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Revisiting the Relationship Between Income Inequality and Economic Growth

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–Introduction. –I. The Renewed Interest in Inequality. –II. Motivation for a New Empirical Estimation. –III. Results. –Final Comments

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Introduction

A copious literature on the relationship between income distribution and economic growth has been developed recently and particularly during the 1990s. Among this literature an important branch has focused on developing theoretical models to posit and explore a causal relationship that, contrary to the traditional Kuznets' curve literature, goes from inequality to growth. Most of these models put forward the existence of a negative correlation between inequality and growth that operates through a myriad of mechanisms. In a related effort, a number of studies have attempted to empirically estimate this relationship by means of different modeling approaches. A broad consensus validating the existence of this negative correlation prevailed until some authors began using panel data estimation techniques that have tended to show a positive correlation.

The aim of this paper is to empirically explore the relationship between inequality and growth in light of recent developments. For this, first a broad overview of the literature in the area is conducted, at both the theoretical and empirical levels. Section I provides such a review, focusing on the rationale of the theoretical models and includes a summary

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of the empirical studies, their methods, and results. In section II the motivation for providing a new empirical estimate is presented. The results of this empirical estimation are reported and discussed in section III. The final section concludes with some comments.

I. The Renewed Interest in Inequality

Kanbur & Lustig (2000) examine the reasons why during the 1990s inequality was brought back on the development economics and economic growth agenda. They found five main motives for this: (a) the debate on the separation of efficiency and equity, (b) the significance of the Kuznets' curve, (c) the noticeable changes in income distribution across countries between the 1980s and 1990s, (d) the changing income distribution patterns experienced within countries and hidden below stable national inequality indices, and (e) the issue of inequality between countries.

Since the appearance of Kuznets' inverted U hypothesis on the relationship between inequality and economic growth empirical work has shown diverging results about its validity. Doubts have been particularly strong regarding the persistence of this relationship for a country over time. In spite of mixed evidence on the nature of the relationship between inequality and growth, from the stand point of endogenous growth theory the independence between the two is questioned with no qualification.

The move toward increased inequality within countries has spurred an ample set of explanations ranging from potential distributional effects from globalization, to government policies and social norms. The increase in inequality between countries experienced since the 1980s has motivated a large body of literature that has helped put inequality back on the agenda. Clearly, one of the issues is convergence. Another set of issues refers to the seeming difficulty of some countries to break the low-income trap while others manage to do so and the consequent quest for the reasons for this difference as well as for policy recipes to achieve this jump. In examining this theme, the connection between inequality and long-term growth has provided a fruitful area of research.

A. Theoretical Effects of Inequality on Growth

An interesting body of literature on this topic mainly based upon endogenous growth theory has been developed from the 1990s. It has become common to classify these theories into categories according to the mechanism that links inequality and growth.

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[1] Apart from the models included in these categories there are two other perspectives that are worth brief mentioning. One has to do with the idea that individual saving rates increase with income

The classification in use here comprises the following: credit market imperfections, political economy, political economy and credit market imperfections, and social unrest.[1]

1. Credit Market Imperfections

Models featuring credit market imperfections are based upon the assumption that a limited capacity to borrow on the part of certain economic agents, leads to rates of return on investment opportunities that do not necessarily equate in the margin. As credit access is limited, the possibility of exploiting investment opportunities depends on the individual's possession of assets and income. Hence, in the presence of decreasing returns, inequality leads to lower average returns and lower growth.

Perotti (1992) uses the loan-to-value ratio for domestic mortgages as a proxy for credit availability, finding that it has a positive effect on the growth rate and that as inequality increases the impact of credit availability on growth becomes larger. Galor & Zeira (1993) pioneered in showing the link between credit market imperfections, income and wealth distribution, and aggregate investment in human capital. Following their work, a number of studies (for instance Benabou, 1996a, and Piketty, 1996) indicate that although education shows high rates of return, poor people tend to forego investing in education due to their inability to borrow and that this, in turn, slows the formation of human capital and lower growth rates. An important issue here is intergenerational mobility as the presence of fixed costs of investment on education may prevent a dynasty that lacks resources at the beginning from doing this type of investment generation after generation.

In some models such as in Perotti (1993), and Saint-Paul & Verdier (1993) the beneficial effects that redistributive policies may have on growth have been highlighted. In contrast, if increasing returns on investment prevail for some range (for example, education yields higher returns only after certain schooling level) inequality may be positively related to growth as it allows some individuals to get through this threshold. A result posited in Aghion & Bolton (1997) and Perotti (1993).

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level and that a higher concentration of income would make possible the presence of higher saving rates and investment and therefore growth. The other relates to the interaction between education and fertility decisions on the part of individuals, which are brought about by the interplay between the direct cost of raising children and the opportunity cost of the parent's human capital. Redistribution of human capital favoring individuals with lower levels of it would increase enrollment ratios and decrease fertility. Establishing a negative relationship between equality and fertility and a positive one between equality and investment in human capital and hence growth.

2. Political Economy

The political economy argument refers to social preference for redistributive taxation. When mean income exceeds the median income in an economy, majority voting tends to favor taxation (provided it is progressive) and government redistributive spending either as direct transfers or as public expenditure programs. This provides the political mechanism for the connection between inequality and growth. On the other hand, higher taxes and transfers distort economic decisions and disincentive private savings and investment causing economic growth to decline. This constitutes the economic mechanism of the linkage. As a consequence, the existence of high inequality is considered a cause of slow growth via its effect on taxation and redistribution through the political system.

Perotti (1996) finds an expected positive relation between inequality and taxation but an unexpected positive relation between marginal taxation and growth. This is consistent with results from other studies, such as Easterly & Rebelo (1993) who find that redistribution has a positive impact on growth. Alesina & Rodrik (1994) directly model productive government expenditure and find that inequality affects taxation through the political process and indirectly impinge upon growth as redistribution disincentive investment and growth. In either case, more equal societies must tend to grow faster. However, the relationship inequality-growth within this perspective may prove tricky, as Barro (1999) has noticed with respect to the implications of whether income inequality is measured *ex-ante* or *ex-post*.

The form of political power may matter. In a one person-one vote democracy context, Persson & Tabellini (1994) claim that the negative effect of inequality on growth should be stronger in democracies than in non-democracies. However, results from other studies are mixed and tend to find either consistent but not significant or inconsistent parameter estimates (see Alesina & Rodrik, 1994, and Perotti, 1996). Benabou (1996b) builds a model that allows for deviations from the one-person-one-vote rule in a specific direction: the political system can lean towards a positive or negative wealth bias. In this context, what matters for growth is not the extent to which the political system deviates from perfect democracy but whose interests are favored by this deviation. It then turns out that the distribution of political power matters too.

3. Political Economy Compounded with Credit Market Imperfections

The main issue within this class of models is redistribution and its effects on growth. In a strict sense, for credit market imperfections models policy is exogenous. On the other hand, complete markets characterize "pure" political economy models. In general, countries face a tradeoff between the benefits of redistribution and its costs and both forces must be accounted for. This is precisely what political economy/credit market imperfections models attempt to do.

In Benabou (1996b), under any given policy, inequality reduces growth and intertemporal efficiency while growth is first increasing on redistribution and then decreasing, regardless of the level of initial inequality. Aghion, Caroli & Garcia-Penalosa (1999) directly address the issue of redistribution. With heterogeneous agents, highly imperfect capital markets, and technology exhibiting diminishing returns to capital, inequality has a negative impact on growth and redistribution a positive one.

A connection between inequality and growth that has been explored by Haussmann & Gavin (1996), Ramey & Ramey (1995), and Alesina & Perotti (1996) is that inequality generates macroeconomic volatility and lowers growth. Unequal access to investment opportunities, jointly with a high degree of capital market imperfection generates credit cycles and macroeconomic volatility. By increasing the share of savers that can directly invest in high return projects or by transferring idle funds from savers to investors volatility would decrease and growth would be enhanced.

A more complex political economy-credit/insurance market imperfections model linking inequality and the social contract (the structure and working of redistributive policies) is provided in Benabou (2000). Efficient redistribution has a wide consensus in a fairly homogeneous society and face strong opposition in a more unequal one. Below a threshold level no allocation of political power can lead to more than a unique social contract, whereas above it there may be multiple steady states. Therefore no unique relationship necessarily arises between inequality and growth and differing empirical results may be in fact non-comparable or be indicative of differing steady state equilibriums that bear weak or no linkage to economic performance.

4. Social Unrest

The basis for the sociopolitical instability approach found in studies by Alesina & Perotti (1996) and Gupta (1990), among others, is that inequality of income and wealth may create incentives for people to engage in activities outside the socially accepted channels of political representation or social action. This form of rent-seeking behavior is wasteful as are the defensive efforts of the potential victims. Furthermore, social unrest discourages investment as it generates uncertainty and disrupts the normal functioning of markets and labor relations. As a consequence, economic growth declines.

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[2] There is multiplicity of studies on the property rights and economic growth linkage that, however, does not explicitly relate it with inequality.

Theoretical models of this view comprise works by Benhabib & Rustichini (1996), and Grossman & Kim (1996).[2] Most of these models focus on the allocation of resources among productive, predatory, and defensive activities in the context of one-time interactions between individuals or social classes. Benabou (1996b) synthesizes the basics of this class of models by means of an economic growth version of the prisoner's dilemma. The model shows that, as in the case of the political economy models, what seems to matter is not inequality per se but the relative distribution of income and political power.

As pointed out by Barro (1999), transfers of economic resources may be an offsetting force in this context. As the poor need some resource level to effectively be able to disrupt the regime, income equalizing transfers promote stability only to the extent that they can overcome the tendency towards rebellious behavior. Even though it appears to be ample empirical evidence in favor of this perspective, the specific channels through which it operates are not entirely clear. As Benabou (1996b) points out it seems to be the "general idea" that political instability negatively affects growth what the evidence supports rather than the particular linkages that models portray.

B. The Empirical Evidence

Due in part to the theoretical origin that most of the research in this area has and to the nature of the available data, most empirical work on this issue is based upon a variation of Barro (1991) and Barro & Sala-I-Martin (1995) cross-country economic growth estimation. Limited work, most notably that by Barro (1999), has taken a simultaneous equations perspective. The usual cross-section estimation regresses a measure of economic growth or investment growth on a set of variables deemed as standard in estimating growth models, to which a measure of income inequality is added. Most of the results of this reduced-form estimation indicate a negative relationship between inequality and growth, although a number of qualifications usually apply to them.

As reduced-form estimates are compatible with several theoretical explanations of the linkage inequality-growth, they cannot provide information on the specific channels through which this relationship takes place and therefore only structural models may supply evidence on them. However, as mentioned, few empirical works have attempted to do so. Perotti (1996) provides such type of evidence for four types of models, finding that the socio-political instability and the education/fertility joint decision approaches attain the strongest support, while the credit market imperfections (linked to human capital investment) approach finds support but suffers from potential measurement error giving the existing data. On the other hand, the political economy approach appears to command the weakest empirical support.

One of the problems associated with cross-section estimations is measurement error in income inequality data. Detailed discussion of this type of data difficulties is provided in Perotti (1996), Deininger & Squire (1996), and Forbes (2000). Recently, the Deininger & Squire (1996) data set has become the most common source for income inequality data. They assembled a relatively large and consistent data set and classified the data points according to its seeming quality level. Forbes (2000) notes that a majority of the data employed in some of the most well-known cross-section studies does not qualify as high quality data, a situation that she considers may lead to biased estimated coefficients. There is discussion however, on the extent to which data selection based upon the criteria used by Deininger and Squire should be regarded as definitive.[3] Atkinson & Brandolini (1999) content that all available measurements of inequality are imperfect and that data considered as low quality by Deininger and Squire reflect actual movements of income inequality for a sub-sample of OECD countries and therefore provide valuable information.

A set of 12 studies that have attempted to empirically measure the relationship between inequality and growth were examined.[4] They use samples that range from nine to 119 countries covering diverse time periods. Seven studies employ cross-section estimations, two use pooled time series-cross section, four use simultaneous equations estimation techniques, one uses panel data estimation, and one uses nonparametric methods.[5] Results from the majority of these models indicate that there is indeed a negative relationship between inequality at an initial point in time and the per capita long-term rate of growth.

Typically, the growth rate measured over a long period of time (20 to 30 years) is regressed on a set of variables that is a slight variation of Barro's (1991) growth regression, to which others are added (the so called Barro-augmented regression).[6] All explanatory

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3 They applied three basic quality standards: that information must come from household surveys, that these surveys must be representative of the whole country, and that the measure of income or expenditure must be comprehensive.

4 Easterly & Rebelo (1993), Alesina & Rodrik (1994), Persson & Tabellini (1994), Birdsall, Ross & Sabot (1995), Clarke (1995), Alesina & Perotti (1996), Perotti (1996), Deininger & Squire (1998), Barro (1999), Forbes (2000), Banerjee & Duflo (2000b), and Easterly (2001)

5 Several studies estimate more than one type of model, so the number of models does not coincide with the number of studies referenced.

6 Typically the Barro-type variables include initial GDP per capita, primary school enrollment or attainment, secondary school enrolment or attainment, and a measure of market distortions.

variables, including income inequality are measured at a time as close as possible to the beginning of the time period for which the growth rate has been measured, in order to avoid endogeneity and "ensure causation". The results tend to be robust to different specifications of the models and ways of measuring inequality, but are frequently found to moderately vary in magnitude and lose significance when regional dummy variables are included. This has been interpreted as a consequence of well known historic regional differences in inequality and as an indication of the existence of non-included variables of regional importance that have some correlation with inequality and actually influence the growth rate.

In spite of the relatively large consensus on the empirical verification of this negative relationship, a handful of studies have recently "challenged" this view. Barro (1999) finds weak overall effects of inequality on growth and investment, and reports that the negative effect of inequality on growth that he finds for low-income countries switches to a positive effect for high-income countries. Li & Zou (1998) and Forbes (2000) report econometric results showing a positive association. In the light of these findings, especially that of Forbes, a debate has resurfaced around the issue.

II. Motivation for a New Empirical Estimation

Seemingly, the immediate reasons for the differing result of Forbes lie in the fact that hers (as is Li and Zou's) is a fixed-effects model yielding estimates that should be understood as a measure of how changes in inequality relate to changes in growth *within* a given country instead of across countries (as regular cross-section studies do). Also, the time period break of 5 years that she uses to build the unbalanced panel data on which the estimation is done, makes the coefficients short to medium run in nature instead of long run indicators as is usual in other studies. For these reasons, Forbes considers that these results do not necessarily contradict other studies'. While currently there is no sufficient data to estimate a long run fixed-effects relationship between inequality and growth, it is possible to think of theoretical channels that in the long run may hamper or even reverse this positive relationship.

Besides, Forbes argues that, contrary to what is commonly claimed, most estimates lack robustness and that the drop in significance that the inequality coefficient suffers when regional dummies are included in the models shows this fact. Furthermore, two econometric problems potentially affect the quality of most studies. First, as mentioned before, is the issue of measurement error in inequality. The development of the Deininger & Squire (1996) database has provided a vast improvement in data quality but measurement error continues nonetheless to be of consideration. Second, the omitted-variable bias is a potentially important problem in the context of these studies. The particular relation between inequality and growth that is found in a country may be due to the effect of variables that are not included in the model. In other words, there is a strong possibility that "unobserved" characteristics of a country determine to a large extent either the degree of inequality or the growth rate or both but are not explicitly accounted for in the model.

There are two possibilities for taking into account the "unobserved" characteristics of a country: one is to consider them to be invariant along time (the fixed-effects approach); the other is to view them as varying according to a certain probability distribution (the random-effects approach). Interestingly, as noted, the two studies that have recently found positive associations between inequality and growth were estimated by using some variant of the fixed-effects approach. Forbes (2000) notes how data quality, period length, and estimation technique influence the sign and significance of the coefficient for inequality for the same specification of the model.

Aghion, Caroli & Garcia-Penalosa (1999), have criticized Forbes' results in three directions. First, on econometric grounds, arguing that the Arellano-Bond GMM estimator (used by Forbes) may have significance problems; second, considering that the five-year break period used for constructing the panel data is *ad-hoc*; third, in Forbes' need to restrict the data to the high-quality data of the Deinigner & Squire (1996) dataset. More recently, Banerjee & Duflo (2000a, b) have made an extensive critique of Forbes' estimates. According to them, there are theoretical and empirical reasons to believe that in the short-run both increases and decreases in inequality are followed by a reduction in the growth rate. That is, there exists a U-shaped relationship between changes in inequality (in any direction) and changes in the growth rate. The direction of this relationship (i.e. whether or not it is U-shaped or inverted-U-shaped) depends upon model parameters. As a consequence, they consider that Forbes' estimate extrapolates this relationship by means of the linear structure that she imposes on her model.

In what follows I generate a new estimation of the relationship between inequality and growth by using a panel data model that tries to take into account some of the just mentioned criticisms of Forbes' model.

A. The Model and the Data

A commonly used model specification is employed for estimating the relationship between inequality and growth. The basic model can be described as follows:

$$(y_{it+a} - y_{it}) / a = \beta X_{it-1} + u_{it} \qquad (1)$$

where y_{it} represents the logarithm of per capita GNP in country *i* at time *t* (therefore the left hand side is the growth rate); *a* is the length of time chosen to break the panel periods;

X_{it-1} is a set of control variables whose values belong to the preceding time period for the year that is closest to the beginning of the current period; and u_{it} is a time varying error term.

The set of control variables comprises the logarithm of per capita GNP ($Income_{it-1}$), the Gini coefficient ($Gini_{it-1}$), a measure of market distortions ($PPPI_{it-1}$), average secondary school attainment for the female population aged over 25 ($Feduc_{it-1}$), and average secondary school attainment for the male population aged over 25 ($Meduc_{it-1}$). Given the short to medium term nature of the panel data sets used to estimate the model (five-year and ten-year breaks) per capita GNP was averaged over five-year periods to smooth out possible yearly serial correlation from business cycles. As usual in these models, income level controls for convergence effects. The PPP price of investment deflated by the exchange rate *vis-à-vis* the U.S. dollar is used as the measure of market distortions. Educational attainment is meant to proxy for the level of human capital available and is preferred to enrollment since it is a stock variable. The purpose of using stock variables measured at the start of the time breaks, rather than flow variables measured throughout the periods is to reduce potential endogeneity.

Table 1 summarizes the definition of the variables employed, indicates the data sources, and provides basic statistics for them. The data set basically employed for estimation includes 52 countries and 225 observations distributed along 7 five-year periods covering from 1960 to 1995. Table 1.A. (in the appendix) presents the list of countries included, the number of observations available per country and the time period covered by them. Following Barro (1999), the data for the Gini coefficients includes, besides the "high quality" data, the observations that are not considered "high quality" by Deininger and Squire due to lack of a clear reference to their source. This allows expanding the database used by Forbes without major loss in comparability.

Since the purpose of the estimations to be presented is to make a comparison with Forbes' results, no attempt is made to experiment with the set of control variables. In the same vein, and in spite of the suggestion about the inconvenience of adjusting the Gini coefficients (Atkinson & Brandolini, 1999), in the cases in which they are based in expenditure rather than in income they were adjusted as suggested by Deininger & Squire (1996) by adding 6.6. This was done on the idea of preserving comparability. Also, for doing sensibility analysis of the results no other measures of inequality were considered since it would have implied an impracticable reduction in the size of the database. Instead, three additional databases were constructed to generate alternative estimations. One using income data from the World Bank (2001) but employing ten-year breaks to build the panel (as in Barro's database, 1999). The other two are based on income data from the

Penn World Tables (real per capita GNP at US$ 1987), covering the period 1960-1990. Of these, one is broken in five-year periods and the other in ten-year periods.

Table 1. *Variable Definition, Source, and Summary Statistics (1960-1990)*

Variable	Description	Source	Mean	Std Dev	Minimum	Maximum
Growth	Real average percapita income growth	Calculated from data below	0.0108	0.0104	-0.0218	0.0409
Income	Log of real GNP per capita at US$ 95 *	World Bank 2001 **	3.5057	0.6540	2.1981	4.5864
Gini	Gini coefficient ***	Deininger & Squire 2000	42.016	9.1683	20.970	68.00
PPPI	Price level of investment at PPP/exchange rate relative to the US	Penn World Tables (v.5.6)	80.033	35.5512	30.940	384.860
Feduc	Average years of secondary schooling; female population aged over 25	Barro & Lee 2000	1.2348	1.0787	0.0240	5.1060
Meduc	Average years of secondary schooling; male population aged over 25	Barro & Lee 2000	1.5894	1.0852	0.1700	5.0680

* GNP was averaged over five year periods to smooth cyclical business fluctuations.

** An alternative data set uses Penn World Tables v. 5.6 as the income source.

*** When based on expenditures, the Gini coefficient was adjusted to income measure (adding 6.6 as in Deininger & Squire, 1996)

B. Estimation

Estimation is made by means of the standard panel techniques: fixed effects and random effects. In these, the model is assumed to have the structure presented in equation (1) but the error term is broken down into a time invariant country-specific component and a time varying error term with the usual properties, as shown in equation (2) below. Contrary to the random effects, the fixed effects estimation assumes that the time invariant country-specific variable v_i is non random. Consequently, the coefficients must be interpreted as marginal changes within a given country rather than across countries as the random effects estimation yields. Estimation using the error term specification in equation (2) is also known as one-way effects (either fixed or random). An alternative specification, allowing for time specific effects is shown in equation (3) and provides the basis for the two-way effects estimation. In both cases the error term (e_{it}) is assumed to be orthogonal to the other variables and v_i is assumed to have zero mean, constant variance, and zero covariance with the v_i corresponding to other countries. In equation (3), in addition, it is assumed that the period effect (e_t) has zero mean, constant variance, zero covariance with the e_t belonging to different time periods, and orthogonality with respect to v_i.

$$u_{it} = v_i + e_{it} \tag{2}$$

$$u_{it} = v_i + e_t + e_{it} \tag{3}$$

The model in equation (1) is then estimated using four different procedures: one-way fixed effects, two-way fixed effects, one-way random effects, and two-way random effects. The model with the basic set of control variables is appended with regional dummies for Latin America (Lad), Asia (Asd), and Africa (Afd), and with a dummy (Iup) that takes on value 1 if the Gini coefficient has increased from the previous to the current cross-section. The regional dummies allow controlling for the usual sensitivity found on the coefficient corresponding to inequality in other studies and the increased-inequality dummy (Iup) is used to test the U-shaped relationship postulated by Banerjee & Duflo (2000a, b).

III. Results

To test the data, a cross-section estimation of the model in equation (1) is performed for 1980, which provides the largest cross-sectional sample. As shown in Table 2, results from this regression are quite consistent with what has been found in the literature. The first column of the table indicates that the basic set of control variables yields a negative and significant effect of inequality on growth, while the second makes it evident that the level and significance of this coefficient is sensible to the introduction of regional dummies.

For a smaller sub-sample[7], in the third column the increased-inequality dummy (Iup) is added to the basic model with the consequence that its inclusion lowers the level and significance of the coefficient for the Gini in a higher proportion than the regional dummies do. This is an indication of the importance of considering movements in the level of inequality in this type of model. Interestingly, the increased-inequality dummy shows a positive and significant relationship with growth. If the Gini is dropped (fourth column), the level and significance of the increased-inequality dummy augment implying that the Gini still captures some effects of inequality on growth and that both variables should belong to the model. Finally, in the fifth and sixth columns the regional dummies are added again and as a consequence, the level and significance of the increased-inequality dummy fall. This result may indicate that nonetheless the increased-inequality dummy plays an interesting role in the model, it is not immune to the effect of other forces that

[7] Since not all countries allow to construct the variable Iup.

are captured via the regional dummies; i.e. as in the case of the Gini, its explanatory power is not so high as to remain significant.

Table 2. *Regression Results: Estimates for the 1980 Cross-Section*

Variable	Alternative Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.0365	0.0100	-0.0050	-0.0222	-0.0259	-0.0247
	(2.70)	(0.84)	(-0.29)	(-1.79)	(-2.14)	(-1.94)
Income	-0.0049	0.0026	0.0040	0.0059	0.0086	0.009
	(-1.55)	(0.87)	(0.98)	(1.50)	(2.37)	(2.34)
Gini	-0.0005	-0.0004	-0.0002			-0.0001
	(-2.62)	(-1.92)	(-1.35)			(-0.39)
PPPI	-0.0000	-0.0001	-0.0000	-0.0000	-0.0001	-0.0001
	(-0.72)	(-1.61)	(-0.54)	(-0.70)	(-1.23)	(-1.27)
Feduc	-0.0132	-0.0034	-0.0179	-0.0193	-0.0068	-0.0071
	(-3.41)	(-0.95)	(-4.28)	(-4.68)	(-1.96)	(-1.96)
Meduc	0.0158	0.0051	0.0175	0.0192	0.0064	0.0066
	(4.00)	(1.35)	(4.49)	(5.14)	(1.97)	(1.97)
Iup			0.0074	0.0082	0.0045	0.0050
			(2.17)	(2.42)	(1.66)	(1.65)
Lad		-0.0035			-0.0065	-0.0050
		(-0.83)			(-2.20)	(-1.08)
Asd		0.0136			0.0119	0.0125
		(3.62)			(4.23)	(3.92)
Afd		0.0112			0.0077	0.0098
		(1.84)			(1.27)	(1.19)
Obvs.	41	41	34	34	34	34
R^2	0.51	0.73	0.55	0.51	0.82	0.82

Dependent variable: average real per capita GNP growth; t-statistics in parentheses

Table 3 reports panel estimates for different model specifications under various estimation techniques. Unlike what was done for the 1980 cross-section, here it is not possible to use the regional dummies since the system becomes unfeasible to solve. The table includes results from all estimation techniques that passed the corresponding specification tests. It should be noted that only one random effects specification passed the test (a Hausman test in this case). This implies that, overall, the variation in the model should be attributed to within country variation and that cross-country variation has limited capability to render significant estimates.

Table 3. *Regression Results: Alternative Panel Estimations*

	One-Way		Two-Way	One-Way		Two-Way	
Estimation Method	Fixed Effects	Random Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	0.0241	0.0129	0.0198	0.0430	0.0584	0.0349	0.0467
	(1.22)	(1.09)	(0.83)	(1.67)	(2.39)	(1.15)	(1.60)
Income	-0.0136	-0.0005	-0.0125	-0.0212	-0.0188	-0.0178	-0.0158
	(-2.15)	(-0.16)	(-1.64)	(-2.50)	(-2.23)	(-1.81)	(-1.62)
Gini	0.0003	0.0001	0.0003	0.0004		0.0003	
	(2.02)	(1.24)	(1.76)	(1.78)		(1.37)	
PPPI	-0.0001	-0.0001	-0.0001	-0.0002	-0.0002	-0.0001	-0.0001
	(-4.35)	(-4.61)	(-2.55)	(-5.05)	(-5.10)	(-3.37)	(-3.45)
Feduc	-0.0067	-0.0077	-0.0063	-0.0072	-0.0084	-0.0088	-0.0100
	(-1.75)	(-2.46)	(-1.60)	(-1.51)	(-1.79)	(-1.80)	(-2.09)
Meduc	0.0068	0.0062	0.0007	0.0080	0.0081	0.0103	0.0108
	(1.85)	(2.11)	(1.78)	(1.76)	(1.79)	(2.17)	(2.26)
Iup				-0.000	0.0013	-0.0000	0.0010
				(-0.01)	(1.13)	(-0.02)	(0.82)
# Ctries.	52	52	52	46	46	46	46
Obvs.	225	225	225	179	179	179	179
R^2	0.67	0.13	0.69	0.70	0.69	0.72	0.71

Dependent variable: average real per capita GNP growth; t-statistics in parentheses
Five-year panel, 1960-1995

The one-way-fixed effects estimation of the basic model (column 1) shows a positive and significant correlation between inequality and growth giving support to Forbes' results. However, the same model when estimated using one-way-random effects (column 2) and two-way-fixed effects (column 3), shows a drop in the level of significance for the coefficient. Hence, there is a reversal of sign for the coefficient on inequality when one passes from the cross section estimation to the panel estimation. Nonetheless, the significance of the coefficient is unstable across panel estimation methods.

When, in columns 4 to 7, the increased-inequality dummy is included in the model, the significance of the coefficient on the Gini drops but, unlike what happens in the cross-section showed before, its value increases in one case (column 4) and stays constant in the other (column 6). In contrast to what happens in the cross-section case, the increased-inequality dummy is never significant in the panel estimation and its sign switches depending on whether or not the Gini is included in the regression.

Up to this point, it is not entirely clear that this empirical exercise decisively supports the idea that inequality and growth are positively correlated. However, it does not appear to lend support for the proposition that there is an U-shaped relationship between changes in inequality and growth.

To further explore the issue and test the sensitivity of the results above, Table 2.A (in the appendix) presents estimated values for the coefficients on the Gini and on the increased-inequality dummy obtained from the base dataset with ten-year breaks (bottom panel in the table) and from the alternative dataset that uses income data from the Penn World Tables (with five-year and ten-year breaks). As in the case of the results from the basic dataset, Table 2.A reports estimates coming from all estimation techniques that passed the corresponding specification tests.

A first difference to be noted is that in this case a larger number of models estimated by means of random effects techniques turned out to be appropriate. However, they tend to produce non-significant coefficients for the Gini. Results from fixed effects estimation tend, again, to show a positive and significant correlation between inequality and growth when the basic model is used and the data correspond to the ten-year breaks datasets. In contrast, the five-year breaks alternative dataset shows estimates that are not significant, although the one corresponding to the two-way estimation is better. This result is surprising since the only variation with respect to the estimates reported in Table 3 is the source for the income data.

Also, within the fixed effects estimation, and consistently with what happened in the base case, when the increased-inequality dummy is included the significance of the coefficient for the Gini decreases. Nonetheless, its impact on the level of the coefficient is mixed, rising sometimes, diminishing in others, and remaining constant in others. Finally, in all cases the coefficient for the increased-inequality dummy is non-significant.

In general terms, it can be said that the results arising from the alternative datasets tend to support those reported for the basic dataset in Table 3. Consequently no overwhelming evidence is found in favor of the existence of a positive correlation between inequality and growth and basically no support is obtained for either the proposition that changes in inequality (in either direction) and growth have a U-shaped relationship or that there is a negative relationship between inequality and growth.

Final Comments

As mentioned, the empirical exploration on the relationship between income inequality and growth carried out in this paper does not lend broad support for the hypothesis that inequality is positively correlated with growth. Even more clearly, it does not support the idea that there exists an U-shaped relationship between changes in inequality and growth. However, and more importantly, no evidence is found of a negative correlation as has been most commonly proposed in the literature on the topic. If a "conclusion" would be forced out of this exercise, it would pinpoint that here there is virtually no panel estimation evidence of a negative correlation between inequality and growth and that a relatively weak but suggestive support is found for the opposite hypothesis.

Finally, the frequent rejection of random effects estimation, that can be considered relatively close to cross-section estimation, should be regarded as evidence that the omitted variables issue is of consideration and that valuable information is to be learned from single-country time series analysis, when this type of data will become available. In the meantime country case studies can be illuminating in unveiling the relationship between inequality and growth regardless as to whether or not a systematic pattern can be found across countries.

Appendix

Table 1.A. *List of Countries, Number of Observations, and Periods Covered*

Country	Obs.	Period *	Country	Obs.	Period *
Australia	6	1965-1990	Korea	7	1960-1990
Bangladesh	6	1965-1990	Malaysia	5	1970-1990
Belgium	3	1980-1990	Mauritius	3	1980-1990
Brazil	5	1970-1990	Mexico	7	1960-1990
Canada	6	1965-1990	Nepal	2	1980-1985
Chile	3	1980-1990	Netherlands	4	1975-1990
China	3	1980-1990	New Zealand	2	1985-1990
Colombia	6	1965-1990	Norway	6	1965-1990
Costa Rica	5	1970-1990	Pakistan	3	1980-1990

Continue...

Dom. Rep.	2	1985-1990	Peru	7	1960-1990
El Salvador	3	1960-1970	Philippines	3	1960-1970
Finland	7	1960-1990	Portugal	2	1975-1980

Table 1.A. *Continued*

Country	Obs.	Period *	Country	Obs.	Period *
France	6	1960-1985	Sierra Leone	2	1970-1975
Greece	2	1975-1980	Singapore	5	1970-1990
Guatemala	3	1980-1990	South Africa	2	1960-1965
Honduras	2	1985-1990	Spain	6	1965-1990
Hong Kong	5	1970-1990	Sri Lanka	7	1960-1990
Hungary	3	1980-1990	Sweden	6	1965-1990
India	7	1960-1990	Thailand	6	1965-1990
Indonesia	6	1965-1990	Trinidad	5	1960-1980
Ireland	2	1975-1980	Tunisia	7	1960-1990
Italy	4	1975-1990	Turkey	2	1970-1975
Jamaica	2	1970-1975	UK	2	1985-1990
Japan	7	1960-1990	USA	7	1960-1990
Jordan	3	1980-1990	Venezuela	6	1965-1990
Kenya	2	1975-1980	Zambia	2	1970-1975

* Periods are labeled based on the first year of the time period (for example 1990 indicates that the control variables in the model belong to the period 1985-1990 and to the year that is closest to 1990, while the growth rate covers the years 1990 to 1995)

Table 2.A *Regression Results: Sensibility of the Basic Results to Different Datasets*

	Alternative dataset: Five-year Panel 1960-1990							
Estimation Method	One-Way Fixed Effects	Two-Way Fixed Effects	One-Way Fixed Effects	One-Way Random Effects	Two-Way Fixed Effects	One-Way Fixed Effects	One-Way Random Effects	Two Way Fixed Effects
Gini	0.0002	0.0004	0.0002	-0.0001	0.0003			
	(0.92)	(1.83)	(0.78)	(-0.50)	(1.03)			
Iup			0.0017	0.0026	0.0011	0.0024	0.0023	0.0020
			(1.01)	(1.79)	(0.61)	(1.70)	(1.73)	(1.38)

Continue...

# Ctries.	55	55	44	44	44	44	44	44
Obvs.	213	213	159	159	159	159	159	159
R^2	0.58	0.63	0.62	0.14	0.63	0.62	0.14	0.63

Table 2A. *Continued*

Alternative dataset: Ten-year Panel 1960-1990					
Estimation Method	One-Way		Two-Way	One-Way	
	Fixed Effects	Random Effects	Fixed Effects	Random Effects	Random Effects
Gini	0.0005	0.0002	0.0006	-0.0003	
	(2.26)	(1.24)	(2.54)	(-1.29)	
Iup				0.0078	0.0063
				(2.66)	(2.26)
# Ctries.	37	37	37	17	17
Obvs.	91	91	91	34	34
R^2	0.78	0.21	0.79	0.32	0.29

Original dataset: Ten-year Panel 1960-1995								
Estimation Method	One-Way		Two-Way		One-Way		Two-Way	
	Fixed Effects	Random Effects	Fixed Effects	Random Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
Gini	0.0005	0.0003	0.0004	0.0003	0.0006		0.0004	
	(2.61)	(1.82)	(2.37)	(1.91)	(1.47)		(1.03)	
Iup					-0.0019	0.0007	-0.0012	0.0019
					(-0.71)	(0.34)	(-0.45)	(0.38)
# Ctries.	44	44	44	44	30	30	30	30
Obvs.	128	128	128	128	72	72	72	72
R^2	0.73	0.19	0.74	0.13	0.75	0.74	0.78	0.78

Dependent variable: average real per capita GNP growth; t-statistics in parentheses

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