The Effect of Inequality on (Human) Development – Insights from a Panel Analysis of the Human Development Index

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Abstract

In this paper we connect two of the main and current lines of research in the development and economic growth literature: The analysis of the effect and transmission channels of inequality on economic growth and the discussion about the necessity for a broader development and prosperity measure. We estimate the effect of net income inequality on the Human Development Index and its components in a panel of 117 countries over the period of 1970 to 2010. In doing so, we find evidence for (1) a negative long-run effect and (2) different short-run impacts of inequality on the different dimensions of development: A positive short-run effect on economic development, but a negative one on education outcomes, hinting at particular transmission channels. In addition, we detect (3) that those effects can be even more pronounced with low levels of development, reconciling seemingly conflicting previous findings in the literature. Moreover, (4) we find some evidence suggesting that the impact of inequality on human development is negatively dependent on the prevailing level of inequality. Finally, we highlight and discuss some interesting directions for future and subsequent research based on our work.

JEL classification: O10, O15, O40, D63
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1 Introduction

The debate about the impact of inequality on economic growth has been in the center of a wide range of economic research for decades. At the same time, the development literature saw a growing discussion about the necessity for an alternative development measure that is based on a broader concept of prosperity and includes more dimensions of wellbeing. The Human Development Index (HDI) emerged as an alternative to pure income measures like GDP. Yet, little effort has been made to explicitly connect and merge these two lines of thought in order to study the effect of income inequality on alternative development measures in general or "human development" as defined by the Human Development Index in particular. This has been the case even though the foundation of the two issues can both be traced back to as far as Kuznets who in his famous Kuznets' curve established a hypothesis about the reverse effect, the one of economic growth on inequality (Kuznets 1955) - and in connection to his work on national accounting added that the welfare of a nation could not be inferred to from a measure of national income (Kuznets 1932). More recently, thorough studies look at the complexity of the impact of inequality on development in more detail and find evidence for the simultaneous existence of different transmission channels or different "types" of inequality. Some of the transmission channels we will see are clearly and directly connected to other dimensions of development like socio-political factors and education topics and only in turn and indirectly affect income. Likewise, the differentiation between *"structural inequality"* connected to institutional factors and equality of opportunities on the one side and *"market inequality"* linked to market forces and equality of outcomes on the other clearly point towards the differentiation between different aspects of development as well (WDR 2006; Easterly 2007). Still, the connection between inequality and an alternative measure capturing these different dimensions of development has not been made explicitly and empirically.

Consequently, this paper sets out to empirically study the effects of income inequality proxied by the net Gini coefficient on HDI and its components in a panel of 117 countries over the period from 1970 to 2010. We try to assess if our results are different from those obtained with pure income measures and strive to link them to the different types of inequality and/or the different theoretically or empirically established transmission channels through which inequality affects development. Moreover, we try to find out if this complex relationship is dependent on further factors and characteristics. In order to answer these questions we estimate different panel model specifications with various estimation techniques to differentiate between short- and long-run effects and find evidence for different effects and channels, as well as dependencies and structural (in)stabilities.

The remainder of this paper is organized as follows: Section 2 reviews and merges the literature on the two important relationships, inequality and economic development on the one side and economic and human development on the other. Section 3 presents the underlying database before Section 4 specifies the empirical model to be estimated. The main results are displayed and discussed in Section 5. Section 6 concludes.

2 Literature Review

1) The effects of inequality on economic growth

The investigation of the causal relationship between inequality and economic growth was brought to the focus of modern economic research by Simon Kuznets (1955) who found an inverted U-shape impact of per capita GDP on income inequality. Thus, this famous Kuznets' curve illustrates the hypothesis that economic development initially increases inequality for low levels of GDP, but eventually, that is to say for sufficiently larger values of GDP, the effect inverts so that further economic growth decreases inequality. Kaldor famously (1956, 1957) reversed the direction of causality and argued that unequal income distributions can be conducive to economic growth through a higher marginal propensity to save in the top income classes. The overproportional increase of the share of income that is saved enables the accumulation of higher investments in physical and human capital fostering economic growth.

The modern study of inequality and economic growth - and the two-way causal channels through which they affect each other - was born. However, the net result and general interpretation was still dominated by the belief that early development stages exhibit a trade-off between equity and economic development in which inequality can induce growth and would itself eventually be attenuated by increasing levels of GDP. Taken together with Solow's (1956) theory of convergence to the same growth paths this body of research was commonly invoked as a rationale for liberal development, trade and growth policies in subsequent years.

The next 60 years saw a wide range of theoretical and empirical studies about the impact of inequality on growth, its signs and magnitudes.[1] Despite gradual improvements in theoretical sophistication, country and year coverage as well as econometrical techniques, the results and evidence were all but unanimous, unambiguous and conclusive. One important deduction to take away from this controversy and its conflicting results is the insight that the effect of inequality on economic growth is highly complex and heterogeneous.[2] It might depend on several factors, including the extent, type and persistency of inequality, the (initial) level of development, other - potentially country-specific - characteristics and the time horizon of analysis. Interestingly, most of the studies that find empirical evidence for a positive overall impact of inequality on subsequent economic growth, like Forbes (2000) for example, rely on panel data and suggest a positive short-run effect. On the other hand, studies based on cross-country analysis and focusing on long-run effects tend to find a negative impact of inequality on economic performance (e.g. Alesina and Rodrik 1994; Persson and Tabellini 1994; and Easterly 2007).[3] Barro (2000) finds a growth effect that depends on a countries' income and is negative in poor countries, but positive in rich countries. Chen (2003) on the other hand presents evidence suggesting that the effect depends on the initial income distribution itself with the effect of inequality being positive when initial inequality is low and negative when it is high.

[1] See Ehrhart (2009) and Galor (2009) for thorough and comprehensive surveys.
[2] Neves and Silva (2013) review some of the empirical literature and try to explain the reasons behind conflicting results.
[3] See Benabou (1996) for a literature review of these empirical cross-section studies.

In the light of acknowledging the complexity and heterogeneity of the inequality-growth nexus, many studies have concentrated on investigating the different impact and transmission channels through which inequality affects economic growth. The theoretical literature has identified a wide range of different positive and negative channels that contribute to an overall effect. We go on to briefly summarize them:

The positive mechanisms circle around 1) the aforementioned higher *savings rate* (Kaldor 1956), 2) *imperfect capital markets* with *investment indivisibilities* (Aghion et al. 1999) in physical and human capital and 3) growth-enhancing *incentives* created by inequality, for example incentives for capital accumulation and innovations (Mirrlees 1971).

On the other side, the literature has identified various mechanisms through which inequality can have a negative and limiting effect on growth. 1) Inequality is typically associated with greater *socio-political instability* and risk of social conflict and unrest, implying uncertainty of property rights and reduction of investment (Alesina and Perotti 1996). 2) In an approach influenced by *political economy* higher redistributive pressure may lead to economic distortions and disincentives (Alesina and Rodrik 1994; Persson and Tabellini 1994), as well as unproductive waste of resources by lobbying against it (Acemoglu and Robinson 2008; Stiglitz 2009; Krugman 2012). 3) Inequality combined with *credit-market imperfections* and set-up costs reduce the possibilities of low income groups to invest in human capital, thus diminishing average human capital investment and long-run growth (Galor and Zeira 1993). Other authors point out 4) the importance of the *middle class* for aggregated demand and *market size* (Murphy et al. 1989; Todaro 1997) or 5) the link between inequality, higher *endogenous fertility* rates and reduced education and growth (Barro 2000; Ehrhart 2009).

For our analysis it is both interesting and important to note and argue that generally speaking the positive transmission channels appear to be associated with an economic effect in the narrower sense, that is to say they have a more direct and immediate impact on economic and national accounting outcomes like GDP or GNI, precisely via savings and investment. The negative mechanisms on the other hand, particularly 1), 2) and 5), are connected to an economic effect in a broader and more indirect sense. Inequality affects opportunities, education as well as health outcomes and thus the socio-political landscape which themselves have an impact on people's behavior that ultimately affects economic performance. Consequently, we could expect that the overall impact of inequality on GDP tends to be more positive than the impact on an alternative welfare measure like HDI that is based on a wider definition of prosperity and captures more dimensions of well-being and development.

In a related and comparable manner, some authors have differentiated between two distinct types of inequality and divided overall inequality into two components. The World Bank World Development Report 2006 distinguishes between *"equality of opportunities"* and *"equality of outcomes"* (WDR 2006) and Easterly (2007) denotes similar concepts as *"structural inequality"* and *"market inequality"*. The first component refers to inequality of individual possibilities due to social, political and institutional structures. It is expected to be harmful to growth and development and manifests itself in education and health outcomes in a first step and subsequent economic achievements in a second step. The latter inequality component however is associated with market forces and creates necessary incentives for investment, innovation and growth via unequal market outcomes and unequal economic success for different levels of skill and education.

Some studies have tried to empirically assess certain negative transmission channels individually and in a two step procedure. By initially analyzing the relationship between inequality and a variable chosen to proxy the mechanism under investigation, to then see the effect of this variable on growth in a second step.[4] However, comprehensive empirical studies and evidence about the (simultaneous) growth effects of different transmission channels or components of inequality are still relatively scarce. Castells-Quintana and Royuela (2014) incorporate the different mechanisms in a single empirical model and analyze them jointly in a cross-country framework. They instrument the various channels and use a system of recursive equations by means of a control function approach in order to assess their relevance and weights. In this way they find a simultaneous positive and negative effect of inequality on growth. The negative channels account for around 80% of the total effect, while the channels exact weights depend crucially on country circumstances.

2) Human Development: The Index, Criticism and Defense

The motivation and meaningfulness of investigating the impact of inequality on an alternative, broader welfare measure in general and HDI in particular has already been established above. It can be justified by the discussion about the multifarious transmission channels and different types of inequality. In the following section we will contribute to this argument and have a brief look at HDI and its development. We also look at the comparison to GDP and criticism the index has received.

Interestingly, the fundamental motivation underlying HDI can be traced back to Kuznets as well. While being one of the main originators of the system of national accounts and GDP, Kuznets added in an early report to the US congress that "the welfare of a nation can scarcely be inferred from a measure of national income" (Kuznets 1932). In the first Human Development Report (HDR) in 1990, 58 years later, the opening lines sound more elaborate, but still remarkably similar at the core: "People are the real wealth of a nation" *(UNDP 1990)*

> *"The basic purpose of development is to enlarge people's choices. […] People often value achievements that do not show up at all, or not immediately, in income or growth figures: greater access to knowledge, better nutrition and health services, more secure livelihoods, security against crime and physical violence, satisfying leisure hours, political and cultural freedoms and sense of participation in community activities. The objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives." (UNDP 1990)*

Of course, even in this view income remains an important factor and is crucial for achieving higher standards of living and more opportunities, but it is still more of a mean than an end in itself. These ideas are based on the work of Economists Mahbub ul Haq (1994) and Amartya Sen's (1985, 1993, 1999) so called *capability approach*. They resulted not only in the HDRs, but also in the creation of the Human Development Index (HDI) as an alternative measure of

[4] Seminal papers of this kind are Perotti (1996), Persson and Tabellini (1994) and Alesina and Perotti (1996).

well-being, prosperity and development. HDI is a multidimensional, composite index of three human development dimensions - health, knowledge and income. Since some changes were introduced in 2010, it is a geometric mean of life expectancy at birth, PPP-adjusted GNI per capita and an education index which in turn is measured by expected years of schooling for children and mean years of schooling for adults.[5] As the sub-indices are normalized between 0 and 1, so is the aggregated indicator which allows for standardized comparison and ranking of countries. The index has been published annually by the United Nations Development Programme (UNDP) in their Human Development Reports since 1990.

The emergence of human development measures can be seen as part of the extensive and still ongoing discussion and criticism of GDP as the main indicator for economic progress and development (Hicks and Streeten 1979; Kenny 2005; Stiglitz et al 2008; European Commission 2009). Sagar and Najam (1998) noted that HDI has become an important alternative to the traditional one-dimensional measures. In fact it became the most commonly used alternative to GDP. Despite this impact in policy and academic circles, the HDI has been subject to a considerable amount of criticism from its start.[6] Two commonly invoked aspects of criticism concentrate on the choice of sub-indicators and the computational methodology (e.g. Srinivasan 1994; Noorbakhsh 1998; Decancq and Lugo 2013). While not entirely resolved, some of this criticism has been met by improving the sub-indicators over the years and adjusting the functional form in 2010. As a third and main point of criticism many authors focused on claiming the redundancy of the index in comparison with GDP. McGillivray (1991), Cahill (2005) and Wolfers (2009) find high correlations of around 0.9 of HDI with GDP, GNP or GNI per capita, therefore suggesting that the latter are as good of a development and growth proxy as HDI, that the index does not contribute any additional information and is thus redundant. Other economists have tried to respond to this criticism and to defend HDI. For one thing, Rodriguez (2009) points out that these very high correlations are often based on the comparison of the rankings of countries according to the two measures, not on the actual values themselves. This tells only part of the story. Moreover, it is evident that the two measures show a substantial amount of connection and correlation, as firstly income is a part of HDI and secondly all the variables are interconnected and interdependent. Economic growth can promote human development via private incentives and consumption opportunities as well as higher tax revenue and public service expenditure (Ranis 2004; Suri et al. 2011). In the other direction, advances in human development foster growth as healthier and more educated individuals can contribute more to the economic performance of a country (Ranis et al. 2000). Yet initially, mere correlation does not imply causality and even after identifying the above structural dependence the two indicators are still by no means "the same thing". A more sophisticated correlation analysis confirms this contention. Dep (2015) finds that even the strong overall rank correlation can break down when analyzing particular years or different income groups of countries separately, especially for middle and high income nations. Other authors show that when analyzing changes or growth rates of the indicators instead of levels, the correlation significantly weakens. It can totally break down or even be negative when doing the same for the non-income components of HDI on the one and GDP on the other side. Thus, the

[5] See data part in Section 3 for the functional formulation of the Index (Hybrid HDI).
[6] See Klugman et al. (2011) for a summary and review of criticism. The last-mentioned Sagar and Najam (1998) study while acknowledging HDI's importance also criticizes the index.

implied argument is that the two indicators react dissimilarly to the same causes and are in fact substantially different (Rodriguez 2009; Gray Molina and Purser 2010; Klugman et al. 2011). To summarize, GDP and HDI are correlated, because as societies develop all three components usually advance and richer countries tend to be healthier and more educated as well. Yet, this connection does not translate one-to-one. Economic growth does not necessarily translate into human development and several dimensions can remain unchanged even if GDP is striving. Thus, development and economic growth should not be seen as the same thing and HDI can bring more dimensions and insights to the development discussion.

The main purpose of the present work is to connect the two different lines of thought and research - the inequality-growth nexus on the one side, the discussion about alternative development measures on the other. We set out to empirically study the effect of inequality on a broader concept of human development as measured by HDI (and its components). This connection has not received much attention in the literature and no study, to the best of our knowledge, has explicitly and empirically studied this impact on human as opposed to "mere" economic development. In doing so we can assess previous findings about the channels through which inequality affects development and try to find evidence of our own.

3 Data

Our main dependent variable is human development as measured by HDI and its components. Since we are interested in analyzing long-term historical trends we rely on the Hybrid HDI. This index takes into account past changes in the HDI calculation and has been introduced and published by the UNDP in the Human Development Report 2010 (UNDP 2010) to ensure comparable data and allow for a systematic assessment of trends in human development over time. The Hybrid HDI applies the same aggregation formula as the new HDI to the set of previous indicators - literacy and gross enrollment for the education index and GDP per capita as the income variable. This does not only allow for greater country and year coverage, but is also more suitable to understand past progress (Gidwitz et al. 2010). The Hybrid HDI is available from 1970 to 2010 and is covering 135 countries that account for 92% of the world's population. It is computed as follows:

$$Hybrid\ HDI = \sqrt[3]{Lifex * EDUx * GDPx}$$

where:

$$Lifex = \frac{Life - 20}{83.166(Japan, 2010) - 20}$$

$$GDPx = \frac{\ln(GDP - \ln(163.28143(Liberia, 1995)}{\ln\big(106769.74(UAE, 1977)\big) - \ln(163.28143(Liberia, 1995))}$$

$$EDUx = \sqrt[2]{Litx * GERx}$$

and:

$$Litx = \frac{(Lit - 0)}{99(several\ countries, several\ years) - 0}$$

$$GERx = \frac{GER - 0}{115.8192(Australia, 2002) - 0}$$

where *Lit* is the literacy rate, *GER* the combined gross enrolment rate, *Life* the Life expectancy at birth, and *GDP* the Gross Domestic Product per capita, PPP adjusted and measured in dollars.

For our main explanatory variable of interest, the inequality measure, we build on Gini coefficients in Frederick Solt's Standardized World Income Inequality Database (SWIID) (Solt 2014).[7] In this database Solt standardizes the United Nations University's World Income Inequality Database (WIID) and data from other secondary sources with a custom missing-data imputation algorithm. The algorithms tries to take into account as much inequality information as possible. Data collected by the Luxembourg Income Study (LIS) serves as the benchmark and standard. The goal of SWIID is to maximize comparability of income inequality data while maintaining the widest possible coverage across countries and years. The database provides comparable Gini indices of gross and net income inequality for 174 countries from 1960 to 2013 along with estimates of the uncertainty of these values. The SWIID data are given as 100 imputations per observation and variable that reflect the mean value and uncertainty for each country-year-Gini triple. In this paper we rely on the net Gini coefficients that reflect net (that is post-tax, post-transfer) income inequality, because the benchmark is taken directly from the LIS key figures, many of our transmission channels are based on disposable income, and Solt generally recommends using the net inequality series (Solt 2014).[8]

Other researchers like Milanovic (2013) and Jenkins (2015) criticized earlier versions of SWIID and its imputation procedure, especially for single country investigations and data-poor regions. The acknowledge that their doubts are less grave in research interested in international cross-country trends. Solt (2015) defends that part of the criticism has become irrelevant with the latest version of his database while other parts are based on misunderstanding either his database or acknowledged advice for cross-national inequality research. He shows that the current SWIID version does not only provide the broadest coverage, but also performs better in terms of comparability than other available sources. In other words, it does better in predicting the LIS values, recognized in the field as the gold standard (Solt 2014). We rely on Solt's SWIID, because our study is interested in an analysis of global cross-country trends and a broad data coverage. At the same time, we keep in mind its limitations, treat the Gini values as variables measured with uncertainty or error and adjust estimation methods accordingly. Specifically, we use estimation methods that are designed to deal with estimations on multiply imputed (MI) data.

[7] The main econometric approach in estimating the inequality impact on development has been to introduce a single inequality measure into a growth equation. The most used and available measure is the Gini Coefficient. Other authors also employ the Theil index or shares or ratios of percentiles along the income distribution.

[8] The argument behind this recommendation is that market inequality cannot be seen as pre-government, but is influenced and biased by market-conditioning policies and policy feedback.

For the control variables we follow the literature of the determinants of cross-country differences in economic growth and development as well as the few studies incorporating HDI explicitly. For the most part they rely on the same or similar controls.[9] The data on these variables are taken either from the Penn World Tables (Heston et al. 2012) or the World Bank's World Development Indicators (World Bank 2016). Table A.1 in the Appendix comprises all our variables, their definition, the source from which the data is collected and information about the available country and year coverage. Here, we take a brief look at the control determinants and hint at seminal papers that established the respective theoretical or empirical link to growth and development.

Investment (% of GDP). A known traditional argument is that countries with higher total investment relative to their GDP tend to grow and develop faster than countries with a lower investment share (e.g. Harrod (1939), Domar (1946), Rostow (1959)).

Government Consumption (% of GDP) can be seen as reflecting aspects of fiscal policy and the need to support the domestic market. Grier and Tullock (1989) found a negative effect of the growth of government consumption on GDP growth.

Openness. The share of exports plus imports relative to GDP provides a measure of how open to international trade and connected with the global economy a particular country is. Many authors and institutions argue that trade openness together with exploiting comparative advantages are important factors fostering development.

Inflation. According to Stockman (1981) "cash-in-advance" economies with higher (anticipated) inflation rates experience reduced economic activity and development.

Urbanization. On the whole, theory and empirical evidence tend to suggest a positive effect of agglomeration on growth and development. However, this is not undisputed or unconditional, but likely to depend on several factors. Castells-Quintana and Royuela (2014) show that Agglomeration can be growth enhancing, especially in early development stages with modest inequality, but that this effect can reverse in high-income economies with high inequality. We consider *UrbanPop*, the percentage of the population that lives in urban agglomerations.

Descriptive Statistics[10]:

Figure 1 depicts the first part of descriptive analysis, while at the same time motivating the use of HDI by addressing the issue of redundancy – the question whether HDI and GDP measure the "same thing". The first panel shows a strong correlation between HDI and the income index frequently pointed out by critics of HDI. Panel B plots the income index against the "Social HDI", the geometric mean of the education and health indices. It displays that the relationship begins to weaken while still being strong. We see substantial variation and the correlation weakens even more in panel C, when plotting the absolute difference between 2010 and 1970 of the income index and HDI respectively. When doing the same for the change in the income index and Social HDI in the last panel, the positive relationship totally

[9] See Barro (1991) and Sala-i-Martin et al. (2004) for seminal papers cross-section papers on the determinants of economic growth.

[10] As in our empirical model we will define the time dimension t as five-year intervals in between 1970 and 2010, we perform our descriptive analysis on the same data selection. The decision and reasons will be discussed with our empirical model in section 4.

breaks down and even turns negative. While we do not argue that the relationship between GDP growth and the change of the non-income development dimension is inherently negative, these correlation results support the stance that HDI and GDP are actually distinct and might react to different causes or differently to the same causes.

The descriptive statistics for all the variables used in the present study are summarized in Table 1. We can see that while most of the variation of both HDI and the Gini Index are ob-

Table 1. Descriptive Statistics

	Mean	**Standard deviation**			**Max**	**Min**
		Overall	Between	Within		
HDI	0.61	0.19	0.18	0.05	0.94	0.12
Gini	36.52	9.31	8.59	3.49	62.28	17.65
GovConsumption	10.08	7.03	6.21	2.98	56.80	0.83
Investment	22.44	10.04	7.87	6.13	66.77	1.30
Openness	68.04	46.22	38.76	24.76	398.18	3.95
Inflation	50.17	495.16	155.58	466.34	12,338.66	-17.02
UrbanPop	50.75	23.85	23.11	6.17	100	2.85

served between countries, there is also some variation within countries over time.

Figure 2 graphs the correlation between HDI and the Gini Coefficient and displays the overall, within and between variation. The overall correlation between HDI and the Gini inequality measure is negative. Interestingly, there is a slightly positive correlation within countries over time, but the correlation between countries is negative and larger in terms of absolute value. While this mere correlation does not allow for any causal inference, this fact could be seen as in line with the reviewed empirical literature were we observed that time-series and fixed effects models tend to suggest a positive (short-run) effect of inequality on development whereas cross-country studies seem to find a negative (long-term) impact.

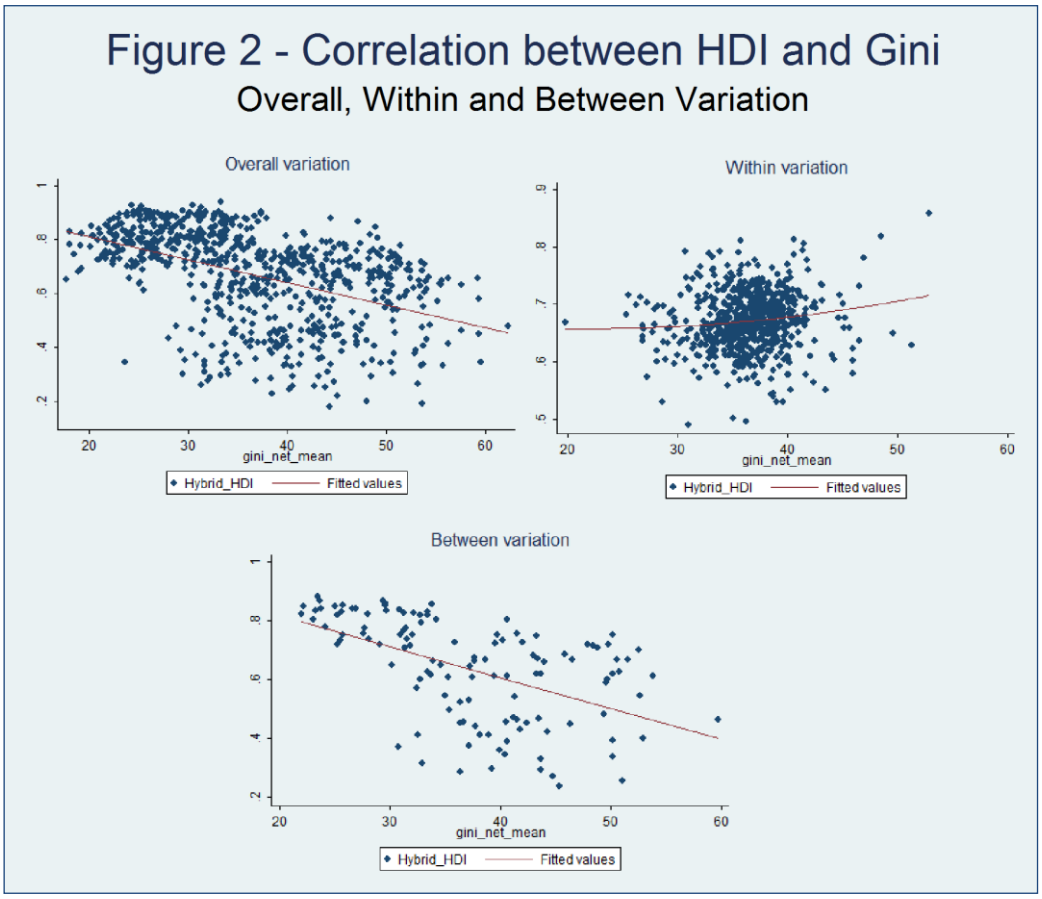

Table 2. Correlation between Gini coefficient and HDI

	Time fixed effects	
	No	Yes
Country fixed effects		
No	**-0.4704**	**-0.4748**
Yes	**0.1145**	**-0.0904**

Table 2 presents this same relationship between our key variables in quantitative results for the correlation coefficient and in more detail. It can be seen that there is a fairly strong nega-

tive correlation of -0.47 in the raw data (overall variation) that depends on average country performance. When we apply the fixed effects dimensions country and time separately, we observe that the overall correlation does not change with respect to the raw data when controlling for time effects only (-0.47). However, it does change drastically and even is slightly positive when controlling for country, but not time effects (0.11). When we add time fixed effects again to control for both, the correlation turns negative again (-0.09). The above resembles what we have seen in Figure 2.

Table 3 shows the correlation of the raw data (overall variation) for all our variables and table 4 does the same after controlling for country *and* time effects. It can be observed that especially the correlations with high absolute values, e.g. between HDI and Urban Population, substantially decrease when looking at changes over time by controlling for country effects (or looking at growth rates).

Table 3. Correlation Raw Data (Overall Variation)

	HDI	**Gini**	**GovCons**	**Investment**	**Openness**	**Inflation**	**UrbanPop**
HDI	1						
Gini	-0.4744	1					
GovCons	-0.3815	0.1309	1				
Investment	0.2485	-0.0627	-0.0980	1			
Openness	0.1998	-0.0397	0.0102	0.1890	1		
Inflation	-0.0260	0.1099	-0.0066	-0.0701	-0.0619	1	
UrbanPop	0.8349	-0.3686	-0.3664	0.1743	0.1412	0.0112	1

Table 4. Correlation Country and Time Effects Controlled Data

	HDI	**Gini**	**GovCons**	**Investment**	**Openness**	**Inflation**	**UrbanPop**
HDI	1						
Gini	-0.0904	1					
GovCons	0.0335	-0.0499	1				
Investment	0.2081	-0.0075	-0.0777	1			
Openness	0.0491	0.0840	0.0189	0.1441	1		
Inflation	-0.0386	0.1044	0.0148	-0.0144	-0.0050	1	
UrbanPop	0.3568	-0.0398	0.0914	0.0075	-0.0381	-0.0339	1

4 Empirical Model

In our descriptive analysis above we revealed a negative overall bivariate correlation between inequality as measured by the Gini coefficient and human development measured by HDI. In order to get closer to the answer of the question whether this will hold as a causal relationship, we next specify an empirical model with the aim to assess the relationship once considering the other determinants of development established by the theoretical and empirical literature. We generally follow the literature on determinants of development and growth that tends to regress (accumulated) growth rates on initial values of explanatory variables (Sala-i-Martin et al. 2004). Here, we rely on Easterly's (2007) argument and we assume that the current value of a development variable is the result of consecutive and accumulated years of growth. Thus, we look at the level of HDI rather than its growth rate. The same is done by most of the few papers investigating the causes of HDI. It makes particular sense when working with Hybrid HDI as its sub-indices are defined relative to the highest values over time and countries in each of the categories and thus there is a computational limit to growth.

We define our time dimension t in five-year intervals from 1970 to 2010 so that we end up with nine points in time (1970, 1975, …, 2005, 2010). This is commonly done because most of our variables tend to be quite persistent or at least slow changing. That way we can increase the within country variation to exploit. All our explanatory variables are lagged in order to reduce the risk of joint determination and simultaneity. The Gini variable, as our main explanatory variable of interest and one where the endogeneity concern might be fairly large, is lagged by two periods.[11] Consequently and taken all the above into account, we end up with the following empirical model that defines the level of HDI (or its components) as a function of the net Gini coefficient and controls:

$$HDI_{i,t} = \alpha + \beta_1 Gini_{i,t-2} + \beta_2 GovConsumption_{i,t-1} + \beta_3 Investment_{i,t-1} + \beta_1 Openness_{i,t-1} + \beta_1 Inflation_{i,t-1} + \beta_1 UrbanPop_{i,t-1} + u_{i,t}$$

5 Results and Discussion

As a starting point, we estimate our main underlying model specified above using five different procedures, while always taking into account the multiple imputation nature (MI) and thus uncertainty of our inequality data and clustering the robust standard errors by countries. The results are presented in Table 5. Columns 1 and 2 show the pooled OLS estimates with and without year dummies to account for time fixed effects. Column 3 displays the (country) fixed effects or within estimates and column 4 the between estimates. The random effects results are presented in column 5. Our controls exhibit the expected signs with investment and ag-

[11] (As we will see) all of these decisions are results of a trade-off decision: Extending the defined length of the time intervals of analysis (here five years) increases the within variation, but decreases the number of periods that can be exploited. Lagging explanatory variables can help to deal with joint, determination and simultaneity, but it also limits the time-series dimension for which the model can be estimated.

glomeration showing a positive and significant impact on human development, while government consumption seems to have a negative effect. Inflation and trade openness report coefficients that are generally not statistically significant.

Table 5. Basic model (MI estimation). Hybrid Human Development Index**.**

	(1)	(2)	(3)	(4)	(5)
HDI_t	OLS-1	OLS-2	FE	BE	RE
$Gini_{t-2}$	-0.00359***	-0.00383***	0.000715	-0.00473***	7.22e-05
	(0.000387)	(0.000382)	(0.000514)	(0.000920)	(0.000463)
$GovConsumption_{t-1}$	-0.00320***	-0.00319***	-9.80e-05	-0.00508***	-0.00106
	(0.00123)	(0.00123)	(0.00124)	(0.00170)	(0.00114)
$Investment_{t-1}$	0.00210***	0.00254***	0.000665**	0.00462***	0.000940***
	(0.000578)	(0.000566)	(0.000264)	(0.00108)	(0.000283)
$Openness_{t-1}$	0.000162*	4.70e-05	-9.58e-05	0.000250	-6.48e-05
	(8.49e-05)	(8.99e-05)	(8.32e-05)	(0.000201)	(9.36e-05)
$Inflation_{t-1}$	-5.42e-06	-1.25e-06	-9.79e-07	3.75e-05	-5.40e-07
	(6.63e-06)	(6.11e-06)	(1.35e-06)	(5.01e-05)	(1.58e-06)
$UrbanPop_{t-1}$	0.00498***	0.00500***	0.00222***	0.00426***	0.00425***
	(0.000266)	(0.000261)	(0.000708)	(0.000429)	(0.000465)
Constant	0.509***	0.495***	0.463***	1.055***	0.369***
	(0.0357)	(0.0360)	(0.0542)	(0.184)	(0.0448)
Time Fixed Effects	NO	YES	YES	YES	YES
Country Fixed Effects	NO	NO	YES	NO	NO
Observations	489	489	489	489	489
Number of countries			117	117	117

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Hausman test between RE and FE: 117.97 (p-val = 0.0000) [no MI, no robust]

With respect to our main variable of interest, the Gini coefficient as a measure for inequality, we observe two similar negative and significant coefficients in our pooled OLS estimates (-0.00359 and -0.00383 respectively) and an even more negative and also highly statistically significant estimate of -0.00473 in the between regression. The parameter for the fixed effects estimate which controls for country and time specificities turns to be not statistically different from zero. The random effects estimate, which is a mix of the between and fixed effects estimates, does show a non-significant parameter as well. The Hausman test applied to the fixed and random effects estimations clearly rejects the null hypothesis of equal vectors of parameters and thus implies that the fixed effects procedure is preferable over the random effects estimation.[12] The test shows that the unobserved heterogeneity (/fixed effects) across clusters (/countries) is correlated with the explanatory variables and implies a potential endogeneity in the random effects estimation.

[12] The Hausman test only works when sparing the *MI* and clustering option. So we estimated the same models without them. In any case, the results are very close to the *MI* and robust procedures, and consequently we believe that the obtained Hausman test leads to a trustable rejection decision. The estimation results can be seen in Table A.2 in the Appendix.

If we assume a dynamic relationship between inequality and development like Partridge (2005)[13] and other authors, then we could interpret the between estimates as a negative long-run impact of inequality on human development, following Baltagi and Griffin (1984) and Pirotte (1999). For example, country A with a Gini coefficient 5 points lower than that of country B can expect a 0.024 points higher HDI (or 2.4 points if we also scale the HDI to 100 as the Gini coefficients). As HDI is a composite measure and the scale of the Gini coefficient can be hard to put into context, we also do this interpretation in standardized terms. The between estimation reports a standardized parameter of -0.23. Thus, if country A has a Gini coefficient one standard deviation lower than that of country B, we expect an HDI approximately 0.23 standard deviations higher. In a tangible example this means that, if the median country, which is Colombia,[14] would have experienced a decrease (increase) of the Gini coefficient in one standard deviation, it would have increased (decreased) its HDI ranking by about 13 (14) positions out of the 135 considered countries in the Hybrid HDI original dataset. As this impact seems to depend highly on average country performance and the interpretation would assume that we included all relevant country characteristics, one still has to be careful with the interpretation in terms of magnitude, even though we found evidence for a negative effect. The fixed effects estimates which control for country and time specificities would capture the shot-run impact of inequality on HDI under the above dynamic relationship assumption which is not statistically significant in our estimation.

To lay the foundation of the next steps of our analysis, it is important for us to clarify that the non-significance in this first FE estimate does not necessarily imply that there exists no effect of the Gini coefficient on all dimensions of human development. This is the case for a considerable number of reasons that we briefly present and list here in order to then come back to one by one in the course of discussing further results: 1) HDI is a composite measure, so inequality might have contrasting effects on different dimensions of human development that cancel each other out, or in other words sum up to an unclear overall effect. 2) In a similar way, the overall impact of inequality on HDI and its components could be a sum of distinct effects for different groups of countries, particularly with respect to their level of development, but also with respect to other possible country-group characteristics. 3) The relationship between inequality and human development might not be (purely) linear or in other words it might depend on the initial or overall level of inequality. 4) Even for the single submeasures and even if the above dependencies would not be relevant, the different positive and negative transmission channels through which inequality has an impact might sum up to a unclear and insignificant overall effect. This is connected to a discussion about the right cross-sectional, time-series or panel data model specification and estimation technique and gives rise to interesting directions for future research.

[13] Partridge (2005) criticizes the use of fixed effects methods in a more general manner, as inequality is highly persistent over time and thus the disadvantages of the FE model might outweigh its advantages under certain further conditions.
[14] Here we use the median country in 1990.

1) The effect of inequality on the components of HDI

HDI is a composite measure of development. Consequently, inequality could have different effects on different components of the index and dimensions of development. To check this, we estimate the preferred fixed effects model on the different components of HDI and present the results in Table 6. Indeed, we can observe that inequality has a significant positive impact on the logarithm of GDP (column 2). This positive fixed effects result of inequality on economic development has been shown in the literature by Li and Zou (1998) and Forbes (2000) among others.[15] The inequality effect on the literacy rate as a proxy for education outcomes on the other hand is negative and statistically significant, at least at 10% level (column 4). Thus firstly, we found evidence for a positive effect of inequality on economic outcomes and a negative effect on literacy rates. The latter is connected with the transmission channel linked to barriers in human capital formation. Both effects could happen simultaneously. Secondly, we saw that the aggregated HDI measuring human development reacts differently and less positive to inequality than the pure income measure. Consequently, as stressed above, HDI and its components are not redundant to GDP, but can add important insights to the development discussion.

Table 6. Fixed Effect Estimates (MI estimation). Components of HDI.

	(1)	(2)	(3)	(4)	(5)
HDI Component $_t$	HDI	lGDP	Life	Lit	GER
Gini $_{t-2}$	0.000715	0.00911**	0.0273	-0.144*	0.0584
	(0.000514)	(0.00399)	(0.0483)	(0.0761)	(0.0913)
GovConsumption $_{t-1}$	-9.80e-05	0.00105	-0.159*	0.102	0.102
	(0.00124)	(0.00852)	(0.0960)	(0.234)	(0.164)
Investment $_{t-1}$	0.000665**	0.00508**	0.0390*	-0.0606	0.153***
	(0.000264)	(0.00210)	(0.0214)	(0.0725)	(0.0524)
Openness $_{t-1}$	-9.58e-05	0.00111**	-0.0132	-0.0455**	-0.00823
	(8.32e-05)	(0.000549)	(0.00848)	(0.0221)	(0.0116)
Inflation $_{t-1}$	-9.79e-07	-1.06e-05	-0.000181	0.000614***	-0.000115
	(1.35e-06)	(1.53e-05)	(0.000111)	(0.000192)	(0.000268)
UrbanPop $_{t-1}$	0.00222***	0.0130*	0.166***	0.596***	-0.180
	(0.000708)	(0.00735)	(0.0517)	(0.173)	(0.131)
Constant	0.463***	7.350***	56.12***	56.28***	62.36***
	(0.0542)	(0.582)	(3.473)	(10.86)	(6.718)
Time Fixed Effects	YES	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES
Observations	489	489	489	489	489
Number of countries	117	117	117	117	117

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[15] Barro (2000), Chen (2003) and Voitchovsky (2005) also find a similar positive effect, but there it depends on further conditions.

2) Inequality and the role of the level of development

In order to investigate the inequality-development relationship for different levels of development, we incorporate a dummy variable for developed countries into our model and interact it with the Gini variable.[16] Column 1 of Table 7 displays the fixed effects estimates for the regression of HDI. The estimate for the Gini coefficient of developing countries (base category) now is positive and statistically significant at 10%-level. At first sight this result is in line with Galor and Moav (2004) who suggest that in early development stages, when physical capital accumulation is the prime engine of growth, inequality is growth enhancing via the higher propensity to save and credit market imperfections, but irrelevant for growth in developed countries,[17] and object Barro (2000). Barro highlights the link between higher inequality and higher fertility rates, which in turn reduce growth given that the average investment in education decreases. He finds that inequality is negatively correlated with growth in low-income countries, but positively in high-income countries, even when controlling for fertility rates.[18]

Table 7. Interaction with Development Dummy. Fixed Effect Estimates (MI estimation).

	(1)	(2)	(3)
HDI Component $_t$	HDI	lGDP	Lit
Gini $_{t-2}$	0.00105*	0.0128***	-0.155**
	(0.000585)	(0.00453)	(0.0774)
Gini $_{t-2}$*Developed	-0.00162*	-0.0178***	0.0547
	(0.000821)	(0.00569)	(0.197)
Controls	YES	YES	YES
Time Fixed Effects	YES	YES	YES
Country Fixed Effects	YES	YES	YES
Observations	489	489	489
Number of countries	117	117	117

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

However, if we take a closer look at the components of HDI individually, we can actually reconcile these two seemingly conflicting papers and standpoints. Column 2 presents a positive and significant fixed effect estimate of the impact of inequality on the logarithm of GDP for developing countries. The effect for developed countries is more negative and adds up to a negative impact which is not significantly different from zero. This results hints at the physical capital accumulation argument made by Galor and Moav for early development stages. By contrast, column 3 presents the respective estimates for the literacy rate and a negative and

[16] In accordance with the Human Development Reports we define as developed countries those classified as possessing a "very high human development", that means an HDI of above 0.8. The final list basically coincides with that of the UN. Notice that the level dummy is omitted in fixed effects estimations as our definition of development is based on 2010 values and hence does not change over time.
[17] For developed countries the two estimates sum to a small negative coefficient which is not significantly different from zero.
[18] In Barro (2000) the overall effect turns insignificant when controlling for fertility, but the development-dependent results hold.

significant effect of inequality on this education outcome. The aggregate impact for developed countries seems to be less negative.[19] This latter result is in line with Barro's findings of a negative effect of inequality on development in developing countries through higher fertility rates and thus lower investment in education. We performed such estimates on the other components of HDI as well, but there we found no evidence for the dependence on the level of development.

To summarize, we saw clear evidence for both: A negative effect of inequality on development via education or human capital accumulation hinting at the *endogenous fertility approach;* and a positive effect of inequality on development via physical capital accumulation hinting at the *higher aggregate savings*, both particularly for developing countries. Thus, our results reconcile Barro (2000) and Galor and Moav (2004).[20] With respect to overall HDI the physical capital accumulation argument seems to outweigh the fertility argument for developing countries, at least in the short-run.

3) Non-linearity or the role of the level of inequality

To answer the question whether the relationship between inequality and HDI might be non-linear in a way that it depends on the level of inequality predominant in the economy, we start by estimating a stripped-down fixed effects model. In this estimation we regress HDI on the Gini coefficient and its square without further controls (column 1).

Table 8. Interaction with Level of Inequality (FE and MI estimates).

HDI_t	(1) Squared – No controls	(2) Squared - Controls	(3) Interaction
$Gini_{t-2}$	0.0116***	0.00185	0.00125*
	(0.00277)	(0.00186)	(0.000741)
$Gini_{t-2}^2$	-0.000126***	-1.47e-05	
	(3.56e-05)	(2.19e-05)	
$Gini_{t-2}$*HIGH			-0.00121
			(0.000835)
Controls	NO	YES	YES
Time Fixed Effects	NO	YES	YES
Country Fixed Effects	YES	YES	YES
Observations	510	489	489
Number of countries	117	117	117

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[19] Although the interaction parameter is not statistically significant here, if we estimate the same regression for the subsample of developed countries the coefficient is close to 0 and insignificant.

[20] Interestingly both these transmission channels are linked to and reinforced by *capital market imperfection* likely to be observed in developing countries where investment indivisibilities lead to positive effects of inequality on physical capital investment, but negative effects on human capital investment/education.

The results show evidence of a quadratic correlation structure with a significantly positive parameter for the Gini index and a smaller, negative and significant parameter for its square. In such a way, if we assume a causal relationship, increasing inequality would have a positive effect on development for low levels of inequality, but this effect would turn negative for high levels of inequality (or other countries with a high level). Some authors like Chen (2003) find such a shifting impact that depends on the (initial) income distribution. When we include our controls and time fixed effects again (column 2) to get closer to such a causal interpretation however, the coefficient signs remain the same, but the estimates are much smaller and not significant any more. Next, we divide all our countries in two equally-sized groups, those with relatively low and those with relatively high levels of inequality, create a dummy variable for the second group and interact it with the Gini coefficient in a linear fixed effects model in order to allow for some structural instability in terms of the level of inequality (column 3). We find that the estimate for the low inequality group is positive and statistically significant at 10%-level. Although the interaction parameter for the high income countries is not significantly different, if we estimate the same regression for the countries with high inequality only, we detect a non-significant parameter close to zero.

Taken these results together, we conclude that we found some hints for a possible non-linearity of the impact of inequality on HDI or in other words for an effect that is dependent on the level of inequality itself. Increasing inequality might be more positive for countries with low levels of inequality compared to those with higher levels. However, this evidence is still not clear, definitive or unambiguous in our data and needs more research and robustness.

4) Discussion and future research

Even without the above dependencies and even for the single subindicators, we might have a situation in which the different impact channels sum up to an unclear overall result. This can particularly affect the fixed effects estimations. The main argument behind using them is that they allow controlling for omitted time-invariant factors. However, if the underlying causal determinants of the development process are persistent, the long-run cross-sectional impacts will be subsumed into the fixed effects, something that has been noted by Fallah and Partridge (2007). If in addition the key (omitted) time-invariant factors like the quality of institutions are those to which a negative effect of inequality is related, then the fixed effects estimate are upwards/positively biased at least when interested in longer-run development. Castells-Quintana and Royuela (2014) found some evidence for the above. In future and subsequent research it would be interesting for us to follow the cross-sectional strategy they use to asses economic growth and apply it to human development, HDI and its components: By instrumenting inequality with different instruments proxying the various transmission channels and using a system of recursive equations by means of a control function approach, we could gain further important insights about the simultaneous impact channels through which inequality affects human development and how this effect might be different compared to the one on economic growth. At the same time we could account for any potentially remaining endogeneity and would not need to lag the inequality variable. The instruments for example

would explicitly include a fertility measure, a variable that is reported as important in Barro (2000) and in the present work.

The full selection, discovery and retrieval of appropriate external instruments for inequality and its channels demand a lot of caution, can be difficult and for data availability reasons maybe even impossible for panel analyses with a considerable coverage of countries and years. Hence, there is another option to tackle the potential endogeneity problem with internal instruments while at the same time addressing an additional econometric concern, the dynamic panel model bias. This option is the Blundell and Bond "system" GMM estimator (1998). When the actual underlying model is dynamic and exhibits endogenous persistence, that is when the endogenous variable depends highly on a lagged endogenous variable as a regressor, fixed effects might suffer a bias when the number of periods is small as they are in our case.[21] In this case consistent estimations can be carried out using the Blundell and Bond estimator. This system GMM estimator uses internal instruments based on past values of the variable to instrument possibly endogenous regressors, first differences are instrumented with lagged levels and levels with lagged changes.

We tried to estimate such a dynamic model by system GMM, but encountered some substantial obstacles that demand further attention, work and sophistication outside the aim and scope of this paper. The first and main difficulty is connected to the multiple imputation nature of our data. The common statistical softwares generally only (fully) support a limited list of estimation techniques with imputed data. Even if estimations can be carried out, they are troublesome, demand further caution and have major limitations, especially with respect to post-estimation commands and tests. With the MI estimations we cannot perform the important Hansen/Sargan and autocorrelation tests that the Blundell and Bond estimator crucially depends on. These tests are possible with a simple regression on the mean of imputations, but that would violate the correct treatment of our inequality data. In addition, in the above cases parameters and standard errors were substantially different for some estimations we could carry out so that we are not confident enough to present reliable and robust results with their interpretations and implications. Moreover, also with respect to the required assumptions underlying our model, we would need to be cautious. The validity of the additional instruments in system GMM rely on the assumption that countries are not too far from their respective steady states so that changes in the instrumenting variables are not systematically related to the fixed effects. All in all and in the scope and aim of this paper we are not confident enough to present robust and reliable results for the dynamic estimations. Thus, we decided to concentrate on the above fixed effects estimations and results and leave the dynamic estimations as a next step for subsequent research outside the scope of this paper.

[21] As we said before, the small number of periods was the result of a trade-off decision with respect to our data. We could extend the number of periods by defining shorter time intervals, but then we would have even more persistent variables and loose within variation.

6 Conclusion

The purpose of this study was to create a starting point for the empirical analysis of the impact of inequality on a broader measure of development in general and human development as measured by the Human Development Index in particular. As relatively little has been done in this direction so far, we started by reviewing and connecting two fields of literature – one about the impact and different transmission channels of inequality on economic development and growth and the other about the necessity for a broader concept and measure of (human) development with the HDI as a main alternative to pure income measures. Although some of the impact channels clearly work through not purely economic variables, but are connected to other dimensions of development, prosperity and wellbeing, this connection has not been made explicitly and in an empirical model.

In our panel analysis we found evidence for a negative long-run effect of inequality on human development. At the same time our results suggest that the impact of inequality can be substantially different for the different dimensions of HDI and aspects of development. This emphasizes the complexity of the relationships between the income distribution and development and recommends the use of alternative development measures as HDI complementary to GDP. Using HDI we found evidence for the simultaneous existence of a positive impact on economic growth, but a negative effect on education outcomes. Connecting this to the stage of development, we were able to reconcile two seemingly conflicting theories. As both of these effects are particularly strong in developing countries, the total inequality impact on development in early development stages could be both positive or negative depending on which of the two effects dominates the other. For overall HDI the effect of inequality seems to be more positive for developing countries than for developed countries. Moreover, we also find some hints for a quadratic relationship or a dependence on the level of inequality. In that way increasing inequality could have a positive impact on development when inequality is low, but a negative impact when it is high already. All in all, HDI can give important and new insight about the transmission channels and impact mechanisms behind the effects of inequality. Looking at human development is not redundant to looking at GDP as it adds more relevant dimensions to the development discussion. Our results can have important implications for development policy and help policy makers understand how inequality is affecting the process of development and not just if or to what extent.

While in general the analysis of the effect of inequality on HDI (and alternative development measures) needs more research and robustness, we pointed out two different specific directions for future and subsequent research in the last part of our discussion. First, the implementation of a dynamic and endogenous panel model requires more work and sophistication. Second, it would be interesting to find instruments proxying the different transmission channels and estimate a cross-sectional model with a control function approach to find out even more about the multifarious effects of inequality on human development and compare them to the ones on economic growth.

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Appendix

Table A.1. Variable Description

Label	Description	Source	Coverage
Hybrid HDI	Hybrid HDI values, HDI=(Lifex*EDUx*GDPx)^(1/3)	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
HDI Rank	Hybrid HDI ranks	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
Life	Life Expectancy	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
Lifex	Health Index, Lifex=(Life-20)/83.17(Japan,2010)-20)	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
Lit	Adult Literacy Rate	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
Litx	Literacy Index, Litx=(Lit-0)/(99(several countries, several years)-0)	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
GER	Combined Gross Enrolment Rate	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
GERx	Combined Gross Enrolment Rate Index, GERx=(GER-0)/(115.82(Australia,2002)-0)	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
EDUx	Education Index, EDUx=(Litx*GERx)^(1/2)	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
GDP	GDP per capita, PPP$	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
GDPx	Income Index, GDPx=(ln(GDP)-ln(163.28(Liberia,1995))/(ln(106769.74(UAE, 1977))-ln(163.28))	United Nations Development Programme - Human Development Report 2010	1970 - 2010 for 135 countries, balanced
Gini	Net (post-tax, post-transfer) Income Inequality Gini Indices (100 imputations)	Standardized World Income Inequality Database (SWIID), Version 5.0, October 2014, Solt (2014).	1960 - 2013 for 174 countries, unbal.
GovConsumption	Government Consumption Share of PPP Converted GDP Per Capita at 2005 constant prices [rgdpl] (%)	Penn World Table 7.1, Nov 2012, Heston et al. (2012).	1950 - 2011 for 189 countries, unbal.
Investment	Investment Share of PPP Converted GDP Per Capita at 2005 constant prices [rgdpl] (%)	Penn World Table 7.1, Nov 2012, Heston et al. (2012).	1950 - 2011 for 189 countries, unbal.
Openness	Openness at 2005 at constant price (%)	Penn World Table 7.1, Nov 2012, Heston et al. (2012).	1950 - 2011 for 189 countries, unbal.
Inflation	Inflation, GDP deflator (annual %)	World Development Indicators, April 2016, World Bank (2016).	1960 - 2015 for 214 countries, unbal.
UrbanPop	Urban population (% of total)	World Development Indicators, April 2016, World Bank (2016).	1960 - 2015 for 214 countries, unbal.

Table A.2. FE and RE estimates for Hausman Test. (NoMI, noVCE).

	(1) **FE** (NoMI)	(2) **RE** (NoMI)	(3) **FE** (NoMI) (NoVCE)	(4) **RE** (NoMI) (NoVCE)
HDI_t				
$Gini_{t-2}$	0.000825	8.41e-05	0.000825	8.41e-05
	(0.000551)	(0.000483)	(0.000492)	(0.000314)
$GovConsumption_{t-1}$	-8.88e-05	-0.00106	-8.88e-05	-0.00106*
	(0.00123)	(0.00114)	(0.000534)	(0.000574)
$Investment_{t-1}$	0.000665**	0.000940***	0.000665***	0.000940***
	(0.000264)	(0.000282)	(0.000208)	(0.000231)
$Openness_{t-1}$	-9.58e-05	-6.48e-05	-9.58e-05**	-6.48e-05
	(8.26e-05)	(9.36e-05)	(4.82e-05)	(5.32e-05)
$Inflation_{t-1}$	-1.02e-06	-5.52e-07	-1.02e-06	-5.52e-07
	(1.32e-06)	(1.58e-06)	(3.01e-06)	(3.42e-06)
$UrbanPop_{t-1}$	0.00222***	0.00425***	0.00222***	0.00425***
	(0.000706)	(0.000467)	(0.000338)	(0.000264)
Constant	0.458***	0.369***	0.458***	0.369***
	(0.0555)	(0.0459)	(0.0226)	(0.0224)
Time Fixed Effects	YES	YES	YES	YES
Country Fixed Effects	YES	NO	YES	No
Observations	489	489	489	489
R-squared	0.838		0.838	
Number of countries	117	117	117	117

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Hausman test between RE and FE: 117.97 (p-val = 0.0000)