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Inequality and human development

The role of different parts of the income distribution

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Abstract: In this paper we reassess the relationship between inequality and human development, focusing on the differential effect associated with the concentration of national income at different parts of the income distribution. To do so, we rely on a large global panel of countries over the last decades which includes information on economic and human development as well as detailed information on the distribution of income within countries. We take advantage of detailed distributive data consistent across countries and over time (World Income Inequality Database companion datasets). We show how the concentration of income at the bottom and top, rather than overall inequality, is negatively associated with human development. This result highlights the relevance of income shares that go to the middle part of the income distribution and seems especially important in what refers to human capital accumulation in middle- and low-income countries and health in high-income countries. Our main results remain significant under different specifications and estimation techniques and after controlling for several country-specific characteristics, including the quality of institutions.

Supplementary material is available on the working paper's webpage (https://www.wider.unu.edu/publication/inequality-and-human-development).

Note: Figure 4 was corrected on 19 April 2023.

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1   Introduction

The first Human Development Report (UNDP 1990) successfully introduced the notion of human development as a process of enlarging people's choices, including living a long and healthy life (health), being educated (education), and having access to the resources needed for a decent standard of living (income). Human development was operationalized as a synthetic index, the Human Development Index (HDI), reflecting the average improvement along these three capabilities and going beyond traditional income-based measures like economic growth.

Also in recent years there has been an increased interest in the role of inequality in shaping economic development, especially as inequality has been persistently high or on the rise within many countries worldwide.[1] As the UN has highlighted, not only is income inequality within countries getting worse but there is an increasing concentration of income at the top; from 1990 to 2015, the share of income going to the top 1 per cent of the population increased in most countries with data (UN 2020a, 2020b). As Piketty (2014) and others have recently shown, this concentration of income at the top is a characteristic of recent economic dynamics. But the role of inequality in development is not straightforward; inequality can be at the same time a necessary toll for economic development and a deterrent for more substantial progress along all dimensions of wellbeing.

In this paper we reassess the relationship between income inequality and the evolution of human development. In doing so we follow the conventional practice of looking at the role of overall measures of inequality (like the Gini coefficient) in overall human development, and in each of its three dimensions, and controlling for other country-specific factors. But we also pay special attention to the fact that summary measures do not always capture well the dynamics of the income distribution. In particular, we analyse the differentiated role of the concentration of income at different parts of the income distribution, such as the bottom, middle, and top. To do so, we rely on a large and novel global panel of countries over the last decades which includes information on economic and human development as well as detailed information on the distribution of income within countries from the World Income Inequality Database (WIID) for close to 150 countries over the 1990–2019 period.

Our econometric results, using fixed effects (FEs) models (which capture the evolution over time within countries rather than cross-country differences), show a positive association between inequality, as measured by the Gini index, and the income per capita component of development, as found in previous works. However, we also find that concentration of income at the bottom and top of the distribution, at the expense of concentration in the middle, is associated with a lower HDI, especially in what refers to human capital accumulation (i.e. education) in developing countries and health in high-income countries. These results, to the best of our knowledge, are novel to the literature.

We relate to previous studies on the relationship between inequality and development. First, we relate to the vast literature addressing the impact of inequality on the income dimension of development, i.e. economic growth (Alesina and Rodrik 1994; Barro 2000; Chen 2003; Easterly 2007; Forbes 2000; Herzer and Vollmer 2012; Partridge 1997; Persson and Tabellini 1994;

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[1] The average Gini index declined from 44.2 in 1990 to 43.0 in 2019 based on our data when countries are not weighted by their population but increased from 41.3 to 44.5 when countries are weighted as inequality increased in the most populous countries, including China and India.

Oechslin and Zweimüller 2014; Ostry et al. 2014, among others). Second, our analysis connects with a more limited set of studies which consider the impact of inequality on other dimensions of development beyond income (including Castells-Quintana et al. 2019; Chetty et al. 2016; Easterly 2007; Pickett and Wilkinson 2015). Finally, we also relate to research which explores the different transmission channels through which inequality has an impact on development (see, for instance, Castells-Quintana and Royuela 2017; Easterly 2007; Marrero and Rodríguez 2013; World Bank 2005).

The remainder of this paper is organized as follows. In the next section we briefly review the literature on inequality and development and explain how different parts of the income distribution may play a differentiated role in the evolution of development. Section 3 takes a look at global data, relying on our unique dataset. In Section 4 we perform econometric analysis. Finally, Section 5 concludes.

2   Inequality and development: an overview

2.1   Inequality and economic development

The modern literature on the inequality–development relationship dates back at least to the 1950s with the seminal works of Lewis (1954) and Kuznets (1955), in which inequality was expected to first increase and then decrease during the development process (the so-called 'Kuznets' inverted U'). Since these seminal contributions an increasing branch of the inequality–development literature has focused on studying the potential *impact* of income inequality on development. It has mainly focused on a narrow view of development as economic growth, reporting mixed results.[2] The effect of inequality on economic growth depends on the time horizon of analysis that is considered, as well as on several country-specific characteristics.

On the one hand, studies which focus on long-run effects (usually based on cross-country variation) tend to find a negative impact of inequality on economic performance (see for instance Alesina and Rodrik 1994; Easterly 2007; Herzer and Vollmer 2012; Persson and Tabellini 1994; Ostry et al. 2014, among others). On the other hand, studies which focus on variation within countries over time, relating to a rather short-run effect, find empirical evidence supporting a positive overall impact of inequality on subsequent economic growth (see for instance Forbes 2000). Oechslin and Zweimüller (2014) corroborated this distinction between the long and short run. But the effect of inequality may also depend on the level of income (as suggested by Barro 2000) being negative in poor countries but positive in rich countries. Moreover, the effect may further depend on the initial income distribution itself, with the effect of inequality being positive when initial inequality is low and negative when it is high (Chen 2003).[3]

One of the reasons why the effect of inequality on growth is inconclusive is that income inequality may affect economic development via a wide range of different channels that can go in both directions. The mechanisms through which inequality can increase economic growth circle around: 1) higher *savings rates* (Kaldor 1956); 2) *imperfect capital markets* with *investment indivisibilities* (Aghion

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[2] See Baselgia and Foellmi (2022), Benabou (1996), De Dominicis et al. (2008), Ehrhart (2009), Ferreira et al. (2022), Galor (2009) and Neves and Silva (2013) for thorough and comprehensive surveys on the effects of inequality on economic growth.

[3] Other studies have focused on the inequality–development nexus focusing on subnational units, following Partridge (1997) for the USA and Royuela et al. (2019) for regions in Organisation for Economic Cooperation and Development (OECD) countries.

et al. 1999) in physical and human capital; and 3) growth-enhancing *incentives* created by inequality, for example for capital accumulation and innovations (Mirrlees 1971). Inequality can also negatively affect growth through: 1) greater *socio-political instability* and risk of social conflict and unrest, implying uncertainty of property rights and reduction of investment (Alesina and Perotti 1996); 2) higher *redistributive pressure*, which in turn may lead to economic distortions and disincentives (Alesina and Rodrik 1994; Persson and Tabellini 1994) as well as an unproductive waste of resources by lobbying against redistribution (Acemoglu and Robinson 2008; Krugman 2012; Stiglitz 2009); 3) *credit-market imperfections* and high set-up costs, which reduce the possibilities for low-income groups to invest in human capital (Galor and Zeira 1993); 4) the importance of the *middle class* for aggregated demand and *market size* (Murphy et al. 1989; Todaro 1997); and 5) the link between inequality, higher *endogenous fertility* rates, and reduced education and growth (Barro 2000; Ehrhart 2009).

Inconclusive results on the inequality–development relationship can also be explained by the acknowledgement of two distinct types (or components) of inequality: inequality of opportunities (or structural inequality), which refers to individual possibilities due to social, political, and institutional structures, and inequality of outcomes (or market inequality), which relates to unequal market outcomes for different levels of skill and education. While structural inequality is expected to manifest in poorer educational and health outcomes, and ultimately in lower levels of development, market inequality creates the necessary incentives for investment and innovation, potentially manifesting itself in higher short-run economic performance (Castells-Quintana and Royuela 2017). Easterly (2007) showed causal evidence of a long-run negative effect of structural inequality on economic development, while Castells-Quintana and Royuela (2017) and Marrero and Rodríguez (2013) found evidence supporting simultaneous positive and negative effects, depending on the type of inequality.

2.2   Inequality and other dimensions of development

While the focus of research on the inequality–development relationship has been on its economic dimension, other researchers have looked at other dimensions of development. Some, for instance, focus on the impact on health outcomes (e.g., Chetty et al. 2016; Leigh et al. 2011; Lynch et al. 2004; Pickett and Wilkinson 2015), while others look at educational attainment (Dabla-Norris et al. 2015; Easterly 2007; Galor and Zeira 1993; García-Peñalosa 1995; Gutiérrez and Tanaka 2009). [4]

In this line, Castells-Quintana et al. (2019) focus on human development using the HDI and its three components (namely income, education, and health). In line with the economic growth literature, inequality was shown to have a clear and robust negative impact on overall human development in the long run. In the short run, they found a positive impact on economic growth but a negative effect on educational outcomes, especially in developing countries.

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[4] Thorbecke and Charumilind (2002) provided a good review of the socioeconomic impact of inequality through several variables, including economic growth, education, and health. However, their study did not perform an econometric analysis. Overall, there is a consensus that high income inequality leads to an increasing frequency of most of the problems associated with low social status within societies, including health problems, violence, high teenage birth rates, obesity, and mental illness (Wilkinson and Pickett 2009) and coalitions against education for the poor (Rajan and Zingales 2006). However, these different effects have not been analysed simultaneously.

2.3 The pattern of the income distribution and its effects on development

To date the literature on the effects of inequality on development, or its various dimensions, has mainly relied on the use of a single inequality measure, the Gini coefficient, to summarize the distribution of income. Aggregate indices of relative inequality such as the Gini coefficient are useful for indicating the direction of the change in inequality over time based on their underlying value judgements.[5] However, inequality can increase or decrease for different reasons, with very different potential implications for human development. For example, a rise in inequality may result from an increase in the concentration of income at the top of the distribution at the expense of the middle part, with clear implications in terms of the political process being captured by the elite. This increase in inequality may also reduce the overall improvement of the country in terms of education or health if the rich already enjoy high development standards. Inequality, however, may rise also if the most disadvantaged population at the bottom is excluded from the benefits of economic development, even if the middle increases its share in national income and expands its access to better education and health. If the income shares of the poor and of the rich increase or decline at the same time, the change in inequality is unclear and depends on the sensitivity of the index used to different parts of the distribution.

The literature on inequality has indeed recently paid special attention to the evolution of the participation of income of different income classes. On the one hand, the quality of growth in terms of inclusiveness is usually assessed by looking at the participation in national income by, for example, the bottom 40 per cent, as in the concept of shared prosperity used by the World Bank (e.g., World Bank 2021a). This specific income share was also included (not without controversy) as the main quantitative target to monitor the achievement of 2030 UN Sustainable Development Goal 10, which predicates reducing inequality within and between countries. On the other hand, a growing and very influential literature (e.g., Picketty 2014) points at the disproportional concentration of income (or wealth) at the very top of the distribution as a key element of distributional dynamics, particularly in most recent decades. This tendency towards a higher concentration of resources at the very top has created alarm about its negative impact on the quality of the political process, and therefore delivery of development.

Therefore the division of the population into bottom, middle, and top, even if using rather arbitrary thresholds, seems to provide a reasonable representation of the dynamics of income distribution in many societies, which can help us to better understand the role of different distributional patterns in phenomena like income growth or human development. In this context the use of the income shares held by the three main income classes, as a complement to analyses based on single measures of inequality, can help to unravel a more nuanced inequality–development relationship.

The potentially differentiated role of different parts of the distribution has generally been overlooked in the literature. Only a few studies highlight the fact that the various mechanisms by which inequality affects economic growth can operate through different parts of the income distribution. This has led some authors to identify separate effects of inequality at the bottom and top tails (Litschig and Lombardi 2019; Voitchovsky 2005) or to study the sensitivity of the relationship to the inequality measure used (Blotevogel et al. 2022).

In sum, the impact of inequality on development is complex and can significantly depend both on how we measure development and on how we summarize changes in the income distribution. To the best of our knowledge, a comprehensive analysis which considers how different measures

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[5] Mainly in terms of the differentiated impact on increasing inequality that a regressive income transfer between two individuals will have, depending on the part of the income distribution (bottom, middle, or top) where it takes place.

capturing different aspects of the income distribution can affect several dimensions of development is still missing in the literature. We aim to fill this gap in what follows.

3   A look at global data

To explore development trends, and the potential role of inequality, we build a novel dataset which combines information on development outcomes, detailed measures of income distribution within countries, and other country characteristics. Our data includes information for almost 30 years and up to 148 countries. Table A1 in the appendix provides definitions and sources for all the variables, while several panels of Table A2 provide basic descriptive statistics for the variables used.

3.1   Human development

As a key measure of human development, we use the Human Development Index (HDI). The HDI was first introduced with the publication of the Human Development Report in 1990 (UNDP 1990) and became a plausible alternative to the use of per capita gross domestic product (GDP) as a measure of a country's performance in terms of development.[6] The index is a summary measure of average achievement in three key dimensions of human development (based on Sen's (1985) capabilities approach). These are: having a long and healthy life (health index based on life expectancy at birth); being knowledgeable (education index based on the mean of years of schooling for adults aged 25 years and more and expected years of schooling for children of school entering age); and having a decent standard of living (income index based on the log of gross national income per capita). The scores for the three HDI dimension indices are normalized based on goalposts for each indicator to fall on a scale between 0 and 1 and aggregated into a composite index using a geometric mean.[7] Note that the HDI does not reflect inequalities, poverty, human security, empowerment, etc. or other relevant dimensions of human development (which may be captured by other specific indices).[8]

As our main series we use the historical HDI series available on the Human Development Data Center website.[9] This is calculated by the Human Development Report Office using the current official methodology and reports comparable annual values for the HDI and its components (education, life expectancy, and income indices) for up to 190 countries between 1990 and 2019.

For robustness analysis we use two other available alternative series that cover a longer time span at the expense of using a smaller number of countries. The first of these is the Hybrid Human Development Index series (HHDI), which reports annual data of the HDI and its components for 135 countries, covering 1970 to 2010, calculated by Gidwitz et al. (2010) as part of the 2010 Human Development Report. This series is hybrid because it combines the new functional form of the

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[6] The methodology of the index was later updated with the publication of the Human Development Report in 2010 (UNDP 2010), with some adjustments in the 2014 release.

[7] In the original 1990 HDI, the composite index was a linear combination, instead of a geometric mean, of a slightly different set of indicators: the education index was based on gross enrolment and adult literacy, while the income index was based on GDP. For our estimates we rescaled the index on a 0–100 scale to show more understandable parameters.

[8] The Human Development Report agenda has recently tried to account for inequality in human development when computing the Inequality-adjusted Human Development Index (IHDI). Many studies have analysed how to incorporate inequality into the HDI (see, for instance Seth 2009). Others have also studied the evolution of inequality across countries in terms of the HDI (e.g., Martinez 2016).

[9] See UNDP (2022).

composite measure and the old indicators to estimate the education and income indices. The second is the Augmented Human Development Index series (AHDI) computed by Prados de la Escosura (2021) for 162 countries, for a much a longer period, between 1870 and 2015 (in five- to ten-year intervals). This historical index is the geometric mean of normalized indices of life expectancy at birth, years of schooling for those aged 15 years and over, per capita GDP, and the Liberal Democracy Index. The last of these is a new dimension not considered in the official HDI and aims to capture political and civil liberties (i.e. agency and freedom).

To have a consistent group of countries and periods of time, and considering our objective of studying long-term trends in the association between inequality and development, we aggregate the data in five-year periods, in line with the literature. Thus the final dataset considers 148 countries over the 1990–2019 period, [10] with an average of 4.4 (five-year) periods. For the HHDI the time frame considered is 1970–2010, averaging 5.1 periods for a maximum of 116 countries, while for the AHDI the data starts in 1950 and ends in 2015, averaging 5.6 periods and a maximum of 140 countries.

Figure 1 shows human development levels across countries in 2019, displaying higher levels in Europe, North America, Japan, and Australia, and lower values in Africa and some Asian countries. Worldwide, the historical HDI series shows a substantial improvement in human development since 1990 (from 0.600 to 0.722 in 2019, on average). Although the HDI levels strongly correlate with other development measures like GDP per capita, it is now considered a much more comprehensive measure, and it is widely acknowledged that economic growth does not necessarily translate into human development as other dimensions of the HDI can remain unchanged even if GDP is thriving. [11]

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[10] The 52 countries not included in the basic HDI dataset are Afghanistan, Andorra, United Arab Emirates, Belize, Congo (the Democratic Republic of the), Congo (the), Comoros (the), Djibouti, Greenland, Guyana, Haiti, Korea (the Democratic People's Republic of), Kosovo, Liberia, Mauritius, Mauritania, Micronesia (Federated States of), Montenegro, Myanmar, Namibia, North Macedonia, Palestine (State of), Papua New Guinea, Puerto Rico, Samoa, Saint Lucia, Sao Tome and Principe, Serbia, Seychelles, Sierra Leone, Singapore, Solomon, Somalia, South Africa, South Sudan, Sri Lanka, Suriname, Syrian Arab Republic (the), Taiwan (Province of China), Tanzania (the United Republic of), Thailand, Timor-Leste, Togo, Tonga, Islands, Trinidad and Tobago, Turkmenistan, Tuvalu, Uzbekistan, Vanuatu, and Yemen.

[11] Dep (2015) found that even the strong overall rank correlation can break down when analysing specific years or income groups, especially for middle- and high-income nations, while Biagi et al. (2017) showed that the evolution and the determinants of the social dimensions of the HDI and the GPD per capita greatly differ.

Figure 1: Human Development Index, 2019
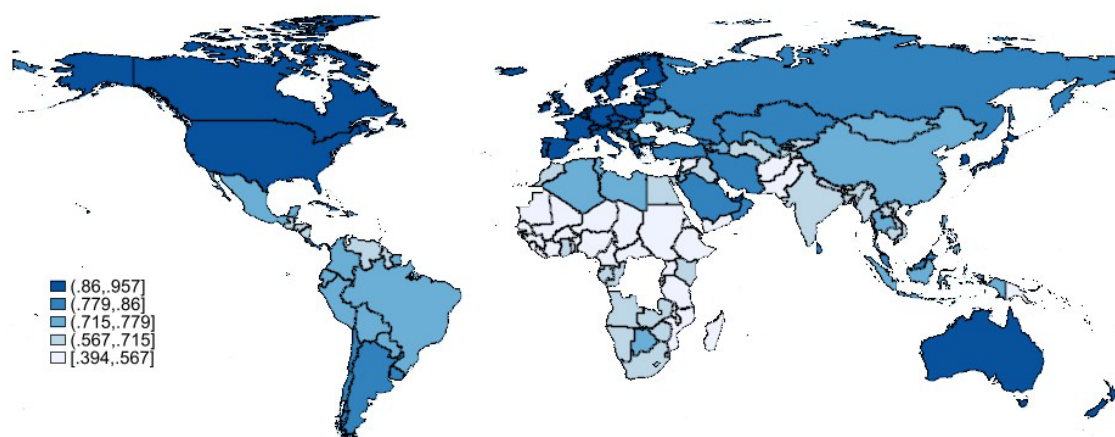
Note: HDI level (from 0 to 1) in 2019 across countries in our sample.

Source: authors' construction based on HDI series from the Human Development Data Center.

3.2 Income inequality

For income inequality data we use country-level income distributions in the global companion dataset of the World Income Inequality Database (WIID) put together by the United Nations University World Institute for Development Economics Research (UNU-WIDER). The WIID Companion (version 31 May 2021) includes estimates for up to 208 countries or territories for the period between 1950 and 2019 for the percentile share of each country's total net income as well as various relative inequality measures computed using these distributions, including Gini coefficients. The distributions are also summarized using the income share of various population groups (such as the bottom 40 per cent, the top 10 per cent, and top 1 per cent).

This dataset was constructed based on the original WIID main dataset, which compiles information, mostly obtained from household surveys, from a variety of countries, reported by various sources such as PovcalNet, ECLAC, SEDLAC, national statistics authorities, etc. or estimated directly from microdata (in the case of LIS and Eurostat).[12] The corresponding series were standardized to be comparable over time and across countries using formation from the same country or similar countries through regression analysis (see details in the corresponding WIID Companion technical notes in Gradín 2021a, 2021b, 2021c). The country series were then completed through linear interpolation between the closest survey years. This data is used for the Gini index as well as for estimates of the bottom 40 and top 10 income shares.

One well-known limitation of income distribution data from household surveys is that it tends to underrepresent the rich or underestimate their incomes. For that reason we also obtain the estimate of the income share of the top 1 per cent in each country from the World Inequality Database (WID) produced by the World Inequality Lab. This data puts an emphasis on correcting the income shares at the top of the distribution that would be obtained from household surveys using information from national accounts and, when available, tax records, or otherwise imputing those values based on information from similar countries. In this case the distribution originally refers

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[12] The full percentile distribution is estimated using the ungrouping method proposed by Shorrocks and Wan (2009), selecting the series that best represent the trend in income distribution in each country (ideally income shares at the decile level, plus the bottom and top 5 per cent).

to gross income per adult. As the coverage of the WID is smaller than the WIID, we adjusted the latter, replacing the income share of the top 1 per cent by the corresponding WID estimates (proportionally re-adjusting the others, i.e. bottom 40 per cent or middle 59 per cent), keeping the original information otherwise. When using the income share of the top 1 per cent in our analysis, we use the estimates from this alternative dataset.

Figure 2 shows income inequality levels (using Gini coefficients) across countries in 2019 (or closest year), with higher values for Africa, Latin America, India, and Pakistan, and lower outcomes for Europe and other developed countries such as Canada and Australia.

Figure 2: Inequality, Gini Index, circa 2019
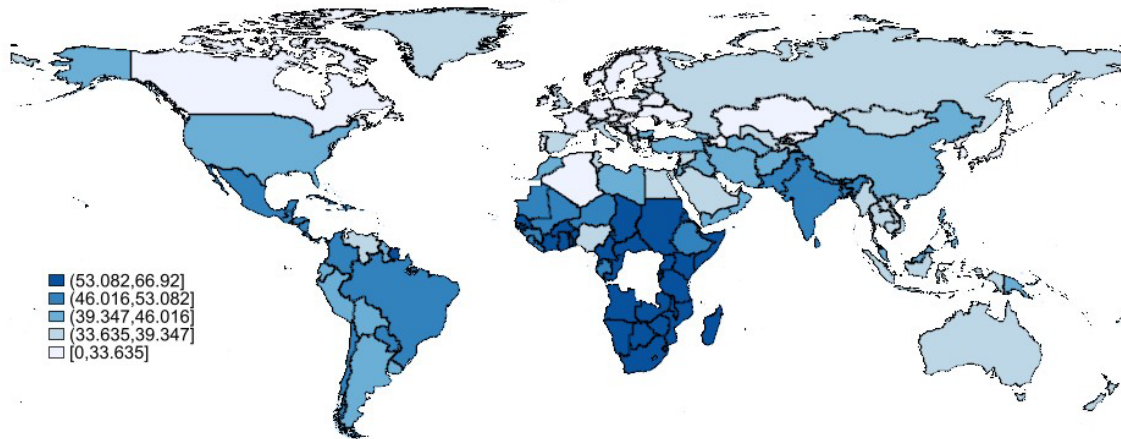
Note: inequality levels measured by the Gini coefficient (from 0 to 100) in 2019 across countries in our sample.

Source: authors' construction based on WIID Companion.

The various income distribution measures used in our analysis are strongly associated, even when controlling for time and country FEs. However, differences across different indices leave room for a differentiated role for each of them in what refers to their association with human development. Disaggregating the information of the distribution into the income shares of the bottom, middle, and top can help us disentangle different distributional changes and how they relate to changes in human development.

3.3 The co-evolution of inequality and development

In this subsection we look at the association between inequality and human development. Table A3 in the appendix shows the corresponding correlation coefficients. When considering the raw data the correlation between inequality and development measures is strong and negative for all inequality measures and human development indicators (i.e. negative for the Gini or the income of the top and positive for the bottom 40 per cent). Yet this linear association strongly declines when controlling for cross-section (country) FEs, while it is reinforced when we control for time FEs. This means that long-run time-invariant country characteristics may help to explain the strong negative correlation between inequality and human development. This conclusion holds for all components of human development considered separately. The correlation statistics are stronger for the series of the official HDI which starts in 1990 and lower for the longer series based on the HHDI and the AHDI.

We also check the two panel dimensions of the data—temporal and cross-sectional dimensions. First, we compute the time series correlation between inequality and human development for all available countries and then we plot the histogram of the 148 correlation statistics. The results for the HDI and the three indicators of inequality considered are displayed in Figure 3 (left column),

while the histograms with the alternative indices of human development, which are very similar, are displayed in the supplementary material to this paper. [13] As can be seen, while the average time series correlation (represented by the vertical red line) is close to zero, there is very large heterogeneity, with modal results close to -1 and +1 for all indices. The evolution of the cross-section correlation between inequality and human development is presented in the right column of Figure 3. As can be seen, the negative correlation between inequality and human development intensified during most of the period studied (i.e. between 1995 and 2015).

Finally, Figure 4 shows the scatterplots between the HDI and the indicators for inequality for both the overall data (grey dots) and country averages (maroon dots). The figure highlights the negative association between inequality and human development, which is almost entirely driven by the cross-sectional (country) dimension of the data.

Figure 3: Time series and cross-section correlation between HDI and inequality indicators
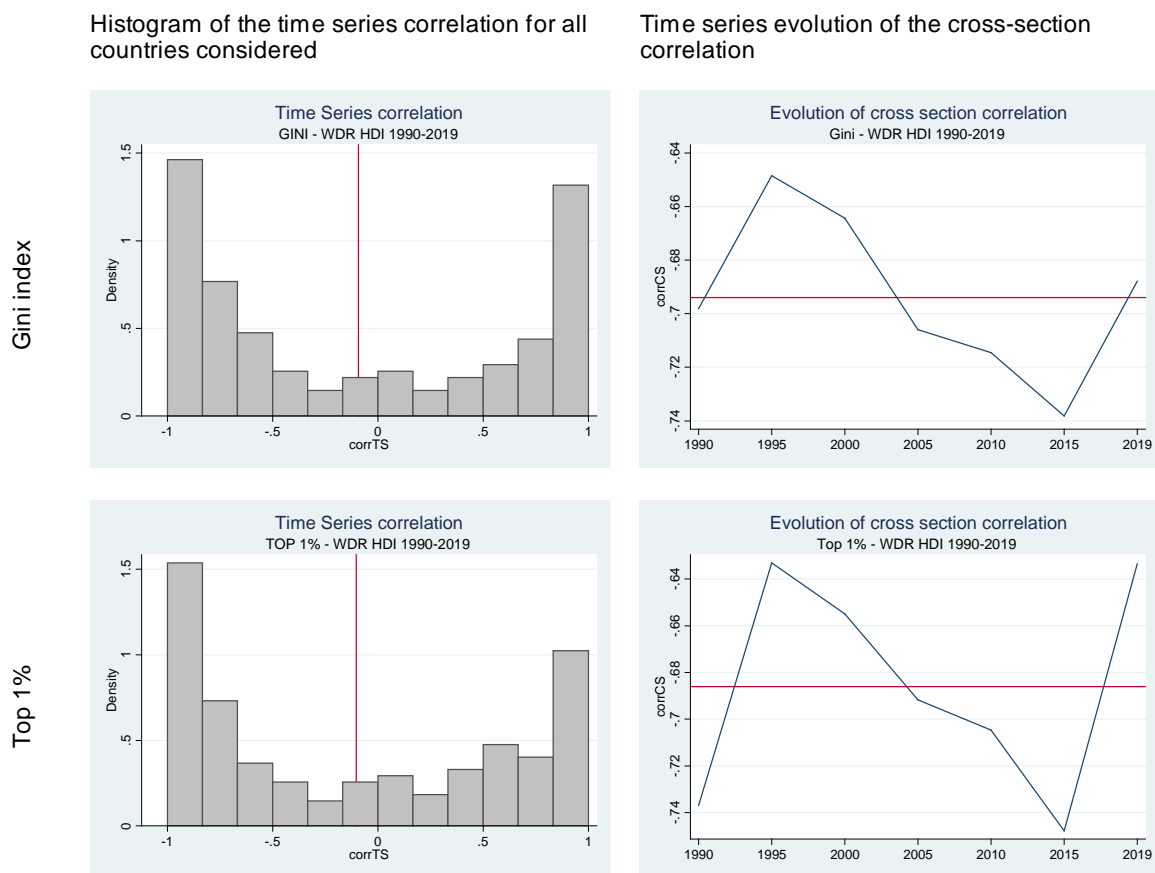
Histogram of the time series correlation for all countries considered

Time series evolution of the cross-section correlation
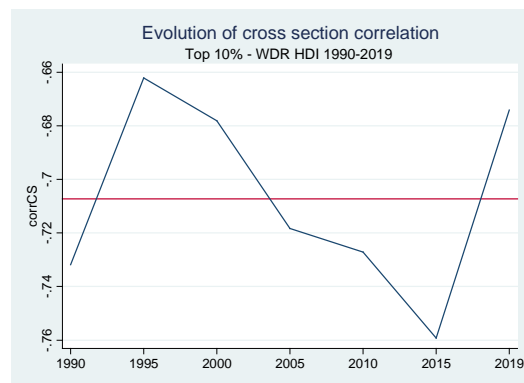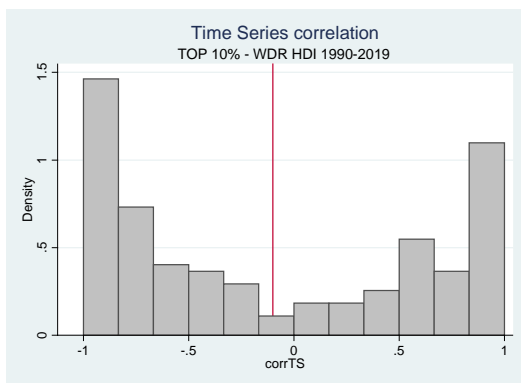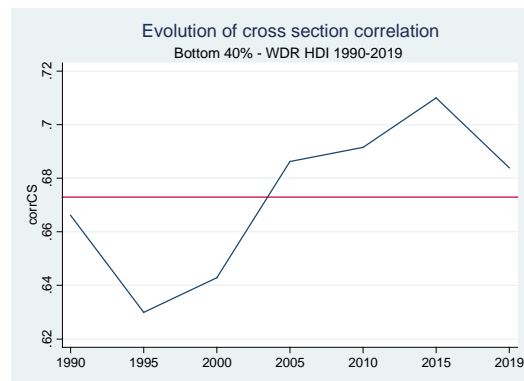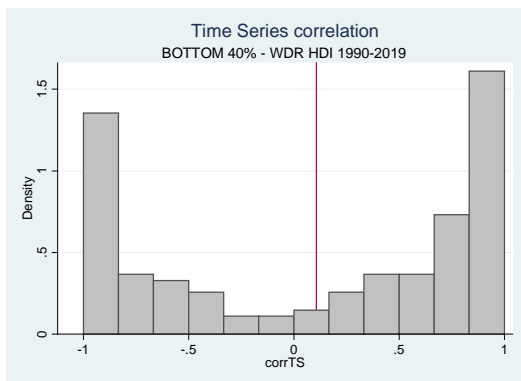
Note: the left column displays the histogram of the time series correlation between inequality and HDI for every country. The right column shows the evolution of the cross-section correlation between countries in every period.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section).

Figure 4: Human Development Index and inequality
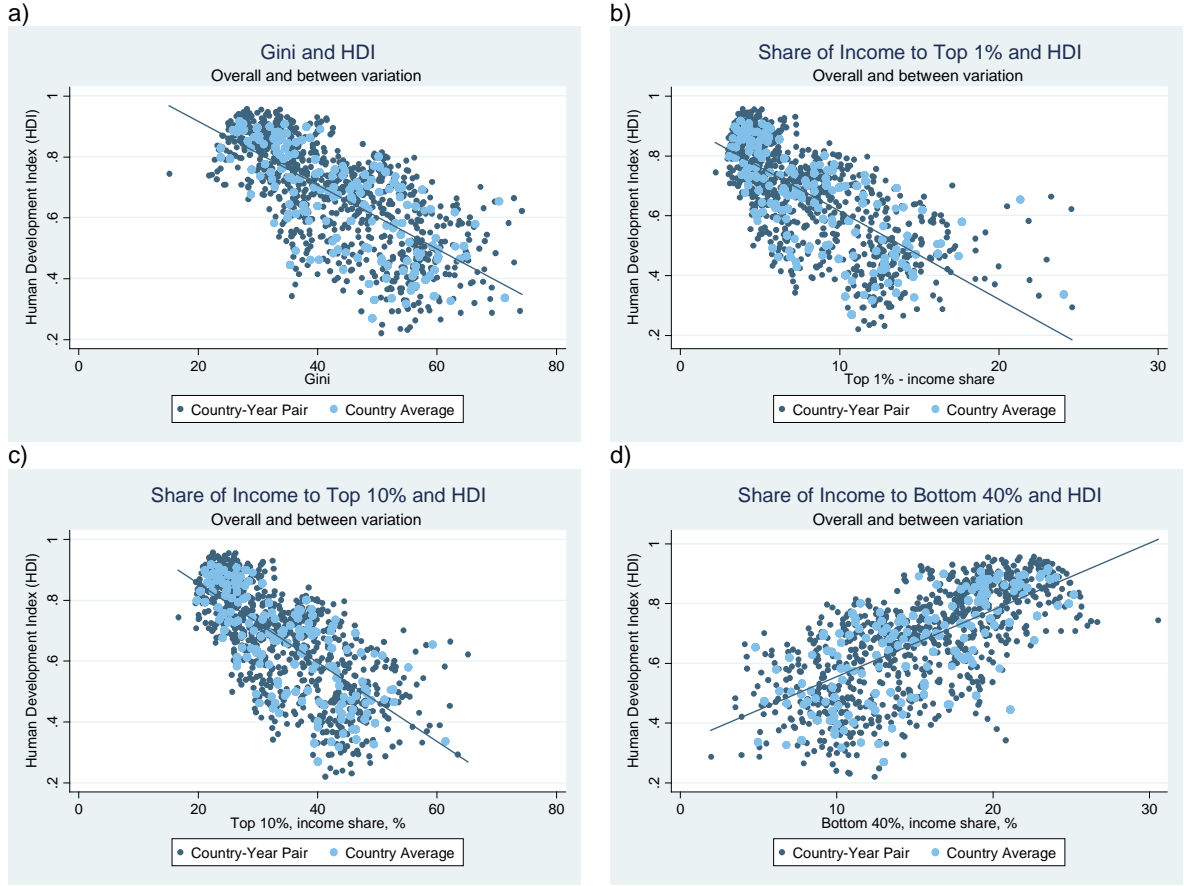
Note: dark blue dots correspond to overall data, while light blue dots indicate country averages.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section).

4   The role of inequality in human development: econometric analysis

We try to unravel the complex association between income distribution and human development by means of an econometric analysis. To do this we first follow the literature on the determinants of long-run economic growth and define human development as a function of inequality and other controls, as specified in Equation 1:

$$HDI_{i,t} = \alpha + \beta \; Inequality_{i,t-10} + X_{i,t-5}\emptyset + \xi_i + u_{i,t} \tag{1}$$

where $HDI_{i,t}$ accounts for human development in country i and time t (the overall HDI or each component, i.e. the income, education, or health indices that are used to produce the HDI), and *Inequality* accounts for one of the four considered measures for inequality (Gini index and income shares of the bottom 40 per cent, top 10 per cent, and top 1 per cent). X is a vector of time-varying country-specific controls, ξ_i refers to individual unobserved heterogeneity, and $u_{i,t}$ is a country–time specific shock. We define our time dimension t in five-year intervals to control for the business cycle and given the persistency of inequality (as is commonly done in the related literature). This time length is standard in the literature as it avoids the use of high frequency data given the long-run character of the association studied and avoids amplifying the error component without adding more information. To reduce endogeneity, in our estimations all explanatory

variables are lagged by five years. Inequality, as our main explanatory variable of interest, is lagged by ten years.

To disentangle the differentiated roles of different parts of the income distribution, we also consider specifications where we include, simultaneously, indicators for the income share of the bottom and top groups (therefore omitting the participation of the middle in national income), as in Equation 2:

$$HDI_{i,t} = \alpha + \beta_1 Bottom_{i,t-10} + \beta_2 Top_{i,t-10} + X_{i,t-5}\emptyset + \xi_i + u_{i,t} \tag{2}$$

where $Bottom$ refers to the income share of the poorest 40 per cent of the population and Top refers to the income share held by the richest 10 per cent (or top 1 per cent) of the population.

4.1 Panel results

We estimate our main underlying models specified in Equations (1) and (2) using different panel data estimation techniques. We cluster standard errors by country. We estimate the model for the HDI as well as for its components. Time and country FEs are included to control for global shocks and for unobserved country-specific characteristics. The results for the interest parameter β (the impact of inequality on human development) are presented in Table 1.

The four panels in Table 1 present, respectively, the results of model (1) considering four alternative indicators of inequality: the Gini index, the share of income held by the bottom 40 per cent, the share held by the top 10 per cent, and the share held by the top 1 per cent. Columns 1 to 3 display the results for the HDI, in column 1 without any control, in column 2 controlling for policy variables (i.e. inflation and price of investment as controls), and in column 3 further including structural factors (i.e. foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output). Columns 4 to 6 display the results for the different components of HDI: income, education, and health, respectively, considering the full set of controls.

As shown, we find no significant association between each measure of inequality and the HDI when cross-sectional variance plays no role and we focus on within-country variation. [14] We only find a positive and significant association between the Gini coefficient and the income component (i.e. higher inequality associated with higher per capita income). These FE panel results for income are consistent with previous findings in the economic growth literature (e.g., Forbes 2000) and are usually interpreted as a short-run association between inequality and economic dynamics.

Using the alternative measures of inequality (income share of either the bottom or the top instead of the Gini index), we also find a negative and significant association between the income share of the bottom 40 per cent and the income component of the HDI, suggesting that the result on a positive association between inequality and income holds when inequality increases, by reducing the share of the lower part of the country income distribution. However, this is not the case when inequality is captured instead by the income share of the top 1 or 10 per cent of the population. For the education and health components we find no significant results in all three cases.

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[14] When cross-sectional variance does play a role (pool-ordinary least squares, between and random effects reported in Tables A4 and A5 in the appendix, with the full list of controls), and likely relating to long-run associations, we find instead a significant negative effect of inequality on all human development indicators (HDI, and HHDI and AHDI in the supplementary material), and all components (education, health, and income, with few exceptions for the latter only affecting significance), in line with the literature. Table A4 introduces the controls sequentially for FEs.

Table 1: Human development and four alternative measures of inequality

Dep. Variable:	(1) HDI	(2) HDI	(3) HDI	(4) Income	(5) Education	(6) Health
Gini	0.046	0.055	0.053	0.169**	0.038	-0.043
	(0.062)	(0.066)	(0.061)	(0.082)	(0.048)	(0.11)
R-squared	0.878	0.878	0.886	0.646	0.877	0.669
Bottom40	-0.107	-0.126	-0.12	-0.383**	-0.106	0.125
	(0.122)	(0.132)	(0.12)	(0.172)	(0.096)	(0.204)
R-squared	0.878	0.878	0.886	0.65	0.877	0.669
Top10	0.03	0.04	0.038	0.153	0.015	-0.037
	(0.079)	(0.082)	(0.078)	(0.094)	(0.062)	(0.143)
R-squared	0.878	0.877	0.885	0.639	0.876	0.669
Top1	-0.024	-0.003	-0.013	0.262	-0.043	-0.199
	(0.175)	(0.179)	(0.173)	(0.188)	(0.142)	(0.316)
R-squared	0.877	0.877	0.885	0.635	0.876	0.67
Observations	681	657	657	657	657	657
Number of countries	152	148	148	148	148	148
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Controls 1	NO	YES	YES	YES	YES	YES
Controls 2	NO	NO	YES	YES	YES	YES

Note: robust standard errors clustered by country reported in parentheses. Significance: * 10%, ** 5%, *** 1%. Control 1 variables include inflation and price of investment; Control 2 consider foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1 in the appendix.

As previously discussed, there may be a differentiated role of different parts of the income distribution in the inequality–HDI relationship, which may explain the non-significant results in Table 1. To explore this possibility, in Table 2, instead of summarizing inequality by a single index, we disaggregate the information of the income distribution into the income share of three groups: bottom, top, and rest (omitted group). In the first panel we introduce the income shares of the bottom 40 per cent and the top 10 per cent (omitting the share of people between percentiles 41 and 90), while in the second panel we introduce the income shares of the bottom 40 per cent along that of the top 1 per cent (omitting the share of people between percentiles 41 and 99).

Table 2: Human development and inequality: Bottom and top income shares introduced simultaneously

Dep. variable:	(1) HDI	(2) Income	(3) Education	(4) Health
Bottom40	-0.220	-0.556**	-0.285	0.245
	(0.166)	(0.267)	(0.180)	(0.222)
Top10	-0.070	-0.124	-0.127	0.086
	(0.110)	(0.127)	(0.111)	(0.192)
R-squared	0.89	0.65	0.88	0.67
Bottom40	-0.336**	-0.622**	-0.346**	0.037
	(0.158)	(0.277)	(0.167)	(0.201)
Top1	-0.381*	0.425	-0.424*	-0.156
	(0.218)	(0.286)	(0.229)	(0.351)
R-squared	0.89	0.65	0.88	0.67
Observations	657	671	658	672
Countries	148	149	148	149

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1 in the appendix.

We find negative and significant coefficients associated with the income share of the bottom 40 per cent and the top 1 per cent. This result suggests that the higher concentration of income at both tails, the bottom and top of the income distribution, at the expense of the rest, is associated with a lower HDI. Note that, while a higher concentration at the bottom reduces inequality, a higher concentration at the top increases it. This result is consistent with single summary measures that average across both effects (e.g., Gini) showing no net effect in Table 1, as well as measures that capture the concentration at only one of the tails. This therefore points to the relevance of analysing differences along the income distribution, as it may be the income share of the middle of the distribution (broadly defined) that counts rather than inequality, as usually defined, in line with some previous research (i.e. Partridge 1997, 2005). Furthermore, it seems that the HDI-reducing role of the concentration of income at both the bottom and the top of the income distribution is only relevant for the educational component of the HDI. This would also follow previous insights in the literature which suggest that lower human capital accumulation may be a potential mechanism for inequality to hurt development (Litschig and Lombardi 2019).

4.2 Results by level of development

In Table 3 we further explore the extent of heterogeneity among countries in the relationship between HDI and income concentration at different parts of the distribution by differentiating by level of development. The first panel (columns 1 to 4) shows the results estimated using the sample of high-income countries only, while the second panel (columns 5 to 8) does the same for middle- and low-income countries. [15]

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[15] Countries are classified based on their status according to the 2021 World Bank classification of all world economies (World Bank 2021b).

For high-income countries there is no statistically significant relationship between inequality and overall HDI, which mainly reflects the lack of a statistically significant relationship for the income and education indices. This means that we do not confirm the general results described in Table 2 in this sample of countries. However, we do find that a higher concentration of income at the bottom 40 per cent and the top 10 per cent, at the expense of the income of the middle, is negatively and significantly associated with health (see column 4). That is, a stronger middle-income group tends to correlate with higher values in the health index (i.e. life expectancy) among high-income countries. This result is in line with previous insights in the literature on health outcomes. According to Leigh et al. (2011), referenced in Ferreira et al. (2022), higher inequality may drive a reduction in the provision of public goods due to preferences heterogeneity (i.e. by increasing the influence of the rich), but at the same time increases in inequality may drive the median voter to support higher public expenditure health services. Interestingly, these outcomes are significant in high-income countries in contrast with the findings of Leigh et al. (2011) for OECD countries which reported no significant bivariate association between overall inequality and mortality.

For low- and middle-income countries we find that the concentration of income at the bottom, at the expense of the rest of the distribution (other than the top 1 per cent), is negatively correlated with the overall HDI (see column 5). By components, although there is no effect of inequality on health, unlike what was observed among high-income countries, we do observe such an effect on income and education, driving the general effects found in the full sample of countries in Table 2. That is, education is negatively correlated with a higher concentration at the bottom and top of the income distribution in these countries (see column 7). In other words a higher income share going to the middle group is associated with higher average education (i.e. a combined index based on enrolment and literacy).

The heterogeneity of these relationships is further explored using alternative classifications of countries, such as high versus low HDI and high versus low inequality. The results in Tables A6 and A7 in the appendix provide very similar results as low- and middle-income countries also tend to have lower HDI and higher inequality. [16]

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[16] We classify a country as high HDI if it is in the top 25 per cent of countries, while the income inequality divide considers the median value.

Table 3: Human development and inequality, by level of development

| | High-income countries | | | | Low- & middle-income countries | | | |
Dep. variable	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	0.083	-0.184	0.523	-0.153*	-0.315	-0.651*	-0.528**	0.386
	(0.127)	(0.146)	(0.348)	(0.088)	(0.22)	(0.351)	(0.216)	(0.308)
Top10	0.045	-0.002	0.292	-0.181***	-0.044	-0.098	-0.198*	0.236
	(0.118)	(0.103)	(0.297)	(0.064)	(0.135)	(0.161)	(0.116)	(0.243)
R-squared	0.94	0.84	0.87	0.96	0.89	0.65	0.90	0.65
Bottom40	0.021	-0.197	0.307	-0.104	-0.442**	-0.741**	-0.531**	0.105
	(0.109)	(0.126)	(0.316)	(0.088)	(0.205)	(0.355)	(0.205)	(0.298)
Top1	-0.025	-0.037	0.283	-0.373***	-0.317	-0.393	-0.489*	0.109
	(0.278)	(0.233)	(0.69)	(0.139)	(0.258)	(0.342)	(0.255)	(0.438)
R-squared	0.94	0.84	0.87	0.96	0.89	0.65	0.90	0.64
Observations	240	242	240	242	417	429	418	430
Countries	48	48	48	48	100	101	100	101

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider high-income countries, while columns 5 to 8 use information for middle- and low-income countries.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1 in the appendix.

4.3   Concentration of income or institutional quality?

One plausible explanation for the previous results is that the effect associated with a higher concentration of income at the top may reflect lower quality institutions. As the literature notes there is a connection between inequality and institutions (see, for instance, Chong and Gradstein 2007), especially when high inequality is characterized by a concentration of income at the top; this high concentration of income may lead to institutions being captured by the elites and may be harmful for development (as highlighted by Piketty (2014) and others). To consider this we proxy institutional quality using data from the International Country Risk Guide (ICRG) from the PRS group. The ICRG evaluates several dimensions of political, economic, and financial risks for some 150 countries over several decades. More specifically, we build two alternative indicators of institutional quality by using principal component analysis (PCA). We build an indicator of *political institutions*, by storing the first component of a PCA analysis which considers the following variables: stability, corruption, military, law, democracy, and bureaucracy. In addition we build an indicator of *socioeconomic conflict*, which stores the first component of a PCA using indicators of internal conflict, socioeconomic conditions, and ethnic and religious tensions.[17] Despite the different definitions, the indicators of *political institutions* and *socioeconomic conflict* are highly and positively correlated (0.73), and the significant association remains after controlling for time and country FEs. Both indicators are also positively correlated with human development indicators and negatively with our inequality variables.

Using our indicators of institutional quality, we first split our sample of countries between high- and low-quality of institutions (see Tables A8 and A9 in the appendix). We find that our main

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[17] Both composite indicators capture close to 60 per cent of the total variance. For interpretation purposes we preferred to consider two alternative indicators of institutional quality rather than the first two principal components of all indicators together. See the supplementary material for more details on these indices.

results hold when looking at countries with low-quality institutions (usually countries with a lower level of development). In these low institutional quality countries, the concentration of income at the bottom and the top, at the expense of the concentration at the rest of the distribution (i.e. the middle), is significantly associated with lower human development, especially in terms of education.

Next, we control for institutional quality directly in our specifications. As expected higher institutional quality is significantly associated with higher human development, particularly in less-developed countries. Remarkably, our coefficient for concentration of income at the top remains significant even after controlling for institutional quality (see tables A10–A13 in the appendix).

4.4 Further robustness checks

Finally, in the appendix we provide additional robustness checks to our main results, first using two alternative series of human development indicators: the HHDI and the AHDI (see a replication of all estimates in sections B and C in the supplementary material). Both the HHDI and the AHDI have longer coverage than the original HDI, which comes at the expense of a smaller sample of countries, and a less standardized definition of the indicators of development. The results yield mainly marginally significant or non-significant results in these two cases. However, when we restrict the period of analysis to human development after 1990, as in the previous tables for the official HDI, the results using the HHDI and AHDI are consistent with our main results. The fact that the results which use data before 1990 yield non-significant or contradictory results may be due to various factors, including the quality of data or the lack of enough information for developing countries in earlier periods. It may also simply reflect different structural dynamics before 1990 in the inequality–HDI relationship, something that could be interesting for further research. The 1990s were characterized by a structural change in terms of inequality trends, with a general tendency of increasing inequality in most world regions, particularly with the transition of Eastern European countries and other emerging countries like China or India from a planned to a market economy, and important regressive structural reforms taking place in western economies (e.g., Gradín and Oppel 2021).

We also tested the robustness of the results to alternative ways of introducing the role of middle-income groups in explaining the inequality–development relationship. Following Partridge (1997, 2005) we estimated a battery of models including the overall dimension of inequality (i.e. the Gini) along with indicators of the share of income held by the middle-income group: the third quintile (Q3) or the middle-income indicator (middle50: share of income held by the 50 per cent of the population from the 41st percentile to the 90th). Q3 or, alternatively, the middle50 is meant to capture the role of the 'middle class' or 'median voter' (crucial for the creation of growth-enhancing social capital (Easterly 2001)), while the Gini controls for the rest of inequality (inequality between the extremes or within each group).[18] The results (see Table A14 in the appendix and in the supplementary material) report positive and significant results for the Gini index in the income dimension of the HDI; while for the education dimension we find a positive and significant result for Q3 in the HHDI, in line with our previous findings. Furthermore, the income and health dimensions report negative and significant results for middle50 in the HHDI and AHDI (only for health). Other results are marginally significant or non-significant.

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[18] The Gini is negatively correlated with middle-income indicators (-0.61 with Q3 and -0.80 with middle50).

5 Conclusions

In this paper we reassessed the inequality–development relationship using a broader definition of human development (including income, education, and health), and exploring the differentiated role of different parts of the income distribution. To do so we relied on a large and unique global panel of countries over the last decades which included information on human development, complemented with detailed information on the distribution of income within countries for close to 150 countries worldwide over the 1990–2019 period.

Our econometric results using FE models (which capture the evolution over time within countries rather than cross-country differences) show a positive association between inequality, as measured by the Gini index, and the income per capita component of development, as found in previous works, with no effect on education or health (or on the overall HDI). However, our results highlight the relevance of analysing differences along the income distribution when studying the inequality–HDI relationship. The positive inequality–income per capita relationship seems to be driven by the share held by the bottom of the income distribution at the expense of the middle-income group. By contrast there is no significant association between a higher concentration of income at the top 1 or 10 per cent and the evolution of income. Indeed, concentration of income at the bottom and top of the distribution, at the expense of concentration in the middle, is found to be associated with a lower HDI, especially in what refers to human capital accumulation (i.e. education) in developing countries and health in high-income countries. These effects are found to be robust to different estimation techniques, the use of alternative measures of human development, and several country-level controls. Notably, the role of the concentration of income at the top is also robust to the inclusion of proxies for the quality of institutions.

These results have unquestionable policy implications. Policy makers concerned with distributional dynamics should worry about high-income concentration at the top, as this concentration can deter higher achievements in terms of health and education, which are integral parts of human development.

Finally, our analysis calls for further research to better understand the complex evolution of inequality and its potential impacts. In particular, our analysis highlights the need for deeper exploration of the specificities of distributional dynamics (for instance by looking at the differences along the whole distribution of income) when assessing the role of inequality in other development outcomes. While we have looked at the HDI in a cross-country setting, further work could look at other indicators of development and explore the inequality–development relationship in specific subnational contexts and policy frameworks. All this research could prove to be of great value in better guiding policies to tackle inequality and at the same time in fostering development.

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Appendix

Table A1: Data description and sources

Label	Description	Source	Coverage
HDI	Human Development Index HDI , HDI=(Life*EDU*GDP)^(1/3)	World Development Report, last release, accessed March 2022	1990–2019 for 189 countries, unbalanced
HDI_Educ	Education Index: simple average between (Expected years of schooling – 0)/(18-0) & (Means years of Schooling – 0)/(15-0)		
HDI_Health	Health Index – (Life expectancy at birth – 20)/(85-20)		
HDI_Income	Income index – linear transformation in logs = (ln(GNI per capita)-ln(100)/(ln(75000)-ln(100))		
hHDI	Hybrid-HDI values, HDI=(Lifex*EDUx*GDPx)^(1/3)	Gidwitz et al. (2010)	1970–2010 for 135 countries, balanced
hHDI_Educ	Education Index, EDUx=(Litx*GERx)^(1/2), considering Literacy Index, Litx=(Lit-0)/(99(several countries, several years)-0) & Combined Gross Enrolment Rate Index, GERx=(GER-0)/(115.82(Australia,2002)-0)		
hHDI_Health	Health Index, Lifex=(Life-20)/83.17(Japan,2010)-20)		
hHDI_Income	Income Index, GDPx=(ln(GDP)-ln(163.28(Liberia,1995))/(ln(106769.74(UAE, 1977))-ln(163.28))		
aHDI	Augmented Human Development Index; AHDI=(Life*EDU*GDP*LibDem)^(1/4)	Prados de la Escodura (2021)	1950–2015 for 162 countries, unballanced
aHDI_Educ	Augmented Human Development Index - Education: average years of total schooling (primary, secondary, and tertiary) – Kakwani convex transformation (min = 0 years and max = 15 years)		
aHDI_Health	Augmented Human Development Index – Health: life expectancy at birth index – Kakwani convex transformation (min = 20 years and max = 85 years)		
aHDI_Income	Augmented Human Development Index – Income – linear transformation with all values in logs (min = 100 (1990 USD) and max = 47,000 (1990 USD))		
aHDI_Democracy	Augmented Human Development Index – Liberal Democracy: linear transformation, with lower and upper bounds at 0 and 1 (based on the Liberal Democracy Index from Varieties of Democracy)		
Price_inv	Price level of capital formation, price level of USA GDPo in 2017=1		

Openness	Ratio of the country's volume of trade to its GDP (sum of the share of merchandise exports and imports at current purchasing power paraties (PPPs)	Penn World Table 10.0 (Revision June 2021) Feenstra et al. (2015)	1950–2020 for up to 207 countries, unballanced
Gov_Cons	Share of government consumption at current PPPs		
Cap-Out ratio	Capital – output ratio: Output-side real GDP at current PPPs (in million 2017 USD) over capital stock at current PPPs (in million 2017 USD)		
Invest	Share of gross capital formation at current PPPs		
Inflation	GDP implicit deflator: ratio of GDP in current local currency to GDP in constant local currency. The base year varies by country.	World Development Indicators	1960–2020 for up to 207 countries, unballanced
law	Law and order measures the strength and impartiality of the legal system, plus an assessment of popular observance of the law. Range of values between 0=minimum Law and Order, and 6=maximum law and order)	International Country Risk Database Howell (2011)	1984–2019 for up to 140 countries, unballanced
democratic	Democratic accountability: measure of how responsive government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society but possibly violently in a non-democratic one. Range of values between 0=minimum democratic accountability and 6=maximum democratic accountability)		
stability	Government stability: assessment both of the government's ability to carry out its declared programme(s), and its ability to stay in office. Range of values between 0=minimum government stability, and 12=maximum government stability)		

Source: authors' construction.

Table A2: Descriptive statistics, five years sample

Variable	Mean	Standard deviation			Min	Max	Countries	Av. years
		Overall	Between	Within				
Gini	42.49	11.99	11.31	3.33	0.00	77.09	180	7.47
Top1	7.86	3.97	4.01	1.16	0.01	27.26	180	7.47
Top10	33.43	9.82	9.47	2.70	0.10	68.77	180	7.47
Bottom40	15.28	5.34	4.96	1.66	0.40	30.55	180	7.47
HDI	0.67	0.17	0.17	0.05	0.22	0.96	170	4.93
hHDI	0.64	0.18	0.18	0.05	0.15	0.94	130	6.35
aHDI	0.37	0.19	0.17	0.08	0.05	0.86	153	7.48
HDI_education	0.59	0.20	0.19	0.07	0.08	0.94	170	4.94
hdHDI_life	0.75	0.15	0.15	0.05	0.17	0.99	175	5.05
HDI_income	0.69	0.18	0.18	0.04	0.28	1.00	173	5.01
HHDI_life	0.74	0.17	0.16	0.06	0.14	1.00	130	6.35
HHDI_education	0.67	0.20	0.18	0.07	0.04	1.00	130	6.35
HHDI_income	0.55	0.19	0.20	0.04	0.02	0.95	130	6.35
AHDI_education	0.27	0.19	0.17	0.07	0.00	0.88	153	7.48
AHDI_life	0.34	0.16	0.14	0.08	0.04	1.00	153	7.48
AHDI_income	0.60	0.18	0.18	0.06	0.18	0.95	153	7.48
AHDI_democracy	0.40	0.28	0.24	0.13	0.01	0.91	153	7.48
p_inv	0.47	0.33	0.17	0.29	0.01	7.88	164	7.45
open	-0.04	0.14	0.14	0.08	-1.56	0.64	164	7.45
gov_cons	0.19	0.09	0.07	0.06	0.01	0.80	164	7.45
cap_out_r	3.43	1.83	1.67	1.04	0.28	14.77	163	7.49
invest	0.21	0.09	0.07	0.06	0.01	0.84	164	7.45
infl	75.29	154.75	109.84	123.47	0.00	3145.86	177	6.72
law	3.79	1.43	1.27	0.67	0.00	6.00	135	5.95
democ	4.10	1.58	1.45	0.78	0.00	6.00	135	5.95
stab	7.58	1.95	1.09	1.71	1.00	12.00	135	5.95

Note: variables' descriptions and labels are displayed in table A1.

Source:authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A3: Correlation analysis, five years sample

	Gini				Top1				Top10				Bottom40			
Variable	Corr	Corr-cs	Corr-ts	Corr-cs/ts	Corr	Corr-cs	Corr-ts	Corr-cs/ts	Corr	Corr-cs	Corr-ts	Corr-cs/ts	Corr	Corr-cs	Corr-ts	Corr-cs/ts
Gini	1	1	1	1	0.94	0.87	0.94	0.87	0.98	0.93	0.98	0.93	-0.76	-0.97	-0.76	-0.97
Top1	0.94	0.87	0.94	0.87	1.00	1	1	1	0.97	0.97	0.97	0.96	-0.79	-0.74	-0.78	-0.75
Top10	0.98	0.93	0.98	0.93	0.97	0.97	0.97	0.96	1	1	1	1	-0.74	-0.81	-0.73	-0.82
Bottom40	-0.76	-0.97	-0.76	-0.97	-0.79	-0.74	-0.78	-0.75	-0.74	-0.81	-0.73	-0.82	1	1	1	1
HDI	-0.69	-0.13	-0.69	0.06	-0.69	-0.17	-0.69	0.10	-0.71	-0.17	-0.71	0.08	0.67	0.10	0.67	-0.05
HHDI	-0.66	0.09	-0.68	-0.02	-0.68	0.04	-0.70	0.05	-0.69	0.06	-0.71	0.01	0.62	-0.11	0.65	0.04
AHDI	-0.57	0.03	-0.61	0.07	-0.57	-0.07	-0.61	0.10	-0.60	-0.05	-0.63	0.08	0.54	-0.09	0.58	-0.06
HDI_education	-0.64	-0.12	-0.65	0.09	-0.63	-0.16	-0.63	0.11	-0.66	-0.15	-0.66	0.09	0.62	0.08	0.63	-0.08
HDI_life	-0.65	-0.13	-0.65	-0.01	-0.70	-0.17	-0.70	0.01	-0.68	-0.16	-0.67	0.01	0.64	0.11	0.63	0.02
HDI income	-0.64	-0.10	-0.62	0.06	-0.62	-0.13	-0.61	0.09	-0.65	-0.13	-0.64	0.07	0.62	0.08	0.61	-0.05
HHDI_life	-0.66	0.09	-0.69	-0.03	-0.69	0.04	-0.72	0.03	-0.69	0.06	-0.72	0.01	0.62	-0.10	0.65	0.05
HHDI_education	-0.57	0.09	-0.61	-0.07	-0.59	0.01	-0.64	-0.04	-0.60	0.04	-0.64	-0.05	0.53	-0.11	0.58	0.07
HHDI_income	-0.65	0.04	-0.65	-0.01	-0.65	0.02	-0.65	0.05	-0.67	0.02	-0.67	0.02	0.62	-0.06	0.62	0.02
AHDI_education	-0.62	-0.03	-0.66	-0.02	-0.60	-0.12	-0.64	0.06	-0.64	-0.11	-0.68	0.02	0.59	-0.03	0.64	0.04
AHDI_life	-0.62	-0.04	-0.67	-0.02	-0.64	-0.12	-0.69	0.07	-0.65	-0.11	-0.69	0.02	0.58	-0.02	0.64	0.03
AHDI_income	-0.62	-0.10	-0.63	-0.05	-0.63	-0.14	-0.63	0.04	-0.65	-0.15	-0.65	-0.02	0.58	0.04	0.60	0.06
AHDI_democracy	-0.37	0.10	-0.39	0.10	-0.36	0.01	-0.38	0.06	-0.39	0.04	-0.41	0.08	0.35	-0.14	0.37	-0.10
p_inv	-0.11	0.06	-0.09	0.08	-0.10	-0.02	-0.08	0.05	-0.11	0.01	-0.09	0.07	0.10	-0.10	0.10	-0.08
open	-0.02	0.04	-0.03	0.02	0.00	0.07	-0.02	0.04	-0.01	0.06	-0.02	0.03	0.03	-0.03	0.04	-0.01
gov_cons	-0.12	-0.02	-0.11	0.01	-0.09	-0.04	-0.08	-0.02	-0.12	-0.03	-0.11	-0.01	0.12	0.00	0.11	-0.03
cap_out_r	-0.31	0.08	-0.31	0.11	-0.30	-0.01	-0.30	0.07	-0.33	0.01	-0.33	0.07	0.29	-0.14	0.29	-0.13
invest	-0.30	0.01	-0.30	0.04	-0.29	0.01	-0.28	0.06	-0.31	0.00	-0.30	0.05	0.29	-0.03	0.29	-0.04
infl	-0.02	-0.05	0.03	-0.02	-0.04	-0.09	0.01	-0.02	-0.04	-0.09	0.02	-0.02	0.00	0.02	-0.04	0.02
law	-0.53	0.04	-0.56	-0.05	-0.47	0.06	-0.50	-0.03	-0.51	0.07	-0.54	-0.02	0.54	-0.01	0.57	0.07
democ	-0.33	-0.03	-0.32	-0.02	-0.34	-0.05	-0.33	-0.01	-0.33	-0.04	-0.32	-0.01	0.45	0.03	0.44	0.03
stab	-0.06	0.01	-0.12	-0.07	-0.05	-0.01	-0.11	-0.06	-0.05	0.01	-0.12	-0.06	0.08	-0.01	0.14	0.07

Note: Corr corresponds to the correlation considering raw data; Corr-cs displays the correlation once the data has controlled for country FEs; Corr-ts shows the correlation once controlled for period FEs; and finally Corr-cs/ts reports the correlation coefficient once controlled both by country FEs and period FEs.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A4: Inequality and human development. Human Development Index

VARIABLES	FE a	FE a2	FE b	FE c	OLS c	Between c	RE c
Gini	0.323**	0.0461	0.0555	0.0523	-0.758***	-0.663***	-0.109*
	(0.137)	(0.0623)	(0.0662)	(0.0615)	(0.0483)	(0.0780)	(0.0618)
Observations	681	681	657	657	657	657	657
Number of id	152	152	148	148	148	148	148
R-squared	0.036	0.878	0.878	0.885	0.651	0.735	0.876
Bottom40	-0.727**	-0.107	-0.126	-0.120	1.539***	1.375***	0.166
	(0.280)	(0.122)	(0.132)	(0.120)	(0.109)	(0.180)	(0.122)
Observations	681	681	657	657	657	657	657
Number of id	152	152	148	148	148	148	148
R-squared	0.044	0.878	0.878	0.886	0.626	0.717	0.879
Top10	0.282*	0.0296	0.0403	0.037	-0.976***	-0.835***	-0.174**
	(0.165)	(0.0787)	(0.0816)	(0.078)	(0.0583)	(0.0899)	(0.0753)
Observations	681	681	657	657	657	657	657
Number of id	152	152	148	148	148	148	148
R-squared	0.018	0.878	0.877	0.885	0.676	0.752	0.874
Top1	0.378	-0.0238	-0.00322	-0.0135	-2.233***	-1.829***	-0.492***
	(0.372)	(0.175)	(0.179)	(0.173)	(0.149)	(0.198)	(0.163)
Observations	681	681	657	657	657	657	657
Number of id	152	152	148	148	148	148	148
R-squared	0.006	0.877	0.877	0.885	0.675	0.752	0.875
Time FE	NO	YES	YES	YES	YES	YES	YES
NO	NO	NO	YES	YES	YES	YES	
Controls 2	NO	NO	NO	YES	YES	YES	YES

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. Control 1 variables include inflation and price of investment; Control 2 consider foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A5: Inequality and components of human development. Random effects estimators. Human Development Index

VARIABLES	Education	Health	Income
Gini	-0.170***	-0.355***	-0.0401
	(0.0520)	(0.0831)	(0.0809)
Observations	658	672	671
Number of id	148	149	149
R-squared	0.868	0.637	0.549
Bottom40	0.276***	0.673***	-0.00304
	(0.104)	(0.163)	(0.172)
Observations	658	672	671
Number of id	148	149	149
R-squared	0.870	0.645	0.627
Top10	-0.249***	-0.457***	-0.112
	(0.0636)	(0.104)	(0.0890)
Observations	658	672	671
Number of id	148	149	149
R-squared	0.867	0.631	0.609
Top1	-0.627***	-1.166***	-0.338*
	(0.141)	(0.226)	(0.179)
Observations	658	672	671
Number of id	148	149	149
R-squared	0.868	0.634	0.607

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%.
All regressions include the full set of controls: time FE, inflation and price of investment;
foreign trade openness, share of government consumption, share of gross capital
formation, and ratio of capital over output.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A6: Income inequality and development, by level of development. Human Development Index

Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	0.245	0.065	0.542	-0.121	-0.338*	-0.698**	-0.518***	0.311
	(0.147)	(0.161)	(0.38)	(0.077)	(0.199)	(0.32)	(0.192)	(0.288)
Top10	0.177	0.123	0.513	-0.211**	-0.093	-0.14	-0.232**	0.159
	(0.15)	(0.123)	(0.346)	(0.079)	(0.125)	(0.15)	(0.106)	(0.226)
R-squared	0.94	0.83	0.87	0.97	0.89	0.68	0.90	0.64
Bottom40	0.178	0.095	0.307	-0.087	-0.446**	-0.759**	-0.505***	0.04
	(0.165)	(0.152)	(0.427)	(0.08)	(0.182)	(0.318)	(0.184)	(0.268)
Top1	0.317	0.408	0.814	-0.494**	-0.409*	-0.449	-0.55**	-0.065
	(0.452)	(0.327)	(1.016)	(0.22)	(0.233)	(0.319)	(0.229)	(0.392)
R-squared	0.94	0.83	0.86	0.97	0.89	0.68	0.90	0.64
Observations	175	177	176	178	482	494	482	494
Countries	33	34	33	34	115	115	115	115

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider highly developed countries (first quartile of the average HDI), while columns 5 to 8 use information for middle- and low-income developed countries (second to fourth quartile of the average HDI).

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A7: Income inequality and development, by level of inequality. Human Development Index

Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	-0.145	-0.496	0.104	-0.06	-0.658	-0.301	-1.008**	-0.534
	(0.161)	(0.279)	(0.249)	(0.103)	(0.429)	(0.246)	(0.398)	(0.87)
Top10	0.008	-0.04	0.194	-0.123	-0.197	-0.063	-0.411***	-0.048
	(0.128)	(0.217)	(0.205)	(0.08)	(0.148)	(0.11)	(0.142)	(0.285)
R-squared	0.92	0.73	0.88	0.93	0.89	0.67	0.90	0.65
Bottom40	-0.271	-0.713	-0.003	-0.079	-0.866*	-0.26	-1.001**	-1.191
	(0.182)	(0.319)	(0.254)	(0.102)	(0.447)	(0.274)	(0.38)	(0.992)
Top1	-0.3	-0.677	0.283	-0.405	-0.674**	-0.092	-0.899***	-0.871
	(0.361)	(0.593)	(0.591)	(0.215)	(0.287)	(0.218)	(0.303)	(0.621)
R-squared	0.92	0.74	0.88	0.94	0.89	0.67	0.90	0.66
Observations	333	334	334	335	324	337	324	337
Countries	73	73	73	73	75	76	75	76

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider less unequal countries (average Gini below the median), while columns 5 to 8 use information for more unequal countries ((average Gini above the median).

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A8: Human development and inequality. Countries with high and low political institutions. Human Development Index

Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	0.066	-0.109	0.14	0.16	-0.403	-0.828	-0.607*	0.324
	(0.668)	(0.465)	(0.571)	(0.61)	(0.172)	(0.131)	(0.021)	(0.329)
Top10	0.118	0.027	0.144	0.231	-0.145	-0.163	-0.325*	0.1
	(0.512)	(0.795)	(0.448)	(0.577)	(0.324)	(0.463)	(0.009)	(0.634)
Observations	376	381	377	382	277	286	277	286
Countries	85	85	85	85	62	63	62	63
R-squared	0.888	0.798	0.867	0.633	0.914	0.66	0.904	0.759
Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	-0.073	-0.172	0.001	-0.035	-0.503*	-0.921*	-0.592*	0.11
	(0.128)	(0.127)	(0.216)	(0.239)	(0.256)	(0.54)	(0.236)	(0.275)
Top1	0.028	-0.058	0.093	0.207	-0.495*	-0.527	-0.744*	-0.093
	(0.367)	(0.213)	(0.404)	(0.831)	(0.283)	(0.465)	(0.263)	(0.401)
Observations	376	381	377	382	277	286	277	286
Countries	85	85	85	85	62	63	62	63
R-squared	0.887	0.798	0.866	0.631	0.917	0.663	0.905	0.758

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider countries with an average of the institutional indicator above the median, while columns 5 to 8 use information for countries with an indicator below the median.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A9: Human development and inequality. Countries with high and low socioeconomic conflict. Human Development Index

Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	-0.034	-0.311	0.104	0.12	-0.124	-0.449	-0.389	0.477
	(0.878)	(0.358)	(0.695)	(0.742)	(0.587)	(0.286)	(0.14)	(0.127)
Top10	0.152	0.11	0.173	0.211	-0.067	-0.133	-0.239*	0.191
	(0.421)	(0.259)	(0.371)	(0.645)	(0.629)	(0.524)	(0.048)	(0.353)
Observations	369	374	370	375	284	293	284	293
Countries	82	82	82	82	65	66	65	66
R-squared	0.889	0.746	0.877	0.622	0.912	0.63	0.894	0.763
Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	-0.274	-0.501	-0.108	-0.139	-0.189	-0.487	-0.346	0.264
	(0.226)	(0.422)	(0.238)	(0.245)	(0.189)	(0.376)	(0.257)	(0.259)
Top1	-0.081	-0.099	0.026	0.022	-0.263	-0.377	-0.505*	0.123
	(0.383)	(0.353)	(0.403)	(0.83)	(0.282)	(0.414)	(0.279)	(0.407)
Observations	369	374	370	375	284	293	284	293
Countries	82	82	82	82	65	66	65	66
R-squared	0.888	0.745	0.876	0.62	0.913	0.632	0.894	0.761

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider countries with an average of the institutional indicator above the median, while columns 5 to 8 use information for countries with an indicator below the median.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A10: Human development and inequality (Top10%). Control with institutions – political instability. Countries with high and low income. Human Development Index

Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	0.088	-0.261*	0.599	-0.165*	-0.394	-0.949**	-0.502**	0.304
	(0.582)	(0.091)	(0.157)	(0.096)	(0.133)	(0.04)	(0.028)	(0.339)
Top10	0.068	-0.021	0.37	-0.182**	-0.133	-0.221	-0.244**	0.093
	(0.631)	(0.862)	(0.284)	(0.017)	(0.285)	(0.224)	(0.03)	(0.603)
Political instability	-0.019	0.117	-0.165	-0.22	0.318*	0.544*	-0.028	0.638*
	(0.937)	(0.601)	(0.775)	(0.136)	(0.1)	(0.076)	(0.909)	(0.078)
Observations	232	234	232	234	346	354	346	354
Countries	46	46	46	46	75	76	75	76
R-squared	0.943	0.848	0.868	0.964	0.913	0.649	0.906	0.73

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider high-income countries, while columns 5 to 8 use information for middle- and low-income countries.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A11: Human development and inequality (Top1%). Control with institutions – political instability. Countries with high and low income. Human Development Index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Variable:	HDI	Income	Education	Health	HDI	Income	Education	Health
Bottom40	0.011	-0.294**	0.363	-0.122	-0.467*	-1.012**	-0.451**	0.091
	(0.939)	(0.032)	(0.374)	(0.223)	(0.055)	(0.027)	(0.038)	(0.754)
Top1	0.012	-0.129	0.462	-0.389**	-0.435*	-0.634*	-0.513**	-0.109
	(0.974)	(0.68)	(0.592)	(0.029)	(0.092)	(0.097)	(0.046)	(0.782)
Political instability	0.004	0.135	-0.118	-0.211	0.333*	0.561*	-0.026	0.663*
	(0.986)	(0.584)	(0.841)	(0.169)	(0.085)	(0.062)	(0.918)	(0.067)
Observations	232	234	232	234	346	354	346	354
Countries	46	46	46	46	75	76	75	76
R-squared	0.943	0.848	0.867	0.964	0.914	0.654	0.906	0.73

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider high-income countries, while columns 5 to 8 use information for middle- and low-income countries.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A12: Human development and inequality (Top10%). Control with institutions – socioeconomic conflict. Countries with high and low income. Human Development Index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Variable:	HDI	Income	Education	Health	HDI	Income	Education	Health
Bottom40	0.077	-0.26	0.591	-0.212**	-0.365	-0.886*	-0.505**	0.369
	(0.603)	(0.102)	(0.143)	(0.03)	(0.161)	(0.056)	(0.029)	(0.261)
Top10	0.058	-0.026	0.37	-0.218**	-0.114	-0.182	-0.245**	0.126
	(0.653)	(0.816)	(0.254)	(0.003)	(0.363)	(0.303)	(0.031)	(0.506)
Socioeconomic conflict	0.087	0.174	-0.146	0.163*	0.344**	0.82**	0.031	0.178
	(0.625)	(0.346)	(0.755)	(0.076)	(0.035)	(0.013)	(0.866)	(0.508)
Observations	232	234	232	234	346	354	346	354
Countries	46	46	46	46	75	76	75	76
R-squared	0.943	0.849	0.868	0.964	0.913	0.662	0.906	0.724

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider high-income countries, while columns 5 to 8 use information for middle- and low-income countries.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A13: Human development and inequality (Top1%). Control with institutions – socioeconomic conflict. Countries with high and low income. Human Development Index

Dep. Variable:	(1) HDI	(2) Income	(3) Education	(4) Health	(5) HDI	(6) Income	(7) Education	(8) Health
Bottom40	0.003	-0.288**	0.354	-0.166*	-0.44*	-0.952**	-0.454**	0.152
	(0.985)	(0.033)	(0.365)	(0.082)	(0.069)	(0.041)	(0.04)	(0.605)
Top1	-0.014	-0.136	0.453	-0.483**	-0.394	-0.544	-0.515**	-0.036
	(0.967)	(0.614)	(0.573)	(0.003)	(0.132)	(0.153)	(0.048)	(0.931)
Socioeconomic conflict	0.112	0.188	-0.082	0.164*	0.341**	0.813**	0.03	0.17
	(0.519)	(0.308)	(0.856)	(0.08)	(0.035)	(0.013)	(0.872)	(0.533)
Observations	232	234	232	234	346	354	346	354
Countries	46	46	46	46	75	76	75	76
R-squared	0.943	0.849	0.867	0.963	0.915	0.666	0.906	0.723

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output. Columns 1 to 4 consider high-income countries, while columns 5 to 8 use information for middle- and low-income countries.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.

Table A14: Income inequality and middle-income indicators. Human Development Index

Dep. Variable:	HDI	Income	Education	Health
Gini	0.054	0.16	0.118	-0.151
	(0.08)	(0.116)	(0.113)	(0.122)
Q3	0.007	-0.043	0.389	-0.525
	(0.328)	(0.472)	(0.467)	(0.489)
R-squared	0.89	0.65	0.88	0.67
Gini	0.09	0.245**	0.091	-0.078
	(0.065)	(0.106)	(0.06)	(0.096)
Middle50	0.123	0.255	0.177	-0.119
	(0.118)	(0.159)	(0.127)	(0.187)
R-squared	0.89	0.65	0.88	0.67
Observations	657	671	658	672
Countries	148	149	148	149

Note: robust standard errors reported in parentheses. Significance: * 10%, ** 5%, *** 1%. All models consider time and country FEs plus several control variables: inflation, price of investment, foreign trade openness, share of government consumption, share of gross capital formation, and ratio of capital over output.

Source: authors' construction based on HDI series from the Human Development Data Center, WIID Companion, and WID.world (see data section). For controls, see Table A1.