LUND UNIVERSITY
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What About the People, Though?

Income inequality and human development

by

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In a developmental context, income inequality has so far been investigated primarily from the angle of its relationship with economic growth. This paper contributes to the limited but growing body of empirical literature examining the interplay between income inequality and human development, here perceived through the capabilities approach. Fixed effects models do not suggest the existence of a within-country relationship between income inequality and development outcomes. However, the validity of FE models is undermined by sample properties. Between estimator and pooled OLS show a negative association between income inequality and life expectancy, daily caloric supply, and human rights protection. The relationship between income inequality and years of education, secondary enrollment gender gap, and polity is revealed when interacting the inequality measure with country income group, showing a negative relationship in the lower income groups. The results further show a fairly consistent and statistically significant relationship between measures of aggregate per capita income and development outcomes. However, the results indicate that the positive contributions to human development caused by an increase in GDP can be more than offset if it is accompanied by the growth of income inequality, suggesting a complementarity between the reduction of income inequality and other development goals.

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1 Introduction

Economic inequality is one of the most persistent features of human society. The understanding of the nature of its social and economic consequences, however, despite a fruitful ongoing discussion and thorough scientific research, remains inconclusive as the field remains riddled with often contradictory findings. However, with the within-country inequalities on the rise in many areas of the world, especially in the economically highly developed societies of Western Europe, its offshoots, and Japan (Milanovic, 2016, p.22), the topic becomes ever more relevant. This paper aims to contribute to the academic debate by examining the relationship between economic inequality and human development.

1.1 Research Problem

The perception of economic inequality has evolved considerably over the decades and while its exact role in economic growth and development remains unclear, the topic is a subject of an intense, politically and ideologically charged public discussion. In academic circles, economic inequality, or at least a certain level of it, has been seen as conducive to economic growth, and therefore contributing to the economic development of a studied society, by scholars such as Lewis (1954) or Kaldor (1966). The debate has, however, continued with renewed vigor throughout the 1990s and early 2000s with a number of seminal contributions challenging both traditional and new perspectives on the socio-economic effects of economic inequality. More recent studies, such as Easterly (2007) or Berg, Ostry and Tsangarides (2014), have found economic inequality to undermine development and growth respectively. However, it is crucial to note that the majority of previous research, even when dealing with the umbrella term of economic development, appears to be primarily concerned with economic growth, even though the concept of development has evolved to such an extent that the terms are no longer interchangeable. The relationship between economic inequality and human development, therefore, appears to remain relatively poorly understood.

1.2 Aim and Scope

While the majority of previous studies has operated with the concept of economic development within the framework of economic growth and structural change, several alternative ways of conceptualizing and measuring development have since been developed. It is, therefore, the aim of this paper, following Easterly (2007) and the recent work of Castells-Quintana, Royuela and Thiel (2019), to investigate the relationship between income inequality and non-economic outcomes of development. More specifically, the paper

examines the relationship between income inequality and what could be considered as outcomes of human development in Sen's (2001) and Nussbaum's (2011) capabilities approach. For the purpose of this study, six distinct variables were chosen to represent the outcomes of development perceived as an expansion of individual freedom, specifically: health proxied by life expectancy at birth, access to proper nutrition approximated by the average daily caloric supply, access to education expressed as mean total years of schooling, gender equity of opportunity proxied by secondary education enrollment ratio of female students, civil liberties approximated by human rights protection scores, and opportunity of political participation expressed by authoritarian/democratic political regime characteristics. While the selected variables and the concepts they are approximating have been, to a varying degree, subject to research, including their potential relationship with income inequality, across a wide spectrum of scientific fields, it is the aim of this paper to view these concepts through the lens of development economics.

In order to estimate the relationship between economic inequality and human development outcomes, the paper employs a set of cross-country comparisons using an unbalanced panel dataset containing information on 90-153 countries, with respect to measurement and data availability of the different development outcomes, between 1970 and 2015. The data has been compiled from a number of existing research outputs and international organizations' published databases. Several econometric estimation methods (fixed effects, between estimator and pooled OLS) are used to examine the relationship. Furthermore, the paper examines whether a difference in the relationship between human development outcomes and income inequality can be observed throughout the country income group categories as defined by the World Bank (2019).

The results obtained using the time-demeaned fixed effects models do not suggest the existence of a statistically significant direct relationship between income inequality and development outcomes. However, the validity of the fixed effects models needs to be put in the context of constraints imposed upon the analysis by the availability of the data. In order to exploit the highly cross-sectional features of the dataset, the between estimator and pooled OLS are further used to estimate the models. The results of both of the latter estimation methods hint consistently at a negative statistically significant relationship between income inequality and life expectancy, daily caloric supply, and human rights protection. The relationship between income inequality and the rest of the observed development outcomes is revealed when interacting the inequality measure with country income group, showing a statistically significant negative relationship, which tends to increase in magnitude in the lower income groups. The results further show a statistically significant relationship between measures of aggregate per capita income and development outcomes across all estimation methods, with the exception of the polity indicator, the variance of which does not appear to be sufficiently captured by the models.

1.3 Outline of the Thesis

The thesis is organized as follows. Section 2 discusses the theoretical grounding of the concepts used in the paper, emphasizing human development, economic inequality, and the methods of their measurement as well as a theoretical justification for the selection of the observed development outcome variables. Furthermore, Section 2 reviews the findings of relevant previous research within the field. Section 3 of the paper discusses the sources and quality of the data used in the analysis as well as the conceptual reasoning behind the selection of the proxies. Section 4 presents the econometric model and the main hypothesis tested in the paper, as well as discussing the methodological approach employed in the analysis. Section 5 presents the results of the cross-country regressions and contextualizes the findings. Finally, Section 6 concludes by summarizing the main results and their implications, as well as pointing toward possible avenues for further inquiry.

2 Theory

The following section deals with the theoretical concepts used throughout the paper. Section 2.1 explores the evolution of the concept of development and its implications for the validity of measurement. Furthermore, the theoretical background for the selection of development outcome variables analyzed in the later sections of the paper is laid out. Section 2.2 discusses the concept of inequality with a focus on the most common methods of measurement and commonly used indicators, including their strengths and weaknesses. Finally, Section 2.3 discusses previous findings regarding the impacts of economic inequality on economic growth and development. It is shown that the discussion on the interplay of economic inequality and economic development has been dynamic and rich in contributions, but, so far, lacking a clear consensus, as there is an abundance of valid but conflicting findings. Furthermore, it is demonstrated that even though there is a growing trend of exploring development "beyond GDP" in the recent literature, the main part of the development discourse has been oriented on, at least on the empirical level, working with the concept of economic growth, rather than focusing on the broader concept of development.

2.1 The Concept of Development

As foreshadowed above, development is a complex phenomenon not easily grasped by a single definition. During the second half of the 20th century, as documented by Syrquin (2018), the development discourse was defined by discussions on the nature of development in terms of relatively easily quantifiable economic indicators, grounded in the exploration of patterns of economic growth and structural change. Key figures of this era of development thinking are, among others, Lewis (1954) with his concept of dual-sector economy, Rostow (1959) promoting the idea of dynamic phases of economic transformation, and Kaldor (1966), who explored the importance of a driving sector (the so-called engine of growth) for the societal change that comes with economic growth. The structuralist framework is, however, to this day, an integral part of development economics. In a similar light, Kuznets (1973) considered development in mostly economic terms, focusing on the growth of the aggregate income. Nonetheless, Kuznets' analysis can be considered more holistic, since he discusses economic growth deeper within the context of social transformation and change accompanying it.

The idea of development goes, however, beyond its strictly economic features. Amartya Sen (2001, p. 3) presents the concept of development as *"a process of expanding the real freedoms that people enjoy"*. By furthering the development, Sen (2001, p. 14) understands removing the factors that hinder this freedom, that is, among others, premature mortality and avoidable morbidity, famine, starvation and undernourishment, inequality of opportunity,

systemic discrimination, poverty, and economic insecurity, and state authoritarianism or social repression. Freedom, on the other hand, is understood as both the expanded opportunities people enjoy, and the processes allowing the expansion of the human capability (Sen, 2001, p. 18). In Sen's concept, then, economic growth is seen as a *means* of development, rather than its primary goal. Sen (2001, p. 19) further acknowledges that income and capability deprivations are correlated. However, it is the expansion of freedom in its constitutive and instrumental role, which presents the ends and means of development respectively – constitutive in the terms of their intrinsic value and direct effects on the quality of life, and instrumental in how various forms of freedom contribute to both economic progress and expansion of other freedoms (Sen, 2001, pp. 35-36). A similar approach to development is proposed by Nussbaum (2011, pp. 20-24), focusing on human capabilities, divided further into combined capabilities, that is the opportunities a person can choose from and act upon, and internal capabilities, meaning learned skills and obtained personality and character traits, which are, however, also shaped by the person's environment. Nussbaum's (2011, pp. 33-34) so-called central capabilities are focused on concepts of dignity and intrinsic value of human life, and include, among others, the capability to live a *life* in good health and not ended prematurely, the capability of retaining one's *bodily integrity* in the sense of enjoying physical safety and freedom of movement, the capability to achieve adequate education, and the capability to exert *control* over one's surroundings through political participation as well as being able to hold and maintain material property.

2.1.1 Measuring development

The definition of what we understand by development directly affects the way it would be measured, as well as the selection of suitable approximations and their validity. A number of studies (e.g. Kaldor, 1966; Dollar, 2013; Contreras & French-Davis, 2014) has been using various forms of the economic product (i.e., GDP or GNI expressed either as total or per capita value) either to approximate the level of development or as a term confounded or synonymous with development. On the other hand, arguments have been raised in regard to the validity of utilizing aggregate level income-based indicators as proxies of development since per capita measures do not reflect inequalities in a given society and therefore can provide little insight in indicating the actual level of development (Stiglitz, Sen & Fitoussi, 2009). Moreover, as per the theory discussed above, income is considered to be the means of development, rather than its outcome (Sen, 2001, p. 19). Furthermore, as argued by Pilling (2018, cited in Moulton, 2018), economic growth is not a sufficient condition of development and, as a matter of fact, the level of development of a society can remain stagnant or possibly even decrease during a period of economic growth as reflected in the growth GDP. Examples of the channels this phenomenon operates through include increases in consumption which do not reflect the increased quality of life (Stiglitz, Sen & Fitoussi 2009) and the observed association of economic growth and environmental deterioration (Masood, 2016, p. 9; Stiglitz, Sen & Fitoussi 2009). Last but not least, GDP does not cover out-of-market activities (Coyle (2014), cited in Moulton, 2018; McMichael, 2016, p. 164), possibly excluding large swaths of the population from the analysis, be it because of the size of the informal sector in a specific country, or due to the omission of domestic labor, among others.

As a part of the ongoing discussion on the validity of GDP for assessing the level of development of a society, several methods of adjusting GDP in regard to social and environmental dimensions (Gianetti, Agostingo, Almeida & Huisingh, 2014) have been proposed, as well as a number of alternative indicators, such as the genuine savings, a concept developed by Hamilton (2000), adding the dimension of sustainability to the national accounts systems, or more complex indices of development (Comim, 2016), with the aim to offer more reflective methods of measurement and cross-country comparison. Human Development Index (HDI) is a well-known, although itself subject to many critiques, example of indicators combining the income-based component (GNI per capita) with socially oriented dimensions (life expectancy, expected years of schooling and average length of education) (UNDP, n.d.). Comim (2016) lists several other indicators and indices that can be used to complement the information given by the GDP and HDI from different perspectives, such as subjective indicators (e.g., Ranking of Happiness index), goal-based indicators (e.g., the Millennium Development Goals (MDGs), the Sustainable Development Goals (SDGs)), and other comprehensive indices (e.g., Index of Sustainable Economic Welfare or the Social Progress Index), to name a few. GDP per capita, however, remains a common proxy for development because of the high availability of data entries over both time and space, enabling long term cross-country comparisons.

Partially inspired by Easterly (2007), this paper chooses an alternative approach. Instead of an aggregate index, the analysis presented here examines the outcomes of development separately. This approach allows for widening the period of observation in comparison with the relatively recently developed comprehensive indicators such as the Social Progress Index. The chosen development outcomes were selected at the intersection of Sen's (2001) and Nussbaum's (2011) conceptualizations, along three umbrella dimensions – basic quality of life, education and opportunity, and socio-political freedoms. Specifically, the selected variables are life expectancy at birth, daily per capita caloric intake, mean total years of education, enrollment ratios of female students in secondary education, upholding of human rights, and political regime characteristics. The variables are conceptually related to the understanding of Development as Freedom, concretely the removal of unfreedoms which hinder development and reduce the potential of human capability, such as premature mortality, undernourishment, lack of access to education, discrimination, and lack of civil and political liberty (Sen, 2001, p. 14). The selected outcome variables can be, in a similar way, easily related to Nussbaum's (2011, p. 33-34) central capabilities, namely those labeled as *Life, Bodily Health, Bodily Integrity*, *Affiliation* and *Control over one's environment*.

Furthermore, the selected development outcome variables are not dissimilar from concepts used in previous efforts to quantify development. The HDI uses life expectancy and mean total years of schooling in its components (UNDP, n.d.), while the Social Progress Index tracks, among its more than fifty components, life expectancy (at 60 years of age), undernourishment, enrollment ratios in primary and secondary education and gender parity in the latter, and a wide range of variables regarding abstract and material socio-political freedoms (Stern & Epner, 2019). Some of the selected variables can be linked to the goal-based indicators of development such as the MDGs (discussed in Way, ed. 2015) or SDGs (expressed in Transforming Our World: the 2030 Agenda for Sustainable Development, 2015). The daily caloric intake can be seen as conceptually related to the MDG 1 (eradication of extreme poverty and hunger), total years of schooling to MDG 2 (achieving universal

primary education), and MDG 3 (promoting gender equality and empowering women) partially overlaps with the secondary education enrollment of female students. In terms of SDGs, the selected variables share features with concepts expressed in SDGs 2 (achieving food security), 3 (promoting health and well-being), 4 (access to education), 5 (gender equality), and 16 (institutional accountability, access to justice and peace).

On a final note, both Sen (2001) and Nussbaum (2011) stress that the aspects of human development they mention are not definitive or exhaustive, and the perception of their relative importance can differ based on the reader's own system of values and ethical approach. In that light, the author of this paper wishes to acknowledge that the choice of variables to indicate the outcomes of human development, although made based on previous theoretical and empirical work, and in line with current discourse, is from equal parts subjective, pragmatic, and arbitrary. In other words, the selection of these variables should not be interpreted as a normative statement.

2.2 Inequality

In its approach to inequality as an explanatory factor, this paper limits its attention to the inequality of income. However, it is of import to acknowledge that inequality *per se* is a much broader concept that can refer to the distribution of a wide range of matters spanning from opportunity, life satisfaction or human capital to consumption, or possession of land and wealth (McGregor, Smith, & Wills, 2019). The focus on inequality of income in this paper is motivated by a number of reasons. Chiefly, data regarding income inequality is readily available in forms that enable cross country comparison across time. Secondly, in a point likely endogenous to the first one, income inequality has been a subject of numerous previous studies. In that context, focus on income inequality enables a higher degree of comparability of results. Finally, inequality of disposable income, that is the financial means people have at their direct disposal, appears to be the best suited to answer the question set out in this paper.

2.2.1 Measuring income inequality

As hinted at above, inequality is a feature of the distribution of the variable in question (McGregor, Smith, & Wills, 2019). Measuring income inequality, therefore, presents the task of comparing a set of distributions (Atkinson, 1970). Arguably, the most popular and most commonly used indicator summarizing the information about given distributions is the Gini coefficient (Mehran, 1976; Palma, 2011; Cobham & Sumner, 2013). However, a substantial number of methods to rank the distributions has been developed and used in research, such as variance, the coefficient of variation, relative mean deviation, and the standard deviation of logarithms (Atkinson, 1970). Furthermore, De Maio (2007) lists several other examples of inequality measures, including the Atkinson index, Generalized Entropy indices, decile ratios, and proportion of total income earned by a given subset of the population.

Some of the early critiques raised against the indices based on summary statistics by Atkinson (1970) was the lack of consistency when comparing the measurements and rankings of distributional outcomes of different countries with each other using various summary statistics of said distributions. This discrepancy, according to Atkinson (1970), arises from the intersection of the respective Lorenz curves. Another Atkinson's (1970) critique aimed directly at the use of the Gini coefficient echoed in later literature (Cobham & Sumner, 2013) is its lack of explicitness in expressing the relation of the actual distribution to the socially preferred welfare function. As described by De Maio (2007), the Gini coefficient is defined as the ratio of the area between the 45° line (symbolizing an absolutely equal distribution of income) and the Lorenz curve normalized by the total area below the 45° line. Gini coefficient values then exist in a closed interval ranging from zero to one, where zero represents the perfectly equal distribution and one maximum inequality. As implied by the definition and recognized in the literature (De Maio, 2007; Palma, 2011; Cobham & Sumner, 2013), Gini coefficient is most sensitive to the changes of the center of the distribution, while changes in the extremes have a considerably smaller effect on the coefficient's value.

This feature of the Gini coefficient constitutes the grounds for one of its most pertinent critiques. Palma (2011) presents evidence that while the incomes in the center of the distribution (deciles 5 to 9) have been converging throughout the era of globalization, the income shares of the bottom 40 % of earners and the 10 % of the richest exhibit a diverging trend. Based on Palma's (2011) observation, Cobham and Sumner (2013) developed an alternative measure of income inequality defined as the ratio of the income share of the 10 % of the richest and of the bottom 40 %. Similarly to the decile ratios described by De Maio (2007), the so-called Palma index is sensitive to the changes at the extremes of the distribution. However, the decile ratios do not provide insight into changes in income distribution beyond the boundaries of the selected intervals. In contrast, however, the advantage of the Palma index over simple decile ratios lies in, according to Cobham and Sumner (2013), its capability to reflect the observed fluctuations in the income shares of bottom 40 % and the top 10 %, which seem to be robust over time while the rest of the income distribution (deciles 5 to 9) has been empirically shown to remain relatively fixed. Furthermore, Cobham and Sumner (2013) report that the Palma index correlates with achievements in poverty reduction goals set by the MDGs. These findings and observations would highly motivate the use of Palma index in the analysis presented in this paper, however, due to pragmatic constraints stemming from data availability discussed in greater detail in Section 3.1, the main analysis relies, in line with the literature and aware of its shortcomings, on the Gini coefficient as the indicator of income inequality. Nonetheless, the Palma index, as well as other alternative income inequality indicators are used to perform robustness checks in Section 5.2.

2.3 Effects of Income Inequality

Previous research on the effects of inequality on development has mostly focused on the effects of income inequality on economic growth as a component of economic development. These findings are, however, still relevant from the capability perspective, since economic

growth is seen as a necessary, although not sufficient, condition of development, even if not its outcome. The following part of the paper presents the different views of the inequality-growth and inequality-development relationship respectively.

2.3.1 Income inequality and economic growth

Lewis (1954) and Kaldor (1966), two of the early development scholars, viewed the unequal distribution of income as a potentially positive feature of the economy. Lewis (1954) argued that conditions of economic inequality favoring the capitalist class would enhance the overall growth, as the owners of capital are, in this view, more likely to save and convert their incomes into productive assets, from which the whole society would benefit. Similarly, Kaldor (1966) perceived increased savings in the capitalist sector as a means of jump-starting the process of industrialization, which he had seen as the primary means of economic development. Apart from the non-linear relationship between economic growth and income inequality visualized as the (in)famous inverted-U curve (see Kuznets, 1955) fervently debated in contemporary research, Kuznets (1973) posited a feedback relationship between income inequality and economic growth. In Kuznets' view, economic transformation and growth come hand in hand with changes in resource distribution and relative social standing of certain groups. The changes in relative incomes can then create grounds for social conflict, which, if unaddressed, can by its costs outweigh the fruits of economic growth.

In contrast, more recent papers, i.e., the so-called *new growth theories* of the early 1990s, such as Alesina and Rodrik (1994), Persson and Tabellini (1994) and Birdsall, Ross and Sabot (1995) challenged the traditional structuralist view of inequality and sparked a debate that has not, as of yet, been conclusively settled. Alesina and Rodrik (1994) provide evidence that higher rates of inequality lead to higher demands for redistribution and, subsequently, lower growth. Similarly, Persson and Tabellini (1994) find a significant negative relationship between economic growth and income inequality. Furthermore, the empiric study carried out by Birdsall, Ross and Sabot (1995) presented evidence on low income inequality being positively associated with economic growth and further concludes that equality promoting policies are capable of fostering the growth of the economy. Conversely, moving closer to the present, the new growth theories have been both challenged and expanded upon by a number of publications. For instance, Aghion, Caroli and García-Peñalosa (1999) write about a two-way relationship between inequality and growth (a concept later developed further by Bourguignon, 2004), where, given imperfect capital markets, inequality fosters economic growth, which in turn increases inequality by inducing technological change. Furthermore, Forbes (2000) reports a statistically significant positive relationship between income inequality and economic growth, where an increase in a country's measured inequality is associated with a mid- to short-term increase of economic growth. Barro (2000), on the other hand, finds no significant relationship between income inequality and economic growth when analyzing the full sample of countries, but, however, reports a negative relationship between income inequality and economic growth for low-income countries and a positive relationship in high-income countries, suggesting that the channels through which inequality influences other socio-political outcomes is dependent on the level of income. Further in this line of argumentation, Galor and Moav (2004) point out that the effects of income inequality vary

depending on the level of economic progress and structural change of the country, i.e., on relative returns to factors (human or physical capital), and factor intensity of the sector fueling the economic growth. Galor and Moav's (2004) conclusions thus imply that results of inquiries about the effects of income inequality are, at least in case of economic growth, contingent on the setting of the sample period and the context of its economic history.

An alternative view of the effects of income inequality has arisen in the *inclusive growth* debate set out by the Commission on Growth and Development (2008) arguing that unaddressed inequalities in terms of income and opportunity have a potential to harm countries' capability of achieving long-term economic growth by increasing the risk of socio-political conflict. Inclusive growth constitutes a growth process that entails broad-based participation due to increased employment and productivity, which in turn supports the longevity of the growth period (Ianchovichina & Lundstrom, 2009). In relation to this framework, Berg and Ostry (2011) find a robust relationship between income inequality and the length of a growth spell experienced by a country, with rising inequality being associated with shorter duration of the period of growth, showing a potential difference in the short- and long-term effects of income inequality in economic growth.

One of the possible explanations for the relative heterogeneity and degree of contradiction in the results of previous research is the number of channels through which income inequality can affect economic and social outcomes. Barro (2000) identified four broad categories of these channels: credit market imperfections (1); political economy and redistribution (2); sociopolitical unrest (3); and saving rates (4). Income inequality then can have, according to Barro (2000) both positive and negative effects through varying mechanisms via all of these channels. In light of these observations, it can be argued that we should see the conflicting results not as contradictory, but rather complementary, each painting a slightly different part of the picture.

2.3.2 Income inequality and development

In this section, the literature concerned with the effects of inequality on other socio-political outcomes falling under the umbrella of development is examined. As posited by McMichael (2017), who further questions the fixation of growth in the development paradigm, *"addressing inequality is a precondition for promoting human development"* (p. 283). However, as mentioned above, the relationship between income inequality and human development *per se*, at least within economics, remains to be investigated more thoroughly. On the other hand, different development outcomes and their relationship with income inequality have individually been the subject of study of a large number of fields within the social sciences. Wilkinson and Pickett (2009) provide a recount of the results of previous studies regarding the relationship of income inequality and numerous social outcomes, including physical and mental health, violence and incarceration as well as outcomes of education, and propose that the effects of income inequality run in parallel with the effects of social status stratification otherwise observed in sociology. This seems to be in parallel with arguments of the new institutional economists, who, as Rutherford (2001) puts it, sought to establish new lines of dialogue between economics and other fields within social science.

Life expectancy and nutrition have been studied extensively within the field of health economics. In terms of the relationship between income inequality and health outcomes, however, the literature appears to be just as contentious as in the case of the relationship between income inequality an economic growth. In a meta-study, Wilkinson (2006) documents the results of previous studies regarding the effects of income inequality on human health and concludes that the majority of studies has been, prior to 2006, in favor of the hypothesized inverse relationship between health outcomes and income inequality, and that the health outcomes tend to be, on average, better in more egalitarian societies. Wilkinson (2006) further posits that the relationship between health outcomes and income inequality is transmitted via the corrosive effect of income inequality on social capital and cohesion, and further through higher rates of crime and violence, and issues related to mental health, such as chronic stress. This observation underlines the distinction between the harmful effects of poverty, defined as *absolute* deprivation by Adelman (1984, p.49), and the potential harm caused by *relative* deprivation, i.e., income inequality. The nature and explanation of the relationship are, however, contested in the literature, and appears to be sensitive to estimation methods and sample selection. For instance, Kawachi and Kennedy (1997) find a negative correlation between health outcomes and income inequality using a cross section analysis of household level data in 50 US states, and Rasella, Aquino and Barreto (2013) confirm the negative relationship between income inequality and life expectancy on a panel of Brazilian states between 2000 and 2009. On the other hand, Blázquez-Fernández, Cantarero-Prieto, & Pascual-Saez (2018) find no statistically significant relationship between life expectancy and income inequality using a panel data analysis design on a sample of 26 European member countries of OECD between 1995 and 2014. In attempts to reconcile the conflicting findings, Mayrhofer and Schmitz (2014) argue that the observed relationship between income inequality and life expectancy can be explained by the aggregation effect of averaging the life expectancy over whole populations. Truesdale and Jencks (2016), conversely, argue that while publication bias may have influenced the number of statistically significant findings, income inequality is at least to some extent, albeit not solely, responsible for the increasing disparities in within country life expectancy. However, the abovementioned examples from the empirical literature also point toward the importance of sample selection for the results and their interpretation.

The relationship of income inequality and nutrition, on the other hand, appears to be far less contentious. Dawson (1997) argues that caloric intake is determined by income inequality, further clarifying that the overall level and growth of income, however, appears to hold more predictive power than its distribution. This observation appears to be widely accepted in the literature, and income inequality is a significant part of food security and demand models (Beghin, Meade & Rosen, 2017). Pickett, Kelly, Brunner, Lobstein and Wilkinson (2005) posit that the relationship between income inequality and caloric intake might be inverse in developed countries, however, their results might not be easily generalizable as the analysis is limited to 25 highest income OECD members, and only consists of constructing Pearson's correlation coefficients weighted by population, without controlling for other potentially important socioeconomic features.

Access to education is influenced by income inequality through several channels, including credit market imperfections and the spatial distribution of the populace with regards to income. Chusseau, Hellier and Ben-Halima (2012, p.232) explain that one of the primary

determinants of the education attainment function is parents' expenditure on child's education, relating the intragenerational transmission of human capital explicitly with disposable income. This inequality can then be, according to Chusseau, Hellier and Ben-Halima (pp. 241-247), further reinforced by credit market imperfections, when low income groups of people are charged with higher risk premiums, and by the spatial dimension of income inequality, causing people of different income groups, who have a different capability of demanding education, settle and concentrate in segregated areas. The relationship is further discussed by Coady and Dizioli (2017), who report a strong empirical link between inequalities in income and education, which appears to be particularly potent in developing countries. The relationship, however, appears to be somewhat endogenous, with higher educational attainment in turn contributing toward lowering inequalities of income (Coady & Dizioli, 2017; Lee & Lee, 2018).

Similarly, the relationship between economic inequality and gender equality appears to be intertwined by channels affecting the relationship in both directions. According to the World Development Report (2006), gender inequality is deeply connected to the institutional arrangements of a given society in both formal (governance and legislature) and informal (customs and social norms) sense. Women often face more difficulties in terms of mobility and access to health and education, restricting their possibilities of accumulating human capital, as well as unequal opportunities on the labor market, often stemming from cultural practices and their economic consequences, such as the 'traditional' division of labor in the household and activities deemed 'appropriate' in regard to social status, or the conventions of inheritance, which affect the distribution of wealth (World Development Report, 2006). Labor market regulations encouraging wider participation and narrowing the earning gaps can, however, according to the World Development Report (2006) contribute to mitigating the restrictions and limitations women face, and thus consequently contribute to human development as seen through Sen's (2001) perspective. On the empirical level, however, the relationship appears to be mostly explored from the other direction, that is tracing the effects of gender inequalities on the inequality of income. Gonzales, Jain-Chandra, Kochhar, Newiak and Zeinullayev (2015) find a robust association between inequalities of income and gender while identifying gaps in education and health to point toward income disparities in emerging markets, while the gender pay gap was the main contributor to income inequality in developed countries, where access to education and health services was more universal. Gender inequality has further been found to contribute to income inequality and undermine economic growth, particularly in low income countries (Hakura, Hussain, Newiak, Thakoor & Yang, 2016).

In the institutionalist framework, Acemoglu, Johnson and Robinson (2004) posit the relationship between resource distribution, akin to economic inequality (including inequality of income, but also inequality of wealth or land) and formation of institutional and political arrangements. In their perspective, the distribution of income affects the distribution of de facto political power, which in turn determines the future socio-political constellations, as well as the form and behavior of holders of de jure political power. This mechanism then allows the elites to engage in rent-seeking and leverage their economic power into protecting their interests at the expense of the rest of the society. The possibility of the elites influencing the decision making process in order to shape future policies better aligned with their interest has also been discussed by Desai, Olofsgård and Yousef (2003), and further elaborated upon

by Krieger and Meierrieks (2018), who, among other findings, report a negative effect of income inequality on economic freedom and rule of law. In a parallel argument, North, Wallis and Weingast (2006) discuss the importance of social orders – limited and open access – for economic growth. Since the transition from limited to open access order is, however, intrinsically connected with the expansion of individual freedoms, the framework deserves a mention in this context. In a limited access order, according to North, Wallis and Weingast (2006), the elites maintain social stability through the use of violence and protect their rents by limiting other actors' access to political decision making and economic activities, leading to aggregate social loss. In an open access system, rents are determined by competitive markets in an environment of non-existent or low barriers to entry, and socio-political stability is maintained through political competition within a firm set of rules all agents are held accountable to. In the developmental context, the limited access order can be understood as a system of entrenched economic inequality translating itself into inequality of income and opportunity. The examples from institutionalist literature illustrate the connection between income inequalities and socio-political arrangements, the time-persistence of the relationship, as well as the high degree of endogeneity that can be expected since inequalities are expected to affect social outcomes, which in turn affect future distribution of assets.

Alongside the institutionalist theoretical framework, Alesina and Perotti (1993) empirically link income inequality to social discontent, instability, and political violence. Falkinger (1999) further models the effects of income inequality on social stability and concludes that the negative effects on social stability can be expected to be higher in countries with a lower level of income, and Birdsall (2007) then provides empirical evidence suggesting that income inequality has a negative effect on the development of accountable institutions and governance, while also being harmful to civic and social life.

To the best knowledge of the author, very few empirical studies have attempted to examine the abovementioned outcomes together from a developmental perspective. Sokoloff and Engerman (2000), examining data from the Americas, linked factor endowments, modes of agricultural production, and initial inequality to lower subsequent outcomes of education and development of institutions and governance. Easterly (2007), following up on the Sokoloff and Engerman (2000) hypothesis with a more complex empirical approach, reports, besides a negative relationship between income inequality and economic growth, a negative impact of income inequality on education and the quality of institutions, both important components of both economic and human development, making further steps toward more holistic analysis. Easterly (2007) further establishes a causal direction of the relationship from inequality to lower development outcomes using the ratio of arable land suitable for sugar cane and wheat and the percentage of the country's area located in a zone of a tropical climate as instrumental variables. Further in this direction, the work of Castells-Quintana, Royuela and Thiel (2019) attempts to bridge the gap between the previous research concerning primarily economic growth, and the broader concept of human development. The authors investigate the relationship between income inequality and HDI, with the results of their panel data analysis suggesting a null short term and a negative long-term relationship between inequality and human development as captured by the HDI, and by replicating Easterly's (2007) instrumental variable approach, further confirming the causal direction of the effect.

3 Data

The following section of the paper deals with the data gathered for the purpose of the analysis. Section 3.1 discusses the sources of the data as well as the conceptual relevance of individual variables in relation to which phenomena they represent. Section 3.2 then further discusses issues common to the dataset as a whole. Finally, Section 3.3 discusses data adjustments and sample restrictions and presents the descriptive statistics of the sample population entering the analysis.

3.1 Source Material

The data for the analysis presented in this paper has been compiled by extracting information from several established databases as well as taking advantage of previous research outputs. The sources are summarized in Table 1 at the end of the section.

The data on *life expectancy at birth* was retrieved from the United Nations Population Division's World Population Prospects 2019 (UNPD, 2019). The dataset contains estimates of life expectancy at birth for 206 countries over the period from 1950 onward in five-year intervals. Average life expectancy is commonly used to approximate for the health of the population in health economics (Blázquez-Fernández et al., 2018) and is used in aggregate development indicators such as the Human Development Index (life expectancy at birth) or the Social Progress Index (life expectancy at 60).

The data points for *daily caloric supply per capita* were retrieved from Roser and Ritchie (2020). The dataset is a compressed version of the original Food and Agriculture Organization of the United Nations Food Balance datasets (FAO 2017, 2020), connecting the data points from the current and historic FAO reports and offering a summarized yearly data points for each reporting country. The Roser and Ritchie (2020) dataset covers 216 entities spanning from 1961 to 2017. The data is constructed from aggregate level information on food production of food fit for human consumption in a given country with subtracted food exports and added food imports. For the purpose of this paper, daily caloric intake serves as a proxy of biological living standards. In previous research, especially within economic history (e.g., Steckel, 2003; Koepke & Baten, 2005), human heights have served to proxy for biological standards of living. However, the use of such data requires careful consideration of observable and unobservable selection biases (Bodenhorn, Guinnane & Mroz, 2017). On the other hand, the data on caloric intake makes it possible to identify critically low values associated with undernutrition and offers more direct insight regarding the average energy supply people can take advantage of. However, it needs to be noted that higher caloric intake should not be automatically considered normatively *better* since overconsumption is a

separate issue researched in health economics. Furthermore, in the aggregation of caloric values, the information on nutritional components, and the "quality" of the ingested calories is lost. According to Pickett et al. (2005), overconsumption is positively correlated with income inequality in developed countries, which, as will be demonstrated below, have a substantial representation in the sample population. Therefore, the estimated coefficients might exhibit an upward bias.

The data for the educational variables (*mean total years of schooling* and *secondary education enrollment ratio of female students*) were retrieved from the Lee and Lee (2016) dataset, which contains estimates of enrollment and educational attainment for the population of 15 years of age and older based on historical records from 111 countries in five-year intervals from 1870 to 2010. Mean total years of schooling are used to proxy for educational attainment. However, it is important to note that the proxy is far from perfect, as years spent in formal education are not necessarily reflective of the outcomes of functional education, i.e., literacy or attained skills and knowledge. In that vein, a constant (skill) returns to education cannot be assumed in a cross-country comparison. The ratio of secondary school enrollment of female students is used to proxy for gender participation and opportunity, a non-economic type of inequality. However, school enrollment ratios do not reflect completion of the education, nor the possibilities of future participation in the labor market.

The *Latent human rights protection scores* were retrieved from Roser (2020). The dataset is based on Schnakenberg and Fariss (2014) and Fariss (2019) and contains entries on 201 countries for the period of 1946 to 2017. The scores are based on variables expressing both physical safety, such as political imprisonment, extrajudicial killings and disappearances, and empowerments, such as the freedom of association, domestic and foreign movement, and uncensored speech (Schnakenberg and Farris, 2014). The index values represent the relative deviation in the country's human rights record from a global country-year standard which is set to zero, allowing to control for changes in monitoring and reporting of the human rights standards, as well as enabling comparison between countries and over time (Fariss, 2019). Human rights are increasingly considered to be connected to, as well as being an intrinsic part of, the concept of development (Patel, 2018) and the human rights protection scores are here used to represent basic civil rights and freedom from oppression, integral parts of Sen's (2001, p. 14) concept of development.

The *political regime characteristics* (Polity2 variable) have been obtained from the Polity IV Project developed at the Center for Systemic Peace by Marshall, Gurr and Jaggers (2019). The PolityIV dataset contains information regarding 194 countries from 1800 to 2018. The Polity2 variable scores, on a scale from -10 to 10, represent the characteristics of the political regime, where the lowest values correspond to full autocracy, and the highest to participatory democracy. Conceptually, Polity2 is used in this paper to represent people's capability to participate in the political decision-making process and affect its outcomes. In a secondary run, the conceptual relationship will additionally be tested using data for liberal and participatory democracy from V-Dem (2020a,b) dataset.

The Gini coefficients used in the main part of the analysis presented in this paper were retrieved from The Standardized World Income Inequality Database (SWIID), version 8.2 (Solt, 2019). SWIID offers, in contrast to other income inequality datasets, wide coverage of

entries over both space and time, and estimates suitable for cross country comparison. The Gini coefficient used in the main analysis is computed from equalized disposable (post tax and transfer) income based on household data (Solt, 2019). Due to methodological shortcomings of the Gini coefficient discussed in Section 2.2.1, additional data on income inequality (Palma ratio and decile income shares) were retrieved from the World Income Inequality Database (UNU-WIDER, 2019) in order to perform robustness checks. However, since the UNU-WIDER (2019) data is compiled from several sources using different methodologies, it has not been deemed suitable for the main analysis as attempts to obtain a methodologically consistent sample resulted in relatively small sample populations.

The data points for population size, real GDP and the shares of government consumption, investment, imports and exports on GDP were retrieved from the Penn World Table version 9.1 (Feenstra, Inklaar & Timmer, 2015). The entries for inflation and the share of the urban population were retrieved from the World Development Indicators database (World Bank 2020a and 2020b respectively).

Table 1 Main sources of data

Variable(s)	Dataset	Author(s)
Life expectancy at birth	UN World Population Prospects	UNPD (2019)
Daily caloric supply per capita	Daily Supply of Calories, OWID	Roser & Ritchie (2020) based on FAO (2017 and 2020)
Mean years of schooling, secondary enrollment ratio (F)	Lee and Lee Long-Run Education Dataset	Lee & Lee (2016)
Human Rights Scores	Human Rights Scores, OWID	Roser (2020) based on Schnakenberg and Fariss (2014) and Fariss (2019)
Polity2	Polity IV	Marshall, Gurr and Jaggers (2019)
Gini coefficient	SWIID v8.2	Solt (2019)
Real GDP, population size, % of government consumption, % of investment, % of imports, % of exports	Penn World Table v9.1	Feenstra, Inklaar & Timmer (2015)
Inflation, % of urban population	World Development Indicators	World Bank (2020a,b)

3.2 Critiques and Constraints

Apart from the issues discussed individually above, the compiled dataset imposes a number of constraints on the analysis, which merit further discussion. Firstly, SWIID, the dataset used to retrieve the main explanatory variable of interest, contains data starting in 1960. However, due to the lag structure employed in the model (10 years lag in case of the inequality measure), the start of the period of observation of the development outcomes variables shifts to 1970. The lag further leads to the loss of observations of the inequality measure from after 2005, leading to a loss of a considerable number of observations, as well as coverage, since recent years, unsurprisingly, appear to be considerably more balanced. The issue with the balance of the panels is, however, not isolated to SWIID, but is shared by other sources of data as well, ultimately carrying the constraint over to the gathered dataset. The panel used in the analysis is heavily unbalanced, with slightly below 30 % of the total observations coming

from the period between 1970 and 1995, while the rest of the observation belongs to the period of 2000-2015, and with the number of time observations varying across countries. The unbalanced quality of the sample is prone to affect the results of the analysis, and its implications are further discussed in Sections 5.

The data regarding the development outcomes, with the exception of the secondary education enrollment ratio of female students, shares a conceptual critique expressed by Syrovatka and Schlossarek (2019), that is, the observed variables are averaged aggregate values not bearing information on the distribution of the development outcomes, neither in population nor in spatial terms. This reduces the reliability of the estimates produced in the analytical part of this paper in two ways. Firstly, means are, by definition, sensitive to extreme and outlying values, and, secondly, the data does not allow for disaggregation and subsequent evaluation of eventual inequalities in the development outcome themselves.

3.3 Descriptive Statistics

The summary statistics of the final sample entering the analysis can be found below (Table 2 and Table 3). For the purposes of comparison, summary statistics of the unrestricted sample can be found in the Appendix A. The sample obtained by gathering the data from the sources listed above was restricted by picking observations in the frequency of five years, and further by removing country-year observations containing missing values. However, in Section 5.2, a robustness check using the high-frequency data is performed.

Table 2 Summary statistics - outcome variables

		Mean	Std. Dev.	Min	Max	Observations	
Life expectancy	Overall	69.33831	9.300651	21.794	83.404	N	705
	Between		8.897996	46.33733	81.42233	n	153
	Within		3.29621	41.62656	85.62256	T-bar	4.60784
Caloric intake	Overall	2831.548	466.5119	1758	3845	N	684
	Between		439.8823	1951.4	3744.25	n	147
	Within		139.9218	2279.048	3263.548	T-bar	4.65306
Totaly years of schooling	Overall	8.239573	2.786872	1.423689	13.24463	N	433
	Between		2.738343	1.781865	12.79757	n	90
	Within		1.045318	5.240087	11.55408	T-bar	4.81111
Female secondary enrollment	Overall	68.35623	26.94267	2	100	N	433
	Between		24.28066	9.849467	97.30814	n	90
	Within		13.40983	21.49814	123.7809	T-bar	4.81111
Human rights	Overall	.3303434	1.582218	-3.262128	5.13997	N	694
	Between		1.440909	-2.57071	4.930872	n	152
	Within		.4817027	-1.372279	2.09738	T-bar	4.56579
Polity 2	Overall	4.959581	5.992237	-10	10	N	668
	Between		5.417005	-10	10	n	141
	Within		2.791267	-7.790419	14.40403	T-bar	4.73759

Table 3 Summary statistics - explanatory variables

		Mean	Std. Dev.	Min	Max	Observations	
Gini (t-2)	Overall	38.08023	9.071445	17.6	66.1	N	708
	Between		8.693942	22.5375	66	n	155
	Within		1.597546	29.65523	47.60023	T-bar	4.56774
ln GDP (t-2)	Overall	8.977874	1.102288	6.123671	11.78977	N	708
	Between		1.111749	6.123671	11.57557	n	155
	Within		.2643401	7.541792	10.21706	T-bar	4.56774
Gov cons (t-1)	Overall	.1812781	.0821277	.0177927	.7428389	N	708
	Between		.0686046	.0177927	.4073746	n	155
	Within		.0523648	-.0964537	.5167423	T-bar	4.56774
Investment (t-1)	Overall	.2213872	.0918488	.0024566	.6596679	N	708
	Between		.0788345	.0555374	.4802158	n	155
	Within		.0508101	.0257758	.4437788	T-bar	4.56774
ln Openness (t-1)	Overall	-.935205	.805491	-3.467552	1.795128	N	708
	Between		.6907748	-2.665696	1.25361	n	155
	Within		.3309431	-2.506016	.1253354	T-bar	4.56774
ln Inflation (t-1)	Overall	2.912457	.6461669	1.842848	8.921546	N	708
	Between		.3961057	2.069661	4.41293	n	155
	Within		.5174357	1.231153	7.707892	T-bar	4.56774
Urb pop (t-1)	Overall	56.13743	22.61143	5.416	100	N	708
	Between		21.87582	9.421	100	n	155
	Within		4.23018	29.58388	75.67966	T-bar	4.56774

The sample restriction appears to have inflated the mean values of the development outcome variables, suggesting that the sample restriction was accompanied by selection bias, as the sample became skewed toward more 'developed', in terms of observed outcomes, countries. Moreover, the change in the mean value of Polity2 in the restricted sample population suggests a selection bias toward more democratic regimes. The selection bias is likely to be caused by the quality of institutions, which is related to countries' statistical and reporting capacity. Furthermore, after adjusting the sample by removing the observations with missing values, the sample population exhibits a considerably lower degree of within variance, reinforcing the cross-sectional aspect of the dataset. This feature is illustrated in Figure 1, showing the within variation of the Gini index (vertical axis) in a subsample of twenty pseudo-randomly (a randomly selected section of the alphabetically ordered sample) selected countries. In the horizontal direction, the subsample illustrates the high degree of variance between the countries. The summary statistics of the explanatory variables, on the other hand, were not affected as strongly by the restriction of the sample, with the exception of the share of urban population, mean value of which is considerably higher in the restricted sample population. Inspecting the composition of the income group categories pre and post the restriction of the sample (Table 4 and Table 5), however, shows that despite the bias toward higher mean values of development outcomes, the sample population has not become disproportionally skewed toward high income countries. On the contrary, the representation of low and lower middle income countries has, in relative terms, increased in the sample

population, accentuating the supposition that level of aggregate income and level of development, albeit related, are not equivalent. Nonetheless, the group of low income countries remains the least represented one in the restricted sample entering the analysis.

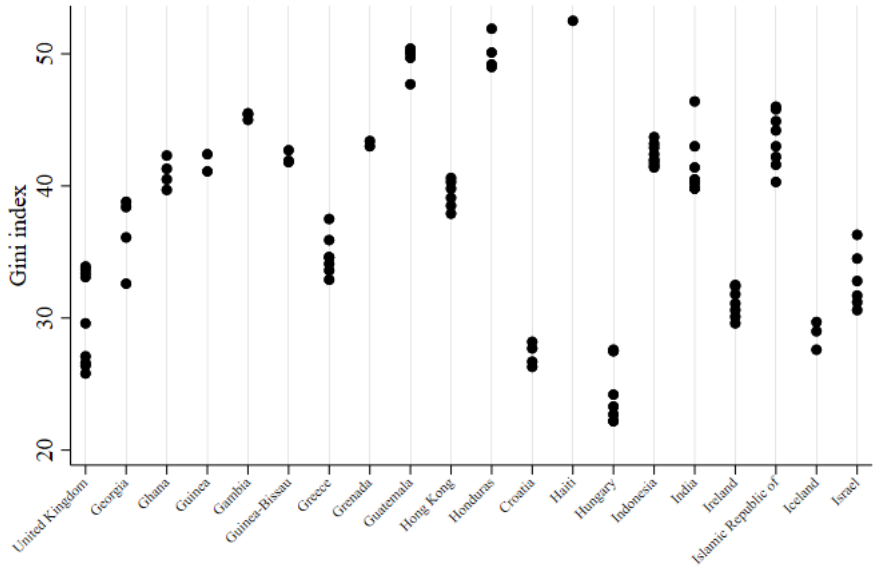

Figure 1 Between and within group variation

Table 4 Income groups - unrestricted sample

	Overall		Between	
	Freq.	Percent	Freq.	Percent
High	4800	36.70	80	36.70
Upper middle	3600	27.52	60	27.52
Lower middle	2820	21.56	47	21.56
Low	1860	14.22	31	14.22
Total	13080	100.00	218	100.00

Table 5 Income groups - restricted sample

	Overall		Between	
	Freq.	Percent	Freq.	Percent
High	282	40.00	45	29.41
Upper middle	189	26.81	44	28.76
Lower middle	157	22.27	39	25.49
Low	77	10.92	25	16.34
Total	705	100.00	153	100.00

4 Methods

The following section of the paper is dedicated to the discussion of the methodological aspects of the analysis. Section 4.1 discusses the justification and the statistical background of the chosen empirical approach and interpretation of the results. In Section 4.2, the econometric model used in the analysis is presented and the tested hypotheses are discussed.

4.1 Empirical Strategy

The analysis is of quantitative nature, carried out with the correlational design (Creswell, 2014, p.414) in mind. The analysis will examine a sample of longitudinal data consisting of 90 to 153 countries (depending on the dependent variable in question) between 1960 and 2015, relying on estimation methods used in previous research – Fixed Effects (time-demeaned within estimator), Between Estimator (group means regression), and pooled Ordinary Least Squares regression using fixed time effects. The analytical approach is based on the works Castells-Quintana, Royuela and Thiel (2019) and to a lesser extent Easterly (2007), with a body of literature within the field of statistics and econometrics supporting the use and interpretation of said methods.

The variation of longitudinal (panel) data consists of two aspects – the within group (i.e., time series) and between group (cross section) variation. The within estimator, a commonly used method of panel data estimation, uses only the within group variation by mean-differencing the observations and thus also removing time invariant variables in the process, including any unobserved and unobservable time invariant group characteristics from the model (Greene, 2012, pp. 399-400). The fixed effects estimation method would intuitively appear to be the best choice to answer the research question set out in this paper since it allows for isolating the effect of observed variables within each country. However, it can lead to biased estimated coefficients in unbalanced panels and for variables with relatively low variation within the group over time (Cameron & Trivedi, 2009, p.251), which is, as demonstrated in Section 3.3, the case of the data gathered for the purpose of the analysis.

The between estimator, on the other hand, only uses the between groups variation, which is achieved by performing the regression using the group means as regressors (Cameron & Trivedi, 2009, p.254). Further, Cameron and Trivedi (2009, p.254) recommend using bootstrapped standard errors to compensate for issues related to potential heteroskedasticity. Between estimator's use of between group variance would, given the strong cross-sectional component of variation in the data, make it an attractive choice. Moreover, the between estimator method has been used explicitly to estimate the relationship between income inequality and the Human Development Index by Castells-Quintana, Royuela and Thiel

(2019), and a conceptually similar method of group means regression was used to estimate the relationship between income inequality and educational and institutional variables by Easterly (2007), further motivating its use in this paper. According to Cameron and Trivedi (2009, p.254), however, pooled estimators are more reliable than between estimator. Pooled OLS models exploit both within and between variation, however, in order to achieve an unbiased estimate, the stochastic error term of the model needs to be uncorrelated with explanatory variables, and the use of group clustered standard errors is recommended (Cameron & Trivedi, 2009, pp. 244-248).

Since it is reasonable to assume that effects of income inequality on development outcomes would not be immediate, but would instead unfold over longer periods of time, the data will be inspected in five-year intervals and employ a lag structure in the explanatory variables, as is not uncommon in literature concerned with income inequality (Banerjee & Duflo, 2003). Given the relatively slowly changing values of the dependent variables and following Castells-Quintana, Royuela and Thiel (2019), the main explanatory variable of interest, income inequality, and the natural logarithm of GDP per capita, an addition to the model, are lagged by two periods (10 years), and the controls by one period (5 years). However, it is important to acknowledge, in opposition to Castells-Quintana, Royuela and Thiel (2019) and many others, that even though lagging explanatory variables is a practice commonly employed with the aim of addressing and resolving endogeneity issues, these claims have been recently challenged by Reed (2015) and Bellemare, Masaki and Pepinsky (2017), who present evidence against lags being a valid strategy to tackle endogeneity and simultaneity in the model, or to establish a causal relationship. However, in the light of literature reviewed in Section 2.3.2, it appears that, on a conceptual level, a certain degree of endogeneity is inevitable, since the relationship between income inequality and socio-political structures and institutions discussed within institutional economics is highly endogenous itself, with distributional inequalities affecting socio-political outcomes, which, in turn, have an effect on future distribution.

Finally, the nature of the proposed exercise prevents by its scope a careful examination of the historical context of each involved country, making the analysis vulnerable to the critiques of quantitative reductionism and *compression of history*. Austin (2008) describes compression of history as an oversimplification of relationships between observed phenomena on the grounds of omitting historical (vertical compression) and spatial (horizontal compression) differences in, and patterns of the events that shape the observed outcomes. Compression of history then leads to neglecting important changes that may have occurred outside of what is observed in the model, such as, in the case of this analysis, the effectiveness of governance, the school curricula when comparing educational attainment, domestic and international political developments, economic junctures, etc. This line of critique does not invalidate the analysis, but it does, however, imply caution when interpreting the results.

4.2 Model

In order to perform the analysis, an econometric model based on Castells-Quintana, Royuela and Thiel (2019) is used:

$$DevOutcome_T = \hat{\beta}_0 + \hat{\beta}_1 \cdot Inequality_{T-2} + \hat{\beta}_2 \cdot GDP_{T-2} + \hat{\beta}_3 \cdot Investment_{T-1} +$$

$$+\hat{\beta}_4 \cdot GovCons_{T-1} + \hat{\beta}_5 \cdot lnOpenness_{T-1} + \hat{\beta}_6 \cdot lnInflation_{T-1} + \hat{\beta}_7 \cdot UrbPop_{T-1} + \hat{\mu}$$

The model is used in sequence to estimate respective relationships between income inequality and variables proxying development outcomes – life expectancy, daily caloric supply per capita, mean total years of schooling, the rate of secondary enrollment of female students, adherence to human rights and political regime characteristics. The main independent variable of interest is income inequality measured by the Gini coefficient based on disposable income, lagged by two periods (10 years). The model is controlled for the share of investment on GDP, the share of government consumption on GDP, economic openness (calculated as the ratio of the sum of exports and imports normalized by GDP, similarly as for example in Aiyar and Ebeke, 2019), the rate of inflation and the share of the urban population. The controls are lagged by one period, that is by five years. In addition to the original model presented by Castells-Quintana, Royuela and Thiel (2019), the natural logarithm of GDP per capita lagged by ten years is added to the vector of controls. The set of control variables is not identical to, but shares common features with previous inequality research, such as Birdsall, Ross and Sabot (1995), Barro (1991 and 2000), Aghion, Caroli and García-Peñalosa (1999), and Aiyar and Ebeke (2019). For the purpose of further analysis of the potentially differential effect of economic inequality on development outcomes, a matrix of dummy variables denoting the income group the country belongs to as per World Bank (2019) definition, is introduced in the model, as well as the interaction term of the income groups with the income inequality variable. Using the 2019 classification of income groups and keeping it constant presents its own set of issues, chiefly the potential misrepresentation of countries' past status. However, this step is necessary since creating historically accurate groups is contingent on the availability of GNI per capita data, which falters in the earlier periods Furthermore, the classifications themselves are only published from 1987. Using those would thus stimulate the need for the past projection of the income grouping beyond 1987, eliminating only a part of the distortion. Constant income groups based in the present, on the other hand, enable a comparison of patterns within the different groups in relation to the present outcomes.

Admittedly, it is to be expected that employing the same set of control variables for such a heterogeneous group of outcome variables may not result in sufficiently explaining the variance in all of them. That is, however, not the purpose of this paper, as each of the considered development outcomes is, by itself a subject of different scientific fields, ranging from demography and health economics to sociology and political science. Instead, this paper aims at investigating the outcome variables from the perspective of development economics, and to observe the effects of economic features on the non-economic development outcomes as a set representing human development.

4.2.1 Hypothesis

The above-described model is used to test the null hypothesis of the estimated coefficient of the inequality measure $\hat{\beta}_1$ being statistically not different from zero. The null hypothesis will be rejected if the estimated coefficient is statistically different from zero at the 10 % level of significance. The expectation based on previous empirical works done by Easterly (2007) and Castells-Quintana, Royuela and Thiel (2019) is that $\hat{\beta}_1$ will take on a negative sign.

$$H_0\colon\ \hat{\beta}_1 = 0$$

$$H_A\colon\ \widehat{\hat{\beta}_1} \neq 0$$

Furthermore, in order to test whether the expected relationship of income inequality and development outcomes differs across country income groups defined by the World Bank (2019), a secondary hypothesis will be tested:

$$H_0\colon\ \ \hat{\beta}_a - \hat{\beta}_b = 0 \quad \cup \quad \hat{\beta}_a - \hat{\beta}_c = 0$$

Where $\hat{\beta}_a$, $\hat{\beta}_b$ and $\hat{\beta}_c$ are the estimated coefficients of interaction terms between income inequality and the income group dummy variables. The interaction approach is opted for over analyzing subsamples of countries based on income level separately in order to obtain a set of estimates which would be comparable across the income groups despite the uneven representation of the groups in the sample population. However, the tradeoff for this advantage of the interaction approach is the assumption of common intersect of the partial slopes imposed by the model.

5 Results

The following section presents the results of the empirical analysis. The fixed effects models indicate no statistically significant relationship between income inequality and development outcomes. However, the fixed effects models are made less reliable by the features of the collected data and sample restrictions, which, as described in Section 3.3, suppressed the within variance of the sample. As an alternative, between estimator and pooled OLS are used to estimate the relationships. The results are consistent across both estimation methods and hint at a negative, statistically significant relationship between income inequality and life expectancy, daily caloric supply, and human rights protection. On the other hand, the analysis does not reveal any statistically significant association between income inequality and total mean years of schooling, secondary enrollment ratios of female students, and the polity scores. A statistically significant relationship emerges when controlling for income level country groups instead of treating income as a continuous variable. Interacting the income groups with the inequality measure further suggests a difference in the effects of inequality across the income groups. The results further show a statistically significant relationship between measures of aggregate per capita income and development outcomes, including in the fixed effects models. The exception is, however, the polity indicator, the variance of which is not sufficiently explained by the model.

Section 5.1 presents the steps of the analysis and the results obtained from the regressions for each of the six selected development outcome variables. In Section 5.2, robustness and sensitivity checks are performed to evaluate the performance of the econometric specifications used in the analysis. Finally, Section 5.3 further discusses the results in relation to existing literature.

5.1 Analysis

The results of pairwise bivariate correlations (Table 6) between the development outcomes and the explanatory variables suggest the existence of statistically significant negative relationships between the development outcomes and income inequality (measured as disposable income Gini coefficient) lagged by 10 years. The associations expressed by the coefficients of correlation are of comparable magnitudes, with the exception of the polity indicator, where the relationship appears to be considerably weaker. The relationships with control variables exhibit expected signs consistent with previous literature when significant, with the lagged values of real GDP per capita, the share of the urban population, the share of investment on GDP, and economic openness appearing to have a positive, and inflation and share of government consumption on GDP negative effect on development outcomes. These

relationships are explored further in Sections 5.1.1 – 5.1.2 using the empirical approach and the econometric model described in Section 4.

Table 6 Pairwise bivariate correlations

	(1)	(2)	(3)	(4)	(5)	(6)
	Life exp.	Calories	Years of edu	F enrollment	Human rights	Polity
Gini	-0.4920*	-0.5681*	-0.4941*	-0.4950*	-0.4508*	-0.2036*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP per capita	0.7654*	0.7358*	0.7822*	0.7887*	0.5049*	0.3680*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
% of gov. cons.	-0.0610*	-0.0693*	-0.0073	0.0010	0.0345	-0.1572*
	(0.0124)	(0.0062)	(0.8166)	(0.9746)	(0.1645)	(0.0000)
% of investment	0.3812*	0.3504*	0.3857*	0.3767*	0.2825*	0.2186*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Openness	0.4377*	0.3494*	0.4356*	0.4413*	0.4859*	0.2794*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Inflation	-0.1277*	-0.1130*	-0.0608	-0.1059*	-0.2280*	-0.0242
	(0.0000)	(0.0001)	(0.0807)	(0.0023)	(0.0000)	(0.4046)
% of urban pop.	0.7400*	0.6885*	0.7419*	0.7425*	0.3589*	0.3887*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Note: p-values in parentheses. Gini and GDP lagged by ten years, controls lagged by five years.

5.1.1 Fixed effects models

We begin the analysis by estimating the expected relationship between economic inequality and development outcomes using the baseline specification of the model presented in Section 4.2 via the time-demeaned within estimator. The results of Hausman test used to assess the suitability of the use of the fixed effects models can be found in Appendix B. The fixed effects models (Table 7) reveal no statistically significant relationship between income

Table 7 Fixed effects models

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Inequality (t-2)	0.064	-1.122	-0.026	-0.131	-0.024	-0.036
	(0.47)	(-0.27)	(-0.86)	(-0.31)	(-1.16)	(-0.40)
ln GDP (t-2)	3.075***	94.946**	1.471***	6.814	0.372**	0.109
	(2.73)	(2.06)	(3.42)	(1.11)	(2.37)	(0.14)
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
Avg. periods	4.608	4.653	4.811	4.811	4.566	4.738
R2 - Within	0.550	0.373	0.696	0.553	0.239	0.181
R2 - Between	0.565	0.500	0.645	0.671	0.303	0.136
R2 - Overall	0.614	0.581	0.645	0.608	0.393	0.177

Note: T-statistic in parentheses. Standard errors clustered on country. Models are further controlled for government consumption, investment, inflation, economic openness and urban population. *p < 0.1 **p < 0.05 ***p < 0.01

inequality and development outcomes, as the estimated parameters of the lagged Gini coefficient are statistically indistinguishable from zero. However, the models, with the exception of the sociopolitical outcomes (columns 5 and 6), exhibit relatively good model fit, explaining about 60 % of the variance. The models further reveal, with the exception of the secondary enrollment ratio of female students, and political regime characteristics in columns 4 and 6, a statistically significant and positive relationship between the real GDP per capita and the development outcomes. The observed association confirms the theoretical expectation that the level of income acts as a means of development expressed by Sen (2001, p. 19).

Due to imperfections of the model and the limited coverage of the collected data, the statistical insignificance of the estimated coefficients of income inequality should be understood as the absence of evidence of the examined relationship, rather than evidence of its absence. The within-country relationship of income inequality and development outcomes might be obscured by the relatively low time-series aspect of data variation captured by the model. As seen in Table 7, the models estimate, due to a large number of missing values, the coefficients from an average of 4.6 periods of observation. As discussed in Section 4.1, fixed effects models become less reliable when the time-variance of explanatory variables is low. This issue is further reinforced by the panel being unbalanced. Moreover, as discussed above, the sample population is biased toward countries with both higher income and levels of observed development outcomes, further obscuring the relationship. Furthermore, it is important to draw attention to the fact that the null result observed would, at its face value, indicate a non-existent *direct* impacts of income inequality on development outcomes. As shown in the literature review (Section 2.3.1), income inequality has, even if challenged and running through a number of different channels, a relationship with economic growth, which in turn affects the level of GDP and ultimately the outcomes of development, as demonstrated in Table 7. The results, therefore, should not be interpreted as ruling out possible effects of income inequality on development outcomes altogether, but rather as not supportive of its direct impacts.

5.1.2 Pooled OLS models

The collected data has, as described in Section 3.3, a strong cross-sectional aspect of variance. In order to exploit this feature of the dataset, the suspected relationship between income inequality and the development outcomes is further inspected using BE and pooled OLS models. The results yielded by the methods are fairly consistent. For that reason, since pooled OLS is considered methodologically more reliable (Cameron and Trivedi, 2009, p.254), only the results of the pooled OLS are discussed in the main text. The results of the BE models can be found in Appendix C. As shown in Appendix D, the OLS models exhibit, overall, a non-constant variation of residuals. In order to correct for issues related to heteroskedasticity, robust standard errors clustered on the country are applied.

The baseline specification of the pooled OLS models (Table 8) reveals a statistically significant negative relationship between income inequality and life expectancy, daily caloric supply, and human rights scores. On the other hand, the models do not indicate any statistically significant relationship of the educational variables, and the polity scores with income inequality. The model further reveals that the logged real GDP per capita has a

Table 8 Pooled OLS models

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Inequality (t-2)	-0.188***	-13.356***	-0.026	-0.249	-0.042***	-0.053
	(-2.99)	(-4.66)	(-1.20)	(-1.38)	(-4.14)	(-0.85)
ln GDP (t-2)	4.580***	216.170***	1.388***	13.770***	0.329**	1.479
	(6.38)	(5.97)	(3.50)	(4.50)	(2.48)	(1.61)
Fixed time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
R2 - Adjusted	0.712	0.655	0.714	0.739	0.546	0.210

Note: T-statistic in parentheses. Standard errors clustered on country. Models are further controlled for government consumption, investment, inflation, economic openness and urban population. *p < 0.1 **p < 0.05 ***p < 0.01

statistically significant relationship with all the analyzed development outcomes except the political regime characteristics.

In the next step of the analysis (Table 9), the aggregate income per capita variable is categorized into groups according to the World Bank (2019) definition, which overall, with the exception of daily caloric supply in column 2, increases the proportion of variance explained by the models. The estimated parameters of income inequality overall increase in magnitude with the addition of the categories and inequality becomes a statistically significant factor for educational attainment and the secondary enrollment ration of female students, albeit only at 10 % confidence level in the case of the latter. The coefficients of the income group dummies are statistically significant across all models and reveal a pattern that further hints at the relationship between GDP per capita and the outcomes of development, showing the penalty endured by lower income countries compared to the group classified as high income. The conceptual relationship should, however, be taken with caution, the reason for which can be illustrated on the case of political regime characteristics (column 6, Table 9), where the significance of the dummies' coefficients is likely to be caused by omitted variable

Table 9 Pooled OLS - income level groups

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Inequality (t-2)	-0.250***	-16.664***	-0.035**	-0.389*	-0.023**	0.012
	(-4.15)	(-4.84)	(-2.17)	(-1.95)	(-2.36)	(0.18)
Upper middle income	-2.220*	-80.768	-1.504***	-11.817***	-1.269***	-4.646***
	(-1.69)	(-0.98)	(-3.54)	(-2.65)	(-5.09)	(-3.18)
Lower middle income	-9.085***	-261.591**	-3.473***	-28.412***	-1.473***	-7.698***
	(-5.27)	(-2.36)	(-5.13)	(-3.89)	(-5.77)	(-5.13)
Low income	-14.531***	-358.259***	-5.336***	-43.440***	-1.104***	-9.046***
	(-6.92)	(-2.93)	(-6.09)	(-5.41)	(-3.19)	(-4.44)
Fixed time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
R2 - Adjusted	0.750	0.619	0.766	0.758	0.600	0.282

Note: T-statistic in parentheses. Standard errors clustered on country. High income country groups as the base. Models are further controlled for government consumption, investment, inflation, economic openness and urban population.
*p < 0.1 **p < 0.05 ***p < 0.01

bias. The model explains only 28.2 % of the observed variance, leaving a lot to be desired. Furthermore, since logged GDP had no statistically significant relationship with the polity score in the baseline model (Table 8), it seems safe to assume that the estimates are likely, in addition to the level of income, picking up on other, unobserved characteristics shared by the countries within the categories. On the other hand, the statistical significance of the years of education after the introduction of the income group dummies may be reflective of the composition of the sample population, which is skewed toward high income and more *developed* countries. Controlling for the income group then, to a certain extent, allows to correct for the selection bias and confirm the negative relationship between income inequality and educational attainment observed by Easterly (2007).

Next, we interact the income group dummies with the inequality measure in order to inspect whether the relationship's intensity differs among the groups of country classification according to the level of income (Table 10). The estimated parameter of income inequality, now to be interpreted as the relationship between income inequality and development outcomes in high income countries, remains statistically significant only for life expectancy at

Table 10 Pooled OLS – income group interactions

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Inequality (t-2)	-0.144**	-14.634***	-0.012	-0.233	-0.013	0.043
	(-2.54)	(-3.15)	(-0.62)	(-0.87)	(-1.05)	(0.54)
High income #	0.000	0.000	0.000	0.000	0.000	0.000
# Inequality (t-2)	(.)	(.)	(.)	(.)	(.)	(.)
Upper middle income #	-0.087***	-2.088	-0.035***	-0.255**	-0.026***	-0.082**
# Inequality (t-2)	(-3.09)	(-0.86)	(-3.38)	(-2.09)	(-4.00)	(-2.26)
Lower middle income #	-0.255***	-6.144**	-0.073***	-0.589***	-0.029***	-0.154***
# Inequality (t-2)	(-6.44)	(-2.12)	(-4.87)	(-3.44)	(-4.48)	(-4.15)
Low income #	-0.380***	-8.041**	-0.113***	-0.930***	-0.017**	-0.172***
# Inequality (t-2)	(-8.97)	(-2.56)	(-5.10)	(-4.70)	(-2.10)	(-3.78)
Fixed time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
R2 - Adjusted	0.768	0.618	0.746	0.745	0.578	0.251

Note: T-statistic in parentheses. Standard errors clustered on country. High income country groups as the base. Models are further controlled for government consumption, investment, inflation, economic openness and urban population.
*p < 0.1 **p < 0.05 ***p < 0.01

birth and daily caloric supply. The interaction terms are, however, statistically significant with relative consistency, and appear to show a pattern of the intensity of the negative relationship between income inequality and development outcomes increasing as the level of income decreases. An F-test (Table 11) confirms the observed pattern of different intensity of the relationship of income inequality and development outcomes, with the exception of the human rights scores, showing that the estimated coefficients are not all identical. The statistical significance of the interaction terms further points to the already discussed selection bias present in the sample, which appears to skew the results toward the shape of the relationship between the observed development outcomes and income inequality in high income countries, which, in turn, may further partially account for the lack of results in the fixed effects models beyond the reasons discussed above. The different dynamics revealed by the interaction terms thus indicate that both the level of per capita income and its distribution

are important predictors of human development outcomes and that more unequal and lower income countries tend to, on average, exhibit lower performance in terms of human development.

Table 11 Pooled OLS interaction terms F-test

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
F	42.90	6.91	7.39	10.04	2.09	3.43
Prob > F	0.0000	0.0014	0.0011	0.0001	0.1271	0.0351

5.2 Robustness and Sensitivity Checks

In order to assess the robustness of the results, several robustness checks have been performed on the pooled OLS models. First and foremost, the models are inspected for sensitivity to selected inequality measure. We start with replacing the disposable income Gini index with the one based on market inequality, that is before taxes and transfers, from the SWIID dataset produced by Solt (2019). Market inequality is, according to McGregor, Smith, and Wills (2019) more reflective of structural inequality in terms of wealth and skill distribution. The results (Table 12) confirm the negative relationship of income inequality and life expectancy and the average daily caloric intake, respectively. The most interesting change to the original results is, however, the positive and statistically significant estimated coefficient assumed by the market Gini when estimating the relationship of income inequality and the political regime characteristics. Upon further examination, the analysis including the income group interaction terms reveals that the results of the baseline OLS models are, due to the selection bias present in the sample, skewed toward estimating the relationship in high income countries. The interaction terms become statistically significant, with the expected signs, across all the investigated outcomes for the groups of upper middle, lower middle, and low income countries. The unexpected positive relationship between income inequality and the Polity2 indicator thus appears to be isolated to high income countries. One of the possible

Table 12 Market Gini

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Gini (market, t-2)	-0.220***	-9.242***	-0.032	-0.290	-0.013	0.157***
	(-3.08)	(-2.65)	(-1.22)	(-1.42)	(-1.02)	(3.04)
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
R2 - Adjusted	0.711	0.624	0.714	0.739	0.506	0.234

Note: T-statistic in parentheses. Standard errors clustered on country. Models are further controlled for GDP per capita, government consumption, investment, inflation, economic openness and urban population. *p < 0.1 **p < 0.05 ***p < 0.01

explanations of the positive association could be the recent growth of income inequality in high income countries observed by Milanovic (2016, p.22). Furthermore, the poor model fit, selection bias of the sample, and the possibility of omitted variable bias need to be mention among the potential confounding factors.

Next, we move on to the alternative measures of income inequality mentioned in Section 2.2.1 using the data from the WIID dataset published by UNU-WIDER (2019). First of all, it is noteworthy to point out the low number of country-observations retrieved from the dataset. The reason for this is that WIID contains data from several sources using a number of methodologies. In order to achieve a reasonable level of comparability while maintaining the maximum amount of available observations, data based on per capita scaled consumption was selected. Nonetheless, due to the high degree of methodological heterogeneity, the sample population was still severely restricted. However, the examination can still provide additional insights into the analysis as the used measures reflect changes at the ends of the distribution, where the Gini coefficient tends to be less sensitive.

Table 13 Alternative inequality measures

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
ln Palma (t-2)	-6.897***	-112.356	-0.871	-10.552*	-0.502*	-1.064
	(-4.89)	(-1.51)	(-1.07)	(-2.04)	(-1.95)	(-0.52)
R2 - Adjusted	0.692	0.613	0.722	0.775	0.393	0.132
ln Ratio 10/10 (t-2)	-5.187***	-77.531	-0.470	-6.778*	-0.297	-0.725
	(-4.62)	(-1.24)	(-0.78)	(-1.82)	(-1.41)	(-0.46)
R2 - Adjusted	0.685	0.611	0.715	0.768	0.379	0.131
ln Ratio 20/20 (t-2)	-6.442***	-96.580	-0.592	-8.252*	-0.410	-0.992
	(-4.83)	(-1.27)	(-0.78)	(-1.76)	(-1.60)	(-0.51)
R2 - Adjusted	0.687	0.611	0.715	0.767	0.384	0.132
Bottom 40 (t-2)	0.725***	11.520	0.099	1.200**	0.058*	0.132
	(4.07)	(1.36)	(1.12)	(2.07)	(1.95)	(0.55)
R2 - Adjusted	0.676	0.611	0.722	0.774	0.393	0.133
ln Top 10 (t-2)	-14.281***	-278.605*	-2.153	-24.752**	-1.395**	-2.884
	(-3.90)	(-1.82)	(-1.27)	(-2.10)	(-2.40)	(-0.62)
R2 - Adjusted	0.698	0.633	0.714	0.787	0.376	0.128
Observations	106	103	46	46	104	104
Countries	65	62	30	30	63	63

Note: T-statistic in parentheses. Standard errors clustered on country. Models are further controlled for GDP per capita, government consumption, investment, inflation, economic openness and urban population. Number of observations and countries common for each column. *p < 0.1 **p < 0.05 ***p < 0.01

The baseline specification results (Table 13) show that the estimated coefficients for inequality in the regressions for life expectancy are consistently statistically significant regardless of chosen measure, in accord with the conclusions of Kawachi and Kennedy (1997). Attention should be brought to the fact that the positive signs of the coefficients estimated for the income share of the bottom 40 % are consistent with the rest of the results with negative parameters, as an increase in this share would typically mean a decrease in overall inequality. The baseline results furthermore show a similar level of consistency of the association between tail-end income inequality and secondary education enrollment ratio of

female students. The rest of the coefficients appears to be less consistent, however, interacting the inequality measures with the income groups reveals that the intensity and significance of the relationship is influenced by the country's level of income in a parallel with the main analysis.

Further, the relationship between political regime characteristics and income inequality is tested using an alternative measurement. The data retrieved from V-Dem (2020a,b) is used, specifically the Liberal democracy index and its two components, Liberal component and Electoral democracy indices. The V-Dem data is, similarly to the Polity IV project, based on quantifying qualitative evidence. V-Dem (2020c) defines the Liberal democracy index through the limits restricting governments' excessive use of power expressed in constitutionally granted civil liberties, making it conceptually slightly different from Polity2, which covers the mechanisms of governing power transitions. The index is a composite of two components, where Liberal component index covers the aspects of the rule of the state and the treatment of minority and opposition political voices, whereas the Electoral democracy index covers the ability and willingness of the governments to respond to the citizens' concerns (V-Dem, 2020c). The indices take values from zero to 1.

Table 14 Alternative indices of political regime characteristics

	(1)	(2)	(3)
	Liberal democracy index	Liberal component index	Electoral democracy index
Inequality (t-2)	-0.005**	-0.002	-0.004*
	(-2.24)	(-1.15)	(-1.76)
R2 - Adjusted	0.430	0.340	0.351

Note: T-statistic in parentheses. Standard errors clustered on country. Models are further controlled for GDP per capita, government consumption, investment, inflation, economic openness and urban population. *p < 0.1 **p < 0.05 ***p < 0.01

The results (Table 14) show a statistically significant negative relationship between income inequality and the Liberal democracy index. The further decomposition in columns 2 and 3 shows that the relationship appears to be driven more by the Electoral democracy component, it is, however, the interplay of both components expressed in the composite that exhibits the strongest association with income inequality. The difference in results from the main analysis

Table 15 Lag structures

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Gini (t-1)	-0.185***	-13.778***	-0.027	-0.342**	-0.046***	-0.079
	(-3.16)	(-4.85)	(-1.29)	(-2.03)	(-4.44)	(-1.28)
R2 - Adjusted	0.717	0.658	0.711	0.741	0.526	0.199
Gini (t)	-0.181***	-13.755***	-0.028	-0.408**	-0.047***	-0.092
	(-3.09)	(-4.68)	(-1.35)	(-2.42)	(-4.46)	(-1.51)
R2 - Adjusted	0.722	0.670	0.709	0.739	0.519	0.226

Note: T-statistic in parentheses. Standard errors clustered on country. Models are further controlled for GDP per capita, government consumption, investment, inflation, economic openness and urban population. Number of observations and countries identical to that of the baseline specification. Disposable income Gini. *p < 0.1 **p < 0.05 ***p < 0.01

given by the conceptual difference between the measures and the partial conceptual overlap between the V-Dem indicators and the category labeled in this analysis as human rights, the relationship of which with income inequality tends to be statistically significant in the models presented in Section 5.1.2.

Last but not least, robustness checks regarding the properties of the model and the sample are performed. The results in Table 15 show the coefficients of the models where, everything else unchanged, the models use the Gini index lagged by one period and unlagged, respectively. The results are fairly consistent with the baseline OLS models due to the relatively low variation of the Gini coefficient. The most prominent point of difference is that the coefficients estimated for income inequality gain statistical significance in the regressions for female secondary enrollment in the specification without the income group dummies when using the shorter lag structure, suggesting that the relationship might, compared to the rest of the observed development outcomes, unfold over shorter periods of time. Conceptually, enrollment rates can be more flexible in terms of their elasticity to immediate economic conditions since enrollment can be viewed, on an individual level, as a singular event with a binary outcome, as opposed to the rest of the observed outcome variables, which proxy for concepts where change occurs slowly or in a more gradual pattern. Further, the models are used with high frequency data for those outcome variables for which yearly data is available. Table 16 shows that the results are not affected in a significant way, as the descriptive statistics of the Gini were not severely affected by the sample restrictions

Table 16 High frequency data

	(1)	(2)	(3)
	Caloric supply	Human Rights	Polity
Inequality (t-2)	-13.746***	-0.042***	-0.057
	(-4.93)	(-4.15)	(-0.93)
Observations	3376	3428	3438
Countries	152	159	146
R2 - Adjusted	0.667	0.552	0.209

Note: T-statistic in parentheses. Standard errors clustered on country. Models are further controlled for GDP per capita,, government consumption, investment, inflation, economic openness and urban population.
*p < 0.1 **p < 0.05 ***p < 0.01

5.3 Discussion

The results of the analysis are relatively consistent across BE and OLS estimates, showing a statistically significant negative relationship of income inequality and life expectancy, daily caloric intake, and the human rights scores proxying for civil rights. In contrast, the fixed effects models reveal no statistically significant relationship between income inequality and the development outcome variables. This is, however, consistent with Castells-Quintana, Royuela and Thiel (2019), who report statistically insignificant results when analyzing the

effects of income inequality on hybrid HDI and its components using fixed effects models (with the exception of literacy rates, which exhibited a statistically significant negative relationship with income inequality) and statistically significant relationships obtained from the pooled estimators. The first implication of this observation would be that while changes of inequality within the country do not appear to have a direct effect on the measured outcomes, more unequal countries tend to, on average, exhibit lower scores in the outcome variables. However, this interpretation has a number of caveats that merit further discussion.

First of all, the aforementioned properties of the sample discussed in Section 3 limit the reliability of the fixed effects models in two ways. Firstly, the sample is biased toward more developed (both in terms of human development and economic power) countries. As shown in Table 10, the relationship of income inequality appears to have a different intensity based on countries' level of income, where high income countries seem to experience much lower penalty incurred by income inequality. The over-representation of developed countries in the sample can then be expected to bias the results in a downward direction. Secondly, the sample properties affect the result by reducing the within variance of the sample population. As already briefly discussed in Section 5.1.1, the within estimator can become unreliable and biased when the time-series aspect of the variance observed in the data is low, especially in case of an unbalanced panel, which is the case of the analyzed sample. The within estimator computes the regression coefficients based on changes observed within a group, which are relatively small in case of the Gini coefficient, and further restricted by the relatively few time observations per country, as well as the length of the observed period. Resource distribution and income inequality appear to be tied together with socio-political and institutional arrangements (Sokoloff & Engerman, 2000; Acemoglu, Johnson & Robinson, 2004; North, Wallis & Weingast, 2006), which, as Williamson (2000) notes, change slowly throughout time, over decades in case of formal rules and polity, and even centuries in case of informal institutions and norms, and culturally formed customs and attitudes. The different temporal dynamics, together with the time span of the sample (particularly relating to the unbalanced quality of the sample population and the relatively low number of time observations per country) and its bias toward democracies, might partially explain the lack of significant results in case of the political regime characteristics as well as account for the difference in the results observed by Easterly (2007). The measure of institutional quality employed by Easterly (2007) comes from the World Governance Indicators, a set of subjective indices of the *perception* of the functioning of the institutions (Kaufmann, Kraay & Mastruzzi, 2010), as opposed to the Polity2 indicator, which is based on hard qualitative evidence (Marshall, Gurr, & Jaggers, 2019).

Continuing with the topic of temporal effects, Baltagi and Griffin (1984) posit that within variation is more reflective of a short run effect of the explanatory variable used in the model, whereas the estimates obtained from between groups variation yield coefficients expressing the long run effects. This distinction between interpretation of between and within group variation is further supported by Pirotte (1999), Barro (2000), Kennedy (2008), and Castells-Quintana, Royuela and Thiel (2019). In light of this literature, the null result of the fixed effects models could be interpreted as a null short-term relationship between development outcomes and income inequality. Castells-Quintana, Royuela and Thiel (2019) further interpret the results of the OLS and BE models as reflective of long run trends. Expecting different short term and long term results would, following the body of literature concerned

with the relationship of income inequality and economic growth, be valid, however, such an interpretation of the between country variance would, in case of the relationship of income inequality and the outcomes of human, require the assumption that the effects of inequality follow, approximately, the same path, including the potential transmission channels, across all observed countries. Given the heterogeneity of channels through which inequality is affecting economic growth described in Section 2.3.1 and the variety of institutional settings that can occur in different countries discussed in Section 2.3.2, this paper will refrain from such a bold conclusion, as there does not appear to be enough theoretical evidence to support it.

Furthermore, this paper has avoided the issue of endogeneity and the direction of the potential causal chain between income inequality and the measured development outcomes. In so far, the analysis presented above does not provide an indication whether income inequality causes the normatively *worse* performance in terms of development outcomes through relative material deprivation, and thus restricting the means of individuals to improve their condition, or if the lower scores in development outcomes limit the opportunities in the labor markets, and in that way reinforce income inequality. However, previous research (Easterly, 2007, and Castells-Quintana, Royuela and Thiel, 2019) suggests that the formerly mentioned relationship is more likely by instrumenting the regressions, in the vein of the hypothesis of Sokoloff and Engerman (2000), by the share of the country's area in a tropical climate zone, and the log ratio of land suitable for cultivation of wheat and sugarcane respectively.

Since the employed models are of lin-log type, where the explanatory variable is linear and some of the controls are either linear or transformed using the natural logarithm, the relative economic significance of the estimates is not clearly visible at the first glance. In order to compare the magnitude of the potential impact, all other factors considered equal, of changes in economic inequality or the log of real GDP per capita, estimates of the effect of the change by one within-country standard deviation are computed. The results of the exercise (Table 17) reveal that, according to the modeled estimations, income inequality can potentially outweigh the benefits brought about by an increase in per capita income. This finding is conceptually related to *ruthless growth*, a term originally coined by UNDP (1996) describing a growth process benefiting the top earners of a given society while leaving the rest of the populace behind in stagnant or worsening conditions leading to increases in poverty. The analysis presented in this paper suggests that, although the two are intrinsically connected (Adelman, 1984, p. 49), the effects of extremely uneven distribution of increases in aggregate income can, beyond material deprivation expressed by poverty, lead to detriments in capabilities representing human development.

Table 17 Economic significance

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
△ Inequality (t-2)	-0.300	-21.337	-0.042	-0.398	-0.067	-0.085
△ ln GDP (t-2)	0.137	6.460	0.041	0.412	0.010	0.044

Note: Coefficients of both variables on linear scale. The unit of change is one within group standard deviation.

Last but not least, it needs to be acknowledged that this paper has not explicitly discussed possible transmission channels of the relationship between income inequality and the development outcomes. It is more than likely that a number of different channels exist for each development outcome and exploring those would be well beyond the scope and purpose of this paper. However, in light of the literature reviewed in Section 2.3.1 and the results of the analysis showing the statistically significant positive relationship between the level of GDP per capita and development outcomes, it can be reasonably assumed that beyond the channels that would transmit the effect to development outcomes individually, such as has been hypothesized for physical health and wellbeing to be affected by income inequality through its effects on mental health (Wilkinson, 2006), the development outcomes would further be affected by inequality *indirectly*, through its effects on economic growth, potentially amplifying the magnitude of the effects observed in the analysis above.

6 Conclusion

The following section concludes the paper. Section 6.1 summarizes the results of the analysis. Section 6.2, evaluates the contribution of the paper as well as its practical implications and discusses further avenues of future research, which could potentially improve the understanding of the relationship between human development and income inequality.

6.1 Research Aims

The principle aim of this paper was to explore the relationship between income inequality and human development, a relationship that has been, to this point, relatively neglected in the empirical literature. The empirical approach of this paper rested mainly on two estimation methods – the within estimator fixed effects and pooled OLS models. The results of the fixed effects models did not reveal any statistically significant within country relationship between income inequality and human development outcomes. However, the reliability of the results was influenced by the selection bias present in the sample population skewed toward high income and more developed countries, and the relatively short and unbalanced time series aspect of the panel. In an attempt to exploit the highly cross-sectional features of the available data, pooled OLS models controlling for time effects were employed. The OLS models suggest a negative, and both statistically and economically significant relationship between human development outcomes and income inequality. In the baseline specification, income inequality entered the equations as a statistically significant predictor in the case of life expectancy at birth, average daily caloric intake, and human rights protection scores. Income inequality further becomes a statistically significant factor of human development outcomes (with the exception of political regime characteristics) when treating average per capita income as a categorical, instead of continuous, variable. Interacting the inequality measure with the income group dummy variables then reveals the partial slopes of the relationship, indicating that income inequality has a negative and statistically significant relationship with life expectancy and daily caloric intake in developed countries; further, income inequality appears to have a negative and statistically significant relationship with development outcomes across the board in the rest of the income groups, hinting at a pattern where greater inequality at lower incomes is associated with greater penalties to human development outcomes. An F-test was used to confirm that the estimated parameters of the interaction terms are not identical.

The measure of inequality used in the main analysis was the Gini coefficient. Due to its shortcomings and the number of critiques raised against it, the analysis was replicated using several alternative measures of income inequality. However, due to the constraints imposed by data availability, the alternative inequality measures used in the sensitivity checks are only

based on decile income ratios and offer a considerably lower amount of observations. Nonetheless, the results appear to be fairly consistent and robust to used inequality measure. The results are further consistent when adjusting the lag structure of the model and the frequency of the data.

6.2 Implications & Further Research

This paper has contributed to the broad body of literature concerned with income inequality in the context of development economics by exploring its effects going beyond those on economic growth. The main implication of the analysis presented above is the apparent importance of income inequality in the process of human development. Beyond its normative implications, income inequality appears to be associated with significant deterioration of human development outcomes. The results of the analysis suggest that, all other things remaining unchanged, the benefits in terms of human development associated with increases of average per capita income can be more than offset by the negative effects on human development outcomes associated with the increase of income inequality. This observation expands on the concept of ruthless growth presented in the Human Development Report (UNDP, 1996) by demonstrating that the negative effects of an uneven distribution of the fruits of economic growth operate not only through absolute but also through relative material deprivation. The results further suggest a potential synergy between promoting the reduction of income inequalities and achieving other development goals.

The analysis presented in this paper opens up new lines of inquiry which, if addressed in future research, could improve the understanding of the relationship between inequalities and human development, as well as and clarify potential policy implications. First of all, this paper has focused solely on the issue of inequality of income. However, other types of economic inequality, such as the inequality of wealth in high income countries, or access to land in developing regions, have been discussed extensively in regard to economic growth and might have a significant relationship with the process of human development. Furthermore, incorporating measures of intergenerational income elasticities to control for the possibility of vertical social mobility might provide additional insights into the effects of income inequality and its interplay with inequality of opportunity. Last but not least, this paper has not explicitly dealt with the transmission channels through which the observed association between income inequality and development outcomes operates. A case study focused on a single country using micro level data, combined with a qualitative exploration of institutional and other factors shaping its economic and social environment, could possibly shed more light on the matter. The micro level analysis would further enable the researcher to consider the spatial elements of both inequalities and development, further enhancing our understanding of the dynamics of the relationship.

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Appendix A

Descriptive statistics – unrestricted sample

Table 18 Outcome variables

		Mean	Std. Dev.	Min	Max	Observations
Life expectancy	Overall	62.86199	11.79749	14.49	83.404	2412
	Between		9.922978	39.21708	77.27142	201
	Within		6.415953	29.18149	83.48441	12
Calories	Overall	2603.198	511.4515	1435	3845	1780
	Between		456.7922	1782.182	3744.25	179
	Within		240.2004	1619.198	3434.835	9.94413
Years of edu.	Overall	6.072278	3.275349	.0424764	13.24463	1221
	Between		2.770397	.9067234	12.02268	111
	Within		1.765142	1.341772	10.35819	11
F enrollment	Overall	45.22941	32.11965	0	100	1221
	Between		24.98812	3.374246	94.17162	111
	Within		20.30724	-12.99559	121.2728	11
Human rights	Overall	.0861998	1.582268	-3.71084	5.13997	2045
	Between		1.48191	-2.683831	4.748697	200
	Within		.7358969	-2.736766	2.759131	10.225
Polity	Overall	.9393246	7.414096	-10	10	1747
	Between		6.10067	-10	10	177
	Within		4.36992	-13.56068	14.02266	9.87006

Table 19 Control variables

		Mean	Std. Dev.	Min	Max	Observatios
Gini (t-2)	Overall	38.14921	9.037034	17.6	66.4	823
	Between		8.651624	21.84	66.13333	176
	Within		1.597144	29.72421	47.66921	4.67614
ln GDP (t-2)	Overall	8.704383	1.224309	5.241423	12.38262	1571
	Between		1.145864	6.01468	11.8914	182
	Within		.3836076	7.157687	10.75728	8.63187
Gov. cons. (t-1)	Overall	.1943228	.1107766	-.3614419	1.121566	1753
	Between		.0847494	.0147958	.5405305	182
	Within		.0753198	-.3879221	1.052504	9.63187
Investment (t-1)	Overall	.2177317	.1291099	-.4396453	1.999953	1753
	Between		.0994848	.0588798	.5984184	182
	Within		.082681	-.3987084	1.73557	9.63187
ln Openness (t-1)	Overall	-1.076409	1.048334	-11.08312	2.313573	1752
	Between		.866468	-3.436008	1.210468	182
	Within		.5978211	-9.420818	1.448975	9.62637
ln Inflation (t-1)	Overall	2.90107	.6613199	1.548334	9.372429	1359
	Between		.4100217	1.808362	5.099725	186
	Within		.555719	.9392143	8.744819	7.30645
Urb. pop.	Overall	49.44891	25.82566	2.077	100	2353
	Between		24.40816	5.640546	100	215
	Within		8.482618	10.11673	81.651	10.9442

Appendix B

Fixed effects models

The use of fixed effects models in this paper was motivated by their use in Castells-Quintana, Royuela and Thiel (2019). However, Hausman test was performed on each model to determine the best strategy to analyze the sample panel data. The results (Table 20) clearly indicate that random effects models would not provide consistent and reliable estimates in case of the sampled data.

Table 20 Hausman test results

	Life expectancy	Calories	Years of edu.	F enrollment	Human rights	Polity
Chi	117.33	32.60	54.08	185.14	90.26	28.35
p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002

Furthermore, the models were tested for constant variance of residuals using a modified Wald test. The results (Table 21) show that the null hypothesis of homoskedasticity (constant variance) was rejected in favor of the alternative, that is, heteroskedastic residuals. Robust standard errors clustered on country are applied to compensate for heteroskedasticity.

Table 21 Wald test results

	Life expectancy	Calories	Years of edu.	F enrollment	Human rights	Polity
Chi	1.4e+32	8.3e+30	1.4e+30	1.5e+33	2.3e+31	6.0e+32
p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix C

Between estimator models

The baseline models (Table 22) reveal statistically significant negative relationships between income inequality and life expectancy, caloric supply and the human rights scores. Conversely, there appears to be no statistically significant association between income inequality and the educational variables and the polity score. Logged GDP per capita appears to have a statistically significant positive relationship with the development outcomes except the human rights scores and polity. The models, with the exception of polity in column 6, have relatively good model fit.

Table 22 BE models

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Inequality (t-2)	-0.220***	-17.045***	-0.018	-0.223	-0.029***	-0.031
	(-3.21)	(-5.30)	(-0.73)	(-0.97)	(-3.11)	(-0.39)
ln GDP (t-2)	4.693***	198.327***	1.377***	13.551***	0.266	1.301
	(5.93)	(5.26)	(3.60)	(4.71)	(1.63)	(1.28)
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
Avg. periods	4.608	4.653	4.811	4.811	4.566	4.738
R2 - Within	0.367	0.149	0.172	0.132	0.109	0.082
R2 - Between	0.712	0.645	0.741	0.805	0.541	0.175
R2 - Overall	0.685	0.643	0.641	0.623	0.510	0.207

Note: T-statistic in parentheses. Bootstrapped standard errors. Models are further controlled for government consumption, investment, inflation, economic openness and urban popoulation. *p < 0.1 **p < 0.05 ***p < 0.01

Categorizing the countries by level of income (Table 23) overall increases the model fit and further corroborates relationship between the average per capita income and development outcome, where decreasing income is associated with increasing penalties born by countries with lower economic performance. However, the income group dummies might be subject to omitted variable bias inflating the estimated coefficients based on unobserved characteristics common to the groups.

Interacting the income group dummies with the inequality measure (Table 24) further hints at the difference of the relationship of income inequality and the development outcomes. Within the group of high income countries, the relationship only appears to be statistically significant for life expectancy and caloric supply, while the rest of the outcome variable does not show any statistically significant response. On the other hand, country groups exhibiting lower economic performance also appear to experience an intensifying negative association between development outcomes and income inequality. To confirm whether the estimates are truly statistically different from each other, a chi-square test is performed. The results (Table 25) confirm that the estimated coefficients of the interaction terms are statistically different from each other, except from the human rights scores.

Table 23 BE models - income level groups

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Inequality (t-2)	-0.315***	-20.196***	-0.034	-0.458**	-0.011	0.048
	(-4.32)	(-6.25)	(-1.35)	(-2.04)	(-1.14)	(0.69)
High income	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Upper middle income	-0.008	-61.018	-1.050**	-5.835	-1.045***	-4.247***
	(-0.01)	(-0.69)	(-2.24)	(-1.12)	(-4.05)	(-2.70)
Lower middle income	-6.526***	-278.710***	-2.560***	-19.975***	-1.113***	-6.826***
	(-4.00)	(-2.60)	(-3.74)	(-3.73)	(-3.97)	(-4.34)
Low income	-11.549***	-394.939***	-4.221***	-28.284***	-1.030**	-8.468***
	(-6.33)	(-3.13)	(-5.23)	(-3.85)	(-2.47)	(-3.96)
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
Avg. periods	4.608	4.653	4.811	4.811	4.566	4.738
R2 - Within	0.193	0.107	0.019	0.041	0.077	0.002
R2 - Between	0.742	0.628	0.777	0.800	0.579	0.270
R2 - Overall	0.706	0.608	0.646	0.600	0.561	0.255

Note: T-statistic in parentheses. Bootstrapped standard errors. Models are further controlled for government consumption, investment, inflation, economic openness and urban popoulation. *p < 0.1 **p < 0.05 ***p < 0.01

Table 24 BE models - income group interactions

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
Inequality (t-2)	-0.225***	-18.639***	-0.010	-0.294	-0.000	0.096
	(-2.78)	(-4.05)	(-0.37)	(-0.95)	(-0.03)	(1.01)
High income #	0.000	0.000	0.000	0.000	0.000	0.000
# Inequality (t-2)	(.)	(.)	(.)	(.)	(.)	(.)
Upper middle income #	-0.032	-1.219	-0.029**	-0.166	-0.023***	-0.085**
# Inequality (t-2)	(-0.92)	(-0.55)	(-2.25)	(-1.23)	(-3.42)	(-2.40)
Lower middle income #	-0.190***	-6.037***	-0.056***	-0.437***	-0.024**	-0.146***
# Inequality (t-2)	(-4.45)	(-2.66)	(-3.47)	(-2.78)	(-2.55)	(-3.44)
Low income #	-0.310***	-8.370***	-0.096***	-0.661***	-0.020*	-0.181***
# Inequality (t-2)	(-6.03)	(-3.06)	(-4.28)	(-3.26)	(-1.78)	(-4.06)
Observations	705	684	433	433	694	668
Countries	153	147	90	90	152	141
Avg. periods	4.608	4.653	4.811	4.811	4.566	4.738
R2 - Within	0.181	0.153	0.019	0.039	0.082	0.022
R2 - Between	0.757	0.621	0.763	0.793	0.563	0.236
R2 - Overall	0.721	0.609	0.630	0.591	0.543	0.232

Note: T-statistic in parentheses. Bootstrapped standard errors. Models are further controlled for government consumption, investment, inflation, economic openness and urban popoulation. *p < 0.1 **p < 0.05 ***p < 0.01

Table 25 BE interaction terms chi-square test

	(1)	(2)	(3)	(4)	(5)	(6)
	Life expectancy	Caloric supply	Years of edu.	F enrollment	Human Rights	Polity
chi2	93.67	19.91	10.97	14.78	0.34	8.79
Prob > chi2	0.0000	0.0000	0.0041	0.0006	0.8422	0.0123

Appendix D

OLS models diagnostics

The OLS models were tested for assumptions violations. Jarque-Bera test was used to check the distribution of residuals. Breusch-Pagan and White's test were used to inspect variance of residuals. The results (Table 26, Table 27, and Table 28) show that the models tend to violate the assumptions of BLUE. In the majority of cases, the residuals are not distributed normally. Furthermore, the variance of the residuals is not constant, indicating further trends uncaptured by the linear relationship imposed by the models exist. Robust standard errors clustered on country are used to compensate for the heteroskedasticity present in the models.

Table 26 Residuals tests - baseline OLS

	Life expectancy		Calories		Years of edu.		F enrollment		Human rights		Polity	
	chi	p	chi	p	chi	p	chi	p	chi	p	chi	p
Jarque-Bera	325.4	2.2e-71	1.816	.4033	1.816	.1104	20.07	4.4e-05	5.796	.0551	190.8	3.6e-42
Breusch-Pagan	134.11	0.0000	1.13	0.2870	12.94	0.0003	22.54	0.0000	0.12	0.7256	5.94	0.0148
White	256.34	0.0000	117.21	0.1290	184.54	0.0000	183.53	0.0000	176.17	0.0000	186.50	0.0000

Table 27 Residuals tests – income group dummies

	Life expectancy		Calories		Years of edu.		F enrollment		Human rights		Polity	
	chi	p	chi	p	chi	p	chi	p	chi	p	chi	p
Jarque-Bera	347.9	2.9e-76	12.3	.0021	1.056	.5896	2.844	.2412	23.04	1.0e-05	154	3.6e-34
Breusch-Pagan	166.66	0.0000	0.00	0.9904	7.82	0.0052	29.43	0.0000	4.81	0.0283	36.21	0.0000
White	297.33	0.0000	171.26	0.0089	175.04	0.0004	179.69	0.0002	173.30	0.0056	278.19	0.0000

Table 28 Residuals tests - income group interactions

	Life expectancy		Calories		Years of edu.		F enrollment		Human rights		Polity	
	chi	p	chi	p	chi	p	chi	p	chi	p	chi	p
Jarque-Bera	418.4	1.4e-91	10.4	.0055	1.054	.5903	4.381	.1119	16.12	3.2e-04	169.8	1.4e-37
Breusch-Pagan	178.31	0.0000	0.00	0.9629	13.26	0.0003	26.37	0.0000	6.63	0.0101	19.10	0.0000
White	285.85	0.0000	174.76	0.0054	184.78	0.0001	173.29	0.0006	184.76	0.0009	283.95	0.0000

The models were further tested for multicollinearity using the variance inflation factor (VIF). The results (Table 29, Table 30, and Table 31) show relatively high score of mean VIF. The values are, however, driven by the year category, where multicollinearity can be expected, and should not bias the rest of the results.

Table 29 VIF - baseline OLS

	Life expectancy	Calories	Years of edu	F enrollment	Human rights	Polity
	VIF	VIF	VIF	VIF	VIF	VIF
Inequality (t-2)	1.48	1.51	1.77	1.77	1.47	1.51
ln GDP (t-2)	4.07	4.17	4.89	4.89	4.09	4.51
Gov cons (t-1)	1.18	1.17	1.14	1.14	1.17	1.20
Investment (t-1)	1.58	1.51	1.75	1.75	1.58	1.62
Openness (t-1)	2.21	2.17	2.14	2.14	2.26	2.23
Inflation (t-1)	1.50	1.51	1.46	1.46	1.51	1.50
Urb. pop. (t-1)	3.25	3.08	3.61	3.61	3.20	3.55
Year						
1975	7.90	7.91	7.37	7.37	13.81	13.80
1980	15.02	15.02	13.82	13.82	27.96	27.92
1985	19.14	18.68	17.32	17.32	36.13	36.06
1990	24.49	23.64	22.01	22.01	46.71	45.72
1995	31.69	30.45	27.42	27.42	60.98	59.93
2000	43.72	42.87	32.91	32.91	84.78	83.54
2005	51.18	49.94	35.69	35.69	99.37	95.99
2010	56.22	54.62	37.37	37.37	108.81	103.56
2015	61.63	59.46	.	.	120.02	112.00
Mean VIF	20.39	19.86	14.04	14.04	38.36	37.16

Table 30 VIF - income group dummies

	Life expectancy	Calories	Years of edu	F enrollment	Human rights	Polity
	VIF	VIF	VIF	VIF	VIF	VIF
Inequality (t-2)	1.78	1.79	2.16	2.16	1.77	1.82
Gov cons (t-1)	1.22	1.21	1.20	1.20	1.22	1.24
Investment (t-1)	1.60	1.53	1.84	1.84	1.60	1.64
Openness (t-1)	2.23	2.16	2.06	2.06	2.25	2.23
Inflation (t-1)	1.55	1.55	1.49	1.49	1.55	1.55
Urb. pop. (t-1)	2.70	2.58	2.78	2.78	2.62	2.92
Income						
Upper middle	2.54	2.51	2.57	2.57	2.47	2.62
Lower middle	3.07	3.10	3.26	3.26	3.02	3.39
Lower middle	3.16	3.13	2.16	2.16	3.12	3.54
Year						
1975	7.91	7.92	7.39	7.39	13.82	13.82
1980	15.02	15.01	13.83	13.83	27.96	27.92
1985	19.13	18.67	17.31	17.31	36.13	36.06
1990	24.48	23.60	21.98	21.98	46.69	45.70
1995	31.69	30.42	27.42	27.42	60.98	59.93
2000	43.77	42.89	32.99	32.99	84.84	83.61
2005	51.38	50.11	35.89	35.89	99.58	96.20
2010	56.53	54.89	37.67	37.67	109.12	103.88
2015	62.06	59.84	.	.	120.44	112.43
Mean VIF	18.43	17.94	12.59	12.59	34.40	33.36

Table 31 VIF - income group interactions

	Life expectancy	Calories	Years of edu	F enrollment	Human rights	Polity
	VIF	VIF	VIF	VIF	VIF	VIF
Inequality (t-2)	2.58	2.59	2.77	2.77	2.54	2.77
Gov cons (t-1)	1.21	1.20	1.17	1.17	1.20	1.23
Investment (t-1)	1.61	1.54	1.84	1.84	1.60	1.64
Openness (t-1)	2.16	2.07	1.98	1.98	2.17	2.15
Inflation (t-1)	1.54	1.55	1.49	1.49	1.55	1.54
Urb. pop. (t-1)	2.62	2.46	2.64	2.64	2.53	2.84
Income group # Inequality						
Upper middle #	3.24	3.19	3.00	3.00	3.14	3.46
Lower middle #	3.52	3.46	3.39	3.39	3.42	4.01
Low #	3.34	3.24	2.13	2.13	3.25	3.81
Year						
1975	7.91	7.92	7.40	7.40	13.83	13.83
1980	15.02	15.02	13.84	13.84	27.97	27.93
1985	19.14	18.68	17.32	17.32	36.15	36.07
1990	24.48	23.61	21.99	21.99	46.72	45.73
1995	31.70	30.43	27.43	27.43	61.01	59.97
2000	43.78	42.91	33.00	33.00	84.89	83.67
2005	51.37	50.11	35.88	35.88	99.64	96.27
2010	56.50	54.87	37.64	37.64	109.17	103.94
2015	62.00	59.80	.	.	120.48	112.49
Mean VIF	18.54	18.04	12.64	12.64	34.51	33.52