet, Ortuño-Ortín, and Wacziarg (2017); CDFRAC: ethnolinguistic fractionalization index with continuous distance computed by Fearon (2003); ALR religious fractionalization index obtained by Alesina et al. (2003); RFRAC: religious fractionalization index provided by Montalvo and Reynal-Querol (2005a, 2005b); MIG00 and MIG90: birthplace diversity indices for years 2000 and 1990, respectively, computed by Alesina , Harnoss, and Rapoport (2016); PDIV: predicted genetic diversity provided by Ashraf and Galor (2013a); CUF: cultural fractionalization index. Correlations have been computed for 108 observations, except for SRELF and CUF, that have been computed for 50 observations.

TABLE A5 Descriptive statistics and correlations: Segregation indices

	ETSEG	ETSEGC	LINGSEG	LINGSEGC	RELSEG	RELSEGC
TOTAL SAMPLE						
Mean	0.11	0.09	0.15	0.10	0.05	0.04
Median	0.06	0.04	0.11	0.06	0.03	0.02
Observations	97	97	92	92	78	78
LOW-INCOME COUNTRIES						
Mean	0.22	0.17	0.21	0.16	0.06	0.05
Median	0.21	0.17	0.19	0.12	0.04	0.03
Observations	16	16	18	18	18	18
LOWER-MIDDLE-INCOME COUNTRIES						
Mean	0.12	0.10	0.21	0.11	0.08	0.07
Median	0.07	0.05	0.22	0.08	0.05	0.04
Observations	24	24	24	24	21	21
UPPER-MIDDLE-INCOME COUNTRIES						
Mean	0.13	0.11	0.14	0.12	0.05	0.04
Median	0.09	0.08	0.10	0.08	0.02	0.01
Observations	21	21	23	23	18	18
HIGH#x02010;INCOME COUNTRIES						
Mean	0.05	0.04	0.07	0.05	0.02	0.01
Median	0.02	0.01	0.04	0.02	0.02	0.01
Observations	36	36	27	27	21	21
LOW POLITICAL STABILITY						
Mean	0.16	0.14	0.20	0.14	0.06	0.06
Median	0.12	0.11	0.15	0.10	0.04	0.02
Observations	53	53	52	52	44	44
HIGH POLITICAL STABILITY						
Mean	0.05	0.03	0.09	0.06	0.04	0.02
Median	0.02	0.01	0.05	0.02	0.02	0.01
Observations	44	44	40	40	34	34
CORRELATIONS						
GDPpc00	−0.36	−0.38	−0.39	−0.30	−0.21	−0.24
GDPpc10	−0.37	−0.38	−0.40	−0.31	−0.22	−0.24
PS	−0.57	−0.57	−0.52	−0.44	−0.25	−0.25
ETSEG	1.00					
ETSEGC	0.95	1.00				
LINGSEG	0.84	0.79	1.00			
LINGSEGC	0.79	0.84	0.79	1.00		
RELSEG	0.32	0.21	0.46	0.15	1.00	
RELSEGC	0.32	0.22	0.42	0.12	0.89	1.00

Notes: ETSEG and ETSEGC: ethnic segregation indices reported by Alesina and Zhuravskaya (2011); LINGSEG and LINGSEGC: linguistic segregation indices provided by Alesina and Zhuravskaya (2011); RELSEG and RELSEGC: religious segregation indices

(Continues)

TABLE A5 (Continued)

provided by Alesina and Zhuravskaya (2011). GDPpc00 and GDPpc10: gross domestic product per capita, in PPP (purchasing power parity) in constant 2011 international dollars, taken from the World Bank for years 2000 and 2010 respectively. The classification of the countries by income level has been made in accordance with the criteria of the World Bank (2016). PS: political stability index taken from the World Governance Indicators. This index varies from −2.5 (minimum political stability) to 2.5 (maximum political stability). We have considered countries below (over) 0 as countries of low (high) stability.

TABLE A6 Segregation and fractionalization indices: Correlations

	ETSEG	ETSEGC	LINGSEG	LINGSEGC	RELSEG	RELSEGC
ALE	0.58	0.51	0.57	0.38	0.24	0.31
ALL	0.49	0.38	0.59	0.30	0.41	0.38
ETFRAC	0.49	0.40	0.56	0.30	0.41	0.38
ELF1	0.25	0.30	0.25	0.18	0.08	0.11
ELF6	0.36	0.30	0.46	0.26	0.37	0.38
ELF15	0.46	0.37	0.56	0.32	0.43	0.41
SRELF	0.50	0.45	0.61	0.33	0.28	0.26
CDFRAC	−0.11	−0.11	−0.11	−0.08	−0.08	−0.09
ALR	−0.03	−0.08	0.07	−0.09	0.09	0.10
RFRAC	0.36	0.30	0.36	0.20	0.40	0.42
MIG00	−0.16	−0.14	−0.22	−0.16	−0.17	−0.16
MIG90	−0.12	−0.10	−0.18	−0.13	−0.17	−0.15
PDIV	0.02	−0.04	0.12	−0.00	0.09	0.17
CUF	−0.28	−0.26	−0.23	−0.20	−0.17	−0.21

Notes: ETSEG and ETSEGC: ethnic segregation indices reported by Alesina and Zhuravskaya (2011); LINGSEG and LINGSEGC: linguistic segregation indices provided by Alesina and Zhuravskaya (2011); RELSEG and RELSEGC: religious segregation indices provided by Alesina and Zhuravskaya (2011); ALE and ALL: ethnic and linguistic fractionalization indices, respectively, obtained by Alesina et al. (2003); ETFRAC: ethnoliguistic fractionalization index provided by Montalvo and Reynal-Querol (2005a, 2005b); ELF1, ELF6 and ELF 15: linguistic fractionalization indices computed by Desmet et al. (2012) disaggregated by levels 1, 6 and 15 respectively, available in Ethnologue; SRELF: ethnolinguistic fractionalization index based on self-reported ethnic and/or linguistic identity by individuals obtained by Desmet, Ortuño-Ortín, and Wacziarg (2017); CDFRAC: ethnolinguistic fractionalization index with continuous distance computed by Fearon (2003); ALR religious fractionalization index obtained by Alesina et al. (2003); RFRAC: religious fractionalization index provided by Montalvo and Reynal-Querol (2005a, 2005b); MIG00 and MIG90: birthplace diversity indices for years 2000 and 1990, respectively, computed by Alesina, Harnoss, and Rapoport (2016); PDIV: predicted genetic diversity provided by Ashraf and Galor (2013a); CUF: cultural fractionalization index.

TABLE A7 Descriptive statistics and correlations: Polarization indices

	POLRQ	POL1	POL6	POL15	EMR	RELPOL
TOTAL SAMPLE						
Mean	0.52	0.28	0.42	0.41	0.04	0.46
Median	0.57	0.11	0.46	0.43	0.02	0.46
Observations	130	130	130	130	130	130
LOW-INCOME COUNTRIES						
Mean	0.53	0.25	0.45	0.41	0.02	0.73
Median	0.57	0.09	0.56	0.38	0.01	0.84
Observations	27	27	27	27	27	27
LOWER-MIDDLE-INCOME COUNTRIES						
Mean	0.53	0.31	0.44	0.40	0.04	0.52
Median	0.53	0.13	0.50	0.43	0.01	0.63
Observations	32	32	32	32	32	32
UPPER-MIDDLE-INCOME COUNTRIES						
Mean	0.64	0.35	0.36	0.37	0.06	0.44
Median	0.66	0.22	0.38	0.44	0.03	0.33
Observations	32	32	32	32	32	32
HIGH-INCOME COUNTRIES						
Mean	0.41	0.20	0.42	0.44	0.04	0.23
Median	0.36	0.07	0.33	0.43	0.02	0.06
Observations	39	39	39	39	39	39
LOW POLITICAL STABILITY						
Mean	0.55	0.33	0.46	0.43	0.04	0.57
Median	0.58	0.23	0.55	0.46	0.02	0.68
Observations	71	71	71	71	71	71
HIGH POLITICAL STABILITY						
Mean	0.48	0.21	0.36	0.37	0.04	0.32
Median	0.49	0.07	0.26	0.31	0.02	0.13
Observations	59	59	59	59	59	59
CORRELATIONS						
GDPpc00	−0.16	−0.15	0.10	0.15	−0.01	−0.40
GDPpc10	− 0.16	−0.14	0.09	0. 14	−0.02	−0.43
PS	−0.20	−0.26	−0.21	−0.12	−0.06	−0.40
POLRQ	1.00					
POL1	0.28	1.00				
POL6	0.29	0.50	1.00			

(Continues)

TABLE A7 (Continued)

	POLRQ	POL1	POL6	POL15	EMR	RELPOL
POL15	0.30	0.32	0.72	1.00		
EMR	0.34	0.79	0.49	0.50	1.00	
RELPOL	0.31	0.34	0.24	0.17	0.17	1.00

Notes: POLRQ: ethnolinguistic polarization index provided by Montalvo and Reynal-Querol (2005a, 2005b); POL1, POL6, POL15: linguistic polarization indices computed by Desmet et al. (2012) disaggregated by levels 1, 6 and 15 respectively, available in Ethnologue; EMR: corrected ethnolinguistic polarization index provided by Esteban et al. (2012); RELPOL: religious polarization index computed by Montalvo and Reynal-Querol (2005a, 2005b). GDPpc00 and GDPpc10: gross domestic product per capita, in PPP (purchasing power parity) in constant 2011 international dollars, taken from the World Bank for years 2000 and 2010 respectively. The classification of the countries by income level has been made in accordance with the criteria of the World Bank (2016). PS: political stability index taken from the World Governance Indicators. This index varies from −2.5 (minimum political stability) to 2.5 (maximum political stability). We have considered countries below (over) 0 as countries of low (high) stability.

TABLE A8 Fractionalization and polarization indices: Correlations

	POLRQ	POL1	POL6	POL15	EMR	RELPOL
ALE	0.50	0.33	0.34	0.14	0.06	0.58
ALL	0.25	0.35	0.35	0.18	0.03	0.49
ETFRAC	0.53	0.27	0.22	0.04	0.01	0.55
ELF1	0.27	0.98	0.46	0.30	0.80	0.36
ELF6	0.23	0.48	0.78	0.52	0.30	0.34
ELF15	0.23	0.43	0.59	0.43	0.10	0.54
SELF	0.46	0.43	0.36	0.31	0.18	0.44
FEARON	0.38	0.60	0.54	0.28	0.33	0.49
ALR	0.10	0.10	−0.02	−0.07	−0.09	0.50
RFRAC	0.28	0.32	0.15	0.05	0.13	0.95
MIG00	0.01	0.01	0.24	0.27	0.04	−0.10
MIG90	0.03	0.05	0.26	0.24	0.05	−0.05
PDIV	−0.18	−0.14	0.07	0.02	−0.39	0.10
CUF	−0.07	0.04	−0.41	−0.33	0.07	−0.17

Notes: POLRQ: ethnolinguistic polarization index provided by Montalvo and Reynal-Querol (2005a, 2005b); POL1, POL6, POL15: linguistic polarization indices computed by Desmet et al. (2012) disaggregated by levels 1, 6, and 15, respectively, available in Ethnologue; EMR: corrected ethnolinguistic polarization index provided by Esteban et al. (2012); RELPOL: religious polarization index computed by Montalvo and Reynal-Querol (2005a, 2005b); ALE and ALL: ethnic and linguistic fractionalization indices, respectively, obtained by Alesina et al. (2003); ETFRAC: ethnolinguistic fractionalization index provided by Montalvo and Reynal-Querol (2005a, 2005b); ELF1, ELF6, and ELF 15: linguistic fractionalization indices computed by Desmet et al. (2012) disaggregated by levels 1, 6, and 15, respectively, available in Ethnologue; SRELF: ethnolinguistic fractionalization index based on self-reported ethnic and/or linguistic identity by individuals obtained by Desmet, Ortuño-Ortín, and Wacziarg (2017); CDFRAC: ethnolinguistic fractionalization index with continuous distance computed by Fearon (2003); ALR religious fractionalization index obtained by Alesina et al. (2003); RFRAC: religious fractionalization index provided by Montalvo and Reynal-Querol (2005a, 2005b); MIG00 and MIG90: birthplace diversity indices for years 2000 and 1990, respectively, computed by Alesina, Harnoss, and Rapoport (2016); PDIV: predicted genetic diversity provided by Ashraf and Galor (2013a); CUF: cultural fractionalization index.
Number of observations: 108, except for SRELF and CUF (50).

TABLE A9 Applications of fractionalization indices (extended)

Indices	Diversity	Dependent variables	Control variables
Fractionalization with discrete distance			
Taylor and Hudson (1972)[1]	Ethnic-linguistic	(-Sig.): *GDPpc Growth*(-Sig.): *Corruption*	Schooling; Assassinations; Financial depth; Black market premium; Fiscal surplus/GDP; Telephones per worker
Alesina et al. (2003)	LinguisticEthnic	(-): *GDPpc Growth*	Annual and Regional dummies; Initial income; Schooling; Assassinations; Financial depth; Black market premium; Fiscal surplus/GDP; Telephones per worker
		(-Sig.): *Government Quality* (Business climate –NS-, Corruption/bureaucratic quality, Taxation –NS-, Size public sector, Size government, Public goods, Schooling and literacy, Political right)	GNP 1970–95; Regional and Legal origin dummies; Religion variables; Latitude; Population 1960
	Religious	Not correlation: *GDPpc Growth*	Annual and Regional dummies; Initial income; Schooling; Assassinations; Financial depth; Black market premium; Fiscal surplus/GDP; Telephones per worker
		(+Sig.): *Government Quality*	GNP 1970–95; Regional and Legal origin dummies; Religion variables; Latitude; Population 1960
Fearon (2003)[2]	Ethnic	(+Sig.): *Conflict Variables* (Armed conflict, Intermediate armed conflict, War, Conflict intensity, Index of social conflict –NS-)	GDPpc; Initial population; % Mountainous, Non-contiguous state; Oil/Diamond; Oil reserves per capita; Political rights; Institutionalized democracy; Executive constraints; Group cohesion; Institutionalized autocracy; Civil liberties; Publicness index
Montalvo and Reynal-Querol (2005a, 2005b)	Ethnic-linguistic	(-Sig.): *GDPpc Growth* (1960 to 1989 organized in 5-year intervals) Direct effect (Canals NS: Investment, Public consumption, Civil wars)	Initial income; Real government consumption/real GDP; Revolutions & coups; Assassinations; Absolute deviation PPP value investment deflator from sample mean; Real domestic investment/GDP, Primary and secondary-school enrolment rates; Civil wars; Regional dummies; Fractionalization (religious) and polarization (ethnic and religious) indices.
		(-NS): *Investment* (Real domestic investment/GDP)	

(Continues)

TABLE A9 (Continued)

Indices	Diversity	Dependent variables	Control variables
		(-NS): *Public Consumption*	Initial income; Revolutions & coups; Assassinations; Civil wars; Democracy index; Fractionalization (religious) and polarization (ethnic and religious) indices.
		(+NS): *Civil Wars*	Initial income; Population; Index of democracy; Regional dummies; Fractionalization (religious) and polarization (ethnic and religious) indices.
	Religious	Not correlation: *GDPpc Growth* (1960 to 1989 organized in 5-year intervals)	Initial income; Real government consumption/real GDP; Revolutions & coups; Assassinations; Absolute deviation PPP value investment deflator from sample mean; Real domestic investment/GDP, Primary and secondary-school enrolment rates; Civil wars; Regional dummies; Fractionalization (ethnic) and polarization (ethnic and religious) indices.
		(-NS): *Investment* (Real domestic investment/GDP)	
		(-NS): *Public Consumption*	Initial income; Revolutions & coups; Assassinations; Civil wars; Democracy index; Fractionalization (ethnic) and polarization (ethnic and religious) indices.
		(+NS): *Civil Wars*	Initial income; Population; Index of democracy; Regional dummies; Fractionalization (ethnic) and polarization (ethnic and religious) indices.
Desmet et al. (2012)	Linguistic	(-Sig.): *Growth* (L6 to L15 disaggregation)	Initial income; Investment/GDP, Schooling years; Population, Openness; Legal origins dummies; Regional dummies
		(-Sig.): *Redistribution* (Transfers and subsidies/GDP) (-Sig. L1; - NS L6 to L15 disaggregation)	GDPpc 1985–95; Population 1985–95; Population above 65; Small Island dummy; Latitude; Legal origins dummies; Regional dummies

(Continues)

TABLE A9 (Continued)

Indices	Diversity	Dependent variables	Control variables
		(Mix): *Output of Public Goods* (Infant mortality (+Sig. L1 to L15); School attainment (-NS L1 to L15); Illiteracy rate (+Sig. L6 to L15); Infrastructure quality index (-NS L1 to L15); health care (NS); measles immunization rates for children (-Sig L1 to L15); access to public services (-Sig. L6 to L15); clean water (-Sig L15); infrastructure (NS)).	Legal origins dummies; Regional dummies; Latitude; GNPpc
		(+Sig.): *Onset Civil Wars* (+Sig. L1; NS L6 to L15 desegregation)	Lagged civil war; Lagged GDP; Lagged population; %Mountainous; Non-contiguous state; Oil exporter; New state; Instability; Democracy lagged; Legal origins dummies; Regional dummies
Esteban et al. (2012)	Linguistic	(+NS): *Conflict Variables* (Armed conflict, Intermediate armed conflict, War, Conflict intensity, Index of social conflict–NS-)	GDPpc; Initial population; %Mountainous, Non-contiguous state; Oil/Diamond; Oil reserves pc; Political rights; Institutionalized democracy; Executive constraints; Group cohesion; Institutionalized autocracy; Civil liberties; Publicness index
Alesina and Zhuravskaya (2011)	LinguisticEthnic	(Mix): *Quality of Government* (Voice, Political stability, Government effectiveness, Regulatory quality, Rule of law, control of corruption). (-Sig.) No controls: (+NS) All controls and both full simple and excluded dictatorships. CANALS LINGUISTIC: (NS) Generalized trust; (+Sig.) Separatist movements; (NS) Subnational budget revenue %. CANALS ETHNIC: (-NS) Ethnic party dummy	GDPpc; Population; Average size of region; Religion dummies; Latitude; Legal origins dummies; Regional dummies; Democratic tradition; %Mountainous

(Continues)

TABLE A9 (Continued)

Indices	Diversity	Dependent variables	Control variables
Desmet Ortuño-Ortín, and Wacziarg (2017)	Ethnic-linguistic identity	(+NS): *GDPpc*	Lagged war; Lagged GDPpc; Lagged population; Mountain %; Non-contiguous territory; Oil; New state; Instability; Democracy lagged; Regional dummies; GDP growth and lagged
		(+NS): *Public Goods* (Variables idem Desmet et al., 2012)	
		(-NS): *Civil Conflict* (Incidence of conflict, Onset of conflict)	
Alesina, Harnoss, and Rapoport (2016)	Birthplace	(+Sig.): *GDPpc* (inverse U-Shaped) (+Sig.) All simple and rich countries; (NS) poor countries	Exogenous (Land area, Landlocked country, Latitude, Population within 100 km from ice free coast; Mean temperature; Mean precipitation); Endogeneous (Genetic diversity, Malaria, Yellow fever and Tuberculosis incidence, Polity2 institutional quality index, Trade openness, Trade diversity, Average GDP/capita at immigrants' origin, Years of schooling, Population size, Regional & Colonial FE)
Bove and Elia (2017)	Birthplace	(+Sig.): *GDPpc*	GDPpc t0; Investment/GDP; Population growth; Average years schooling; Government consumption/GDP; Trade openness/GDP; Ethnic inequality index; Regional dummies
Ashraf and Galor (2013a)[3]	Genetic *(observed and predicted)*	(+Sig./ hump-shaped relationship.): *Development Outcomes* historical and contemporary (population density in 1500; GDPpc 2000) CANALS: (+Sig.) Scientific productivity; (-Sig.) Trust (+Sig.): *Civil Conflict* (Frequency, Incidence, and Onset of civil conflict)	Neolithic transition timing; Land productivity controls; Institutional and cultural controls; Geographical controls; Country-specific disturbance; Legal origins dummies; Regional dummies; Ethnic fractionalization. Geographical Characteristics; Institutional Factors; Ethnolinguistic Fragmentation; Natural Resources and Development Outcomes.
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes	(+Sig.): *GDPpc*	Lagged war; Lagged GDPpc; Lagged population; Mountain %; Non-contiguous state; Oil; New state; Instability; Democracy lagged; Regional dummies; GDP growth and lagged; Genetic diversity

(Continues)

TABLE A9 (Continued)

Indices	Diversity	Dependent variables	Control variables
		(+Sig.): *Public Goods* (Variables idem Desmet et al, 2012)	
		(-Sig.): *Civil Conflict* (Incidence of conflict, Onset of conflict)	
Fractionalization with continuous distance			
Fearon (2003)[2]	Ethnic (Linguistic distance. $\delta = 0.5$)	(-Sig.): *Conflict Variables* (Armed conflict, Intermediate armed conflict, War, Conflict intensity, Index of social conflict)	GDPpc; Initial population; %Mountainous, Non-contiguous state; Oil/Diamond; Oil reserves pc; Political rights; Institutionalized democracy; Executive constraints; Group cohesion; Institutionalized autocracy; Civil liberties; Publicness index
Esteban et al. (2012)	Ethnic (Linguistic distance. $\delta = 0.05$)	(-Sig.): *Conflict Variables* (Armed conflict, Intermediate armed conflict, War, Conflict intensity, Index of social conflict)	
	Linguistic (Linguistic distance. $\delta = 0.5$ and $\delta = 0.05$)	(-NS): *Conflict Variables* (Armed conflict, Intermediate armed conflict, War, Conflict intensity, Index of social conflict)	
Alesina, Harnoss, and Rapoport (2016)	Birthplace (Genetic and GDP distances)	(+Sig.): *GDPpc* Effects largest for immigrants from richer countries and from intermediate levels of cultural proximity	Exogenous (Land area, Landlocked country, Latitude, Population within 100 km from ice free coast; Mean temperature, Mean precipitation); Endogeneous (Genetic diversity, Malaria, Yellow fever & Tuberculosis incidence, Polity2 institutional quality index, Trade openness, Trade diversity, Average GDP/capita at immigrants' origin, Years of schooling, Population size, Regional & Colonial FE)
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes(Distance values)	(+Sig.): *Public Goods* (Variables idem Desmet et al., 2012) (-Sig.): *Civil Conflict* (Incidence of conflict, Onset of conflict)	Lagged war; Lagged GDPpc; Lagged population; Mountain %; Non-contiguous state; Oil; New state; Instability; Democracy lagged; Regional dummies; GDP growth and lagged; Genetic diversity

Notes: [1]The results for Growth were obtained by Easterly and Levine (1997) and those for Corruption by Mauro (1995). Both studies used the Taylor and Hudson (1972) index. [2]The results were obtained by Esteban et al. (2012) using the Fearon (2003) index. [3]The results for Conflicts were obtained by Arbatli et al. (2020) using the Ashraf and Galor (2013a) index.
(+Sig.): positive and significant results, (-Sig.): negative and significant results, (NS): not significant, (Mix.): mixed results.

TABLE A10 Applications of polarization indices (extended)

Indices	Diversity	Dependent variable	Control variables
Polarization with discrete distance			
Montalvo and Reynal-Querol (2005a, 2005b)	Ethnic-linguistic	(NS): *GDPpc Growth* (1960 to 1989 organized in 5-year intervals). Indirect effect (CANALS Sig.: Investment, Public consumption, Civil wars)	Initial income; Real government consumption/real GDP; Revolutions & coups; Assassinations; Absolute deviation PPP value investment deflator from sample mean; Real domestic investment/GDP, Primary and secondary-school enrolment rates; Civil wars; Regional dummies; Fractionalization (ethnic and religious) and Polarization (religious) indices.
		(-Sig.): *Investment* (Real domestic investment/GDP)	
		(+Sig.): *Public Consumption*	Initial income; Revolutions & coups; Assassinations; Civil wars; Democracy index; Fractionalization (ethnic and religious) and Polarization (religious) indices.
		(+Sig.): *Civil Wars*	Initial income; Population; Index of democracy; Regional dummies; Fractionalization (religious) and Polarization (ethnic and religious) indices.
	Religious	(+NS): *GDPpc Growth* (1960 to 1989 organized in 5-year intervals). Indirect effect (CANALS Sig.: Investment, Public consumption, Civil wars)	Initial income; Real government consumption/real GDP; Revolutions & coups; Assassinations; Absolute deviation PPP value investment deflator from sample mean; Real domestic investment/GDP, Primary and secondary-school enrolment rates; Civil wars; Regional dummies; Fractionalization (ethnic and religious) and Polarization (ethnic) indices.
		(-Sig.): *Investment* (Real domestic investment/GDP)	
		(+Sig.): *Public Consumption*	Initial income; Revolutions & coups; Assassinations; Civil wars; Democracy index; Fractionalization (ethnic and religious) and Polarization (ethnic) indices.
		(+Sig.): *Civil Wars*	Initial income; Population; Index of democracy; Regional dummies; Fractionalization (ethnic and religious) and Polarization (ethnic) indices.

(Continues)

TABLE A10 (Continued)

Indices	Diversity	Dependent variable	Control variables
Desmet et al. (2012)	Linguistic	(-NS): *Growth*(L1 to L15 desegregation)	Initial income; Investment/GDP; Schooling years; Population; Openness; Legal origins dummies; Regional dummies
		(-Sig.): *Redistribution* (Transfers and subsidies/GDP) (-Sig. L1; -NS L6 to L15 desegregation)	GDPpc 1985–95; Population 1985–95; Population above 65; Small island dummy; Latitude; Legal origins dummies; Regional dummies
		(Mix): *Output of Public Goods* (Infant mortality (+Sig. L1 to L15); School attainment (-NS L1 to L15); Illiteracy rate (+Sig. L6 to L15); Infrastructure quality (-NS L1 to L15); Health care (NS); Measles immunization rates children (-Sig. L1 to L15); Access public services (-Sig. L6 to L15); clean water (-Sig. L1 to L6); infrastructure (NS))	Legal origins dummies; Regional dummies; Latitude; GNPpc
		(+Sig.): *Onset Civil Wars* (+Sig. L1; - NS L6 to L15 desegregation)	Lagged civil war; Lagged GDP; Lagged population; %Mountainous; Non-contiguous state; Oil exporter; New state; Instability; Democracy lagged; Legal origins dummies; Regional dummies
Esteban et al. (2012)	Ethnic	(+Sig.): *Conflict Variables* (Armed conflict, Intermediate armed conflict, War, Conflict intensity, Index of social conflict–NS-)	GDPpc; Initial population; %Mountainous, Non-contiguous state; Oil/Diamond; Oil reserves pc; Political rights; Institutionalized democracy; Executive constraints; Group cohesion; Institutionalized autocracy; Civil liberties; Publicness index
	Linguistic	(NS): *Conflict Variables* (Variables idem Ethnic)	

(Continues)

TABLE A10 (Continued)

Indices	Diversity	Dependent variable	Control variables
Desmet Ortuño-Ortín, and Wacziarg (2017)	Ethnic-linguistic identity	(+NS): *Public Goods* (Variables idem Desmet et al., 2012)	Lagged war; Lagged GDPpc; Lagged population; Mountain %; Non-contiguous state; Oil; New state; Instability; Democracy lagged; Regional dummies; GDP growth and lagged; Genetic diversity
		(-NS): *Civil Conflict* (Incidence of conflict, Onset of conflict)	
Bove and Elia (2017)	Birthplace	(+Sig.): *GDPpc* (All time 1960-2010 and sub-periods; -Sig. 2000-10)	GDPpc t0; Investment/GDP; Population growth; Average years schooling; Government consumption/GDP; Trade openness/GDP; Ethnic inequality index; Regional dummies
Desmet, Ortuño-Ortín, and Wacziarg (2017)	Cultural attitudes	(-Sig.): *Civil Conflict* (Incidence of conflict, Onset of conflict)	Lagged war; Lagged GDPpc; Lagged population; Mountain %; Non-contiguous state; Oil; New state; Instability; Democracy lagged; Regional dummies; GDP growth and lagged; Genetic diversity
		(+NS): *Public Goods* (Variables idem Desmet et al., 2012)	
Polarization with continuous distance			
Esteban et al. (2012)	Ethnic and Linguistic (Linguistic distance. $\delta = 0.5$ and $\delta = 0.05$)	(+Sig.): *Conflict Variables* (Armed conflict, Intermediate armed conflict, War, Conflict intensity, Index of social conflict)	GDPpc; Initial population; %Mountainous, Non-contiguous state; Oil/Diamond; Oil reserves pc; Political rights; Institutionalized democracy; Executive constraints; Group cohesion; Institutionalized autocracy; Civil liberties; Publicness index

Notes: (+Sig.): positive and significant results, (-Sig.): negative and significant results, (NS): not significant, (Mix.): mixed results.

TABLE A11 Overlapping indices (Desmet, Ortuño-Ortín, and Wacziarg, 2017)

Index	Expression	Definition
Individual antagonism ($v_i^{r(q)}$)	$\frac{\pi_i^{r(q)}-\pi^{r(q)}}{\pi^{r(q)}}$	Antagonism felt individual belonging to group i for a question q with answer $r(q)$
Social Antagonism for a question q (SA^q)	$\sum_{i=1}^{I}\sum_{r\,(q)=1}^{R(q)}\frac{\pi_i(\pi_i^{r(q)}-\pi^{r(q)})^2}{\pi^{r(q)}}$	The social antagonism for a given question q is defined as a χ^2 index.
Social Antagonism (SA)	$\frac{1}{Q}\sum_{q=1}^{Q}\sum_{i=1}^{I}\sum_{r(q)=1}^{R(q)}\frac{\pi_i(\pi_i^{q,r(q)}-\pi^{q,r(q)})^2}{\pi^{q,r(q)}}$	The social antagonism for all selected questions $q = 1\ldots Q$ is a χ^2 index
Cultural fractionalization (CUF)	$\frac{1}{Q}\sum_{q=1}^{Q}(1-\sum_{r(q)=1}^{R(q)}\pi_{q,r(q)}^2)$	Probability that two randomly drawn individuals from a population give different answers to a question
Cultural fractionalization within a group i ($\mathrm{CUF_i}$)	$1-\sum_{r\,(q)=1}^{R(q)}(\pi_i^{r(q)})^2$	Probability that two members of the same ethnic groups give a different answer to a question
Within cultural fractionalization (CUF^W)	$\sum_{i=1}^{I}\pi_i CUF_i$	Weighted average for the I groups of CUF_i
Fixation Index (F_{ST})	$\frac{CUF-CUF^W}{CUF}$	Cultural fractionalization that is not explained by the within cultural diversity across ethnic groups

Notes: $i = 1\ldots I$; ethnic groups; $q = 1\ldots Q$: questions selected from the WVS; $r(q) = 1\ldots R(q)$:possible answers to each question q; $\pi^{r(q)}$: percentage of the population that gives answer $r(q)$; $\pi_i^{r(q)}$: percentage of individuals of ethnic group i that gives answer $r(q)$; $\pi^{q,r(q)}$: percentage of the overall population that gives answer $r(q)$ to a question q; $\pi_i^{q,r(q)}$: percentage of individuals of ethnic group i that gives answer $r(q)$ to a question q.