A CROSS-COUNTRY INVESTIGATION OF INEQUALITY AND GROWTH WITH THEIL INDEXES

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Abstract

A Cross-Country Investigation of Inequality and Growth With Theil Indexes

In our study, we investigate empirically any systematic relationship between income inequality and economic growth in both directions; the effects of growth or development on inequality (the Kuznets hypothesis) and the effects of inequality on subsequent growth. The study is carried out in a traditional cross-country estimation using recently updated data on several variables and Theil indexes as inequality measures. The relationship between inequality and growth are investigated in different samples for two periods; 1965-1985 and 1985-2005 peiods. Our findings do not support the Kuznets hypothesis; the inverted-U relationship between per capita income and inequality seems to be an artificial statistical fact as a consequence of the Latin American countries clustering in the middle, with high inequalities. But our estimation results show that poor countries are statistically more unequal than richer countries and that inequality tends to fall over the course of development. Our estimation results do not also show any statistically significant relationship between inequality and subsequent growth.

Keywords: income inequality, distribution, growth, development, Theil index, human capital, Kuznets hypothesis, Latin effect

Jel Classification: C500, E130, J240, O150, O470

Özet

Çalışmamızda gelir eşitsizliği ile ekonomik büyüme arasında herhangi bir sistematik ilişki olup olmadığını ampirik olarak araştırdık; ilişki, büyüme ya da gelişmenin eşitsizlik üzerine etkileri (Kuznets hipotezi) ve eşitsizliğin daha sonraki büyüme üzerine etkileri olarak iki yönlü olarak ele alınmıştır. Geleneksel ülkelerarası kesit tahmin yöntemi ile yürütülen çalışmamızda birçok değişken için yakın zamanda yenilenmiş veriler ve eşitsizlik ölçütleri için Theil endeksleri kullanılmıştır. Eşitsizlik ve büyüme arasındaki ilişki değişik örneklemlerle 1965-1985 ve 1985-2005 olmak üzere iki dönemde araştırılmıştır. Bulgularımız Kuznets hipotezini desteklememektedir. Kişi başına gelir ile eşitsizlik arasındaki ters-U şeklinde bir ilişki, yüksek eşitsizliklere sahip Latin Amerika ülkelerinin ortada kümelenmelerinden dolayı yapay istatistiksel

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bir olgu olarak gözükmektedir. Ancak tahmin sonuçlarımız fakir ülkelerin zenginlere göre istatistiksel olarak daha eşitsiz olduklarını ve gelişme süreci içinde eşitsizliğin düşme eğiliminde olduğunu göstermektedir. Tahmin sonuçlarımız ayrıca eşitsizlik ve sonraki büyüme arasında istatistiksel olarak anlamlı bir ilişki göstermemektedir.

Anahtar Kelimeler: gelir eşitsizliği, dağılım, büyüme, gelişme, Theil endeksi, beşeri sermaye, Kuznets hipotezi, Latin etkisi

Jel Sınıflaması: C500, E130, J240, O150, O470

1. INTRODUCTION

The relationship between income inequality and economic growth has long been a major concern for economists. In the 1950s there has been an upsurge in the theoretical interest especially after the works of Simon Kuznets (1955), who argued that in the development process of a country inequality would first rise and then fall, which is the well-known Kuznets 'inverted-U' hypothesis.

In the last two decades there is a growing body of studies in inequality and growth as more and more data has become available on different variables of a large group of countries. Much of these studies investigated empirically the existence of the Kuznets inverted-U curve and analysed the interconnections between inequality and subsequent growth. These have been undertaken in both directions, from inequality to growth and vice versa, with different aspects of development. These studies have reached different outcomes based on different methodologies, models and different data sets.

The aim of this paper is to investigate empirically any systematic relationship between income inequality and economic growth in both directions; the effects of growth or development on inequality (the Kuznets hypothesis) and the effects of inequality on subsequent growth. The study is carried out in a traditional cross-country ordinary least-square estimation using recently updated data on several variables and a much consistent data on income inequality, the Theil indexes, instead of Gini coefficients or percentile shares that most studies use.

The relationship between inequality and growth are investigated in different samples for two periods, covering the years between 1965-1985 and

1985-2005. As the later period is characterized with globalization, our choice of periods considers possible effects of globalization in these relationships.

The paper is organized as follows: In section 2, we first review the literature on how growth or development may affect income distribution, i.e. the Kuznets hypothesis, and then several channels proposed for the effects of inequality on subsequent growth, with empirical results of various related studies. Section 3 describes our data and considers our empirical framework and methodology. In section 4 we present our empirical findings and compare them with the results of other studies. Finally in the last section we provide some concluding remarks and consider areas of future research.

2. THEORETICAL BACKROUND

There have been several theoretical arguments in the literature for the relationship between inequality and growth, and this relationship has been investigated in both directions, from inequality to growth and vice versa.

i. Effects of Growth on Inequality

In his seminal 1955 contribution, Kuznets argued that the relationship between the level of per capita income and inequality in the distribution of income may take the form of an inverted U. According to Kuznets, as per capita income rises in the development process of a country, inequality may initially rise, reach a maximum at an intermediate income level and then decline: hence the name 'inverted-U' hypothesis. Until recently, this was considered a well established relation between growth and inequality. The hypothesis of Kuznets owed much to the observations about labor factor shift during development process from traditional agriculture to modern industry sector, a process that had been formally considered in the Lewis's labor-surplus growth model (Lewis 1954). Although Kuznets did not explicitly model the intersectoral shifts of populatiıon, his basic idea of an inverted-U relationship was built on these considerations about development process.[1]

[1] Kuznets' hypothesis was formally modeled later as a dualistic model by Robinson (1976) and elaborated by Anand and Kanbur (1993).

Kuznets proposed that income distribution was relatively more equal at low levels of income in the early stages of development. As almost all labor were employed in agricultural sector, there were unlimited supplies of labor in the form of disguised unemployment. The marginal contribution of labor was almost zero and a minumum subsistence wage prevailed among all people. If an economy starts with its entire population in agriculture (stage of more or less equal income distribution), a large part of that population can be removed to newly emerging modern industry without any reduction in agricultural output. Industry will have to pay that labor a wage a bit above the subsistence wage prevailing in agriculture to get it to move. Even if agriculture is completely stagnant, industry can grow without putting any demands on agricultural output. At this stage income growth takes place only in industry. After the development proceeded through industrialization, the distribution of income became more unequal as people moved across sectors. Kuznets observed that average per capita income of the rural population was lower than that of the urban, and inequality in percentage shares within the distribution of rural population was narrower than that of the urban population. Industrial pays (wages and returns to capital in industry) exceeded agricultural wages, then resulting in large inequality between incomes of these two sectors. Eventually, as industrialization proceeded, most of the labor were allocated in industry or the economy reached certain point where factor movement equalized returns across sectors; then the distribution of income, moving in reverse direction, became more equal again (Kuznets, 1955). This process was the economic mechanism underlying the hypothesis.

Another line of theoretical argument since classical economists has been that economic growth in market economies always leads to increased inequality; that is growth can not take place without a worsening of income distribution. It has been suggested that inequality is an unpleasant precondition for growth; more unequal income distribution would lead to higher growth through higher savings. In case that individual savings rates rise with the level of income, then a redistribution of resources from rich to poor would tend to lower the aggregate rate of savings, and would so reduce capital accumulation and growth. Higher savings propensities associated with more unequal income distribution were variously attributed to the effect of a rising profit share (Ray, 1998: 284-92). Keynes (1936) had earlier stressed the effect of distribution on aggregate

demand. Kaldor (1956) suggested that a redistribution to high-income households that have savings propensities greater than low-income households would increase aggregate savings, stimulating investments, and thereby growth.

As Banerjee and Duflo (2003) points out later, there are other explanations recently discussed for the relationship between growth and inequality. First, wealth and other income-generating assets are historically unevenly distributed and only the rich can save and invest, meaning that growth goes always to the initially rich. Second, as in Acemoglu (2002) technological progress and the rising importance of service sector increase the demand for skilled and educated labor, whose marginal product always exceeds that of unskilled labor. In this way inequality between skilled and unskilled pays will pertain. A third explanation takes attention to differences in borrowing capabilities. Only asset owners are elligible to put up collateral and thus have access to credit for investment (Baro, 2000).

Since Kuznets first expressed his observations on the relationship between inequality and growth, a large number of empirical studies has attempted to test the inverse U-hypothesis. There are mixed findings for the hypothesis in empirical studies. As our limited space does not permit to cite all of them, we will submit some examples in relation to the points we make.[2]

Generally, there are two ways to test this hypothesis. As the relationship in the hypothesis is formulated on intertemporal basis, time-series studies of individual countries will be more appropriate. To do this, one needs data on inequality of individual countries that go back centuries in the past. However, there are quite few countries with reliable time-series data long enough to perform such a study. (In the 1950s they were even more scarce.) Reliable data collection are new, and in most cases their consistency are questionable. Given the scarcity of available time series, the other way is to perform cross-country studies and examine variations in inequality at a single time across countries at different development stages. In such cross-section studies, it is assumed that countries at different stages of development follow much the same patterns in their development processes, and that cross-country variations in inequality thus

[2] For a comprehensive survey, one may refer to Lipton and Revallion (1995) and more recently to Kanbur (2000), among others.

convey information corresponding to intertemporal variations of a single country. As is the case in almost all cross-section studies, countries may differ greatly with regard to what is assumed to be the same. Then results must always be interpreted with caution, unless controls are used for intercountry variations. Due to the lack of reasonably long time-series data, most of the studies have been based on more available, cross-section data.

Kuznets (1955) analysed time series of inequality indicators (income shares of various quintiles) for the United States, England and Germany, which were the only countries for which sufficiently long series were available at the time and provided evidence for his hypothesis. In the same study, he then compared these developed countries with three developing countries; India, Ceylon (Sri Lanka today) and Puerto Rico. He observed greater inequality in the developing countries.

A few years later, Kravis (1960) investigated inequality data of eleven countries and compared these with reference to the United States. He found that Denmark, Israel and the Netherlands has less income inequality than the United States; Great Britain, Japan and Canada about the same degree of income inequality; and Italy, Puerto Rico, Sri Lanka and El Salvador more inequality than the United States. Kuznets (1963) provided further support using data from eighteen countries.

Paukert (1973) studied historical data on income distribution in a number of countries and made cross-country comparisons for fifty-six countries, of which forty were developing countries. Using gini coefficients and per capita income levels data, his findings confirmed Kuznets' hypothesis.

Ahluwalia (1976) examined a compilation of cross-section data for sixty-two countries (including fourteen developed and six socialist countries). He made a distinction between levels of per capita GNP and growth rates of GDP. Using data on income shares of various percentile groups and several indicators of development, he identified a statistically significant U-shaped pattern with levels of per capita income.

Given the data available at the time, the hypothesis is accepted largely and became one of the stylized facts for nearly four decades. Later, studies in the beginning of 1990s found mixed findings. Oswang (1994) and Milanovic

(1994) suggested some support, whereas some others, such as Bourguignon (1995), Bruno, Ravallion & Squire (1995), did not confirm the hypothesis.

The compilation of inequality data by Deininger and Squire in 1996 made later possible studies with much larger data. This data set, comprised of Gini coefficients and quintile shares, contained 682 'high-quality' observations for 108 countries (Deininger and Squire, 1996). Both cross-country and individual time-series tests of the hypothesis based on this much larger data set have rejected in most cases the Kuznets curve. Deininger and Squire (1996) concluded little systematic relationship between growth and changes in inequality. In a later study, Deininger and Squire (1998) analysed cross-country variations and time-series of about fourty countries. In their cross-section analyse they found little support for an inverted-U relationship between income levels and inequality. In about 90 % of the countries they found no support for the hypothesis; only 5 countries (Brasil, Hungary, Mexico, Philippines and Thailand) had a statistically significant inverted U-curve development.

Ravallion and Chen (1997), analysing household surveys of sixty-seven developing and transitional countries over 1981-94, found a significant negative correlation between economic growth and changes in inequality over the whole sample; that is increases in incomes were associated with lower inequality. However excluding the countries of Eastern Europe and Central Asia from the analysis, they found no correlation between growth and inequality in either direction. In those countries they observed a tendency for the inequality to increase during negative growth episode.

In individual country studies, inequality shows an increasing pattern in most of the countries in the last decades after a period of stable economic growth between the 1950s and mid 1970s. Cornia (2004) has documented that 48 out of 73 countries has experienced increasing inequality during that period. Inequality remained constant in 16 and decreased in only 9 of these countries. Deaton and Dreze (2002) reports increasing inequality for India between and within states in the 1990s. Ravallion and Chen (2007) studied China over the 1982-2001 period and found inequality rising, though not continously, and more so in some periods and provinces. Thus China and India, accounting for more than half of the population in all developing countries has hence worsening income distribution. Inequality has also increased in most of Latin America in

the 1980s and continued to rise in about half of them during the 1990s, as reported in Cornia (2004), among others. Atkinson (2003) investigated changes in inequality in the OECD countries. He finds that inequality has risen in the United States since the early 1970s. The rise in inequality has been even bigger in the United Kingdom since 1980. He also reports increases, though moderate and diverse, in inequality in other OECD countries as well. According Milanovic (2005) and Sala-i Martin (2006) inequality has also increased in developed countries in the 1980s and 1990s. This trend in rising inequality is explained by the dynamics of the what is named 'globalization' process, including but not limited to neoliberal policies such as trade and finance liberalizations, technological change favoring skilled labor, division of labor across countries, changes in labor market institutions and transition of socialist countries to 'free' market economies (Cornia 2004). Dollar and Kraay (2002), with an extended data of Deninguire and Squire (1996), examined the evolution of the income share of the poorest fifth quantile across countries and concluded that growth has no systematic effect on the share of the poorest but on their absolute average income as average incomes of the poorest rise proportionately with average incomes, having no significant effect on the overall income distribution.

Ram (1997) using 239 observations from Deininger-Squire data set for 19 developed countries specified an upright "U" relationship between inequality and income levels. Barro (2000) and later Barro (2008) (which updates and extends his earlier work in 2000), on the other hand, provided support for the Kuznets curve. Using the World Income Inequality Database (WIID) compiled by the United Nations (UN), Barro concluded in both studies that an inverse-U shaped relation exists as an empirical regularity.

ii. Effects of Inequality on Growth

From 1950s through 1970s mainstream economists have been influenced greatly by the trade-off between inequality and growth of dualistic models. Many economists concluded that countries should grow first and redistribute later. Later in the 1970s studies were aimed at identifying redistributive mechanisms for poverty reduction that would not slow down growth. After the Second World War, many East Asian countries had relatively low inequality levels and high growth rates compared to the countries with similar income levels. In contrast Latin American countries had higher levels of inequality and their growth rates were significantly lower than the East Asian countries. In the 1990s and thereafter, there has been a surge of interest again in the question that income inequality may not only be a final outcome, but may also have a role in predicting the subsequent macroeconomic performance (United Nations Development programme, World Development Report 2005).

Galor and Zeira (1993) showed that initial distribution affected aggregate output and investment, both in the short and long run. As they predicted in their conclusion, this relationships between income inequality (and more generally income distribution) and macroeconomics attracted more studies then after. Several mechanisms or channels have been proposed to explain how initial (*ex ante*) inequality may affect growth. For surveys of these theoretical considerations one may refer to Benabou (1996) and Attanasio and Binelli (2003) among others.

One of the mechanisms suggested to explain the relationship from inequality to growth, starting with Loury (1981), is capital-market imperfections. Galor and Zeira (1993), Agion and Bolton (1997) and Piketty (1997) are examples of such models in the 1990s. According to these models, in credit markets, creditors may have difficulties in collecting defaulted loans because of imperfect legal institutions, inefficient law enforcement or imperfect information. In these circumstances creditors require either collaterals or differing lending rates which in turn lead to limited acces to credit. As the ability of individuals to borrow and invest depends on their wealth and incomes, they have different capabilities and investment opportunities. Poor people in particular either do not have enough assets fot the colleteral or they face high borrowing rates; they then do not find the same chances as richer ones in

investing in human capital that offers relatively high rates of return or they can not get loans to start up a business as easily. In these circumstances a reduction in inequality through a distortion-free redistribution of assets and income or an improvement in the capital markets and legal institutions raises the average productivity of investments and thus the rate of economic growth. The effects of these improvements in poor countries will be larger than richer countries. An economy with less inequality is then expected to have higher growth rate in these circumstances (Barro, 2000). However, Barro (2000) indicates also that an offsetting tendency arises in this channel if there exist fixed costs in investments or a minimum scale or project size, that favor concentration of assets. As a result of this offsetting tendency, inequality will have positive effects on growth.

Another channel proposed by Perotti (1993), Alesina and Rodrik (1994), Persson and Tabellini (1994) and Benabou (1996) among others relied on political economy considerations. The effect of inequality on growth arises through the balance of power in the political system. The key to this argument is the 'median voter theorem' which states that if preferences for the values of certain policy variables such as tax rate and government spending vary monotonically across distribution of income and if the distribution of political power is uniform, that is each person has one vote with equal weight, then the preference of the median voter in income distribution will determine the outcome of the voting process in a democracy. The difference between mean income and median voter income determines the level of income inequality. Then the lower is the income of the median voter relative to the mean, the greater will be the income inequality, and the median voter will favor redistribution from rich to poor through explicit transfer payments and public-expenditure programs that will typically have distortionary effects on economic decisions. That will reduce work effort and incentive to save and will discourage investment. As a result this will lead to lower growth. Even if redistributive policies are prevented by lobbying activities of the rich, it is argued as in Esteban and Ray (2006) that these activities will consume resources and raise sometimes bribery of corrupt government bureaucrates that will in turn lower growth. But, if these resources change the distribution of political power away from uniformity, then the predicted effect of inequality on growth through redistribution will not be realised.

Imperfect capital markets and political economy can offer alternative (or complementary) explanations of how income inequality is negatively related to economic growth, but they are not the only channels. Alesina and Perotti (1996) and Benhabib and Rustichini (1996) argue that greater income inequality creates social discontent that leads to social conflict and political instability. Social unrest increases the probability of coups and mass violence and other disruptive activities. These in turn raise uncertainty in the politic and economic environment, threaten property rights and reduce investment and growth. The security of property rights is also the main focus of Grossman and Kim (1996) and Gonzales (2007). But in this case also there are offsetting effects: if redistributive policies promote sociopolitical stability, they will have an offsetting effect.

In Rodrik (1999), a different channel in the context of social conflict is emphasized in relation with the ability of a country to respond effectively to external shocks. Rodrik observes this in countries that experienced sharp drops in growth rates after 1975. When deep social divisions are coupled with weak institutions of conflict management, sociopolitical instability increases the economic costs of external shocks by delaying the necessary adjustments in fiscal policy and in key relative prices, creating uncertainty and raising the need for further redistributive policies.

These are the main channels argued in the literature for the effects of inequality on growth. If we now return to the empirical findings, the relationship from inequality to growth has been investigated in various cross-country growth regressions. The estimations are performed controlling for a number of usual variables, such as initial inequality, human capital proxies, physical capital investments and regional dummies. There are quite large number of cross-country regressions run over different data sets and periods with different measures of income distributions.

In most of the studies higher initial income inequality seemed to be associated with lower growth rates, leading most economists to conclude that inequality had a negative impact on growth. In cross-country growth regressions, Alesina and Rodrik (1994), Persson and Tabellini (1994), Alesina and Perotti (1994) and Bourguignon (1995), using the data available to them at the time, found significantly negative coefficients on inequality variables.

The survey of Benabou (1996) over twenty-three studies carried out in the early 1990s reported that most of these studies provided empirical evidence of a negative effect of inequality on growth. As that survey made also clear, in some studies, when initial stock of human capital or regional dummies were included in the regressions, the coefficient on income inequality has a lower coefficient. It sometimes is not significant as in Benhabib and Spiegel (1994) with the inclusion of human capital and in Deninguire and Squire (1996) with regional dummies for Latin America and sub-Saharan Africa.

By the introduction of the more comprehensive data set by Deninguire and Squire (1996), numerous studies have questioned the relationship from inequality to growth with larger number of countries and longer time intervals. There are mixed findings in these later studies: some found a negative relation between initial inequality and subsequent growth, and some others a positive relation or no relation at all.

Li and Zou (1998) and Forbes (2000), using the Deininger-Squire data on inequality and an improved econometric technique, found a positive relationship between initial inequality and growth. Forbes (2000) claimed that the negative relation found in the earlier studies was the result of country-specific, time-invariant, omitted variables that generated a negative bias in the estimated inequality coefficients. However, according to Banerjee and Duflo (2003), this result was misleading because of the linear structure imposed on highly nonlinear data.

Barro (2000) investigated the relation in a panel of countries and found no support for a relation between inequality and growth in his sample as a whole. However, distinguishing between low-income and high-income countries, he found a negative relation between inequality and growth in the sample of low-income countries, but a positive relation in the sample of high-income countries. Panizza (2002) studied cross-state variations in the United States and found negative relationship between income inequality and growth. Barro (2008) which extends and update Barro (2000) uses again cross-country growth regressions to evaluate the effects of income inequality an growth rates. In contrast with his earlier findings in Barro (2000), he finds the estimated coefficient on inequality to be significantly negative for the whole sample. The

effect of inequality diminishes as per capita income rises and eventually becomes positive for high-income countries.

All these empirical studies with different results seem to show that the debate is not settled yet. Several problems arise when comparing empirical results with each other. Differences in results stem from various sources such as differences in coverage and quality of data sets, differences in sample sizes and estimation techniques and differences in model specifications or selection of control variables.

3. THE DATA AND EMPIRICAL FRAMEWORK

In our study, our main purpose is to seek any systematic relationship between inequality and growth, with recently updated data on several variables and a much consistent data on income inequality. The Kuznets hypothesis and the possible effects of inequality on subsequent growth are investigated in different samples for two periods, covering the years between 1965-1985 and 1985-2005. As the later period is characterized with globalization, our choice of periods considers possible effects of globalization in these relationships.

The data on income inequality that we use are measures of manufacturing pay inequality indexes, computed for the University of Texas Inequality Project (UTIP). These are Theil indexes based on the United Nations Industrial Development Organization (UNIDO) Industrial Statistics and referred shortly as the UTIP-UNIDO Data Set (available online at their website). Most of the empirical studies on inequality use Gini coefficients and various quantile ratios based on household surveys. Deininger and Squire (1996) at The World Bank collected a large number of disparate surveys and compiled them in an extensive data set, which has then became a standard reference for empirical work. Later, The United Nations University-World Institute for Development Economics Research (UNU-WIDER) and the United Nations Development Programme (UNDP) have extended further the Deininger-Squire (DS) data in their World Income Inequality Database (WIID). The quality and limited availability of data on income inequality have been a problem ever since Kuznets first proposed his hypothesis. In order to be reliable, the data on inequality should be derived from nationally representative household surveys and should be comparable with respect to the type of income (wage, non-wage

and before and after tax, etc) and the recipient unit (households, individuals, etc). The collection of reliable and high frequency data is certainly difficult and expensive. Sources and methods of the published Gini coefficients vary greatly across countries. Deininger and Squire distinguished 'high-quality' data meeting certain criteria as a subset, from less reliable ones and they coded them as "accept" for users of their data sets. They emphasized the advantages and limitations of their data set. In the WIID, entries are presented in a different form with their problems of consistency across countries and across time.

The DS and WIID data sets significantly expanded the coverage of available data. However the data points are still limited in number and unbalanced across countries as the household surveys are not carried out frequently. Besides, the consistency and comparability of the data have been questioned by many. As Galbraith and Conceicao (2000) and Atkinson and Brandolini (2001) points out, the household surveys on which these inequality measures have been based are conducted in different countries with various income definitions, recipient units and different data processing procedures. For these reasons, the choice of data is one important aspect of differences in empirical findings. In using Gini coefficients, it is very important to consider the different sources at individual country level and also the differences between *adjusted* and *reported* values of these coefficients even when they are marked 'accept' or are considered reliable (Galbraith and Kum, 2003). Anand and Kanbur (1993) among others have also emphasized the sensitivity of the results in empirical studies to the selection criteria. Deininger and Squire (1996) themselves also agree to be cautious in using their own data set and suggest the use of consistently defined measures to assure the cross-country comparability.

In our study we use measures of manufacturing pay inequality of the UTIP. They are between-group components of the Theil index computed using data on wages, earnings and employment in the UNIDO Industral Statistics. Manufacturing pay has been measured with appropriate quality in most of the countries for more than forty years. Under certain criteria, Galbraith and Conceicao (2000) indicates that these measures give results that represent also the inequality within industries and they greatly parallel the overall inequality in household incomes, including those outside the manufacturing sectors. These theil indexes are considered reliable and consistent as systematic measurement

errors are not observed in the data on which they are based. And it is easy to detect a rare gross error as these data are avalaible in high frequencies (Galbraight and Kum, 2003).

Theil indexes are not available for every country for the years in question in our study. As a conventional practice, in our empirical study too, we used theil indexes available closest to the year in question for each country in the two periods.

In our work, the source of data on per capita GDP, investment rate and openness ratio is Penn World Tables 6.3 (PWT6.3 2009). For per capita GDP, we use in PWT real GDP per capita chain index at constant 2005 prices. Investment rate is investment share (private plus government) of real GDP per capita at constant 2005 prices. Openness ratio is the ratio of the sum of exports and imports to real GDP at constant prices, i.e. the total trade as a percentage of GDP. Data on schooling are average years of schooling of total population above age 15 at primary, secondary and tertiary levels and are taken from Barro-Lee Data Set (2010). Total fertility rates are taken from World Development Indicators of the Wold Bank (WDI, 2010).

Our empirical study starts with an estimation of income inequality as a bivariate function of real per capita GDP as in Equation (1). We will refer to this as Model 1 in our regression results for inequality and the Kuznets hypothesis.

$$I_{T,i} = \beta_0 + \beta_1 \ln y_{0,i} + \varepsilon_i \tag{1}$$

Here I_T stands for the inequality measure, the UTIP-UNIDO Theil index in our case; y represents real per capita GDP, subindices T and 0 indicate the end and the start of period respectively. The subscript i indicates country. We employ a log transformation of y since its distribution is much more like the Normal distribution (We apply also log transformation to certain variables later in our work for the same reason, though in some cases for theoretical reasons). The error term ε is assumed to satisfy white noise assumptions.

To test the Kuznets hypothesis, we estimate a polynomial regression model of income inequality first as a function of only real per capita GDP as in the following equation (Model 2 in results):

$$I_{T,i} = \beta_0 + \beta_1 \ln y_{0,i} + \beta_2 \left(\ln y_{0,i}\right)^2 + \varepsilon_i \quad (2)$$

We add squared term of *lny* to capture nonlinear shape of the Kuznets Curve. With this specification, a U shape emerges only if β_1 and β_2 are of different signs. If $\beta_1 > 0$ and $\beta_2 < 0$, then the shape that results is precisely an inverted-U. On the other hand, if $\beta_1 < 0$ and $\beta_2 > 0$, the curve takes the form of an upright-U.

Table 1: Means and Standard Deviations of Variables in Regressions for Income Inequality (Kuznets Hypothesis)

Variable	**1965-1985**	**1985-2005**
Theil index	0.0436 (0.0273)	0.0459 (0.0257)
Log (per capita GDP)	8.1358 (0.9668)	8.9027 (1.0306)
Dummy for Latin America	0.2173 (0.4147)	0.1612 (0.3708)
Dummy for Sub-Saharan Africa	0.2717 (0.4472)	0.1612 (0.3708)
Log (openness ratio)	3.6722 (0.7349)	3.8609 (0.6959)
Number of Observations	92	62

Note: Each cell shows the mean of the variable, with the standard deviation in parentheses.

Then in Model 3 and 4 we add successively to Equation (2) regional control variables for Latin America and Sub-Saharan Africa. By introducing regional dummy variables we want to find out if there are statistically significant regional differences with respect to reference region. In this way we would be checking whether findings of the Model 2 for the Kuznets hypothesis, if significant, are sensitive to the introduction of the regional dummies. Finally we add trade openness variable in the last model, Model 5. The descriptive statistics of the variables used in these regressions are provided in Table 1. Regression results for inequality and the Kuznets hypothesis for the period 1965-1985 and the period 1985-2005 are provided respectively in Table 3 and Table 4.

For the effects of inquality on growth, we use a linear growth regression model that is based on conditional covergence in a human-capital augmented neoclassical growth framework. The model is often referred to as a "Barro" regression because of his famous 1991 article and his subsequent studies. It was proposed almost simultaneously by Mankiw, Romer and Weil (1992) and others, and it has became a standard practice in growth econometrics. The model is linear in the log of initial per capita GDP, investment rate, some measures of human capital, population growth rate or fertility rate and a set of "production function shifters" that usually include policy, institutional and structural controls.

Our base regression model which we will refer to as Model 1 is as follows:

$$G_T = \alpha_0 + \alpha_1 \ln y_0 + \alpha_2 \ln s_k + \alpha_3 \ln h + \alpha_4 \ln fert + \eta_i \qquad (3)$$

Here G_T is period average growth rate of per capita GDP, lny_0 is log of per capita GDP at the start of the period and lns_k, log of period average investment rate. *lnh* represents log of human capital at start of the period. As proxies for human capital we use average years of schooling of total population above age 15 at three level of education (primary, secondary and tertiary). *Lnfert* is log of total fertility rate at the start of the period. η_i is assumed to satisfy white noise assumptions and *i* indicates the country. Log of per capita GDP stands for convergence and its coefficient α_1 is expected to be negative. α_2 and α_3, coefficients of log of investment rate and log of human capital respectively are expected to be positive as are typical of growth regressions. The coefficient of log of fertility α_4 should be negative as this variable has a negative effect on the steady-state level of output per capita in neoclassical growth models (Mankiw, Romerand Weil 1992, Barro and Sala-i Martin 1995).

Then we add our measure of inequality as an independent variable to the model to test, if any, the effects of inequality on subsequent growth. Trade openness variable is also added to capture the possible effects of trade liberalization. This is Model 2 in our growth regressions:

$$G_T = \alpha_0 + \alpha_1 \ln y_0 + \alpha_2 \ln s_k + \alpha_3 \ln h + \alpha_4 \ln fert + \alpha_5 \ln open + \alpha_6 ineq + \eta_i \qquad (4)$$

Here *lnopen* is log of period average openness ratio and *ineq* is the UTIP-UNIDO Theil index, measured at the beginning of each period. Finally, in Model 3 we add to Model 2 dummy variables for Latin America and Sub-Saharan Africa. The descriptive statistics of the variables used in growth regressions are provided in Table 2. Regression results for the period 1965-1985 and 1985-2005 are provided respectively in Table 5 and 6.

Table 2: Means and Standard Deviations of Variables in Regressions for Economic Growth

Variable	**1965-1985**	**1985-2005**
Growth rate	2.2499	1.5469
	(1.6218)	(1.6611)
Log (per capita GDP)	8.3671	8.7068
	(0.9055)	(1.0096)
Log (investment rate)	3.1093	2.9504
	(0.4234)	(0.4838)
Log (primary schooling years)	0.9437	1.1529
	(0.7497)	(0.7078)
Log (secondary schooling years)	-0.5254	0.3597
	(1.0547)	(0.6979)
Log (tertiary schooling years)	-2.9913	-1.9519
	(1.2643)	(1.1192)
Log (total fertility rate)	1.5717	1.2459
	(0.4174)	(0.5459)
Log (openness ratio)	3.7617	4.1151
	(0.6293)	(0.5144)
Theil index	0.0418	0.0424
	(0.0271)	(0.0270)
Dummy for Latin America	0.1967	0.2272
	(0.4008)	(0.4214)
Dummy for Sub-Saharan Africa	0.1475	0.2183
	(0.3575)	(0.4155)
Number of Observations	61	88

Note: Each cell shows the mean of the variable, with the standard deviation in parentheses.

Different samples are used for the inequality and growth regressions and for different periods. In our work samples include countries at vastly different levels of economic development. We excluded countries either because of missing data or because the low quality of data (mainly countries reported with Grade D in PWT6.3), with an intenson to keep our samples as large as possible.

Ordinary least square (OLS) estimation is applied throughout our work. In our estimations we checked the normality assumption of variables and performed other standard tests; Jarque-Bera normality tests for the residuals, Breusch-Godfrey Serial Correlation LM test, Breusch-Pagan-Godfrey heteroscedasticity test and the CUSUM and CUSUM of Squares stability tests. In models where heteroscedasticity is detected White estimators are used for heteroscedasticity-corrected variances and standard errors.

4. EMPIRICAL FINDINGS

The estimation results and models for the Kuznets hypothesis and the effects of inequality on growth are presented in seperate tables for each period as mentioned before. Our empirical results for the Kuznets hypothesis for periods 1965-1985 and 1985-2005 are shown in Table 3 and Table 4 respectively. The growth regressions are presented in Table 5 for the 1965-1985 period and in Table 6 for the later period. The numbers on top of the tables indicate different models estimated, so results of each model are in a single column.

In Tables 3 and 4, the estimation results of the bivariate model of inequality on per capita income (Model 1) are shown in the first column. When we look at the results of the 1965-1985 and 1985-2005 periods, the estimated constant β_0 is positive and the estimated coefficient on log (per capita GDP), β_1 is negative in both periods and they are statistically significant at 1 % level. The negative value of β_1 indicates an inverse relation beetween per capita income and inequality. It seems that poor countries are statistically more unequal than richer countries and increases in per capita income are associated with declining wage inequality. However the low value of R^2 indicates that only a small portion of variations in inequality may be explained with variations in per capita income (R^2 is 18 % in the 1965-1985 period and 40 % in the later period).

Table 3: Regression Results for Income Inequality (Kuznets Hypothesis) 1965-1985

Explanatory Variable	**1**	**2**	**3**	**4**	**5**
Constant	0.1424 (0.0000)	-0.2754 (0.1134)	-0.1284 (0.5226)	-0.2650 (0.2044)	-0.2508 (0.2359)
Log (per capita GDP)	-0.0121 (0.0000)	0.0920 (0.0323)	0.0554 (0.2647)	0.0831 (0.1059)	0.0781 (0.1371)
Log (per capita GDP) squared	--	-0.0064 (0.0141)	-0.0041 (0.1638)	-0.0056 (0.0733)	-0.0053 (0.0973)
Dummy for Latin America	--	--	0.0122 (0.0628)	0.0161 (0.0166)	0.0161 (0.0166)
Dummy for Sub- Saharan Africa	--	--	--	0.0185 (0.0109)	0.0177 (0.0174)
Log (openness ratio)	--	--	--	--	0.0017 (0.6218)
R-Squared	0.18	0.22	0.25	0.30	0.30
Prob(F-Statistic)	0.0000	0.0000	0.0000	0.0000	0.0000
Durbin-Watson	2.16	2.15	2.10	2.00	1.98
S.E.of regression	0.024	0.024	0.024	0.023	0.023

Note: p values of the associated t-Statistic are in parentheses.

To test Kuznets inverted-U hypothesis we first run Model 2, our polynomial model in Equation (2). In Model 3 we add to the base model first a dummy varible for Latin America, then a dummy for Sub-Saharan Africa in Model 4 and log of openness ratio in Model 5. Breusch-Pagan-Godfrey tests indicated heteroscedasticity problem at conventional levels in Model 2 and 3 in Table 1 of the 1965-1985 period; for this reason, White method is used in estimation of parameters to get rid of heteroscedasticity and to obtain standard errors of OLS estimators that are corrected for heteroscedasticity (Gujarati, 2004: 417).

Table 4: Regression Results for Income Inequality (Kuznets Hypothesis) 1985-2005

Explanatory Variable	**1**	**2**	**3**	**4**	**5**
Constant	0.1876 (0.0000)	-0.1373 (0.3948)	-0.0072 (0.9646)	-0.0614 (0.7454)	-0.0957 (0.6220)
Log (per capita GDP)	-0.0159 (0.0000)	0.0613 (0.1101)	0.0297 (0.4452)	0.0408 (0.3484)	0.0510 (0.2616)
Log (per capita GDP) squared	--	-0.0045 (0.0451)	-0.0026 (0.2421)	-0.0032 (0.1945)	-0.0037 (0.1442)
Dummy for Latin America	--	--	0.0164 (0.0207)	0.0169 (0.0187)	0.0162 (0.0252)
Dummy for Sub-Saharan Africa	--	--	--	0.0057 (0.5564)	0.0071 (0.4687)
Log (openness ratio)	--	--	--	--	-0.0031 (0.4023)
R-Squared Prob(F-Statistic)	0.40 0.0000	0.44 0.0000	0.49 0.0000	0.49 0.0000	0.50 0.0000
Durbin-Watson	1.90	1.96	1.84	1.84	1.84
S.E.of regression	0.019	0.019	0.018	0.018	0.018

Note: p values of the associated t-Statistic are in parentheses.

When we look at the results for the Kuznets hypothesis (Model 2) in Table 1 for the 1965-85 period, the estimate of β_1 is positive and the estimate of β_2 is negative and they are statistically significant at conventional levels. The signs of the coefficients seem to support an inverted-U curve. The estimates of these coefficients for the 1985-2005 period (Table 2) have the same signs, but they are statistically significant at higher levels. Although the signs and significances of the coefficients may seem to support the Kuznets hypothesis, there are reasons to be skeptical.

First, as the low values of R-squared indicate, per capita GDP can explain some, not even half of the variations in inequality across countries (This of course does not reject the possibility of a tendency in the direction of the Kuznets hypothesis.).

Second, there is a more fundemental problem and it is indeed related with all such cross-country studies. By putting countries as different as Zambia, Sweden and Korea for instance in a sample in such cross-country studies and running regression we implicitly assume that *all* countries have the *same* inequality-income curve; not only the form of the curve is the same, but the parameters are also the same (i.e. the same β's in every country). However countries may have structural differences for having higher or lower inequality and that should be taken into account. In such cases we suspect structural differences, we then assume that the form and parameters of the curves are the same in each country so that the curves are parallel to each other but the intercepts are different. (Gujarati, 2004: 297-312). This is done by introducing country-specific dummy variables which move the intercept of the estimated curves, hence allowing to test differences in the intercepts, or the importance of being structually different per se.

Most of the countries with high inequality and middle per capita income are the Latin American countries. The inverted U may be an artificial fact as a consequence of these Latin American countries clustering in the middle. In other words it may be true that middle income countries have higher inequality and this shows itself in an inverted-U curve. But it is also quite possible that middle income countries are Latin American and that these countries have different structural reasons for higher inequality. This is termed "Latin effect". In large samples we might expect these effects to vanish, but the number of countries in the world is limited, especially when each country counts just as one unit (Ray,1998: 2007). Sub-Saharan countries are also suspected to have structural differences in this regard since these countries are characterized with persistent high inequality and low income. There are several explainations for Sub-Saharan countries in the literature but the role of economic institutions created in the colonial period, political instability and powerty trap are the most cited ones (e.g. Angeles, 2007).

Indeed, the coefficient of dummy variable for Latin America in Model 3 is positive and statistically significant in the two periods (associated p values are about 6 and 2 percent respectively). This indicates that mean value of inequality is higher in Latin countries than non-Latin countries. Adding a dummy for Latin America to the equation does not alter the signs of the β_1 and β_2 coefficients but

reduces greatly their significances. Similar results of the *Latin effect* are also obtained in several other studies with Gini coefficients such as Deininger and Squire (1996). When a second dummy is introduced for Sub-Saharan countries in Model 4 and 5, the coefficient of dummy for Latin America is again positive and statistically significant in all models, in both periods. The coefficient of the dummy for Sub-Sahara is positive in all models; it is statistically significant in the 1965-1985 period, but it is not statistically significant in the later period at usual levels. In the later period introducing dummy for Sub-Sahara increases significance levels of β_1 and β_2 compared to Model 3 where there is only dummy for Latin America, but they are still not significant at 5 percent. In Model 5 log of openness variable is added to the model; its coefficient is positive in the 1965-1985 period and negative in the later period, but is not statistically significant and does not increase R^2 in both periods.

In sum, although their signs do not change, the coefficients β_1 and β_2 are not significant when regional dummies are used for the intercept terms. When dummy for Latin America is introduced the Kuznets inverted-U curve largely vanishes. This suggests that structural differences across countries may artificially convince someone that an inverte-U curve exists when in fact it does not. If any conclusion has to be made, inequality tends to fall over the course of development, at least during last four decades as supported with the results of the bivariate model, Model 1.

Now we return to the estimation results and models for the possible effects of income inequality on subsequent growth. They are presented in Table 5 and 6 for the 1965-1985 and 1985-2005 period respectively. Breusch-Pagan-Godfrey tests indicated heteroscedasticity problem at conventional levels in models in Table 6; for this reason, White method is used in estimation of parameters in these models to get rid of heteroscedasticity and to obtain standard errors of OLS estimators that are corrected for heteroscedasticity (Gujarati, 2004: 417).

Model 1 is the standard conditional convergence model in human capital augmented neoclassical growth framework, as in Mankiw, Romer and Weil (1992). The log (per capita GDP) is at 1965 level in the 1965-1985 regressions and at 1985 level in the 1985-2005 regressions. The estimated coefficient on log (per capita GDP) expresses conditional convergence as indicated before. The

convergence is conditional in the sense that countries with lower initial GDP will tend to grow faster only if the other explanatory variables are held constant; so the expected sign is negative for this coefficient. In all models of the two periods the estimated coefficient of log (per capita GDP) is negative and statistically significant at 1% level.

Table 5: Regression Results for Economic Growth (1965-1985)

Explanatory Variable	**1**	**2**	**3**
Constant	20.1444	20.3425	19.5461
	(0.0000)	(0.0000)	(0.0000)
Log (per capita GDP)	-2.0967	-2.1641	-2.0708
	(0.0000)	(0.0000)	(0.0000)
Log (investment rate)	1.2259	1.1539	1.0661
	(0.0022)	(0.0049)	(0.0175)
Log (primary schooling years)	-0.3508	-0.3116	-0.2289
	(0.2545)	(0.3272)	(0.5021)
Log (secondary schooling years)	1.4378	1.4319	1.3356
	(0.0000)	(0.0000)	(0.0004)
Log (tertiary schooling years)	-0.1393	-0.1278	-0.1592
	(0.5574)	(0.6279)	(0.5567)
Log (total fertility rate)	-2.2219	-2.3245	-2.1712
	(0.0001)	(0.0002)	(0.0031)
Log (openness ratio)	--	0.2266	0.2095
		(0.3623)	(0.4259)
Theil index	--	-2.5753	-2.7674
		(0.6934)	(0.6798)
Dummy for Latin America	--	--	-0.2412
			(0.5908)
Dummy for Sub-Saharan Africa	--	--	-0.3715
			(0.4867)
R-Squared	0.63	0.64	0.64
Prob(F-Statistic)	0.000000	0.000000	0.000000
Durbin-Watson	2.07	2.04	2.00
S.E.of regression	1.030	1.041	1.055

Note: p values of the associated t-Statistic are in parentheses

Investment rate is the ratio of real gross domestic investment (private plus government) to real GDP and we use period averages of this variable in regressions in each period. The expected sign of the coefficient on this variable is positive as the higher is the investment rate, the higher will be the physical capital accumulation rate, and hence the growth rate, during transition to steady-state in neoclassical growth model. Its estimated coefficient is as expected positive and statistically significant at 1% in all models, except at 5% in Model 3 for the 1985-2005 period.

There are various proxies used for human capital in the literature such as various educational attainment rates, schooling data at different levels of education, or some measures of health level such as life expectancy, mortality rate at age one. The expected sign of the coefficient on this variable is positive. We use schooling years at primary, secondary and tertiary levels of total population, all observed at the start of each period. The variable the most frequently reported in the literature as significantly related to subsequent growth is average years of male secondary education (e.g.Barro 1991, 2000). In our estimations, the coefficient on log (secondary schooling years) is positive and statistically significant at 1% in the models of the 1965-1985 period and it is positive but not statistically significant at conventional levels in the models of the later period. Tertiary schooling years variable is not significantly related to subsequent growth in all models. The sign of the estimated coefficient on log (primary schooling years) is positive only in the models of the later period and it is statistically significant only (at 1 % level) in Model 3 for the 1985-2005 period. The estimated coefficients on log (primary schooling years) in models in the 1965-1985 period and the estimated coefficient on log (tertiary schooling years) in all models tend to enter negatively in the equation. This is not unusal in growth regressions. Barro and Sala-i Martin (1995) state this as a “puzzling finding” and they indicate that “ one possible explanation for the negative estimated coefficients is that a large spread between male and female attainment is a good measure of backwardness; hence, less female attainment -especially at the higher level- signifies more backwardness and accordingly higher growth potential through the convergence mechanism.” (Barro and Sala-i Martin, 1995: 431-432).

Table 6: Regression Results for Economic Growth (1985-2005)

Explanatory Variable	**1**	**2**	**3**
Constant	7.3381	6.5970	6.7934
	(0.0143)	(0.0261)	(0.0174)
Log (per capita GDP)	-0.9784	-0.9654	-0.9703
	(0.0002)	(0.0001)	(0.0001)
Log (investment rate)	1.3198	1.3763	1.1233
	(0.0035)	(0.0035)	(0.0411)
Log (primary schooling years)	0.4944	0.4184	0.7985
	(0.0786)	(0.1350)	(0.0167)
Log (secondary schooling years)	0.2892	0.1843	0.1478
	(0.4004)	(0.5959)	(0.6471)
Log (tertiary schooling years)	-0.2509	-0.1785	-0.3698
	(0.2735)	(0.4437)	(0.2210)
Log (total fertility rate)	-1.8705	-2.1243	-1.6924
	(0.0009)	(0.0008)	(0.0060)
Log (openness ratio)	--	0.1631	0.0783
		(0.5597)	(0.7699)
Theil index	--	8.7879	11.060
		(0.2162)	(0.1379)
Dummy for Latin America	--	--	-0.9392
			(0.0292)
Dummy for Sub-Saharan Africa	--	--	-1.3066
			(0.1056)
R-Squared	0.39	0.41	0.46
Prob(F-Statistic)	0.000000	0.000001	0.000000
Durbin-Watson	1.94	1.88	1.82
S.E.of regression	1.335	1.335	1.298

Note: p values of the associated t-Statistic are in parentheses.

The fertility rate has a negative effect on the steady-state level of per capita GDP and on the growth rate in neoclassical growth framework with exogenous population rate. The coefficient of the log (total fertility rate) is thus

expected to be negative. In all models in the two periods the sign of the estimated coefficient is negative and is statistically significant at 1% level.

In Model 2, we add log of openness ratio and our inequality variable, Theil index to the base model. The estimated coefficient of openness ratio is positive but it is not statistically significant in all models. In Model 3 we add to the previous explanatory variables regional dummy variables for Latin America and Sub-Saharan Africa. The coefficients of the dummy variables are negative but are not statistically significant except in Model 3 of the 1985-2005 period. In Model 3 the coefficient of dummy for Sub-Sahara is statistically significant at 10% and that of the dummy for Latin America at 5 % level. This tends to indicate that in Latin America and Sub-Saharan Africa the mean growth rates are lower than that in the bechmark countries.

The estimated coefficient on the Theil index is negative in models of the 1965-1985 period and positive in the models of the 1985-2005 period, but it is not statistically significant at all at conventional levels in the models of the two periods.

The effects of inequality on subsequent growth, if any, seem to be ambiguous in our study, in both periods. There are several methodological and theoretical arguments for this result. Anand and Kanbur (1993) among others have emphasized the sensitivity of the results to the selection of sample, model specification and estimation techniques. As we previously mentioned, there are theoretically offsetting effects of inequality on subsequent growth. As Barro (2000) points out**,** the offsetting effects make the net effects of inequality on growth ambiguous. This is reflected in less robust, ambiguous or opposing results in empirical studies.

5. CONCLUDING REMARKS

In our study we investigated the relationship between inequality and growth in both directions. Our research is carried out in two periods: 1965-1985 and 1985-2005. Several models have been estimated to test the Kuznets hypothesis and to detect the possible effects of inequality on subsequent growth.

Our estimation results show that poor countries are statistically more unequal than richer countries and increases in per capita income are associated

with declining income inequality. Inequality tends to fall over the course of development. However only a small portion of variations in inequality may be explained with variations in per capita income levels.

Our findings do not support the Kuznets hypothesis. They show that when structural differences across countries and regions are not taken into account, an inverted-U curve seems to emerge, which may artificially convince someone that an inverte-U curve exists when in fact it does not. Most of the countries with high inequality and middle per capita income are the Latin American countries. The inverted U seems to be an artificial statistical fact as a consequence of these Latin American countries clustering in the middle.

The debate on the Kuznets hypothesis and the possible effects of inequality on subsequent growth is not settled yet as many empirical studies indicate us with different and opposing results. Differences in coverage and quality of data sets, differences in sample sizes and estimation techniques and differences in model specifications and selection of control variables changes results dramatically. There is no standard theoretical and empirical model of inequality and growth and no standard selection of control variables for use in econometric study. In our study we did not find any statistically significant relationship between inequality and subsequent growth.

As our results support, it seems that we can not establish a straightforward relationship between inequality and growth, in any directions. To analyse and explain cross-country variations in income inequality, subsequent research needs to focus on the interconnections between inequality and other factors, such as land and wealth distribution, education, health and differences in structures, institutions, governance, political stability and regional differences. As more and more data become available, time-series studies of individual countries considering such factors are also expected to provide rich insights for variations of inequality across countries and across time. It is also important that research be directed on redistributioanal policies that will not hamper growth and policies that will generate or increase growth without worsening income distributions.

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