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Inequality and Growth Revisited

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Asian Development Bank

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Abstract:

This paper updates and extends the work of Barro (2000). International data confirm the presence of the Kuznets curve—an inverse-U shape relationship between income inequality and per capita GDP—that is relatively stable from the 1960s into the 2000s. The direct effect of international openness on income inequality is also found to be positive. On the other hand, a cross-country-growth equation shows a negative effect of income inequality on economic growth, holding fixed a familiar set of other explanatory variables. This effect diminishes as per capita GDP rises and may be positive for the richest countries.

Keywords: Inequality, growth, Kuznets curve, Gini coefficient.

JEL Classifications: O4, I3.

I. Introduction

My previous study (Barro 2000) used panel data for many countries from 1960 to analyze the two-way interplay between income inequality and economic performance. The effect of real per capita gross domestic product (GDP) on inequality involved the well-known inverse-U-shaped relation known as the Kuznets curve. Starting from a low value, an increase in per capita GDP tended to raise inequality. But this relation eventually flattened out at sufficiently high per capita GDP, and further increases tended to reduce inequality.

The earlier study summarized theories, starting with Kuznets' analysis, for the presence of the Kuznets curve. The main idea is that economic development-including shifts from agriculture to industry and services and the adoption of new technologies-initially benefits mainly a minority of the population. As the new methods of production become widespread, the benefits from economic development are shared more evenly, and higher per capita GDP tends to reduce inequality.

At an empirical level, my previous results confirmed the presence of the Kuznets curve across countries and over time. However, the curve did not explain a large fraction of the observed variation in income inequality.

The second direction of effect involved the impact of income inequality on rates of economic growth. My discussion summarized existing economic theories of this relation, with a focus on four major features: credit-market imperfections, political economy, social unrest, and saving rates. These theories did not produce clear empirical predictions for the overall effect of income inequality on economic growth. I studied the relation, empirically employing a cross-country regression framework. The regressions included as explanatory variables the initial levels of per capita GDP, health, and school attainment, along with several other variables. One conclusion was that the overall effect of income inequality on economic growth was weak and, often, statistically insignificantly different from zero. However, there was an indication that inequality was bad for growth in poor countries and good for growth in rich countries. These results could be interpreted from the perspective of some of the underlying theoretical models. In particular, the differing effects for poor and rich could reflect the greater impact of credit market restraints in poor countries.

The present analysis updates the previous cross-country research. In particular, I consider whether the relationships between income inequality and economic performance have changed along with developments that can be characterized as globalization. Particularly interesting here is whether international trade has a regular relationship with income inequality and whether this relationship has shifted over time. I also assess whether the Kuznets curve-relating inequality to the evolution of per capita GDP-has shifted in recent years.

II. Income-Inequality Data

Fortunately, there is now more and better international information on income inequality compared to the data available for my previous study—which relied on the World Bank's Deininger and Squire (1996) data set. The present work uses as its principal source the *World Income Inequality Database* from May 2007 compiled by the United Nations (UN). This data base builds on the Deininger-Squire compilation to include recent observations and to supplement the earlier data. My analysis uses only the UN data categorized as quality grades 1–3; that is, I exclude grade 4, labeled as memorandum items, which are viewed as unreliable. I add in high-quality Deininger-Squire (World Bank) data for country/year observations not covered by the UN.

Table 1 shows the evolution of income inequality for world averages from the 1960s to the 2000s. The table considers three standard measures of income inequality: the Gini coefficient; the share of income going to the lowest quintile of the income distribution and; the share going to the highest quintile. The Gini coefficient can be viewed as an average of deviations of quintile shares from 0.2, the value that holds under full equality. In the formula for the Gini coefficient, positive weights apply to upper-income shares and negative weights to lower-income shares.[1] Thus, a higher Gini (measured on a zero-to one scale) signifies more income inequality.

The (equally weighted) world average for the Gini coefficient stays close to 0.4, declining from 0.43 in the 1960s to 0.39 in the 2000s. The lowest-quintile income shares tell a similar story. The average share goes from 5.6% in the 1960s to 6.1% in the 2000s. For the upper-quintile share, the world average shows little trend, varying between 46% and 49%.

Table 2 shows means and standard deviations for some of the variables used in the subsequent analysis. The samples used in the table are dictated by the availability of income-inequality data (and correspond specifically to the regression system used in Table 3). The number of country observations goes from 54 in the 1960s to 77 in the 1970s, 90 in the 1980s, 120 in the 1990s, and 92 in the 2000s (in which information is available through 2004).

The income-inequality data derive from surveys or other information sources that differ by concept. Two important distinctions are whether the underlying economic definition corresponds to income or consumer spending, and on whether the income figures are gross or net of taxes. Empirically, patterns of inequality differ particularly as to whether the data cover gross income, on the one hand, versus net income or expenditure, on the other Table 2 shows that the breakdown by type varied over time—37% of the observations applied to net income or spending in the 1960s, compared with 67% in the 2000s. Another distinction is whether the underlying economic unit is an individual versus a household or family. In the 1960s, 37% of the observations were for individuals, compared with 83% in the 2000s.

Table 2 also shows statistics for variables used in the subsequent regressions. These variables are dummies for sub-Saharan Africa and Latin America, a dummy for being a former colony, and an international-openness variable (the ratio to GDP of exports plus imports, filtered for the usual effect on trade from country size).

III. Estimated Kuznets Curves

Table 3 shows results for regression systems intended to estimate Kuznets curves. The dependent variables are measures of income inequality—the first three columns have Gini coefficients, the next has the lowest quintile share, and the last has the highest quintile share. The equations are for five time periods; the dependent variable for the first period is around 1965, and so on for the other periods.

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[1] If Qi is the income share for quintile i, and if we assume that each agent within each quintile has the same income, the Gini coefficient can be expressed as $GINI = 0.4 \cdot [2 \cdot (Q5-0.2) + (Q4-0.2) - (Q2-0.2) - 2 \cdot (Q1-0.2)]$.

The results in columns 1 and 2 show the usual Kuznets relationship—a significantly positive effect on the Gini coefficient from the log of per capita GDP and a significantly negative effect from the square of the log of per capita GDP. In these systems, per capita GDP applies in 1960 for the first period, and so on for the other periods. Column 1 includes as additional regressors only the two definitional variables mentioned before. The dummy for net income or expenditure has significantly negative coefficients. That is, gross income shows significantly more measured inequality—because taxes tend to be equalizing (and, perhaps, because consumption is smoother than income). The dummy for individual observations is also negative and sometimes statistically significant. That is, households show somewhat more inequality than persons.

Column 3 of Table 3 adds in some regressors that turn out to have considerable explanatory power for income inequality. The dummies for sub-Saharan Africa and Latin America are significantly positive and large in size. That is, these regions exhibit substantially more income inequality than other places, for given per capita GDP. The dummy for a former colony is also significantly positive.

The results in Table 3, column 2 show that the openness variable has a significantly positive coefficient, though the effect is not large in magnitude. A one-standard-deviation increase in the openness variable (by 0.4; see Table 2) tends to raise the Gini coefficient by about 0.01, compared to the sample standard deviation of the Gini coefficient of around 0.10 (see Table 2).[2] Thus, there is evidence that, for given per capita GDP, more trade creates more income inequality. However, this result does not consider that trade also affects economic growth, as explored later, and thereby affects levels of per capita GDP. The effects on per capita GDP have to be considered to estimate the full impact of trade on income inequality. Moreover, if trade raises per capita GDP (as the later evidence indicates) trade can increase inequality while simultaneously lowering poverty (defined as the number of persons below a given level of real income).

Figure 1 uses the results from Table 3, column 2 to depict the partial relation between the Gini coefficient and the log of per capita GDP. The inverted-U relation follows from the estimated pattern of coefficients—positive on the log of per capita GDP and negative on its square. The derivative of the Gini coefficient with respect to the log of per capita GDP is given from the estimated coefficients as 0.292 - 0.0364*log(GDP), where GDP is now a shorthand for real per capita GDP. Therefore, the effect is positive for log(GDP) less than 8.02—or per capita GDP below $3,050 (in 2000 US dollars)—and then becomes positive. Note from Table 2 that this break point is well below the sample mean for log(GDP) of around 8.5. The majority of observations are in the range where higher per capita GDP leads to lower income inequality.

The estimates in Table 3 include separate intercepts for each time period. For the specification in column 2, the intercepts—expressed relative to that for the 1960s—are -0.011 (s.e. = 0.012) for the 1970s, -0.018 (0.013) for the 1980s, 0.012 (0.014) for the 1990s, and 0.006 (0.014) for the 2000s. A test that these values are jointly equal to zero (so that a single intercept applies from the 1960s to the 2000s) has a p-value of 0.011. Therefore, a common intercept is rejected at conventional significance levels. However, the results do not show quantitatively important variations in the intercept over time. Therefore, there is no indication that income inequality has

[2] The filtering for country population and area in the construction of the openness variable eliminates the part of trade that arises naturally in response to variations in country size. The results support the idea that openness matters for inequality relative to this natural openness, rather than in an absolute sense. If the openness ratio (exports plus imports relative to GDP) is also entered into the regression system, the coefficient on this ratio is -0.034 (s.e. = 0.022), which differs insignificantly from zero. The coefficient of the openness variable remains significantly positive: 0.064 (0.028).

been changing much, for given values of per capita GDP, international openness, and the other explanatory variables.

We can also consider whether the Kuznets coefficients—on log(GDP) and its square—have been varying over time. In this case, the hypothesis of equal coefficients for the five time periods has a p-value of 0.12. Therefore, stable coefficients would be accepted at conventional significance levels. However, the point estimates for the 2000s are notably high; 0.49 (s.e. = 0.09) on log(GDP) and -0.029 (0.005) on its square, compared to the overall values of 0.29 (0.06) and -0.018 (0.003) in Table 3, column 2. Therefore, there is an indication that Kuznets effects are particularly important in recent years.

We can similarly assess the stability of the effect of the international-openness variable on income inequality. In this case, the hypothesis of equal coefficients for the five periods has a p-value of 0.96. Hence, the data clearly accord with stability in this effect. That is, there is no indication that income inequality has become more sensitive over time to the extent of international trade.

Even with a stable coefficient on the international-openness variable, the rising trade share from the 1960s to the 2000s would have contributed, on its own, to rising income inequality. Table 2 shows that the mean of the openness ratio rose from 0.47 in the 1960s to 0.87 in the 2000s. This sharp expansion of trade generated an increase in the mean of the openness variable (which includes adjustments for country size) from 0.02 in the 1960s to 0.39 in the 2000s. With the coefficient of 0.026 on the openness variable in the Gini-coefficient system (Table 3, column 2), this rise in trade implies an increase in the estimated average Gini coefficient by about 0.01 (compared to the sample mean of around 0.40 and standard deviation of 0.10 in Table 2).

This small predicted effect of rising trade on income inequality is not the full story. If enhanced trade leads to faster economic growth, as discussed later, the trade expansion would lead, over time, to higher average levels of per capita GDP. Because the majority of countries are in the range of the Kuznets curve where higher per capita GDP lowers income inequality, this effect would tend to reduce the average Gini coefficient. Hence, an expansion of world trade need not generate greater world income inequality. This result is consistent with the observation from Table 2 that the sample average of the Gini coefficients has fallen somewhat from the 1960s to the 2000s.

The estimates discussed thus far used intercepts that varied over time but did not introduce separate intercepts for each country (although the error terms in the regressions were allowed to be correlated over time within country). Table 3, column 3 introduces country fixed effects; that is, a separate intercept for each country. This specification necessarily drops any explanatory variables that remain constant over time within a country—these variables from column 2 are the dummies for sub-Saharan Africa and Latin America and the dummy for former colony.

The coefficient estimates in column 3 show the usual Kuznets pattern: significantly positive for the log of per capita GDP and significantly negative for its square. A difference compared with columns 1 and 2 is that the magnitudes of the fixed-effects coefficients are smaller. This difference likely arises because the fixed-effects estimates isolate short-term variation over time within countries, whereas the estimates without fixed effects tend to pick up longer-run responses. In the fixed-effects case, the estimated breakpoint between positive and negative marginal effects of log(GDP) on the Gini coefficient occurs at 7.56, compared to the higher value of 8.02 from the specification in Table 3, column 2. According to the fixed-effects results, the marginal impact of higher per capita GDP on the Gini coefficient is negative for per capita GDP greater than $1,920 (In 2000 US dollars). Hence, even a greater majority of observations are in the range in which more prosperity means less income inequality.

Columns 4 and 5 of Table 3 show estimated Kuznets curves when inequality is gauged by the share of income accruing to either the lowest or highest quintile of the income distribution. These results are similar to those from before in that, initially, higher per capita GDP generates more inequality in the sense of a higher Gini coefficient (column 2), a lower income share for the lowest quintile (column 4), and a higher income share for the highest quintile (column 5). Subsequently, all of these effects reverse sign.

IV. Inequality as a Determinant of Economic Growth

Table 4 uses cross-country growth regressions to assess the effects of income inequality on economic growth. The analysis considers determinants of growth rates of per capita GDP over four periods: 1965–75, 1975–85, 1985–95, and, depending on the availability of recent GDP data, from 1995 to 2003 or 2004. The results in column 1 omit consideration of income inequality, whereas those in columns 2 and 3 include Gini coefficients as measures of income inequality. The sample sizes correspond to the availability of data on Gini coefficients and are, therefore, the same for all three cases.

The right-hand sides of the regressions comprise explanatory variables that are familiar from the conditional-convergence framework.[3] The results in Table 4, column 1 show the usual significantly negative effect from the initial log of per capita GDP. Thus, holding fixed the other explanatory variables, countries tend to grow faster if they start poorer. Initial health (proxied by life expectancy at age one) has a significantly positive effect, and initial upper-level school attainment of males has a positive but statistically insignificant effect. As already mentioned, the openness variable has a significantly positive effect on growth rates. Changes in the terms of trade have a positive but statistically insignificant effect. The fertility rate has a significantly negative effect, and the investment ratio has a positive but statistically insignificant effect.

Column 2 of Table 4 adds to the regressions of the Gini coefficient. This variable applies around 1965 to the growth equation for 1965–75, and so on for the other periods. The estimated coefficient, -0.036 (s.e. = 0.014), is significantly negative. This result contrasts with my earlier findings in Barro (2000), in which the income-inequality variable had an insignificant effect in this type of regression system. The present estimated coefficient of -0.036 implies that a one-standard-deviation increase in the Gini coefficient reduces the growth rate on impact by about 0.4% per year.

Column 3 of Table 4 adds an interaction term between the Gini coefficient and the log of per capita GDP. The Gini variable is still significantly negative. The significantly positive coefficient on the interaction term indicates that the impact of inequality on growth is most negative for the poorest countries. This effect attenuates as per capita GDP rises. Eventually—at a per capita GDP of $11,900 (in 2000 US dollars)—the estimated effect of inequality on growth becomes positive. These results resemble my earlier findings in the sense of revealing that inequality is bad for growth in poor countries and good for growth in rich countries. However, the break point is now at a higher value of per capita GDP. Thus, for most of the sample, the estimated effect of

[3] See Barro (1991) and Barro and Sala-i-Martin (2004) Chapter 12.

inequality on growth is now in the negative range. This result accords with the significantly negative inequality coefficient shown in column 2, which omitted an interaction term with GDP.

Figures 2 and 3 depict the results graphically. Figure 2, based on Table 4, column 2, shows the average partial effect of the Gini coefficient on growth. (The effect is partial in the sense of holding fixed the influences of the other explanatory variables contained in the system.) Consistent with the statistically significant negative coefficient, the relation is negative. However, it is also clear from Figure 2 that variations in income inequality do not account for a lot of the variations in growth rates.

Figure 3 uses the results from Table 4, column 3 to show the partial relation between growth and the Gini coefficient for two ranges of per capita GDP. The left panel is for per capita GDP less than \$11,900, the break point implied by the estimated coefficients. The negative relation between growth and inequality shows up in this range. The right panel applies for per capita GDP above \$11,900. There are many fewer observations in the right panel compared to the left one (69 versus 185) because, as mentioned, the majority of the country-period observations fall in the interval where greater inequality is estimated to reduce growth. The pattern in the right panel also makes clear that there is little evidence for a range of positive effect of inequality on growth. Rather, the main indication is that the negative effect of inequality on growth does not apply for rich countries.

De Gregorio and Lee (2004) argue that, in addition to direct effects, income inequality affects economic growth indirectly by influencing other determinants of growth. In particular, they find that more inequality tends to raise fertility and lower secondary school enrollment and the rule of law. Through these channels, greater income inequality would lower economic growth by more that the direct effect already discussed. I have investigated some of the indirect channels discussed by De Gregorio and Lee (2004). I find that income inequality (gauged by the Gini coefficient) has a positive effect on the log of the total fertility rate, but the coefficient is not statistically significant at conventional levels. Combining the point estimate of this coefficient with the estimated effect of the fertility variable on economic growth (Table 4, column 2) leads to an indirect effect of inequality on growth that is minor compared to the direct effect (-0.001, versus a direct effect of -0.036).

I find that inequality has a significantly negative effect on male upper-level school attainment, the variable used in Table 4. However, male upper-level school attainment has a small and statistically insignificant effect on economic growth, once income inequality is held constant (Table 4, column 2). Hence, this indirect channel produces little.

I found a negligible and statistically insignificant effect of income inequality on the rule of-law indicator, which enters as a growth determinant in Table 4. Therefore, the inclusion of a rule-of-law channel adds little.

I also considered the interplay between income inequality and health—a channel not considered by De Gregorio and Lee (2004). There is some indication that higher income inequality leads to lower life expectancy; that is, to a higher value of the reciprocal of life expectancy, the variable used in Table 4. However, the coefficient is not statistically significant at conventional levels. Combining the point estimate of this coefficient with the estimated effect of the life-expectancy variable on economic growth (Table 4, column 2) generates an indirect effect of inequality of growth that is minor compared to the direct effect (-0.002 versus -0.036).

The conclusion is that I get little overall effect from the various indirect channels considered. The main impact of income inequality on economic growth seems to be the direct effect shown in Table 2.

V. Concluding Observations

International data show that the Kuznets curve is a clear empirical phenomenon. Income inequality first rises but subsequently declines with per capita GDP. The range of declining inequality covers the majority of country-time observations. The Kuznets curve is reasonably stable from the 1960s through the 2000s. However, this curve does not explain the bulk of the observed variation in income inequality across countries or over time.

The direct effect of international openness on income inequality is positive. The coefficient that captures this effect is stable over time. With a fixed coefficient, the expansion of world trade since the 1960s translates into a larger influence on inequality in the 2000s, relative to earlier decades. However, the contribution is still modest, compared to the mean and standard deviation of observed income-inequality measures.

Because trade stimulates economic growth, there is also an indirect effect of trade on inequality, involving rising levels of per capita GDP. This channel reduces income inequality over time in most countries. Moreover, the increases in per capita GDP mean that enhanced trade can lower poverty even if income inequality rises.

A cross-country-growth framework reveals a negative effect from income inequality on economic growth, holding fixed a familiar set of other explanatory variables. This effect of inequality on growth diminishes as per capita GDP rises and may be positive for the richest countries. Other findings are familiar from previous empirical studies. In particular, there is conditional convergence in the sense that poor countries grow faster, holding fixed a set of explanatory variables. Growth is particularly encouraged by greater international openness, higher life expectancy, better rule of law, and lower fertility.

Table 1: Evolution of Inequality Measures, 1960s–2000s

Variable	1960s	1970s	1980s	1990s	2000s
Gini Coefficient	0.43	0.41	0.39	0.41	0.39
Lowest quintile share	0.056	0.056	0.060	0.056	0.061
Highest quintile share	0.483	0.468	0.467	0.493	0.465

Notes: Data are from United Nations, World Income Inequality Data Base, and Deininger and Squire (1996). Averages give equal weight to each country with available data. The samples correspond to those used in Tables 2 and 3.

Table 2: Means and Standard Deviations of Variables

Variable	1960	1970	1980	1990	2000
Gini coefficient	0.43 (0.10)	0.41 (0.10)	0.39 (0.11)	0.41 (0.11)	0.39 (0.10)
Lowest quintile share*	0.056 (0.021)	0.056 (0.021)	0.060 (0.024)	0.056 (0.024)	0.061 (0.024)
Highest quintile share*	0.48 (0.08)	0.47 (0.08)	0.47 (0.09)	0.49 (0.10)	0.47 (0.08)
Dummy for net income or expenditure	0.37	0.44	0.68	0.77	0.67
Dummy for individual	0.37	0.38	0.72	0.91	0.83
log(per capita GDP)	8.11 (0.90)	8.38 (0.99)	8.52 (1.04)	8.48 (1.13)	8.88 (1.02)
Dummy for Sub- Saharan Africa	0.074	0.17	0.22	0.26	0.13
Dummy for Latin America	0.28	0.25	0.24	0.18	0.23
Dummy for former colony	0.67	0.68	0.69	0.66	0.51
Openness ratio	0.47 (0.44)	0.63 (0.44)	0.67 (0.49)	0.77 (0.50)	0.87 (0.51)
Openness variable	0.02 (0.33)	0.14 (0.32)	0.19 (0.38)	0.29 (0.40)	0.39 (0.43)
No. observations	54	77	90	120	92

*Numbers of observations for lowest quintile share for the various periods are 47, 65, 81, 117, and 81. Numbers for highest quintile share are 41, 57, 77, 115, and 81.

Notes: Sample periods correspond to those from the regression system in Table 3, column 2. Each cell shows the mean, with the standard deviation in parentheses. Gini coefficients and quintiles shares (from United Nations, World Income Inequality Data Base, and World Bank, Deininger and Squire Income Inequality Data Base) are observed near to the middle of each decade. Real per capita GDP (in 2000 US dollars from Penn-World Tables) is at the start of each decade. Dummy for net income or expenditure signifies that income inequality is computed from an income concept based on income net of taxes or on consumer expenditure, rather than gross income. Dummy for individual means that the economic unit is an individual, rather than a household or family. Openness ratio (from Penn-World Tables and World Bank, World Development Indicators or WDI) is the ratio of exports plus imports to GDP. The openness variable filters the openness ratio for the estimated effects from the logs of country population and area (data from WDI). (This filtering takes out an overall constant term but not the individual intercepts for each period.) The values are averages for each decade.

Table 3: Regression Results for Income Inequality (Kuznets curves)

Explanatory variable	Dependent Variable (1)	Gini coefficient (2)	Country fixed effects (3)	Lowest Quintile (4)	Highest Quintile (5)
log(per capita GDP)	0.266** (0.066)	0.292** (0.058)	0.183** (0.067)	-0.063** (0.014)	0.229** (0.050)
log(per capita GDP) squared	-0.0179** (0.0039)	-0.0182** (0.0034)	-0.0121** (0.0040)	0.0037** (0.0008)	-0.0143** (0.0029)
Dummy net income/expend.	-0.0543** (0.0091)	-0.0393** (0.0082)	-0.0426** (0.0080)	0.0100** (0.0020)	-0.0443** (0.0075)
Dummy individual	-0.0188 (0.0099)	-0.0173* (0.0087)	-0.0215* (0.0085)	0.0075** (0.0022)	-0.0095 (0.0080)
Dummy sub-Saharan Africa	--	0.092** (0.014)	--	-0.0217** (0.0034)	0.090** (0.013)
Dummy Latin America	--	0.085** (0.013)	--	-0.0187** (0.0031)	0.066** (0.011)
Dummy former colony	--	0.049** (0.011)	--	-0.0101** (0.0028)	0.0374** (0.0095)
Openness variable	--	0.026* (0.011)	0.014 (0.019)	-0.0012 (0.0026)	0.0154 (0.0089)
Number of observations	54, 78, 91 123, 94	54, 77, 90 120, 92	54, 78, 91 121, 93	47, 65, 81 117, 81	41, 57, 77 115, 81
R-squared	.14, .18,.24 .27, .47	.35, .39, .59 .57, .66	--	.17, .45, .50 .53, .60	.40, .45, .60 .58, .71
s.e. of regression	.092 .093 .096 .098 .073	.080 .081 .070 .075 .059	.054 .047 .044 .070 .046	.019 .016 .017 .016 .015	.065 .062 .054 .066 .045

*Significant at 5% level
**Significant at 1% level

Notes: See Table 2 for definitions and sources of variables. Dependent variables are Gini coefficients, lowest quintile income shares, or highest quintile income shares, as indicated. Panel systems cover 1960s, 1970s, 1980s, 1990s, and 2000s. Coefficients were estimated by seemingly-unrelated-regression technique. Standard errors of coefficients are in parentheses. Each period has an individual intercept (not shown). For the regression system in column 2, the estimated intercepts, expressed relative to that for the 1960s, are -0.011 (s.e. = 0.012) for the 1970s, -0.018 (0.013) for the 1980s, 0.012 (0.014) for the 1990s, and 0.006 (0.014) for the 2000s. A test that these four relative intercepts are jointly zero has a p-value of 0.011. The system in column 3 includes country fixed effects.

Table 4: Regressions for Economic Growth

Explanatory variable	(1)	(2)	(3)
log(per capita GDP)	-0.0248** (0.0029)	-0.0228** (0.0029)	-0.0359** (0.0057)
1/(life expectancy at age one)	-4.02** (1.10)	-4.04** (1.07)	-3.23** (1.08)
upper-level school attainment (years)	0.0022 (0.0015)	0.0013 (0.0015)	0.0016 (0.0014)
openness variable	0.0100** (0.0034)	0.0103** (0.0033)	0.0091** (0.0032)
terms-of-trade change	0.112 (0.066)	0.120 (0.064)	0.109 (0.064)
Rule-of-law indicator	0.0251** (0.0065)	0.0260** (0.0064)	0.0275** (0.0064)
log(total fertility rate)	-0.0173** (0.0050)	-0.0111* (0.0054)	-0.0133* (0.0052)
investment ratio	0.034 (0.025)	0.032 (0.024)	0.035 (0.024)
Gini coefficient	--	-0.036** (0.014)	-0.297** (0.098)
(Gini coefficient)* log(per capita GDP)	--	--	0.0316** (0.0118)
Number of observations	47, 66 71, 70	47, 66 71, 70	47, 66 71, 70
R-squared	0.35, 0.50 0.44, 0.12	0.37, 0.49 0.43, 0.22	0.36, 0.50 0.48, 0.27
s.e. of regression	.015, .015 .018, .017	.015, .015 .018, .016	.015, .015 .017, .015

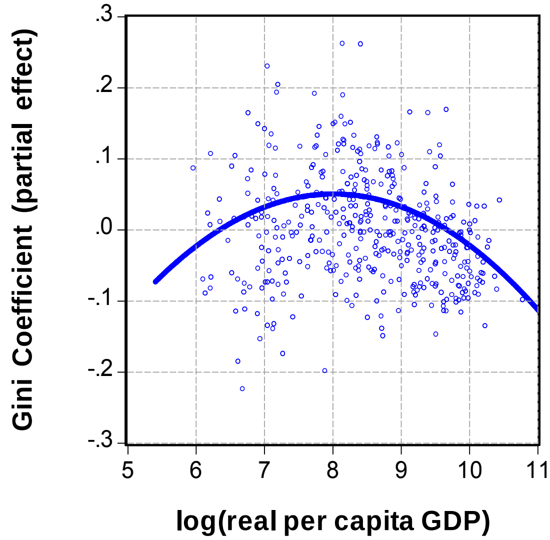
*Significant at 5% level
**Significant at 1% level

The dependent variable is the annual growth rate of real per capita GDP (from Penn-World Tables). Panel systems cover 1965-75, 1975-85, 1985-95, and 1995-2003/4. Coefficients were estimated by three-stage least-squares. Standard errors of coefficients are in parentheses. Each period has an individual intercept term (not shown). For the regression system in column 3, the estimated intercepts, expressed relative to that for 1965-75, are -0.0137 (s.e. = 0.0029) for 1975-85, -0.0134 (0.0038) for 1985-95, and -0.0164 (0.0044) for 1995-2003/4. A test that these three relative intercepts are jointly zero is rejected with a p-value of 0.000.

Explanatory variables observed as averages for the ten-year periods are the openness variable (described in Table 2), an indicator for the rule of law (from Political Risk Services), and the ratio of investment to GDP (from Penn-World Tables). Variables observed at the start of each ten-year period are the log of per capita GDP and the average years of school attainment of males at the secondary and higher levels (from Barro and Lee [2001]). Variables observed for 1960, 1970, 1980, and 1990 are the reciprocal of life expectancy at age one and the log of the total fertility rate (both from WDI). The terms-of-trade variable is the growth rate of the terms of trade (export prices relative to import prices, from International Monetary Fund) over the 10-year period, multiplied by the average over the same period of the openness ratio (exports plus imports as a ratio to GDP). For the first two periods, the rule-of-law variable is the earliest value available (from the early 1980s). The Gini coefficient (in columns 2 and 3) applies, as in Table 3, roughly to 1965, 1975, 1985, and 1995. For the interaction term (column 3), the log of per capita GDP is for the same years.

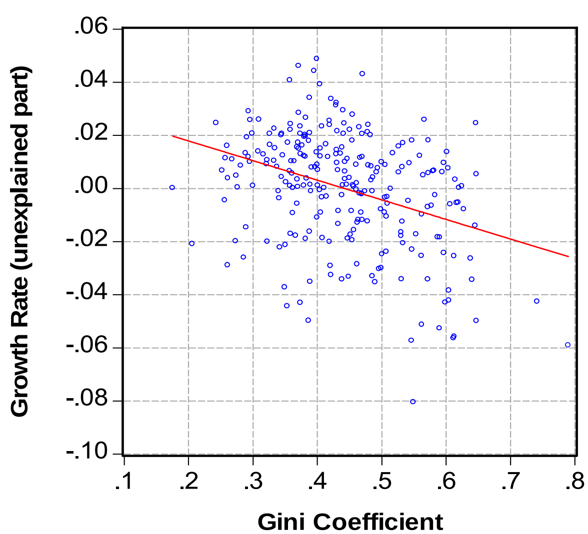
Instruments are five-year lagged values (applying to 1960, etc.) of the log of per capita GDP, the log of the total fertility rate, the rule-of-law variable (when available), and the investment ratio. In the interaction term for the Gini coefficient, the log of per capita GDP is for 1960, 1970, 1980, and 1990. For the other variables, the instruments coincide with the explanatory variables (applying to the start of each growth-rate period or to earlier times).

Figure 1: A Kuznets Curve: Effect of per capita GDP on Gini Coefficient



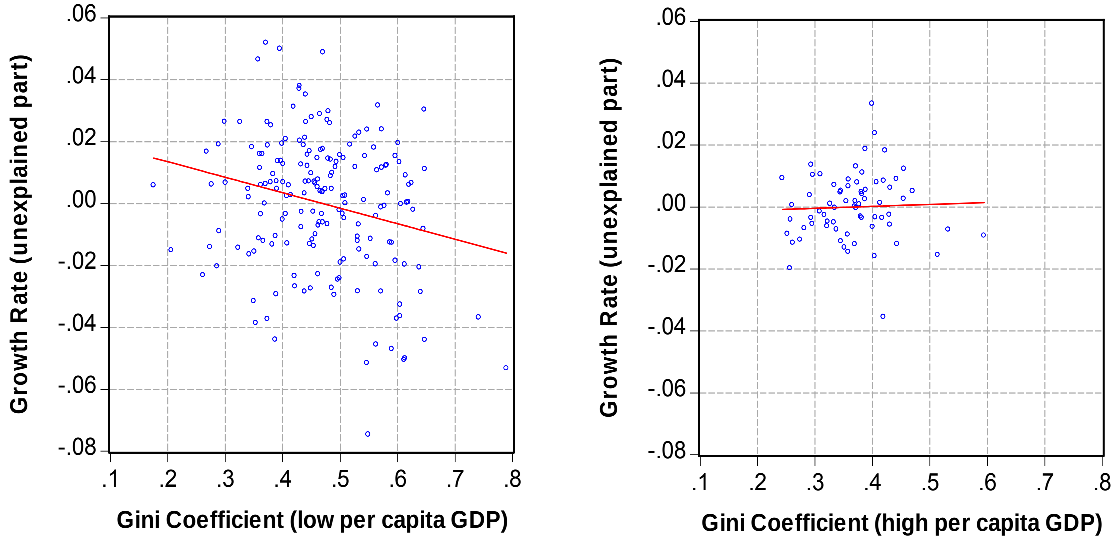
This graph corresponds to the regression system in Table 3, column 2. The curve shows the partial relation between the Gini coefficient and the log of per capita GDP, holding fixed the estimated effects of the explanatory variables other than the log of per capita GDP and its square.

Figure 2: Effect of Income Inequality on Economic Growth



This graph corresponds to the regression system in Table 4, column 2. The curve shows the partial relation between the growth rate of per capita GDP and the Gini coefficient, holding fixed the estimated effects of the explanatory variables other than the Gini coefficient. (The variable on the vertical axis has been normalized to have a mean of zero.)

Figure 3: Effects of Income Inequality on Economic Growth: Two Ranges of per capita GDP



These graphs correspond to the regression system in Table 4, column 3. The curves show the partial relation between the growth rate of per capita GDP and the Gini coefficient, holding fixed the estimated effects of the explanatory variables other than the Gini coefficient and its interaction with the log of per capita GDP. (The variables on the vertical axis have been normalized to have means of zero.) The left-side graph is for per capita GDP less than $11,900 (185 observations). The right-side graph is for per capita GDP greater than $11,900 (69 observations). The break point of $11,900 (in 2000 US dollars) corresponds to the shift from a negative to a positive marginal estimated effect of the Gini coefficient on the growth rate of per capita GDP.

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About the paper

Robert Barro revisits and confirms the inverse U-shaped relationship between income inequality and GDP per capita (the Kuznets curve) with newer and better information. He also finds a positive impact of international trade on income inequality. On the other hand, the effect of income inequality on economic growth appears to be weak and statistically insignificant. There is some evidnce that inequality is bad for growth in poor countries and good for growth in richer countries.

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