Intersectional Inequality in Education in Africa, Asia, and the Americas

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Abstract

Intersectional inequality — the notion that disparities run along combinations of social groups such as gender or ethnicity — has become an increasingly prominent concept in the social sciences. However, there is little empirical research applying an intersectional framework to measure inequality. We propose two novel metrics of intersectional inequality based on the concept of horizontal inequality. Based on these measurements, we analyze educational intersectionality in gender and ethnicity using Demographic and Health Surveys data from 39 low- and middle-income countries and census data from the United States. We show that the intersectional perspective unveils a lot of inequality that remains masked if gender and ethnicity are analyzed in isolation. For countries with high intersectional inequality that is more than the sum of gender and ethnic inequality, reducing inequalities based on gender and ethnicity separately might not be enough to "leave no one behind," as the United Nations Agenda 2030 envisions.

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1 Introduction

Leave no one behind, the central principle of the 2030 Agenda for Sustainable Development, highlights that "barriers people face in accessing services, resources and equal opportunities are not simply accidents of fate or a lack of availability of resources, but rather the result of discriminatory laws, policies and social practices that leave particular groups of people further and further behind" (UNSDG, 2022). In other words, disadvantages occur not only for individuals but also for whole social groups, for instance, women or members of marginalized ethnic groups. Since individuals have little (or no) influence over group membership, like gender or ethnicity, these systematic disparities are not only problematic from the perspective of equality of opportunity, but they are detrimental to economic development on a broader scale (Ferreira et al., 2014; Marrero and Rodríguez, 2013). In response, economists increasingly apply the concept of horizontal inequality when measuring inequalities between social groups, such as gender or ethnicity (Mancini et al., 2008).

At the same time, "intersectionality" has become a buzzword in the social sciences. For example, the UN Sustainable Development Group states that identifying inequalities requires disaggregation beyond gender, geography, and age and should occur in multiple and intersecting ways (UNSDG, 2022). The term *intersectionality* was coined by Crenshaw (1989, 1991) as a critical theoretical framework to describe the distinct discrimination faced by members at the "intersection" of social groups. For example, Black women might face specific disadvantages that neither Black men nor white women experience. Similarly, Kabeer (2016) uses the term "intersecting inequalities" to highlight individuals' overlapping disadvantages, reinforcing their exclusion. The particular overlaps that characterize marginalization vary by context, but Kabeer (2016) points out that the most enduring forms of group-based disadvantages are strongly associated with identities (arguably) ascribed at birth, such as race, caste, gender, and ethnicity. Therefore, this framework could be viewed as an extension of the horizontal inequalities framework. However, intersectionality remains mostly exclusive to theory in the humanities and is only starting to gain traction in the quantitative social sciences. More specifically, there are very few examples directly linking the concept of intersectionality to the measurement of group-based inequalities in low- and middle-income countries (see e.g., Kabeer and Santos, 2017; Lenhardt and Samman, 2015).

To fill this gap, our work seeks to reconcile the intersectionality framework with the measurement of horizontal inequalities. In particular, we document and analyze intersectional inequalities in educational attainment in 40 countries by combining gender and ethnicity to form intersecting groups. As long as educational outcomes differ systematically and substantially across social groups, the world is unlikely to succeed in "leaving no one behind," as stated by the Agenda 2030 and its Sustainable Development Goals (SDGs) (Stuart and Woodroffe, 2016). This paper contributes to an analytic framework to detect intersecting group-based inequalities to inform policy-making. Moreover, we also focus on education for analytical reasons, since many other well-being indicators, such as income or wealth, are hardly separable among members of the same household. Thus, measuring gender inequalities in these outcomes is not feasible. Meanwhile, education is an outcome that accrues entirely to the individual, allowing us to analyze gender differences in schooling.

We descriptively analyze how educational attainment varies across intersecting groups and time. To this end, we combine data from several rounds of the Demographic and Health Surveys (DHS) in 39 low- and middle-income countries between 1992 and 2019 as well as data from the US Current Population Survey (CPS) 2019, resulting in 2,689,289 individual observations. Little is known about intersecting inequalities in the global context and the DHS data pose a unique opportunity to analyze this topic. We include US data since the intersectionality literature has its origins in the US, making it relevant to put the magnitude of the results for low- and middle-income countries into perspective.

Our first measure of intersectional inequality is the schooling ratio between the group with the lowest (most disadvantaged) and the group with the highest (most advantaged) average education. We do this across gender, ethnicity, and the combination thereof. Compared to other inequality measures, this approach emphasizes the extremes of the distribution, in line with the principle to "leave no one behind." We find that intersectional inequality between ethnicity and gender differs significantly across countries and is larger than horizontal inequality by ethnicity and gender separately. Intersectional inequality is mainly driven by ethnic inequality and less by gender inequality since ethnic inequalities still tend to be more pronounced in many countries. The second measure of intersectionality we propose — which we refer to as surplus intersectionality — aims to quantify the intersectionality that is "more than the sum of its parts" of gender and ethnic inequality. To this end, we first estimate how much inequality would arise if gender inequality were constant across all ethnic groups as a synthetic counterfactual. We compare this measure with the observed, first-order intersectional inequality and calculate the difference. We find that in 27 countries, the inequality between the group with the highest educational attainment and the lowest educational attainment is larger than the inequality we would observe if gender inequality were the same across all ethnic groups. Interestingly, for 13 of the countries in the sample, surplus intersectionality is negative, indicating less gender inequality in the most advantaged/disadvantaged ethnic groups.

We use regression analysis to identify the main correlates of horizontal and intersectional inequality. The analysis shows that intersectional inequality and horizontal inequality in education are highly associated with the general level of education. Countries with generally higher educational attainment have lower group-based inequality by gender, ethnicity, and the intersection of the two. Controlling for mean education, GDP per capita is not correlated with gender, ethnic inequality or our first measure of intersectionality. However, surplus intersectionality is not correlated with increasing education levels, but it increases with increasing GDP per capita. The results are robust when controlling for sample size and the number of ethnic groups.

This paper contributes to five different strands of literature touching on intersectional inequality.

First, on a broader level, this paper speaks to established theoretical literature in sociology, social psychology, and gender studies that conceptualizes intersectionality theoretically. Kimberlé Crenshaw (1989) coined the term, and what has followed is an ample discussion about the consequences of adopting an intersectional perspective, not only for social sciences but also for public policy (to name just a few examples: Alexander-Floyd, 2012; Berger and Guidroz, 2010; Bowleg, 2008; Cho et al., 2013; Choo and Ferree, 2010; Few-Demo, 2014; Hancock, 2007; Shields, 2008; Strid et al., 2013; Walby et al., 2012). However, the cited works make little to no prescriptions of *how* intersectionality could be operationalized quantitatively. The paper at hand contributes to this literature by proposing a framework for how researchers could include intersectionality in the quantitative measurement of inequality.

Second, the research that empirically applies an intersectional perspective primarily addresses education inequality at the intersection of race and gender in the US context. A number of studies examine the Black gender gap in college success (Keels, 2013; McDaniel et al., 2011; Mittleman, 2021), labor market returns to math performance (Riegle-Crumb, 2006), or success expectations in STEM-related subjects (Parker et al., 2020, review article). Together, the studies paint a clear picture of intersectional disparities in education. Black women do not fully profit from the generally closing gender gap in education, yet Black men are typically even worse off than Black women. These effects are partly offset by socioeconomic status, especially for Black women (i.e., there is no gender gap for Black women with high socioeconomic status) (Keels, 2013). These findings highlight the importance of intersectionality as an analytical framework because they provide essential insights usually lost when considering social identities like race and gender in isolation. However, the methodological frameworks applied in the cited studies are not necessarily applicable to other countries where the concepts of race and ethnic groups differ substantially from the US context.

For example, in the non-US context, Sen et al. (2009) analyze inequality in access to health services at the intersection of gender and social class in India. They find that the probability of non-treatment is only lower for women from poor households while being poor (or "lower class") is not relevant for men. The authors model intersectionality as interaction terms in their regressions and report the probability (odds ratio) of having a particular health-related outcome for members of a social group compared to a reference group. Our study departs from this literature in several aspects. On the one hand, we explicitly relate our empirical analysis to the theoretical literature on intersectionality. As such, intersectionality is not merely meant as an afterthought, but as an analytical lens through which to study inequalities. On the other hand, we emphasize the measurement of inequality as an outcome. Using inequality ratios, we express inequality in one measure instead of inferring differences between the groups from regression analyses. This method allows us to define intersectional inequality as a universal measure, irrespective of the specific context. Furthermore, we look beyond the US and focus on 39 low- and middle-income countries, which allows us to assess the relevance of intersectionality for a large part of the world's population.

Third, our study integrates the concept of intersectionality into the growing literature on the measurement of horizontal inequality.[1] Shorrocks (1984) was among the first to propose the decomposition of inequality measures into population subgroups. This idea is mirrored in a growing body of research studying the concept of horizontal or between-group inequality (See e.g., Langer (2005), Langer et al. (2007), Mancini et al. (2008), Mancini (2008), Stewart (2009), Elbers et al. (2008), Cederman et al. (2011), Cederman et al. (2015), Canelas and Gisselquist (2018), Leivas and Dos Santos (2018), McDoom et al. (2019), Tetteh-Baah (2019)). To the best of our knowledge, only one study explicitly measures intersecting inequalities based on horizontal inequality across countries. Specifically, Lenhardt and Samman (2015) analyze intersecting inequalities in women's education (at the intersection of ethnicity, wealth status, and place of residence) in 16 low- and middle-income countries using DHS data, but do not include education data on men.

Fourth, another strand of the literature indirectly touches the topic by studying inequality of opportunity in developing countries (Ferreira et al., 2014; Brunori et al., 2019). While the concept of horizontal inequality is conceptually linked to inequality of opportunity, the two are not the same. Whereas the inequality of opportunity literature is usually concerned with identifying circumstantial variables (or "types")

[1] For literature on inequality in its "vertical" sense, see e.g., Piketty and Saez (2014) for the US and Europe and Ravallion (2014) for developing countries.

that jointly explain overall inequality (see e.g., Brunori and Neidhöfer, 2021), we take a different approach and model horizontal inequality give gender and ethnicity as types. This approach has the advantage that inequality can be compared across countries using a fixed set of circumstantial variables, while inequality of opportunity typically identifies different types, depending on the context.

Last, and more remotely, our research ties to a broader literature on gender inequality and ethnic and religious inequalities in education in the Global South. For gender inequality in education, see e.g., King and Hill (1995), Lopus and Frye (2018), Klasen (2002), Klasen and Lamanna (2009). For ethnic and religious inequalities, see e.g., Easterly and Levine (1997), Montalvo and Reynal-Querol (2003), Montalvo and Reynal-Querol (2005), Alesina et al. (2016), Houle and Bodea (2017), Muller (2017), Alcorta et al. (2018), Cooray and Potrafke (2011), Hajj and Panizza (2009). All of this literature documents large and persisting (although somewhat declining) gaps in ethnic and gender inequality.

The remainder of this paper proceeds as follows. Section 2 introduces the concept of intersectional inequalities and describes the empirical strategy to estimate intersectional inequalities and the subsequent analysis. Section 3 presents more information on the data. Section 4 presents the results of the analysis. Section 5 concludes.

2 Measures

2.1 Conceptual framework

The most common concept of inequality measurement is "vertical inequality" (Bourguignon, 1979; Cowell, 1988; Lambert and Aronson, 1993). Vertical inequality typically measures inequality between individuals within or across geographic or economic entities. Some measures, such as the Gini coefficient or the Theil index, take the whole distribution of an outcome into account, while others, such as the Palma Index or the P90/P10 ratio, compare specific percentiles of the distribution. In contrast to vertical inequalities, horizontal inequalities occur between different social groups, such as gender, ethnicity, religion, or rural vs. urban population. They are, thus, often referred to as between-group inequalities (see Figure 1).

Place Figure 1 here

For our proposed measures of intersectional inequalities, we closely follow the concept of horizontal inequality, but we add an additional dimension. As Figure 1 shows, instead of analyzing inequalities across gender and ethnicity separately, we use “intersecting” groups, i.e., we compare women and men that belong to different ethnic groups. This intersectional perspective allows us to uncover gender differences within and across ethnic groups.

2.2 Inequality ratio

To measure horizontal and intersectional inequality between social groups, we mainly focus on the inequality ratio (IR). It is a simple (unweighted) ratio between the group with the highest average of an outcome variable — in our case, years of education — and the group with the lowest average. Formally, we can describe IR in the following way. Let s_j be the mean in years of education for group j as follows,

$$s_j = \frac{\sum^{i \in j} educ_i}{n_j}, \tag{1}$$

where n represents the number of observations in group j. Then, the inequality ratio IR for characteristic G is calculated as

$$IR(G) = \frac{min\{s_j, ..., s_J\}}{max\{s_j, ..., s_J\}},\ where\ G \in \{gender, ethnicity, gender \times ethnicity\} \tag{2}$$

Because the numerator is weakly smaller than the denominator, the inequality ratio is bounded between 0 and 1. A value closer to 1 implies complete equality, whereas a value closer to 0 implies more inequality between the groups. Compared to other inequality measures, such as the Gini or Theil index, the inequality ratio has the advantage of being intuitively interpretable and mainly conveying information about the tails of the distribution (Conceicao and Ferreira, 2000; Cobham and Sumner, 2013). Its value tells what fraction of education the group with the lowest average has compared to the highest group. For example, assuming men have higher average education than women (as is the case in most countries in our sample), an inequality ratio of $IR(gender) = 0.75$ means that women have, on average, 75% of the years of education of men. Moreover, when there are only two groups — as is the case for gender — there are hardly any reasons to resort to a more complex measure of horizontal inequality, such as the Gini index. When there are more than two groups, the inequality ratio has the property of omitting large parts of the information by only comparing the two most extreme groups. However, considering the SDG principle of “leave no one behind,” one could argue that any observed differences between any social groups in the middle of the welfare distribution are irrelevant and that we are particularly interested in the group “left behind”.

What sets the approach described in this paper apart from the standard measurement of horizontal inequalities is the intersectional perspective. In the measurement of standard horizontal inequalities, the grouping G is defined by one characteristic, meaning that group j always represents either one gender or ethnic group. Here, we use intersecting groups, in other words, every combination of gender and ethnicity. In this simple setup, the number of groups is doubled compared to the original number of ethnic groups. That is, for each ethnic group, there is now a separate group for women and men.

We deliberately do not weigh the group averages by the corresponding population size. The motivation for this approach is that we do not want to impose relative importance on any group's outcome. On the contrary, we are particularly interested in the outcomes of minority groups. Our measure only considers the two extreme groups (most advantaged/disadvantaged), which, in many cases, represent minorities. Using population weights will lead to strong distortions if one of the extreme groups is particularly small while the other is large. Hence, we adhere to the "anonymity" axiom of inequality measures, in the sense that which group has a given (education) outcome does not matter.

Mechanical and surplus intersectionality. We first compare the estimates of "first-order" intersectional inequality ($gender \times ethnicity$) to the horizontal inequality estimates based on single groupings (*gender or ethnicity*). However, these estimates only give us a limited benchmark to evaluate the relative importance of intersectional inequality. The issue with directly comparing the inequality ratio $IR(gender \times ethnicity)$ to $IR(gender)$ and $IR(ethnicity)$ is that part of the gap between the intersectional and the horizontal inequality measure based on single groups arises "mechanically." In other words, if there is at least some gender inequality within the most and least disadvantaged ethnic groups, one will always obtain a greater inequality ratio for the intersectional groupings relative to gender and ethnicity in isolation.

We could think about a hypothetical situation where the education gender gap was constant across ethnic groups to avoid this problem. In other words, one can calculate the "mechanical" component of the intersectional inequality ratio by applying the same relative difference between women and men for the lowest and the highest educated ethnic group, as is the case for a country's overall population. Going forward, we refer to this measure as "mechanical intersectionality." We then calculate the difference between the mechanical intersectionality and the observed intersectional inequality. As a result, we obtain a measure of "surplus intersectionality." The larger the value of this measure, the larger the additional component of in intersectional inequality, i.e., the more a particular intersecting group is disadvantaged or advantaged relative to gender and ethnic inequality. In other words, intersectional inequality is larger than the sum of its (horizontal inequality) parts. Figure 2 illustrates the intuition behind mechanical and surplus intersectionality.

Place Figure 2 here

Formally, we define mechanical intersectionality in the following way. Let

$$s_{min} = min\{s_j, ..., s_J\}, s_{max} = max\{s_j, ..., s_J\}, \tag{3}$$

denote the respective group average of the ethnic groups with the lowest and the highest education. Assuming women have, on average, lower education than men, then the mechanical gender differences within the two extreme ethnic groups can be written as

$$s_{min}^{mech} = s_{min}\left(1 - \frac{(s_{overall} - s_{female})}{s_{overall}}\right), s_{max}^{mech} = s_{max}\left(1 - \frac{(s_{overall} - s_{male})}{s_{overall}}\right), \tag{4}$$

where $s_{overall}$ denotes the total (gender-weighted) average in education. Then the inequality ratio of mechanical intersectionality is

$$IR_{mech}(gender \times ethnicity) = \frac{s_{min}^{mech}}{s_{max}^{mech}}. \tag{5}$$

Surplus intersectionality is just the difference between the mechanical inequality ratio and the observed intersectional inequality ratio:

$$\Delta_{gender \times ethnicity} = IR_{mech}(gender \times ethnicity) - IR_{obs}(gender \times ethnicity) \tag{6}$$

Note that because a lower inequality ratio means higher inequality, we subtract observed intersectionality (which is a smaller number) from mechanical intersectionality (which is usually a larger number). Hence, if $\Delta > 0$, it means that we observe *higher* intersectional inequality (lower ratio) than what we would expect if gender inequality was constant across ethnic groups.

3 Data

To construct the horizontal and intersectional inequality measures, we use data on individuals' education in years of schooling and measure inequality grouped by gender and ethnicity. From the total of 337 surveys from 84 countries of the DHS, we use all DHS rounds where both women and men were interviewed, and the respondent's gender, ethnicity, and years of education were recorded. The resulting sample of 39 low- and middle-income countries contains data from 1992 until 2019 (see Table C2 for a detailed list of the countries and sample sizes per country). The sample consists predominantly of African countries, but South Asian and Latin American countries are also adequately represented. Altogether, the countries included in the sample account for roughly 24% of the world's population and for 80% of the population of all African countries. The sample is not globally representative of low- and middle-income countries due to the absence of Middle Eastern countries. This gap does not arise because there is no DHS data for this region, but because, in many cases, ethnicity was not elicited, or no data on men was administered as part of the DHS survey. Furthermore, China is not part of the DHS program at all and for India, there is only data on caste membership, which is too distant from any definition of ethnicity to be comparable. In addition to the DHS data, we include data from the Current Population Survey (CPS) 2019 for the United States (US) (Flood et al., 2021). The reason for including the US is that the concept of intersectionality originates from the US context. Thus, we think it is relevant to see how global intersectional inequality in education based on ethnicity/race and gender compares to the US. In contrast, most European statistical offices do not record ethnicity, and therefore, this type of analysis cannot be conducted in this context.

We split the data into three birth cohort brackets; up to 1969, between 1970-1979, and 1980 and after. We chose these cohort brackets such that they have a high degree of overlap of countries across time. Splitting the data into cohort brackets allows us to control for time trends in education within countries. Overall, this approach results in 97 cohort-country combinations.

Education, the primary variable of interest, is measured by years of schooling. We prefer years of schooling over, for instance, the highest completed level of education because it is the most widely elicited statistic of education. Moreover, we set an upper bound of 17 years of education (12 years of primary and secondary education and five years of tertiary education).[2] Also, we limit the sample to respondents that are 25 years and older to mitigate the problem that many younger respondents might still be in school.

To calculate between-group inequality, we use gender and ethnicity as grouping variables. While it would be conceivable to group by other characteristics, such as religion, region, or urban vs. rural residence, we decided to focus on the two variables

[2]People that hold advanced tertiary degrees, such as a Ph.D., are relegated to 17 years of education.

most unequivocally ascribed at birth. Yet, in contrast to gender, ethnicity poses two challenges when used as a grouping variable. First, ethnic groups are not harmonized across DHS survey rounds. In other words, the definition of ethnic groups is not consistent across survey rounds within a given country. Second, many ethnic groups have a small sample size. Particularly for younger and older cohorts, the number of observations for a given cell (a cohort-ethnicity-gender combination) is too small for a meaningful statistical analysis. To counter these challenges, we harmonize ethnic groups across survey rounds to ensure a minimum of 40 observations per cell and consistent grouping. As a first step, we harmonize ethnic groups across survey rounds within countries. For this purpose, we identify the larger groups to which smaller sub-groups belong if they only appear in particular DHS rounds. To identify the connections, we rely primarily on the online database Ethnologue. In a second step, we count the observations for each combination of ethnic groups, gender, and cohort bracket. We then merge each ethnic subgroup where one gender does not reach at least 40 observations for a cohort bracket into a larger ethnic group, again using the Ethnologue database. When merging is impossible, smaller ethnic groups are lumped into a separate group called "other." See Table C4 in the Appendix for a detailed list of the surveys used and the ethnic groupings.

4 Results

Table 1 shows descriptive statistics for key variables of our analysis split by birth cohort brackets. It shows an increase in education of 1.4 years between the first (column 1) and the third (column 3) cohort bracket. Further, the share of female respondents is eleven percentage points higher for younger birth cohorts. The average number of ethnic groups remains constant, which one should expect given that we harmonized ethnic groups across survey rounds. Regarding sample size and composition, Table 1 shows that the sample size is not equally distributed across cohorts. However, this issue arises from the fact that only countries with observations in all three cohort brackets were included in this table in order to ensure comparability over time. The share of the rural population decreased by four percentage points in the most disadvantaged groups, while it decreased by one percentage point in the most privileged groups.

Place Table 1 here

4.1 First-order intersectional inequality

Figure 3 shows the estimates for inequality ratios by gender, ethnicity, and intersecting groups (*gender* × *ethnicity*). An inequality ratio of 1 implies perfect equality between the groups with the lowest and highest average education. In contrast, a ratio close to 0 indicates large disparities between the two most extreme groups.

Place Figure 3 here

The ratios are generally high (closer to 1) for gender, indicating relative equality in education across the sample of countries. Although, some countries like Afghanistan, Niger, and Chad still display high education inequality between men and women. In Guyana, the country with the lowest gender gap in education, the inequality ratio is one, implying equal years of education for women and men. In Afghanistan, the country with the widest gender gap, women, on average, have only 23% of men's education. Compared to the results for gender, the ratios for ethnicity are generally lower, indicating higher inequality between the most and least disadvantaged groups. Only a few countries display lower inequality by ethnic groups than gender (Afghanistan, Guinea, Togo, Liberia, and Kazakhstan). Ethnic disparities are exceptionally high in African countries compared to Asia and the Americas, with inequality ratios ranging as low as 13% in Ethiopia.

The inequality ratios for intersecting groups (*gender* × *ethnicity*) are displayed in the lightest tone. Intersectional inequality is strictly higher than inequality based on gender and ethnic groups (manifested in low ratios), which we would expect (see Section 2). Figure 3, however, also shows that intersectionalities are very high. In almost half of the countries in our sample, intersectional inequality ratios are below 30%. This means that in almost half of the countries, the women of one ethnic group, on average, have less than a third of the years of education than men of another ethnicity. For example, for the latest available cohort (1980 and younger) in Ethiopia, *Nuer* men have an average of 10.01 years of education, while *Affar* women have an average of 0.35 years, resulting in an inequality ratio of 0.03 (Figure A1 in Appendix A shows the group means by gender, ethnic, and intersecting groups). However, in eleven countries, for at least one cohort group, gender order is reversed, meaning that either the group with the lowest education is male or the group with the highest education is female (see Table C3 in Appendix C). This is the case in Albania, Brazil, Burkina Faso, Guyana, Honduras, Kazakstan, Moldova, Mozambique, the Philippines, South Africa, and the US.

Furthermore, there are five countries where the most disadvantaged intersecting group has a different gender than the generally more disadvantaged gender in at least one cohort group. For instance, in the Philippines, for the 1970-1979 cohort, men have 89% of the average years of education compared to women. Yet, the most disadvantaged group consists of women from the (also most disadvantaged) *Maguindanaon* ethnic group, who only have 45% of the average years of schooling that the most advantaged group has (*female Tagalog*). Similarly, in twelve countries, the ethnicity of the most disadvantaged intersecting group does not correspond to the overall most disadvantaged ethnic group. For all of these examples, an intersectional perspective uncovers inequalities that would be missed by looking at gender and ethnic inequality separately.

Analyzing intersectionalities over time, we find that the more disadvantaged gender is constant across cohorts in all countries (see Table C3 in the Appendix). In only six countries, the most disadvantaged ethnic group changes over time, whereas the most advantaged ethnic group changes in 16 countries over time. This indicates that disadvantages based on ethnicity are more persistent than privileges. The average inequality ratios by cohort in Table 1 reveal that gender inequality decreased by nine percentage points from the older to the younger birth cohorts and ethnic inequality decreased by seven percentage points. At the same time, intersectional inequality decreased by eleven percentage points.

Last, Figure 3 also shows that the inequality measures seem to be highly correlated. The Spearman correlation is 0.95 for intersecting and ethnic and 0.83 for intersecting and gender. This implies that intersecting inequality is more driven by ethnicity than by gender, with ethnic inequalities being higher and more variable across countries than gender inequalities.

4.2 Surplus intersectionality

As discussed in Section 2, the ratio for intersectional inequality will always be smaller (and therefore indicate more inequality) than the separate inequality ratios for gender or ethnicity. This property was evident in Figure 3: as long as there is some gender inequality in the most disadvantaged ethnic group, the most disadvantaged intersecting group will always have a smaller average than the ethnic group with the lowest education. This property is *mechanical*, meaning that it is not an artifact of intersectionality in its narrow definition, but that it arises *by design*. Thus, we calculate a measure for *mechanical intersectionality* that reflects the intersectional inequality that would arise if all ethnic groups had the same gender inequality as the whole population.

Figure 4 shows the difference between the *mechanical intersectionality* and the observed intersectional inequality, which we call *surplus intersectionality*. A zero value indicates that observed and mechanical inequality are the same, i.e., no surplus inequality. A value above zero indicates that the observed inequality is higher than the mechanical inequality ratio, i.e., the inequality across groups is larger than we would expect from adding up ethnic and gender inequalities. A value below zero indicates that observed inequality is lower than mechanical inequality.

Place Figure 4 here

Twenty-seven out of 40 countries show positive surplus intersectionality. In these countries, observed intersectional inequality is higher than mechanical intersectionality. In other words, the gender gap is particularly wide for the most advantaged or disadvantaged ethnic groups. In some sense, one could say that in these countries, measuring inequality in an intersectional manner highlights that women (sometimes men) of certain ethnic groups are particularly disadvantaged or men (sometimes women) of particular ethnic groups are particularly advantaged. For instance, in Kenya, the country with the highest surplus intersectionality, the observed intersectional inequality ratio is 0.16 while the mechanical ratio is 0.23, resulting in a surplus intersectionality of 0.07 (or seven percentage points). This difference is substantial considering the already low observed and mechanical intersectionality values.

Meanwhile, 13 out of 40 countries exhibit values below zero. This result can only arise when observed gender inequality is smaller (higher ratio) in the extreme ethnic groups than across the whole distribution. Therefore, the gender gap is narrower for the most advantaged and the most disadvantaged ethnic group compared to the overall population of that country. For example, in Zimbabwe, the country with the lowest surplus intersectionality, one would expect a mechanical inequality ratio of 0.34 if the relative gender gap was the same across all ethnic groups. However, the observed intersectional inequality ratio is 0.42, resulting in a negative surplus intersectionality of -0.08 or 8 percentage points. This implies that the observed gender gaps in the most extreme groups are smaller than for the overall population.

4.3 Sensitivity analysis

As we have seen in Figure 3 there is considerable variation in intersectional inequality across countries from 0.89 (South Africa) to 0.02 (Burkina Faso), which raises questions regarding the role of sample size as a driver of this variation. In principle, by the law of large numbers, neither the number of groups nor the relative group size should impact the inequality ratio if the sample size approaches infinity. In other words, if the sample is large enough, the inequality ratio between arbitrarily drawn partitions of the sample (i.e., groups) converges to one — in other words, perfect equality across groups, no matter how many groups. However, in reality, sample sizes are limited, and with an increasing number of groups, "extreme" mean values for one group become more likely because the number of observations per group becomes small. Hence, part of the intersectionalities we observe might be due to small sample sizes in combination with many groups.

Place Figure 5 here

We conduct a sensitivity analysis to test whether the sample size and the number of groups play a significant role in determining the inequality ratios. We simulate samples by randomly drawing education and group membership from a given distribution, varying sample sizes and the number of groups. By doing so, we can estimate how much of the observed intersectional inequality across countries could be caused by differences in sample sizes and the number of groups. Most country-cohorts have between 4,000 and 10,000 observations. But a couple also have only 2,000 or up to 30,000 observations (see Table C2 in the Appendix). The number of groups (gender times ethnicity) mostly ranges from 6-20 intersecting gender-ethnicity combinations (see Table C4), but a couple of countries have up to 36 groups (Zambia and Ethiopia).

Figure 5 shows that, given a low number of groups, differences in sample size have a negligible effect on the inequality ratio. The inequality ratio is practically one with four groups (the minimum number of groups for an intersectional inequality ratio with gender and ethnicity), whether there are 30,000 or 2,000 observations. Any number of groups up to 16 does not lead to any significant change in measured intersectional inequality. However, a small sample size in combination with many groups might lead to high measured inequality by chance. For example, with 32 groups and 2,000 observations (62 observations per group), the simulated inequality ratio is close to 0.75. It is rare to have 32 groups, but possible. In Ethiopia and Zambia, the number of intersecting groups is 36 (18 ethnic groups split by gender). However, the sample size for these countries is between 10,000 and 20,000. Hence, the inequality ratio we could observe by chance is around 0.90, or a 10% downward bias. This value is a much lower intersectional inequality than we observe for these countries (0.03 for Ethiopia and 0.5 for Zambia), but still, a fact that we need to take into account. Hence, we control for sample size and the number of ethnic groups (given that the number of observed genders is the same across countries) when running regressions to identify correlates of the inequality ratios.

4.4 Correlates of intersectional inequality

In Table 2, we first explore correlates of horizontal and intersectional inequality. While the results do not identify the causal drivers of intersectional inequality, this correlational analysis is still useful to analyze time trends in inequalities and whether general improvements in education or economic well-being benefit all groups equally, i.e., reduce horizontal and intersectional inequalities.

Place Table 2 here

Panels A-F show that the average level of education in a given country seems to be significantly associated with less horizontal inequality in education, both with regard to gender and ethnicity. An increase of one year in schooling is associated with a decrease of 5.1 (gender), 6.0 (ethnicity), and 6.5 percentage points (intersecting) of the gap between the most disadvantaged and the most privileged group. Given the considerable variation in average education across countries, the magnitude of these coefficients is remarkable. Moreover, as panels A, C, and E show, there is no significant relationship between a country's inequality ratio and its economic performance, measured by current GDP per capita (log). We also do not find any general global time trend on horizontal or "first-order" intersectional inequality, as can be seen from the cohort fixed effects.

Looking at surplus intersectionality (Columns I and J), we find no effect of general increases in education on reductions of additional inequality that is beyond the sum of ethnic and gender inequality. In contrast, we find that increases in GDP per capita (controlling for education) lead to an increase in surplus inequality. A one percent increase in GDP is associated with a 1.4 percentage point increase in surplus intersectionality [3] Moreover, the R^2 is remarkably high for regressions in panel A-H, with mean education contributing most to explaining variances in inequalities across countries, whereas the independent variables chosen have practically no explanatory power in explaining variation in surplus intersectionality.

As a robustness check, we add the cohort sample size and the number of ethnic groups as control variables in Panel B, D, F, H, and J. Adding the two variables only marginally changes the results obtained in Panels A, C, E, G, and I. Moreover, the coefficients on sample size and the number of ethnic groups are very small (but pointing in the expected direction), indicating that they have a negligible effect on observed differences in inequalities across countries.

[3] Note that surplus intersectionality is not an inequality ratio, but the difference between two ratios where the observed inequality ratio is subtracted from the constructed mechanical inequality ratio. Therefore, in contrast to Panels A to H, the reader should interpret a positive sign on the coefficients as the percentage point *increase* in surplus intersectionality.

5 Conclusion

In this study, we propose two approaches to incorporate the intersectionality framework into the measurement of horizontal inequalities based on extensive household survey data from low- and middle-income countries. Hence, we bridge the gap between more qualitatively oriented social sciences and their conceptualization of inequalities and quantitative fields of social sciences, which have so far focused on measuring vertical and, to some extent, horizontal inequalities. We show that framing horizontal inequality from an intersectional perspective reveals large disparities between women and men of different ethnic groups. We show that in many cases, specific combinations of gender and ethnicity uncover disadvantaged groups that are not apparent when gender and ethnicity are analyzed separately. Moreover, we show that in about two-thirds of the sample, there is surplus intersectionality, indicating more inequality than "the sum of its parts" (gender and ethnic inequality).

Furthermore, we find that the main correlate of gender and ethnic inequality as well as "first-order" intersectional inequality is the average level of education in a country, whereas time trends and economic growth do not seem to play a role, all else being equal. The situation is different for surplus intersectionality, where general improvements in education do not decrease the intersectional inequality that is more than the sum of its parts.

Given these results, policymakers should take these intersectionalities into account when designing and implementing programs to increase access to education. In countries with high surplus intersectionality, special attention should be put on the targeting of education policies as general increases in education levels and economic growth might leave the most vulnerable groups behind.

Yet, our analysis also faces some limitations that should be taken into account when interpreting our findings. First, the definition of the social identity that we summarize under the umbrella term "ethnicity" actually differs substantially across countries. In large parts of Africa, ethnic groups run along the lines of languages, dialects, or tribal kinship. In other contexts, such as the US or Brazil, race is the more salient social identity and is defined by a mixture of skin color, national origin, and indigenous status. Thus, cross-country comparisons of ethnic group inequality should be made with caution. Nevertheless, it is worth reemphasizing that any large disparities in education between "arbitrarily" generated groups are likely to be an indicator of discrimination.

Second, in contrast to the Gini or Theil index, the inequality ratio only considers the two most extreme groups. Therefore, we cannot draw any conclusions about the middle of the education distribution. In our view, against the backdrop of *leaving no* *one behind*, it is warranted to consider only the most advantaged and disadvantaged groups. Third, our inequality measure does not directly give us any information about the gender of the two most extreme intersecting groups. For instance, it could be that, in some cases, the most advantaged and disadvantaged intersecting groups are both of the same gender. For the sake of simplicity, we leave the resolution of this issue to future research.

Lastly, the measure of surplus inequality does not distinguish whether surplus intersectionality occurs because one group is particularly advantaged or disadvantaged. Yet, the two cases do not have the same implications for policy. While the former would imply that education policy should be spread as widely as possible, the latter calls for specifically targeted interventions, for example, for females of the lowest education ethnic group. To avoid this problem, one could, for instance, contrast the relative disadvantage of the women in the lowest educated ethnic group with the country average rather than comparing it against the most advantaged group. However, the drawback of this approach is that it would not reflect elite capturing. Consequently, we leave this line of questioning to future research.

Another open question for future research is the cause of intersectional inequality in different contexts. What is the social environment, and what are the policies and institutional factors that shape intersectional inequalities in education in specific contexts? We touched upon this question in our analysis, but more rigorous research is needed to fully answer it. Our approach could also be extended to other social identity groups (such as religion or place of residence) and other well-being indicators, such as health or wealth.

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Tables and Figures

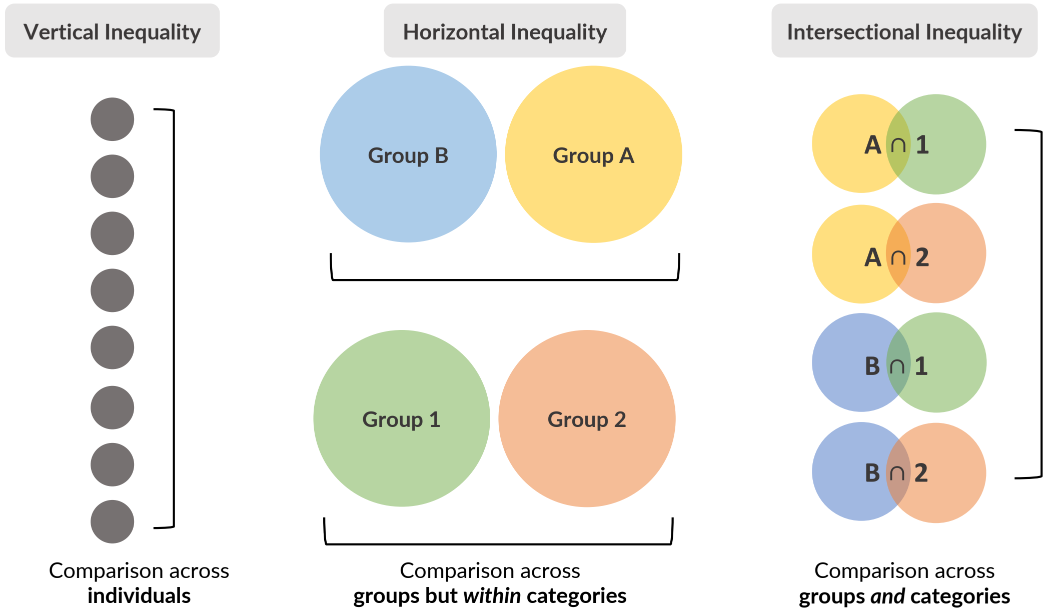

Figure 1: Concepts of inequality measurements

Note: Authors' own representation adopted from Lenhardt and Samman (2015)

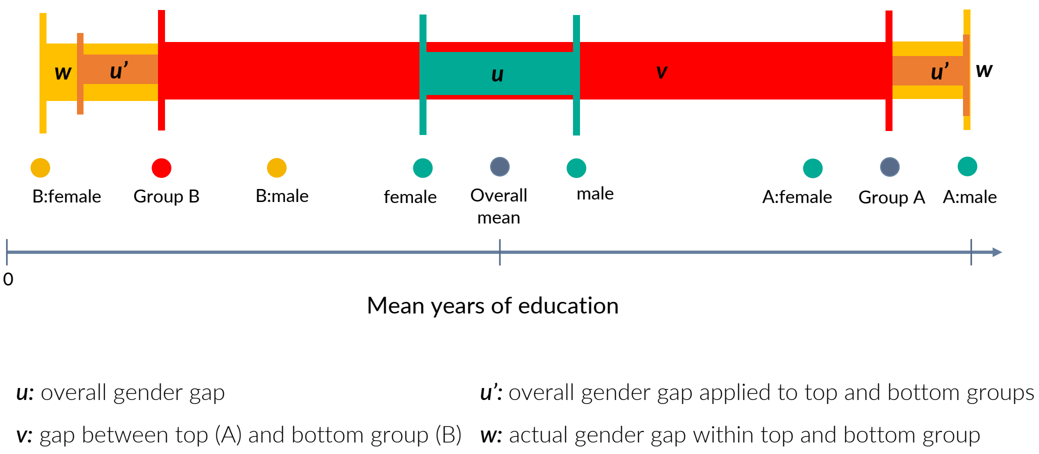

Figure 2: Schematic depiction of the observed and mechanical intersectional inequality

Note: Figure depicts a hypothetical scenario in which there are two categories with two groups each: female and male, group A and group B. In Group A, the observed gender gap equals the overall gender gap. In Group B, the observed gender gap is larger than the overall gender gap, resulting in surplus intersectionality.

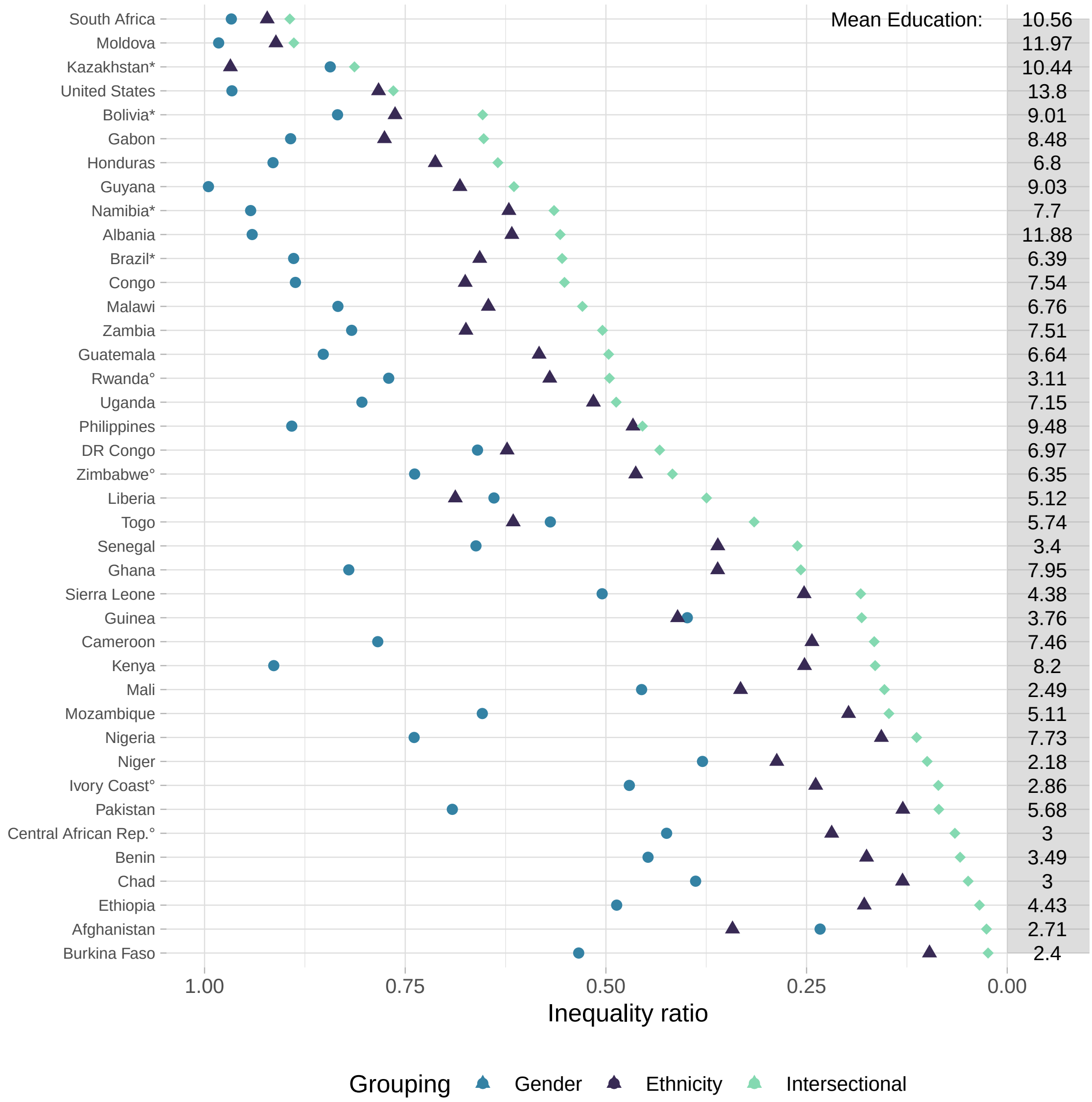

Figure 3: Inequality in education (years of schooling) by gender, ethnicity and intersecting groups

Notes: Aggregated data by country of n =2,689,279 individuals of the last available cohort; no mark means 1980 and younger cohort; countries marked with $*$ means 1970-1979 cohort; countries marked with $^\circ$, the cohort born in 1969 and earlier was used. Using DHS sample weights, estimates show inequality ratios between groups with the lowest and highest average years of education. A value of 1 implies parity and a value of zero implies total inequality between the two most extreme groups. Sources: DHS 1992-2019 and US CPS 2019.

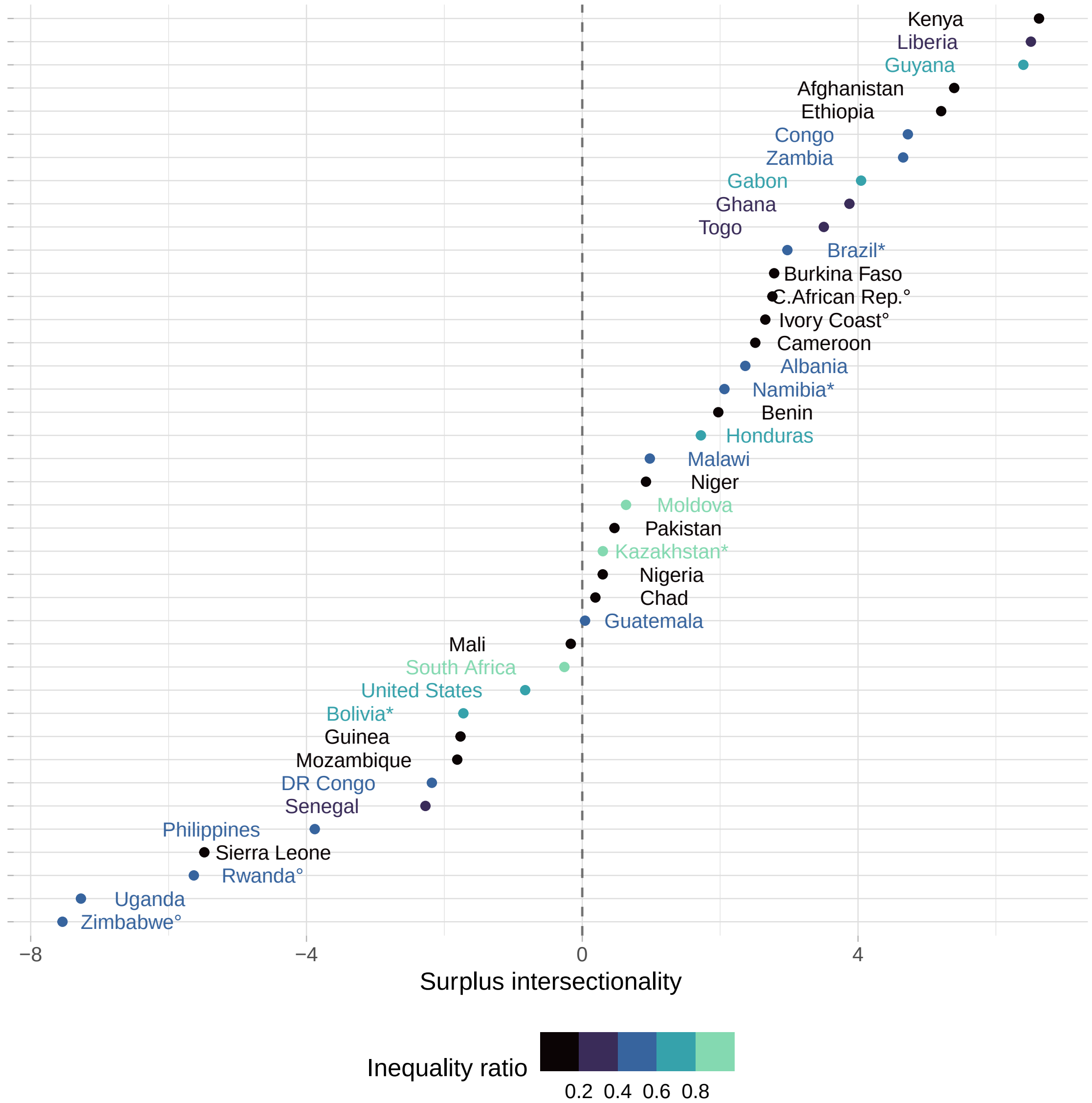

Figure 4: Surplus intersectionality (difference between mechanical and observed intersectional inequality

Note: Aggregated data by country of n =2'689'279 individuals of the last available cohort; no mark means 1980 and younger cohort; countries marked with $*$ means 1970-1979 cohort; countries marked with $^\circ$, the cohort born in 1969 and earlier was used. Estimates show the relative difference (in percent) between mechanical and observed intersectional inequality ratios. Values above zero indicate higher observed intersectional inequality (lower IR) than would be the case with constant relative gender gaps across ethnic groups. Sources: DHS 1992-2019 and US CPS 2019.

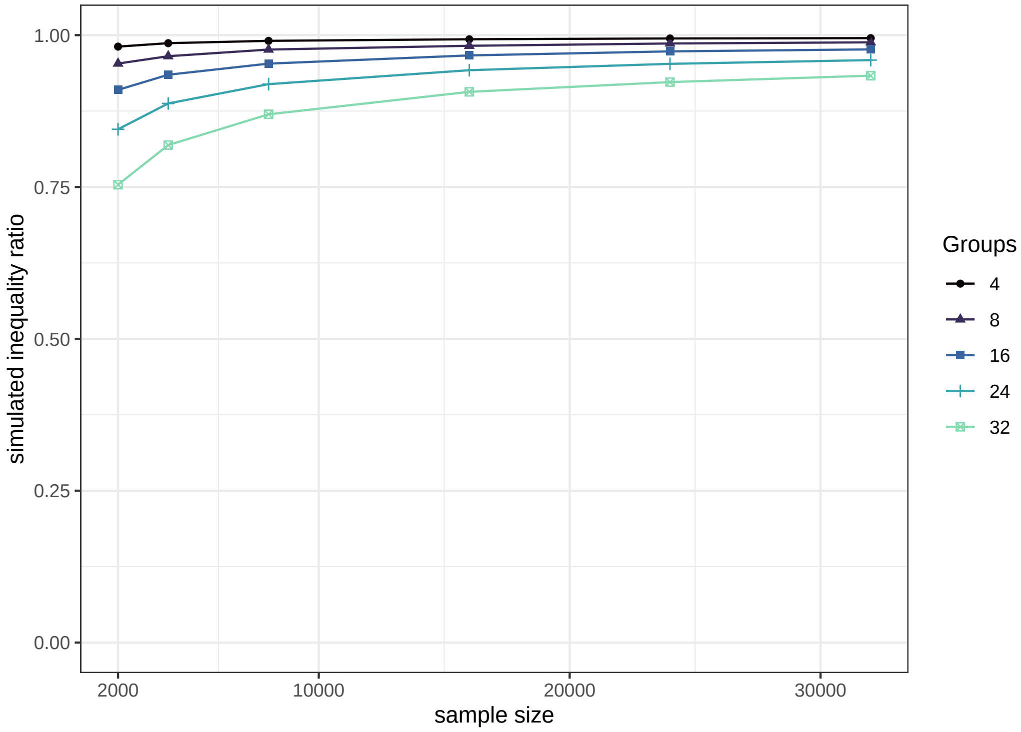

Figure 5: Simulation with varying group size and sample size

Notes: Based on averages across 1000 iterations. Education data is drawn randomly from a truncated normal distribution bounded between 0 and 17 years with $\mu = 5.5$ and $\sigma = 3$, corresponding to the average education and standard deviation across all countries.

Table 1: Descriptive statistics by birth cohort brackets

Characteristic	**-1969**, N = 30	**1970-1979**, N = 30	**1980-**, N = 30
Education (yrs)	5.0 (3.4)	5.6 (3.4)	6.4 (3.3)
IR(gender)	0.63 (0.21)	0.67 (0.21)	0.72 (0.20)
IR(ethnicity)	0.39 (0.25)	0.44 (0.25)	0.47 (0.25)
IR(gender*ethnicity)	0.26 (0.25)	0.32 (0.28)	0.36 (0.26)
Female (%)	0.62 (0.08)	0.72 (0.07)	0.73 (0.08)
No. of ethnic groups	8 (4)	8 (4)	8 (4)
Sample size	34,320 (133,352)	22,700 (67,330)	29,491 (104,609)
Rural pop. lowest %	0.70 (0.22)	0.69 (0.23)	0.66 (0.22)
Rural pop. highest%	0.48 (0.23)	0.49 (0.24)	0.47 (0.22)

[1] Mean (SD); Median (IQR) for no. of ethnic groups.

Notes: Aggregated by birth cohort brackets; n =2,689,279 individuals older than 25 years and younger than the birth cohort of 1920. For comparability, only countries with observations in all three cohort brackets are included. Sources: DHS 1992-2019 and US CPS 2019.

Table 2: Correlates of group inequality in education (OLS)

	Group inequality ratio									
Inequality ratio:	Gender		Ethnicity		Intersect.		Mechanical		Surplus	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Mean education (yrs)[a]	0.051***	0.052***	0.060***	0.059***	0.065***	0.063***	0.063***	0.061***	-0.002	-0.002
	(0.007)	(0.007)	(0.012)	(0.010)	(0.011)	(0.009)	(0.010)	(0.008)	(0.002)	(0.002)
Log(GDP p.c.)[b]	0.024	0.037	-0.017	-0.038	0.008	-0.009	0.018	0.005	0.010	0.014**
	(0.026)	(0.024)	(0.038)	(0.030)	(0.031)	(0.024)	(0.031)	(0.023)	(0.006)	(0.006)
No. of ethnic groups		-0.0003		-0.021**		-0.018**		-0.017**		0.001
		(0.003)		(0.009)		(0.007)		(0.007)		(0.001)
Sample size[d]		-0.0003***		-0.0001		-0.0001		-0.0002		-0.00008***
		(0.00009)		(0.0002)		(0.0001)		(0.0001)		(0.00002)
Cohort 1970-1979[c]	-0.009	-0.013	0.006	0.015	0.005	0.012	0.0005	0.007	-0.004	-0.006
	(0.016)	(0.017)	(0.014)	(0.013)	(0.014)	(0.012)	(0.012)	(0.011)	(0.007)	(0.006)
Cohort 1980-[c]	-0.006	-0.004	-0.025	-0.009	-0.021	-0.007	-0.019	-0.005	0.002	0.001
	(0.023)	(0.022)	(0.025)	(0.020)	(0.023)	(0.019)	(0.022)	(0.018)	(0.007)	(0.007)
(Intercept)	0.195	0.099	0.247	0.586**	-0.106	0.186	-0.159	0.087	-0.053	-0.100**
	(0.186)	(0.182)	(0.264)	(0.239)	(0.209)	(0.190)	(0.206)	(0.185)	(0.044)	(0.049)
Num.Obs.	106	106	106	106	106	106	106	106	106	106
R2 Adj.	0.753	0.769	0.537	0.648	0.677	0.753	0.700	0.774	0.004	0.043
DV	0.682	0.682	0.450	0.450	0.330	0.330	0.344	0.344	0.013	0.013

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note:
Aggregated country-cohort bracket level data from 40 countries; n=2'689'279 individuals older than 25 years and younger than birth cohort of 1920; Cluster-robust standard errors on the country-level in parentheses.

[a] Country-wise weighted mean years of education with DHS sampling weights;

[b] Last available year;

[c] Ref: Cohort -1969;

[d] Corresponds to country-cohort sample size in units of 1000.

Appendix A Group means by country

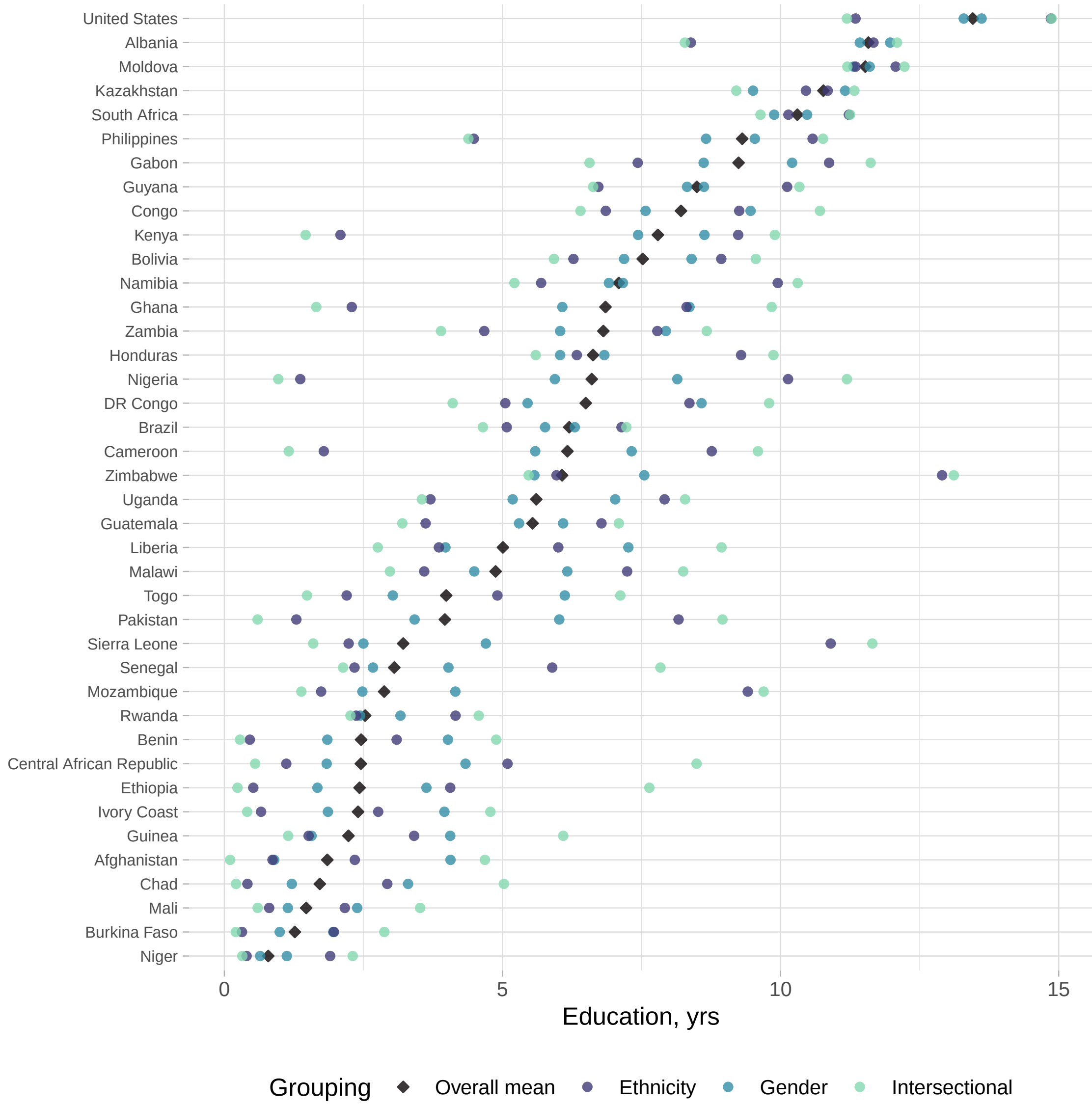

Figure A1: Average years in education by group

Notes: Pooled data from 40 countries; n =2,689,279 individuals older than 25 years and younger than the birth cohort of 1920. Estimates to the right of the overall mean represent the average education of the group with the highest education. Means are calculated using DHS sample weights. Sources: DHS 1992-2019 and US CPS 2019.

Appendix B Robustness checks with the Theil Index

Alternatively to the inequality ratio IR we can use a variant of the Theil Index, which is a special case of the General Entropy measures, as follows:

$$T(G) = \frac{1}{J}\sum_{j=1}^{J}\frac{s_j}{\mu_s}arsinh(\frac{s_j}{\mu_s}),$$

where s_j denotes the group averages, as previously defined for IR, J denotes the numbers of groups and μ the unweighted mean of all s_j. Instead of the natural logarithm, as is normally used for the Theil Index, we use an inverse hyperbolic sine transformation ($arsinh$). It has the advantage of being defined for zero values, which is a problem that we would inevitably run into with education data from low- and middle-income countries.

Repeating the regressions shown in Table 2, but with inequality measured by the Theil Index instead of the inequality ratio leads to the results reported in Table B1. The results remain fairly comparable.

Table B1: OLS regression of between-group Theil indices of education inequality

Variable	Group Theil Index					
	Gender		Ethnicity		Intersect.	
	(A)	(B)	(C)	(D)	(E)	(F)
Mean education (yrs)[a]	-0.011***	-0.011***	-0.015***	-0.015***	-0.027***	-0.027***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)
Log(GDP p.c.)[b]	0.003	-0.003	0.013	0.013	0.020	0.018
	(0.007)	(0.006)	(0.011)	(0.011)	(0.012)	(0.011)
No. of ethnic groups		-0.001		0.001		0.001
		(0.001)		(0.002)		(0.003)
Sample size[d]		0.00009***		0.00003		0.0001**
		(0.00002)		(0.00004)		(0.00004)
Cohort 1970-1979[c]	0.006	0.008	-0.007	-0.007	-0.004	-0.003
	(0.007)	(0.008)	(0.004)	(0.005)	(0.008)	(0.009)
Cohort 1980-[c]	0.005	0.006	-0.0008	-0.002	0.003	0.002
	(0.009)	(0.009)	(0.007)	(0.007)	(0.010)	(0.010)
(Intercept)	0.958***	1.010***	0.931***	0.917***	0.971***	0.977***
	(0.046)	(0.040)	(0.069)	(0.078)	(0.077)	(0.079)
Num.Obs.	106	106	106	106	106	106
R2 Adj.	0.477	0.500	0.376	0.375	0.576	0.583
DV	0.919	0.919	0.945	0.945	0.980	0.980

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note:
Aggregated country-cohort bracket level data from 40 countries; n=2'689'279 individuals older than 25 years and younger than birth cohort of 1920; Cluster-robust standard errors on the country-level in parentheses.

[a] Country-wise weighted mean years of education with DHS sampling weights;
[b] Last available year;
[c] Ref: Cohort -1969;
[d] Corresponds to country-cohort sample size in units of 1000.

Appendix C Aggregated Data

Table C2: Education inequality ratios by birth cohort and country for gender and ethnicity

Cohort	Education	IR(gender)	IR(eth.)	IR(gen:eth)	Mechanical	Surplus	obs.
Afghanistan							
1970-1979	1.6 (3.62)	0.19	0.37	0.01	0.07	0.07	10207
1980-	2 (3.94)	0.23	0.34	0.03	0.08	0.05	17528
Albania							
-1969	11.37 (4.04)	0.94	0.79	0.73	0.74	0.01	10061
1970-1979	11.35 (4)	0.99	0.75	0.70	0.75	0.04	7103
1980-	12.14 (4.64)	0.94	0.62	0.56	0.58	0.02	6443
Benin							
-1969	2.33 (4.06)	0.46	0.07	0.03	0.03	0.01	17112
1970-1979	2.19 (3.7)	0.44	0.15	0.06	0.06	0.01	19084
1980-	2.86 (4.51)	0.45	0.18	0.06	0.08	0.02	17737
Bolivia							
-1969	6.78 (5.1)	0.83	0.67	0.57	0.55	-0.02	8613
1970-1979	8.57 (4.92)	0.83	0.76	0.65	0.64	-0.02	6097
Brazil							
-1969	6.13 (4.23)	0.92	0.72	0.65	0.66	0.01	9031
1970-1979	6.94 (3.88)	0.89	0.66	0.55	0.58	0.03	894
Burkina Faso							
-1969	0.92 (2.8)	0.50	0.16	0.05	0.08	0.03	18787
1970-1979	1.54 (3.52)	0.44	0.14	0.05	0.06	0.01	11479
1980-	1.96 (3.78)	0.53	0.10	0.02	0.05	0.03	4883
Cameroon							
-1969	5.24 (4.54)	0.69	0.11	0.05	0.07	0.03	13493
1970-1979	6.27 (4.58)	0.75	0.21	0.09	0.16	0.06	13365
1980-	7 (4.99)	0.78	0.24	0.17	0.19	0.03	12775
Central African Republic							
-1969	2.45 (3.64)	0.42	0.22	0.07	0.09	0.03	4616
Chad							
-1969	1.19 (2.84)	0.28	0.13	0.02	0.04	0.02	9039
1970-1979	1.61 (3.3)	0.30	0.17	0.04	0.05	0.01	7536
1980-	2.44 (3.97)	0.39	0.13	0.05	0.05	0.00	7733

Table C2: Education inequality ratios by birth cohort and country for gender and ethnicity *(continued)*

Cohort	Education	IR(gender)	IR(eth.)	IR(gen:eth)	Mechanical	Surplus	obs.
Congo							
-1969	8.13 (4.38)	0.72	0.66	0.48	0.47	0.00	5256
1970-1979	8.2 (3.75)	0.81	0.81	0.62	0.65	0.03	7173
1980-	8.32 (3.85)	0.89	0.68	0.55	0.60	0.05	3930
DR Congo							
-1969	6.28 (4.59)	0.54	0.57	0.30	0.31	0.01	6636
1970-1979	6.55 (4.45)	0.65	0.61	0.44	0.39	-0.05	9335
1980-	6.59 (4.58)	0.66	0.62	0.43	0.41	-0.02	9355
Ethiopia							
-1969	1.48 (3.35)	0.32	0.10	0.00	0.03	0.03	17072
1970-1979	2.34 (3.92)	0.51	0.12	0.01	0.06	0.05	20654
1980-	3.42 (4.69)	0.49	0.18	0.03	0.09	0.05	18944
Gabon							
-1969	8.6 (3.8)	0.76	0.68	0.42	0.52	0.10	2079
1970-1979	9.03 (3.87)	0.80	0.58	0.48	0.47	-0.01	2680
1980-	9.81 (3.82)	0.89	0.78	0.65	0.69	0.04	2506
Ghana							
-1969	6.14 (5.18)	0.66	0.16	0.11	0.10	0.00	11024
1970-1979	6.88 (5.03)	0.72	0.32	0.15	0.23	0.08	6505
1980-	8.27 (5.17)	0.82	0.36	0.26	0.30	0.04	5177
Guatemala							
-1969	4.26 (4.7)	0.76	0.42	0.27	0.32	0.06	3783
1970-1979	4.92 (4.74)	0.80	0.49	0.37	0.39	0.02	7471
1980-	6.38 (4.9)	0.85	0.58	0.50	0.50	0.00	10798
Guinea							
-1969	1.77 (4.24)	0.38	0.38	0.16	0.14	-0.01	4734
1970-1979	1.64 (3.95)	0.28	0.42	0.12	0.12	0.00	4253
1980-	3.03 (5.29)	0.40	0.41	0.18	0.16	-0.02	5811
Guyana							
-1969	7.92 (3.39)	0.97	0.66	0.61	0.64	0.02	2065
1970-1979	8.64 (3.28)	0.95	0.65	0.62	0.62	0.00	2327
1980-	9.26 (3.09)	1.00	0.68	0.61	0.68	0.06	1118
Honduras							
-1969	5.66 (4.57)	0.89	0.61	0.46	0.54	0.08	4657

Table C2: Education inequality ratios by birth cohort and country for gender and ethnicity *(continued)*

Cohort	Education	IR(gender)	IR(eth.)	IR(gen:eth)	Mechanical	Surplus	obs.
1970-1979	6.44 (4.3)	0.94	0.68	0.62	0.63	0.01	7036
1980-	7.51 (4.34)	0.91	0.71	0.63	0.65	0.02	6768
Ivory Coast							
-1969	2.4 (3.91)	0.47	0.24	0.09	0.11	0.03	6088
Kazakhstan							
-1969	10.77 (2.51)	0.85	0.96	0.80	0.82	0.02	3533
1970-1979	10.77 (2.24)	0.84	0.97	0.81	0.82	0.00	875
Kenya							
-1969	6.55 (4.3)	0.75	0.16	0.07	0.12	0.05	19245
1970-1979	8.16 (3.94)	0.87	0.20	0.12	0.17	0.05	18720
1980-	8.84 (3.99)	0.91	0.25	0.16	0.23	0.07	15797
Liberia							
-1969	4.39 (5.16)	0.35	0.55	0.18	0.20	0.02	1402
1970-1979	4.55 (5.01)	0.51	0.57	0.29	0.29	0.00	3187
1980-	5.59 (5.12)	0.64	0.69	0.37	0.44	0.07	3776
Malawi							
-1969	3.63 (3.65)	0.60	0.34	0.16	0.20	0.04	15246
1970-1979	4.56 (3.96)	0.66	0.44	0.28	0.29	0.02	21043
1980-	6.32 (3.89)	0.83	0.65	0.53	0.54	0.01	17567
Mali							
-1969	1.29 (3.11)	0.47	0.34	0.12	0.16	0.03	21039
1970-1979	1.3 (3.2)	0.46	0.38	0.16	0.17	0.01	15553
1980-	2.01 (3.99)	0.46	0.33	0.15	0.15	0.00	12203
Moldova							
-1969	11.5 (2.33)	0.97	0.93	0.90	0.90	0.00	4121
1970-1979	11.54 (2.52)	0.99	0.97	0.96	0.96	0.00	2320
1980-	11.78 (2.74)	0.98	0.91	0.89	0.90	0.01	258
Mozambique							
-1969	2.21 (2.94)	0.47	0.17	0.11	0.08	-0.03	8073
1970-1979	3.09 (3.49)	0.62	0.18	0.13	0.11	-0.02	5241
1980-	3.96 (3.93)	0.65	0.20	0.15	0.13	-0.02	3993
Namibia							
-1969	6.57 (4.24)	0.98	0.54	0.47	0.54	0.07	3882
1970-1979	8.11 (3.76)	0.94	0.62	0.56	0.59	0.02	1868

Table C2: Education inequality ratios by birth cohort and country for gender and ethnicity *(continued)*

Cohort	Education	IR(gender)	IR(eth.)	IR(gen:eth)	Mechanical	Surplus	obs.
Niger							
-1969	0.61 (2.15)	0.60	0.18	0.12	0.10	-0.01	13895
1970-1979	1.18 (2.83)	0.46	0.27	0.15	0.12	-0.03	4970
1980-	1.17 (2.91)	0.38	0.29	0.10	0.11	0.01	1142
Nigeria							
-1969	5.51 (5.68)	0.63	0.10	0.05	0.06	0.02	18869
1970-1979	6.44 (5.69)	0.70	0.11	0.06	0.08	0.02	35890
1980-	7.16 (5.86)	0.74	0.16	0.11	0.12	0.00	47233
Pakistan							
-1969	3.09 (4.61)	0.44	0.13	0.01	0.06	0.05	2838
1970-1979	3.88 (4.95)	0.49	0.20	0.06	0.10	0.04	5525
1980-	4.49 (4.96)	0.69	0.13	0.09	0.09	0.00	5456
Philippines							
-1969	8.92 (4.21)	0.93	0.39	0.37	0.36	-0.01	7089
1970-1979	9.9 (4)	0.89	0.47	0.45	0.42	-0.04	4765
Rwanda							
-1969	2.53 (3.28)	0.77	0.57	0.50	0.44	-0.06	4364
Senegal							
-1969	2.39 (4.23)	0.59	0.44	0.23	0.26	0.02	23810
1970-1979	2.92 (4.35)	0.60	0.40	0.25	0.24	0.00	25146
1980-	3.59 (4.86)	0.66	0.36	0.26	0.24	-0.02	35847
Sierra Leone							
-1969	2.87 (4.88)	0.47	0.18	0.07	0.09	0.02	6013
1970-1979	2.44 (4.37)	0.49	0.14	0.09	0.07	-0.02	12515
1980-	3.87 (5.1)	0.50	0.25	0.18	0.13	-0.05	17503
South Africa							
-1969	8.78 (4.31)	0.92	0.74	0.67	0.68	0.01	1154
1970-1979	10.02 (3.58)	0.99	0.90	0.89	0.89	0.00	2537
1980-	10.85 (2.69)	0.97	0.92	0.89	0.89	0.00	4221
Togo							
-1969	3.34 (4.1)	0.42	0.37	0.13	0.16	0.02	7482
1970-1979	3.8 (4.11)	0.46	0.37	0.15	0.17	0.03	4954
1980-	5.38 (4.7)	0.57	0.62	0.32	0.35	0.04	4077
Uganda							

Table C2: Education inequality ratios by birth cohort and country for gender and ethnicity *(continued)*

Cohort	Education	IR(gender)	IR(eth.)	IR(gen:eth)	Mechanical	Surplus	obs.
-1969	4.17 (3.92)	0.58	0.37	0.23	0.21	-0.01	7065
1970-1979	5.11 (4.29)	0.69	0.47	0.35	0.32	-0.03	7187
1980-	6.91 (4.5)	0.80	0.52	0.49	0.41	-0.07	10809
United States							
-1969	13.23 (2.87)	0.99	0.72	0.72	0.71	0.00	739514
1970-1979	13.5 (2.91)	0.97	0.74	0.72	0.72	-0.01	376732
1980-	13.65 (2.64)	0.97	0.78	0.76	0.76	-0.01	580778
Zambia							
-1969	6.44 (4.05)	0.70	0.53	0.36	0.38	0.02	14043
1970-1979	6.77 (3.87)	0.78	0.62	0.52	0.48	-0.03	13487
1980-	7.4 (4.01)	0.82	0.67	0.50	0.55	0.05	10080
Zimbabwe							
-1969	6.07 (4.02)	0.74	0.46	0.42	0.34	-0.08	4506

Note:

Education reports mean (sd); IR(G) reports inequality ratios between the group with the highest and lowest average education.

Table C3: Names of groups with the lowest and highest education by birth cohort

Country	Cohort	Gender low	Gender high	Ethnicity low	Ethnicity high	Intersect. low	Intersect. high
Afghanistan							
Afghanistan	1970-1979	F	M	nuristani	tajik	F:nuristani	M:tajik
Afghanistan	1980-	F	M	nuristani	uzbek	F:nuristani	M:uzbek
Albania							
Albania	-1969	F	M	other	albanian	F:other	M:albanian
Albania	1970-1979	F	M	other	albanian	M:other	M:albanian
Albania	1980-	F	M	other	albanian	M:other	M:albanian
Benin							
Benin	-1969	F	M	Peulh	Yoruba	F:Peulh	M:Yoruba
Benin	1970-1979	F	M	Peulh	Other	F:Peulh	M:Fon
Benin	1980-	F	M	Peulh	Fon	F:Peulh	M:Adja
Bolivia							
Bolivia	-1969	F	M	quechua	none	F:quechua	M:none
Bolivia	1970-1979	F	M	quechua	none	F:quechua	M:aymara
Brazil							
Brazil	-1969	M	F	black	white	M:black	F:white
Brazil	1970-1979	M	F	black	white	M:black	M:white
Burkina Faso							
Burkina Faso	-1969	F	M	Touareg	Gurunsi	F:Touareg	M:Bobo
Burkina Faso	1970-1979	F	M	Touareg	Dioula	F:Touareg	M:Dioula
Burkina Faso	1980-	F	M	Touareg	Other	M:Touareg	M:Lobi
Cameroon							
Cameroon	-1969	F	M	Arab-choa/Peu...	Côtier/Ngoe/O...	F:Biu-Mandara	M:Côtier/Ngoe...
Cameroon	1970-1979	F	M	Arab-choa/Peu...	Beti/Bassa/Mbam	F:Biu-Mandara	M:Beti/Bassa/...
Cameroon	1980-	F	M	Arab-choa/Peu...	Côtier/Ngoe/O...	F:Arab-choa/P...	M:Beti/Bassa/...
Central African Republic							

Table C3: Names of groups with the lowest and highest education by birth cohort *(continued)*

Country	Cohort	Gender low	Gender high	Ethnicity low	Ethnicity high	Intersect. low	Intersect. high
Central Afric...	-1969	F	M	haoussa	yakoma-sango	F:haoussa	M:yakoma-sango
Chad							
Chad	-1969	F	M	gorane	sara (ngambay...	F:gorane	M:sara (ngamb...
Chad	1970-1979	F	M	kanembou / bo...	sara (ngambay...	F:kanembou / ...	M:sara (ngamb...
Chad	1980-	F	M	kanembou / bo...	sara (ngambay...	F:kanembou / ...	M:sara (ngamb...
Congo							
Congo	-1969	F	M	Other non-Con...	Mbohhi	F:Other non-C...	M:Mbohhi
Congo	1970-1979	F	M	Other Congolese	Mbohhi	F:Other non-C...	M:Mbeti
Congo	1980-	F	M	Other non-Con...	Mbohhi	F:Other non-C...	M:Mbeti
DR Congo							
DR Congo	-1969	F	M	uele lac albert	bakongo	F:ubangi and ...	M:bakongo
DR Congo	1970-1979	F	M	uele lac albert	bakongo	F:uele lac al...	M:bas-kasai a...
DR Congo	1980-	F	M	uele lac albert	bakongo	F:ubangi and ...	M:cuvette cen...
Ethiopia							
Ethiopia	-1969	F	M	Affar	Welaita	F:Gumuz	M:Welaita
Ethiopia	1970-1979	F	M	Affar	Guragie	F:Berta	M:Nuer
Ethiopia	1980-	F	M	Affar	Nuer	F:Affar	M:Nuer
Gabon							
Gabon	-1969	F	M	other	myene	F:kota-kele	M:fang
Gabon	1970-1979	F	M	kota-kele	myene	F:kota-kele	M:myene
Gabon	1980-	F	M	kota-kele	myene	F:kota-kele	M:myene
Ghana							
Ghana	-1969	F	M	gruma	ga/dangme	F:gruma	M:ga/dangme
Ghana	1970-1979	F	M	gruma	akan	F:gruma	M:akan
Ghana	1980-	F	M	gruma	akan	F:gruma	M:akan
Guatemala							

Table C3: Names of groups with the lowest and highest education by birth cohort *(continued)*

Country	Cohort	Gender low	Gender high	Ethnicity low	Ethnicity high	Intersect. low	Intersect. high
Guatemala	-1969	F	M	maya/other	ladina/mestiza	F:maya/other	M:ladina/mestiza
Guatemala	1970-1979	F	M	maya/other	ladina/mestiza	F:maya/other	M:ladina/mestiza
Guatemala	1980-	F	M	maya/other	ladina/mestiza	F:maya/other	M:ladina/mestiza
Guinea							
Guinea	-1969	F	M	peulh	soussou	F:peulh	M:other
Guinea	1970-1979	F	M	peulh	soussou	F:guerzé	M:soussou
Guinea	1980-	F	M	peulh	other	F:peulh	M:other
Guyana							
Guyana	-1969	M	F	amerindian	african	F:amerindian	F:african
Guyana	1970-1979	M	F	amerindian	african	F:amerindian	F:african
Guyana	1980-	M	F	amerindian	african	M:amerindian	F:african
Honduras							
Honduras	-1969	M	F	None	Other	M:None	F:Other
Honduras	1970-1979	M	F	None	Other	M:None	F:Other
Honduras	1980-	M	F	None	Other	M:None	F:Other
Ivory Coast							
Ivory Coast	-1969	F	M	Burkina-Faso	Ivorian	F:Burkina-Faso	M:Ivorian
Kazakhstan							
Kazakhstan	-1969	M	F	Other	Russian	M:Other	F:Russian
Kazakhstan	1970-1979	M	F	Other	Russian	M:Russian	F:Russian
Kenya							
Kenya	-1969	F	M	turkana	kikuyu	F:turkana	M:kikuyu
Kenya	1970-1979	F	M	somali	kikuyu	F:somali	M:kisii
Kenya	1980-	F	M	somali	kisii	F:somali	M:kisii
Liberia							
Liberia	-1969	F	M	Kpelle	Grebo	F:Kpelle	M:Other Kru

Table C3: Names of groups with the lowest and highest education by birth cohort *(continued)*

Country	Cohort	Gender low	Gender high	Ethnicity low	Ethnicity high	Intersect. low	Intersect. high
Liberia	1970-1979	F	M	Kpelle	Other Kru	F:Kpelle	M:Other Kru
Liberia	1980-	F	M	Kpelle	Other	F:Kpelle	M:Grebo
Malawi							
Malawi	-1969	F	M	sena	tumbuka	F:sena	M:tumbuka
Malawi	1970-1979	F	M	sena	tumbuka	F:sena	M:tumbuka
Malawi	1980-	F	M	sena	tumbuka	F:sena	M:nkondhe
Mali							
Mali	-1969	F	M	dogon	malinke	F:dogon	M:malinke
Mali	1970-1979	F	M	tamacheck	malinke	F:dogon	M:malinke
Mali	1980-	F	M	tamacheck	bobo	F:tamacheck	M:bobo
Moldova							
Moldova	-1969	M	F	moldovan	other	M:moldovan	F:other
Moldova	1970-1979	M	F	moldovan	other	M:other	F:other
Moldova	1980-	M	F	moldovan	other	F:moldovan	F:other
Mozambique							
Mozambique	-1969	F	M	Chewa	Portuguese	F:Sena	F:Portuguese
Mozambique	1970-1979	F	M	Chewa	Portuguese	F:Chewa	M:Portuguese
Mozambique	1980-	F	M	Chewa	Portuguese	F:Chewa	M:Portuguese
Namibia							
Namibia	-1969	M	F	kavango langu...	afrikaans	F:kavango lan...	M:afrikaans
Namibia	1970-1979	M	F	kavango langu...	afrikaans	F:kavango lan...	M:afrikaans
Niger							
Niger	-1969	F	M	Touareg/Touar...	Other	F:Touareg/Tou...	M:Other
Niger	1970-1979	F	M	Touareg/Touar...	Other	F:Touareg/Tou...	M:Djerma
Niger	1980-	F	M	Touareg/Touar...	Djerma	F:Kanouri	M:Djerma
Nigeria							

Table C3: Names of groups with the lowest and highest education by birth cohort *(continued)*

Country	Cohort	Gender low	Gender high	Ethnicity low	Ethnicity high	Intersect. low	Intersect. high
Nigeria	-1969	F	M	Fulani	Yoruba	F:Fulani	M:Ijaw/Izon
Nigeria	1970-1979	F	M	Fulani	Yoruba	F:Fulani	M:Ijaw/Izon
Nigeria	1980-	F	M	Fulani	Igbo	F:Fulani	M:Yoruba
Pakistan							
Pakistan	-1969	F	M	Barauhi	Urdu	F:Balochi	M:Urdu
Pakistan	1970-1979	F	M	Barauhi	Urdu	F:Barauhi	M:Urdu
Pakistan	1980-	F	M	Barauhi	Urdu	F:Barauhi	M:Urdu
Philippines							
Philippines	-1969	M	F	maguindanaon	tagalog	F:maguindanaon	F:tagalog
Philippines	1970-1979	M	F	maguindanaon	tagalog	F:maguindanaon	F:tagalog
Rwanda							
Rwanda	-1969	F	M	hutu	tutsi/other	F:hutu	M:tutsi/other
Senegal							
Senegal	-1969	F	M	Poular	Other	F:Poular	M:Diola
Senegal	1970-1979	F	M	Poular	Diola	F:Poular	M:Diola
Senegal	1980-	F	M	Poular	Diola	F:Poular	M:Diola
Sierra Leone							
Sierra Leone	-1969	F	M	Fullah	Creole	F:Kono	M:Creole
Sierra Leone	1970-1979	F	M	Other	Creole	F:Other	M:Creole
Sierra Leone	1980-	F	M	Other	Creole	F:Other	M:Creole
South Africa							
South Africa	-1969	M	F	black/african	white/coloure...	M:black/african	M:white/colou...
South Africa	1970-1979	M	F	black/african	white/coloure...	M:black/african	M:white/colou...
South Africa	1980-	M	F	black/african	white/coloure...	M:black/african	F:white/colou...
Togo							
Togo	-1969	F	M	para-gourma/akan	akposso/akebou	F:para-gourma...	M:adja-ewe/mina

Table C3: Names of groups with the lowest and highest education by birth cohort *(continued)*

Country	Cohort	Gender low	Gender high	Ethnicity low	Ethnicity high	Intersect. low	Intersect. high
Togo	1970-1979	F	M	para-gourma/akan	akposso/akebou	F:para-gourma...	M:akposso/akebou
Togo	1980-	F	M	para-gourma/akan	kabye/tem	F:para-gourma...	M:ana-ife
Uganda							
Uganda	-1969	F	M	Ruanda-Rundi	baganda	F:moru-madi	M:baganda
Uganda	1970-1979	F	M	moru-madi	baganda	F:moru-madi	M:langi
Uganda	1980-	F	M	Ruanda-Rundi	baganda	F:alur-acholi	M:alur-acholi
United States							
United States	-1969	M	F	Other race	Japanese	M:Other race	F:Japanese
United States	1970-1979	M	F	Other race	Japanese	M:Other race	M:Japanese
United States	1980-	M	F	Other race	Chinese	M:Other race	F:Chinese
Zambia							
Zambia	-1969	F	M	mbunda	lozi	F:mbunda	M:namwanga
Zambia	1970-1979	F	M	mbunda	namwanga	F:mbunda	M:namwanga
Zambia	1980-	F	M	mbunda	lozi	F:mbunda	M:other
Zimbabwe							
Zimbabwe	-1969	F	M	black	white	F:black	F:white

Note:

Table reports the names of the groups with the lowest and the highest average education that were used to calculate inequality ratios.

Table C4: Survey years and ethnic groups

Country	Survey years	Ethnic groups	N groups
Afghanistan	2015	tajik, other, pashtun, hazara, uzbek, turkmen, nuristani	7
Albania	2009, 2018, 2017	albanian, other	2
Benin	1996, 2001, 2006, 2012, 2011, 2018, 2017	Other, Yoa/Lokpa, Bariba, Fon, Yoruba, Peulh, Betamaribe, Dendi, Adja	9
Bolivia	2004, 2003	quechua, none, aymara, other	4
Brazil	1996	mixed/other, white, black	3
Burkina Faso	1992, 1999, 2003, 2010	Mossi, Bobo, Gurunsi, Fulfuldé/Peul, Lobi, Dioula, Other, Gurma, Touareg, Senufo, Bissa, Dagara	12
Cameroon	1998, 2004, 2011, 2018, 2019	Arab-choa/Peulh/Haoussa/Kanuri, Biu-Mandara, Other, Bantoïde South-West, Bamilike/Bamoun, Adamaoua-Oubangui, Grassfields, Côtier/Ngoe/Oroko, Beti/Bassa/Mbam, Kako/Meka/Pygmé	10
Central African Republic	1994	banda, mandjia, ngbaka-bantou, other, yakoma-sango, gbaya, mboum, haoussa, sara	9
Chad	1996, 2004, 2014, 2015	arabic, sara (ngambaye/sara madjin-gaye/mbaye), other, ouadaï / maba / massalit / mimi, hadjarai, gorane, kanembou / bornou / boudouma	7
Congo	2005, 2011, 2012	Kongo, Other Kongo, Other Congolese, Balari, Teke, Mbohhi, Mbeti, Other non-Congolese, Ubangi, Sangha	10
DR Congo	2007, 2014, 2013	cuvette central, bas-kasai and kwilu-kwngo, ubangi and itimbiri, kasai, katanga, tanganika, bakongo, basele-komo, maniema, kivu, uele lac albert, other	8

Table C4: Survey years and ethnic groups *(continued)*

Country	Survey years	Ethnic groups	N groups
Ethiopia	2000, 2005, 2011, 2016	Tigray, Amhara, Affar, Oromo, Guragie, Welaita, Somali, Sidama, Berta, Kefficho, Other, Gumuz, Agew, Gamo, Highlands, Hadiya, Ometo-Gimira/Basketo, Nuer	18
Gabon	2012	kota-kele, other, nzabi-duma, shira-punu/vili, fang, myene, mbede-teke	7
Ghana	1993, 1998, 2008, 2014	akan, guan, ewe, ga/dangme, other, mole-dagbani, grussi, gruma	8
Guatemala	2015, 2014	ladina/mestiza, maya/other	2
Guinea	1999, 2018	peulh, malinké, soussou, kissi, other, guerzé	6
Guyana	2009	amerindian, mixed/other, indian, african	4
Honduras	2012, 2011	None, Other indigenous, Other, Maya chorti, Lenca	5
Ivory Coast	1994	Other nationality, Burkina-Faso, Ivorian	3
Kazakhstan	1999	Kazakh, Russian, Other	3
Kenya	1999, 1998, 2003, 2009, 2008, 2014	kikuyu, meru/embu, luhya, luo, kamba, taita/taveta, other, somali, mijikenda/swahili, kisii, kalenjin, maasai, turkana, oromo/gabbra/borana	14
Liberia	2013	Other Kru, Grebo, Kpelle, Other Mande, Other, Bassa	6
Malawi	2000, 2004, 2005, 2010, 2016, 2015	other, tumbuka, tonga, nkondhe, ngoni, chewa, yao, sena, lomwe, mang'anja	10
Mali	1996, 1995, 2001, 2006, 2012, 2013, 2018	peulh, bambara, sarkole/soninke/marka, sonrai, other, malinke, senoufo/minianka, dogon, bobo, tamacheck	10
Moldova	2005	other, moldovan	2
Mozambique	1997, 2011	Makhuwa, Other, Sena, Tswa/Rhonga, Portuguese, Lomwe, Chewa, Changana, Chopi/Tonga, Shona/Ndau	10
Namibia	2000	other, kavango languages, oshiwambo, afrikaans, damara/nama, herero	6
Niger	1992, 1998, 2006	Other, Djerma, Peulh, Haoussa, Kanouri, Touareg/Touareg Bella	6

Table C4: Survey years and ethnic groups *(continued)*

Country	Survey years	Ethnic groups	N groups
Nigeria	2008, 2013, 2018	Hausa, Other, Igbo, Yoruba, Fulani, Kanuri/Beriberi, Igala, Ibibio/Efik/Anaang, Tiv, Ijaw/Izon, Ekoi, Urhobo et. al	12
Pakistan	2012, 2013	Pushto, Punjabi, Siraiki, Other, Urdu, Barauhi, Sindhi, Balochi	8
Philippines	2003	tagalog, ilocano, cebuano, other, waray, other bisaya, ilonggo, bicolano, kapampangan, maguindanaon	10
Rwanda	1992	hutu, tutsi/other	2
Senegal	1993, 1997, 2005, 2011, 2010, 2014, 2015, 2016, 2017, 2018, 2019	Wolof, Other, Poular, Serer, Mandingue, Diola, Soninke	7
Sierra Leone	2008, 2013, 2019	Mende, Temne, Other, Mandingo, Limba, Loko, Kono, Creole, Sherbro, Fullah	10
South Africa	2016	black/african, white/coloured/other	2
Togo	1998, 2013, 2014	adja-ewe/mina, kabye/tem, para-gourma/akan, other, ana-ife, akposso/akebou	6
Uganda	1995, 2011, 2016	langi, alur-acholi, moru-madi, other, banyoro, banyankore, chiga, baganda, Ruanda-Rundi, masaba-luhya, batoro, teso-turakana, basoga, bagisu, Other Nyoro-Ganda	15
United States	2019	Black, White, Two or more races, Other Asian, American Indian, Other race, Chinese, Japanese	8
Zambia	1996, 2002, 2001, 2007, 2013, 2014	lala-bisa, lunda, lozi, nsenga, chewa, mambwe-lungu, bemba, lenje-tonga, tumbuka, namwanga, luvale, ngoni, ushi, kaonde-nkoya, other, chokwe-luchazi, lamba, mbunda	18
Zimbabwe	1994	black, other, white	3