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AN EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN INEQUALITY AND GROWTH

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Abstract

This paper studies the correlation between inequality, measured by the Gini coefficent of incomes, and the growth rate of per capita GDP in a panel of countries between the late 1950s and late 1990s. Inequality Granger causes growth with a negative coefficient, while growth Granger causes inequality with a positive sign. Quantitatively, the former effect appears much larger than the latter. Once I allow for the effect to differ between rich and poor countries interesting differences emerge. While lagged inequality appears positively correlated with growth in the subgroup of rich countries, in poor countries besides a negative and significant effect of lagged inequality on growth there is a negative and significant effect of lagged growth on inequality.

JEL classification: O11, O40, D3, C23.

Keywords: growth, inequality, panel, GMM, Granger causality.

Contents

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1. Introduction[1]

The relationship between inequality and economic growth has long been debated in the literature. Arguments that yield a positive and a negative relationship have both been offered. Bénabou (1996) and Aghion *et al.* (1999) provide excellent surveys of the various contributions. On the one hand, inequality would provide more incentives to accumulate both physical and human capital and therefore foster growth. This could be because the rich save more than the poor, or because large sunk costs entail investment indivisibilities or because lower distortionary taxation (usually associated with more inequality) raises returns to saving. On the other hand, inequality may reduce investment opportunities, worsen borrowers' incentives and generate macroeconomic instability: all of these channels would directly reduce economic growth. The idea is that when agents are heterogeneous and capital markets are imperfect, greater inequality may be bad for growth because it would limit productive investments in physical and human capital.

Underlying the above arguments there is the assumption of causality running from inequality to growth. Yet, the sign of the effect of higher growth on inequality seems equally theoretically ambiguous. Recent discussion has focused on finding an explanation for changes in earnings dispersion (see Atkinson, 1997, for a survey). Since earnings are a substantial share of overall income this has obvious implications for overall income inequality. Trade openness or technical change — or a combination of the two — might have enhanced growth, benefiting, via a demand shift, skilled versus unskilled labor and thereby exacerbating earnings dispersion. In fact, the effect of both the increased liberalization of international trade and faster technical change on inequality is theoretically unclear, since it may depend on the extent of the reallocation of resources induced by trade reforms or on the nature of the technical progress. Further, other growth-enhancing policies may also have an influence on inequality, which is *a priori* ambiguous. A non-exhaustive list includes public spending, policies to curb inflation and credit market reforms. The absence of a clear conclusion from the theoretical standpoint calls for compelling empirical evidence.

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[1] This study was first undertaken while I was visiting the Department of Economics of the University of California at Berkeley, which I thank for hospitality. I also thank seminar participants at the Bank of Italy and two anonymous referees. I particularly benefited from discussions with Andrea Brandolini. All errors are mine. The opinion expressed in this paper are the author's and cannot be attributed to the Bank of Italy. E-mail: patrizio.pagano@bancaditalia.it

With respect to the effect of inequality on growth, recent studies have reached opposite conclusions, possibly due to the estimation method adopted. In general, as suggested by Banerjee and Duflo (2003), it seems that studies that emphasize the cross-sectional variability of inequality data find a negative correlation between lagged inequality and subsequent growth, while studies that emphasize the time-series variability find the opposite result. For instance, Perotti (1993, 1996), Alesina and Rodrick (1994) and Persson and Tabellini (1994) find, in a cross-section of countries, that greater initial inequality reduces the subsequent average rate of growth, where the average is taken over a possibly very long time span. In the same venue, Barro (2002) using a panel of countries over ten-year averages reaches the same conclusion with random country effects, which again exploit the cross-sectional variability of the data. On the other hand, these results have been challenged by Li and Zu (1998) and by Forbes (2000), who in a panel of countries with five-year averages and country fixed effect — and therefore emphasizing the time series variability of the data — find a positive correlation between lagged Gini coefficient and subsequent per capita income growth.

Empirical analysis is also not conclusive with respect to the effect of higher growth on inequality. For instance, Berman *et al.* (1994), using US data, find that faster skill-biased technical change, and therefore higher growth, delivers an increase in inequality. On the contrary, Dollar and Kraay (2002), using cross-country data, show that growth delivers the same benefits to the lowest quintile of the distribution of incomes as to the average individual and, therefore, that it does not increase inequality, measured as the ratio of the two quintiles.

In the only paper, to my knowledge, that treats the evolution of growth and inequality as the outcome of similar processes and estimates a reduced-form model, Lundberg and Squire (2003) claim that while some policy variables involve a trade-off between more growth and less inequality, expanded schooling and more equitable distribution of land will decrease income inequality and may also enhance growth.

As highlighted by Forbes (2000), all of these studies have to tackle two relevant econometric problems: measurement error in inequality and omitted-variable bias. Measurement error is always a concern in cross-country studies and inequality is one of the variables most severely subject to it. Countries have different definitions of it and varying degrees of accuracy in data collection. Furthermore, few of them have compiled data on income distribution on a regular basis and sometimes the data collected is unreliable, coverage is uneven, and there is a lack of consistency in the definition of income and the unit of account. In general, since no good instrument for inequality exists, it is difficult to correct for these problems. The point is that, on one hand, random measurement error could generate an attenuation bias and reduce the significance of results. On the other hand, however, systematic measurement error could lead to either a positive or negative bias, depending on the correlation between the measurement error and the other variables in the regression. This suggests the importance of including country fixed effects.

Another source of concern in a cross-country regression could be omitted-variable bias, although one cannot predict its direction in a multivariate context. This is especially true in a growth regression framework, where given the numerous variables that have been proved to be correlated with growth, it is difficult to predict *a priori* how omitted variables could affect estimates of the relationship between inequality and growth. Again, one method of reducing omitted-variable bias is to use a panel technique which, by including fixed effects, at least gets rid of the bias caused by the omission of time-non-varying explanatory variables.

This paper tries to examine the complex dynamic relationship between inequality and growth using the statistical concept of Granger causality, where one variable is regressed on lagged values of the other variable as well as on its own lags. Therefore, unlike most of the previous literature, it looks explicitly to the two-way relationship between these variables. The aim is to extract some empirical regularities, which would help researchers in building models.

In order to deal with the aforementioned problems of measurement error and omitted-variable bias I concentrate on a fixed-effect model. But contrary to all empirical literature, which, under a similar approach, takes 5 or 10-year averages of Gini coefficients in order to obtain a panel that is more balanced and less subject to business-cycle fluctuations, I explicitly use all the time-series variation of the data. As suggested by Attanasio *et al.* (2000), annual data provide information that is lost when averaging, especially in periods of rapid evolution of the variables of interest. Furthermore, it is not guaranteed that averaging over fixed interval would help in identifying long-run relationships, since the length of interval over which averages are computed is arbitrary, while business cycles may vary across countries and over time. By emphasizing the time series feature of the data I am forced to work with a limited sample of countries, but the results proved robust to various sensitivity experiments.

The estimation method employed is a Generalized Method of Moments technique developed by Arellano and Bond (1991). It is well suited to control for any measurement error and for any time-invariant omitted variables. Results should be used to assess the correlation between inequality and growth within country. They suggest that an increase in a country's level of income inequality has a negative effect on subsequent economic growth. On the other hand, an increase in a country's economic growth is associated with higher subsequent income inequality. Quantitatively, the former effect appears much larger than the latter. The negative relationship between inequality and subsequent growth contrasts with the results of other papers that adopt a similar approach (e.g. Li and Zou, 1998, or Forbes, 2000) and suggests, at least, caution in taking time-averages of the data. Interesting differences emerge when I allow for the Granger-causing variable to differ between rich and poor countries. In particular, in the latter, besides a negative effect of lagged inequality on subsequent growth I also find a negative effect of lagged growth on subsequent inequality. On the other hand, in rich countries inequality appears positively associated with growth.

In the rest of the paper I first introduce the empirical strategy (section 2). Then, in section 3 I discuss the characteristics of the dataset and the adjustment necessary to make the Gini coefficients of income comparable across countries and years. In section 4 I will examine formally the correlation between inequality and growth, also performing several sensitivity experiments and allowing for differences between rich and poor countries. Finally, section 5 concludes.

2. Model

I adopt the following general specification of the dynamic relationship between inequality and growth

$$growth_{j,t} = \sum_{l=1}^{K} \beta_l^g growth_{j,t-l} + \sum_{l=1}^{J} \gamma_l^g ineq_{j,t-l} + v_j^g + \varepsilon_{jt}, \qquad (1)$$

$$ineq_{j,t} = \sum_{l=1}^{M} \beta_l^i ineq_{j,t-l} + \sum_{l=1}^{N} \gamma_l^i growth_{i,t-l} + v_j^i + \eta_{jt}. \qquad (2)$$

The coefficients γ_l^g are relevant for Granger causality running from inequality to growth, while the coefficients γ_l^i are relevant for Granger causality running in the opposite direction.

I assume that the residuals of the two equations of the system $(\varepsilon_{jt}, \eta_{jt})$ are uncorrelated with the variables on the right-hand side and are i.i.d.

Note that in both equations (1) and (2), lagged dependent variables are functions of the individual effects (i.e. country effects in my sample, respectively v_j^g and v_j^i), so that the standard fixed-effect estimator is biased and inconsistent. Moreover, in principle, the variable different from the lagged dependent may not be considered strongly exogenous.

An interesting estimation technique would be to consider coefficients varying across countries and then focus on 'mean group' estimates of the parameters of interest (Pesaran and Smith, 1995). Unfortunately this option is not practicable with these datasets, given the absence of sufficiently long time series for most of the countries in the sample.

Therefore, to eliminate the bias and estimate this dynamic regression model I rely on the GMM estimator suggested by Arellano and Bond (1991) that estimates the equations in first differences. In fact, due to the differentiation, country-specific effects ν_j have been eliminated. However, as first-differencing induces MA(1) residuals, instrumental variable techniques are called for. In these equations, if there is no serial correlation in the time-varying component of the error term, endogenous variables lagged two or more periods are valid instruments. The absence of serial correlation is tested by examining the first-differenced residuals: if the disturbances are not serially correlated, there should be (evidence of significant negative first-order serial correlation and) no evidence of second-order serial correlation in the differenced residuals.[2] Like Attanasio *et al.* (2000) in their study on the relationship between savings and growth, rather than investigate the optimal lag specification, and given the data constraints, I decided to use in each equation a fixed number of lags of both the dependent and the other RHS variable; that is, I assume $K = J = M = N = 2$. The set of instruments used in each of the regressions presented below is reported in the notes to the corresponding table and the validity of instruments has been checked via a Sargan test of over-identifying restrictions.[3] As standard in the literature, in the tables I present one-step estimates, since the asymptotic

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[2] The test statistics are based on the standardized average residual autocovariances and are asymptotically distributed as $N(0,1)$ under the null hypothesis of no autocorrelation.

[3] The Sargan test is distributed as a χ^2 with degrees of freedom equal to the number of instrumental variables minus the number of parameters.

standard errors for the two-step estimators can be unreliable in finite samples (Blundell and Bond, 1998). Standard errors and test statistics are robust to heteroskedasticity.

In the tables I report a summary of the main results.[4] In particular, I present the sum of the coefficients on the lagged Gini in the regression for growth — and of lagged growth in the regression for Gini — as well as the p-value of the tests that such a sum is zero. Moreover, I present the long-run coefficients defined as $\sum_{l=1}^{2} \gamma_l^x / (1 - \sum_{l=1}^{2} \beta_l^x)$, where $x = g, i$ respectively in the inequality-to-growth and in the growth-to-inequality equations and the p-value of a Granger-causality test, corresponding to the test of the hypothesis that all the γ_l^x's are zero. The difference between the sum of the lagged coefficients and the long-run coefficients implicitly indicates the persistence of the dependent variable.

3. Data set

As mentioned in the Introduction, for the data on inequality I use the Dollar and Kraay (2002, henceforth DK) dataset.[5] It contains more than 900 observations for Gini coefficients covering 137 countries over the period 1950-1999. Almost 75 per cent of these data are from the UN-WIDER World Income Inequality Database. The others are from Deininger and Squire (1996), Chen and Ravallion (2000) and Lundberg and Squire (2003).

The inequality dataset is a highly unbalanced panel of observations. Only a few countries have continuous time series of annual observations on income distribution. For the others, information is much more dispersed.

For the income data I use the latest release of the Penn World Tables (mark 6.1, Heston *et al.*, 2002).

This gives me two samples:

A. all countries with at least two consecutive annual observations of lagged Gini coefficients and three consecutive annual observations for per capita GDP growth (forty countries with an average of 7.25 observations per country; ‘growth dataset’); the estimation period is 1958-1999.

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[4] A complete set of results is available upon request.

[5] Downloaded from the World Bank website on April 25, 2003.

B. all countries with at least three consecutive annual observations of Gini coefficients and two consecutive annual observations for lagged per capita GDP growth (thirty-one countries with an average of 7.77 observations per country; 'inequality dataset'); the estimation period is 1958-1998.

The resulting samples of countries included in the analysis are clearly not representative, yet — as will be clearer below — they are balanced overall in terms of coverage of rich and poor countries, both as regards the number of observations and of countries. Details on the countries included in each set of regressions are in Table 12.

3.1 *Data adjustment*

Since they are described at length in DK, I will not spend much space in discussing the various characteristics of the dataset, except for the following point. A critical problem of inequality data is that this collection of Gini coefficients comes from national surveys that are highly heterogeneous in terms of coverage, welfare criterion (gross income, net income or consumption) and unit of observation (individuals or households). The DK dataset is limited to inequality measures based on nationally representative surveys. To obtain comparable inequality measures I adjust the Gini figures as in DK, with a notable difference. Since I use all available data, I run the 'adjustment' regression using the whole annual dataset: I regress the Gini coefficient on a set of regional dummies, dummies indicating whether the welfare measure is gross income or consumption, and a set of year dummies. Unfortunately, since for most of the data it is not possible to control for the unit of observation, I follow DK and ignore this difference. The results are reported in Table 1. As expected, they are very similar to those reported in DK. All the variables included are highly significant. Gini coefficients measured in terms of consumption are on average smaller, while those measured in terms of gross income are larger. The 'adjusted' Gini coefficient is then obtained by subtracting, where necessary, the coefficient of the dummy consumption or of the dummy gross income from the unadjusted Gini.

Despite this adjustment procedure, I am aware that this dataset has the same problems of secondary datasets raised by Atkinson and Brandolini (2001). However, first of all one can argue that the strong requirement for at least two or three consecutive annual observations I impose favors only countries with potentially 'good' statistics. In fact, while these requirements limit the number of countries covered in the analysis, they also keep in only countries that collect inequality statistics more continuously. Second, it is clear that, despite these adjustments, substantial measurement error remains. But as long as the measurement error is country-specific — as I think it is, given the above discussion about country heterogeneity in surveys and the substantial stability in Gini coefficients (see Li *et al.*, 1998) — in all the regressions that follow it will be captured by the country fixed effect. Finally, in the sensitivity analysis I run some regressions using only data on Gini primarily referred to income — that is, making only net/gross adjustment and dropping data referred to expenditures — and only to net income, that is, dropping all the observations referred to expenditure or gross income. In both cases results remain extremely stable.

Before running the Granger-causality test embedded in equations (1) and (2), I first investigate the static relationship between the two variables of interest by analyzing the contemporaneous correlation. Given the panel structure of the dataset, correlation coefficients can be computed in various ways. I first consider the whole dataset of annual data and then that on time-averaged data, which emphasizes the cross-sectional dispersion.

Notice that the growth rate is by far more variable than the Gini coefficient. For instance, in the growth dataset the coefficient of variation of real per capita GDP growth is 1.51 against 0.23 for the Gini. Further, while the coefficient of variation of Gini coefficients is almost unchanged (0.27) when going to time-averaged data, confirming the substantial stability of inequality across time, the coefficient of variation of growth rates computed on time-averaged data almost halves (0.81), but is still larger than the Gini. In the inequality dataset the pattern is little changed.

In Table 3 I present both pairwise and rank correlation coefficients in the two datasets I selected above. The first result is that all coefficients are statistically not different from zero. Moreover, point estimates are negative for coefficients calculated on annual data, but they become positive on time-averaged data. The latter result gives a first snapshot of how things can change when using the whole annual dataset or that of time-averaged data.

I now turn to a more formal investigation of the relationship between inequality and growth, which takes explicit account of the possibility of dynamic correlation and controls for the effect of omitted variables.

4. Results

Table 4 reports the results of the basic specification where per capita GDP growth is regressed on two of its own lags and two lags of the Gini coefficients. In column FE I present the outcome of the standard fixed-effect regression. I then tackle the bias arising from the correlation of the lagged dependent variable with the fixed effect and use the Arellano and Bond - GMM estimator of the first-differenced model (column GMM 1). Next, I also allow for the other RHS variable — that is Gini in the growth equation and growth in the inequality equation — to be considered as endogenous and therefore to be instrumented (column GMM 2).

Let me first examine the basic specification of the inequality-to-growth regressions (Table 4). As reported by other authors (Forbes, 2000) the FE estimator suggests a positive point estimate of the coefficient of lagged Gini, yet in this sample it is not statistically different from zero. On the contrary, once the endogeneity of the lagged dependent variable is properly accounted for, it becomes negative. In fact, with the GMM estimator the Granger-causality test indicates a strong significance, both when Gini is considered exogenous (column GMM 1) and when it is considered predetermined (column GMM 2). In line with the results of Easterly *et al.* (1993) growth rates do not show much persistence and, correspondingly, the point estimates of lagged inequality in the long run are very similar to those in the short run. The estimated long-run effect of Gini on growth is higher in absolute value when it is also instrumented for (column GMM 2). These results clash with those obtained by Forbes (2000) and, since the specification and the datasets are relatively similar, suggest caution in time-averaging the data.

Quantitatively, the coefficients estimated in Table 4 are not small: one standard deviation decrease in the Gini coefficient (equal to 7.4 percentage points in this sample, see Table 2) is associated with an increase in the long run of per capita income growth rate of 0.3 percentage points if I use the estimate of column GMM 1 or of 0.7 percentage points if I use the estimate of column GMM 2. Note that the average per capita growth rate in the sample is 2.8 per cent.

Turning now to the basic specification of the growth-to-inequality regression (Table 5), the FE estimator suggests a strong positive correlation between lagged growth and subsequent inequality. The impact is particularly evident in the long run, suggesting a high persistence in the Gini indices. Yet, as explained above, this result is affected by the correlation of the lagged dependent variable with the fixed effect. Once this is accounted for, the correlation between lagged growth and subsequent inequality remains positive, but the size of the coefficient becomes much smaller. Moreover, the similar magnitude of the sum of coefficients of lagged growth and the long run indicates that the high persistence in the Gini indices disappears. According to point estimates, the long-run effect of growth on Gini is larger here when growth also is considered endogenous (column GMM 2).

In this case, however, the estimated effects are quantitatively small. In fact, a 1 standard-deviation increase in the growth rate (equal to 4.2 percentage points) delivers in the long run an almost nil increase in the Gini coefficient, between .04 and .07 points.

4.1 *Robustness*

To check the robustness of the above results I run several regressions. For simplicity, and given that results are mainly unchanged in the two basic GMM specifications, I always instrument only for the lagged dependent variable.

First of all I tackle directly some of the issues raised by Atkinson and Brandolini (2001) about secondary datasets and concentrate on subsamples. In particular, since, as mentioned above, the collection of Gini coefficients includes some coefficients calculated on gross incomes and some on expenditures, I run the same basic regressions on a subset of the original data. I either use only Gini coefficients referred to incomes alone — therefore performing only the gross/net adjustment discussed in section 3.1 and dropping those referred to consumption — or Gini coefficients referred only to net incomes — and thus dropping both those referred to gross incomes and those referred to consumption. Of course, this reduces the number of countries included in the analysis, respectively to 25 and 17 in the inequality-to-growth regression and to 24 and 17 in the growth-to-inequality regressions. Results are reported in the first two columns of Tables 6 and 7. The main results are unchanged: inequality is negatively related to subsequent growth and growth is positively related to subsequent inequality. In both types of regressions the magnitude of coefficients in significantly higher when only data on Gini coefficients primarily referred to net income are included in the analysis. It may be argued that this result is due to the fact that since there is less measurement error there is also less attenuation bias.

The second type of sensitivity analysis I perform in this section is designed to check whether the results are driven by any particular country series. I therefore first exclude those countries with a minimal number of observations, that is, countries that have only two consecutive annual observations for the Gini coefficient in the inequality-to-growth regression and countries that have only three consecutive annual observations for the Gini coefficient in the growth-to-inequality regression (columns labelled 'obs$>$1'). Then I exclude, one at a time, those countries with the largest number of observations. They comprise two developed economies, the US and the UK, and two developing economies, Taiwan and India. Again, the main message remains unchanged: inequality is negatively related to subsequent growth and growth is positively related to subsequent inequality.

Finally, I also run regressions with the lag length set at 3. Since results are essentially the same, even if the significance of Granger-causality coefficients is less evident, for brevity I do not report them.

4.2 *Controls*

One of the advantages of assuming fixed effects is that they account for any time-non-varying omitted variables. Still, it is possible that the sign and/or the magnitude of the correlation coefficients reported above may be influenced by the omission of some important explanatory variables. To account for this possibility, in this section I include as controls the following variables, although the list is far from exhaustive. The controls are the degree of openness, the price of investment, the logarithm of 1 plus the rate of inflation and the government share of real per capita GDP.

Trade openness — measured by the sum of exports and imports in constant prices divided by real per capita GDP — has been found to be good for growth (e.g. Frankel and Romer, 1999) and blamed for the widening of the distribution of incomes in some countries (e.g. Wood, 1994). Since some authors (for instance Spilimbergo *et al.*, 1999) have argued that it may reflect the size of the country, I used the residuals of the regression of trade openness on the logarithm of population and of the country area.

In each country, the price of investment measures how the cost of investment varies between the country and the US. In the empirical growth literature this variable has been used to capture market distortions that influence the cost of investment, such as tariffs, regulation, corruption and the cost of foreign exchange.

Inflation creates uncertainty and has been found to be bad for growth (Fischer, 1993). Furthermore, as long as the poor are less able to hedge against inflation than the rich, higher inflation could deliver more inequality.

Finally, Easterly and Rebelo (1993) found that the higher government consumption the lower GDP growth, since a high public share of GDP implies more taxes to balance the budget and taxes are bad for growth.

All control variables are dated t and are treated as exogenous.[6] I first insert these control variables one at a time and then all together. The main messages of the previous section remain unchanged: inequality Granger-causes growth with a negative sign, while growth Granger-causes inequality with a positive sign. In the inequality-to-growth regression (Table 8) trade openness is positively and significantly correlated with subsequent growth, but this effect disappears when all controls are used together (column [5]). On the contrary, inflation is negatively and robustly correlated with subsequent growth. Both market distortions and the government share of GDP do not seem to have any significant effect on growth. In all cases lagged Gini appears still to Granger-cause growth with a negative coefficient and the magnitude of its coefficients is quite unaffected.

In the growth-to-inequality regression, none of the control variables appears to be significantly correlated with subsequent inequality (Table 9). In all cases, growth Granger-causes Gini with a positive coefficient very similar to that obtained in the basic specification.

Overall, these results confirm the basic findings that inequality is negatively correlated with subsequent growth and growth is positively correlated with subsequent inequality. Still, as emphasized by Barro (2000) and Banerjee and Duflo (2003), they might conceal possible non-linearities. This is the object of the next section.

4.3 *Rich vs. Poor*

In this section I allow Granger causality coefficients to differ for initially rich and poor countries. To identify rich and poor countries I separate the original OECD from non-OECD economies.[7] I allow the coefficients of the Granger-causing variable — that is Gini in the

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[6] I also run some regressions treating the controls as endogenous — and instrumenting them with lagged values — without obtaining different results, so I omitted to report them for brevity.

[7] Actually I selcted member countries of the OECD before May 1973, when New Zealand joined.

inequality-to-growth regression and growth in the growth-to-inequality regression — to differ between OECD and non-OECD economies, while I impose the coefficients of the lagged dependent variable to be the same across subgroups. I run a separate regression with and without control variables and with the Granger-causing variable considered exogenous or endogenous.

Results display interesting differences across subgroups. In particular, in the inequality-to-growth regression, inequality appears to be negatively and significantly correlated with subsequent growth only in poor countries, whereas in the sub-sample of rich countries the opposite effect prevails. This is consistent with the credit market imperfections story cited in the introduction. In poor countries where the constraint posed by credit market imperfections in much more binding, more redistribution (and therefore less inequality) would be associated with higher growth. On the other hand, in the subgroup of rich countries, where credit constraints are less binding, the incentive effect provided by more inequality seems to prevail. The result also remains valid controlling for other variables, both when the Gini coefficient is treated as exogenous (columns [1] and [2] in Table 10) and when it is instrumented for (columns [3] and [4])

In the growth-to-inequality regressions, too, interesting differences between rich and poor countries emerge. In particular, in non-OECD economies growth appears to Granger-cause inequality with a negative coefficient, while in the OECD lagged growth is positively correlated with subsequent inequality. These differences persist even allowing for control variables (columns [2] and [4]) and for endogeneity of lagged growth (columns [3] and [4]).[8]

However, it is worth noting that for OECD countries the coefficient linking long-run growth to inequality appears to be not significantly different from zero. On the other hand, for poor economies the long-run coefficient is negative, but its magnitude is quite small: doubling the average growth rate of the sample — that is going from 3 to 6 per cent — would imply (taking the estimate of column [2]) a decrease in the Gini coefficient of just 0.3 percentage points and the average Gini in the sample is 33.6 per cent.

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[8] These estimates must be taken with caution, since the very high statistic in the Sargan test might signal overfitting bias.

5. Concluding remarks

The results of this paper can be read as a cautionary tale. The difference between random-effect and fixed-effect results in assessing the effect of lagged inequality on growth may be due to the (arbitrary) choice of taking five or ten-year averages of Gini coefficients. Once one uses the whole annual dataset, a fixed-effect (Arellano-Bond) estimator points to a negative correlation between lagged inequality and growth. This is especially true for 'poor' countries, while for 'rich' countries the opposite relationship might hold.

With respect to the reverse correlation — much less explored in the literature — lagged growth seems to be positively correlated with subsequent inequality, but its effect seems quantitatively negligible. Both correlations are robust to the definition of Gini and to the exclusion of countries with either very short or very long time series on the Gini coefficient. They also survive to the introduction of (some) controls.

Once I allow for the effect to differ between rich and poor countries interesting differences emerge. While inequality appears positively correlated with growth in the subgroup of rich countries, in poor countries, besides a negative and significant effect of lagged inequality on growth, there is a negative and significant effect of lagged growth on inequality. Stretching these results somewhat, it can be said that they provide some support for the view that in poor countries the feedback between these variable can create a virtuous cycle. Redistributive polices, possibly targeted at easing credit constraints, would lower inequality and enhance growth; in turn, higher growth would further reduce inequality.

Appendix

Data sources

Inequality: GINI adjusted as in Table 1; Dollar and Kraay(2002).

Growth: RGDPCH (percentage change) ; Heston *et al.* (2002)

Openness: OPENK adjusted (see main text); Heston *et al.* (2002)

Price of investment: PI; Heston *et al.* (2002)

Inflation: $\log(1 + \text{consumer price inflation})$; International Financial Statistics, IMF.

Public expenditure: KG; Heston *et al.* (2002)

Data adjustment: dependent variable raw Gini

constant	.3246***
	(.0119)
expenditure	-.0241***
	(.0082)
gross income	.0386***
	(.0052)
East Asia & Pacific	.0370***
	(.0059)
E. Europe & Central Asia	-.0456***
	(.0077)
Middle East & North Africa	.1007***
	(.0120)
Latin America & Caribbean	.1630***
	(.0067)
South Asia	.0380***
	(.0084)
Sub-Saharan Africa	.1520***
	(.0121)
obs	933
R^2	0.5917

Notes: estimation by OLS. Standard error in brackets. A whole set of year dummy variables included

Table 2

Inequality and growth: summary statistics

	growth		Gini	
	mean	st. dev.	mean	st. dev.
all countries	.028	.042	.321	.074
OECD	.024	.029	.303	.037
others	.031	.055	.336	.101

Table 3

Inequality and growth: contemporaneous correlations

	pairwise		rank	
	growth dataset	inequality dataset	growth dataset	inequality dataset
Annual	-.1044		-.0882	
	[0.106]		[0.172]	
obs	241		241	
Country average	.0824	.1343	.1244	.2496
	[0.613]	[0.472]	[0.444]	[0.176]
obs	40	31	40	31

Notes: P-values in square brackets below coefficients.

Growth equation: basic specification

dep. var. growth	FE	GMM 1	GMM 2
lagged Gini (sum)	.0317	-.0394	-.1018
	[0.711]	[0.769]	[0.513]
long-run Gini	.0356	-.0407**	-.0986***
	{0.342}	{0.020}	{0.000}
obs	290	290	290
countries	40	40	40
R^2	0.3087		
Sargan(p-val)		0.4077	0.8658
LM1(p-val)		0.0029	0.0035
LM2(p-val)		0.9844	0.9079

Notes: All regressions include a whole set of year dummy variables. Estimation by Fixed Effects estimator in column FE and Arellano-Bond estimator in columns GMM 1 and GMM 2, one-step results with robust standard errors. In square brackets below coefficients, p-values of the test that the sum of lagged Gini coefficients is zero; in curly brackets below coefficients, p-values of the test that all lagged Gini coefficients are simultaneously zero. R^2 is the within-R^2 in column 'FE'. In the column 'GMM 1', the maximum number of lags of the dependent variable used as instruments is 5. In the column 'GMM 2', the maximum number of lags of the dependent and the explanatory variables used as instruments is 2. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Inequality equation: basic specification

dep. var. Gini	FE	GMM 1	GMM 2
lagged growth (sum)	.1340**	.0084	.0120
	[0.034]	[0.897]	[0.855]
long-run growth	.5254**	.0101**	.0158***
	{0.016}	{0.012}	{0.009}
obs	241	241	241
countries	31	31	31
R^2	0.6945		
Sargan(p-val)		0.9877	0.9833
LM1(p-val)		0.0020	0.0029
LM2(p-val)		0.0548	0.0610

Notes: All regressions include a whole set of year dummy variables. Estimation by Fixed Effects estimator in column FE and Arellano-Bond estimator in columns GMM 1 and GMM 2, one-step results with robust standard errors. In square brackets below coefficients, p-values of the test that the sum of lagged growth coefficients is zero; in curly brackets below coefficients, p-values of the test that all lagged growth coefficients are simultaneously zero. R^2 is the within-R^2 in column 'FE'. In the column 'GMM 1', the maximum number of lags of the dependent variable used as instruments is 5. In the column 'GMM 2', the maximum number of lags of the dependent variables used as instruments is 1 and of the explanatory variables is 2. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Table 6

Growth equation: sensitivity analysis

dep var. growth	inc	net inc	obs>1	exUSA	exGBR	exTWN	exIND
lagged Gini (sum)	-.1024	-.6603**	-.0736	-.1127	-.0631	-.0284	-.1008
	[0.537]	[0.042]	[0.584]	[0.4063]	[0.619]	[0.830]	[0.459]
long-run Gini	-.1308*	-.5827**	-.0774**	-.1177**	-.0642***	-.0289**	-.1092*
	{0.052}	{0.044}	{0.011}	{0.021}	{0.008}	{0.026}	{0.077}
obs	211	117	282	250	261	266	266
countries	25	17	32	39	39	39	39
Sargan(p-val)	0.9492	0.9974	0.4720	0.8924	0.7343	0.5704	0.8165
LM1(p-val)	0.0052	0.0709	0.0026	0.0059	0.0046	0.0050	0.0042
LM2(p-val)	0.3353	0.7223	0.9944	0.8727	0.8788	0.9705	0.9728

Notes: All regressions include a whole set of year dummy variables. Estimation by Arellano-Bond estimator, one-step results with robust standard errors. In square brackets below the coefficients, p-values of the test that the sum of lagged Gini coefficients is zero; in curly brackets below the coefficients, p-values of the test that all lagged Gini coefficients are simultaneously zero. In the column ‘net inc’, the maximum number of lags of the dependent variable used as instruments is 2; in the column ‘inc’, the maximum number of lags of the dependent variable used as instruments is 3; in all the other columns, the maximum number of lags of the dependent variable used as instruments is 5. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Table 7

Inequality equation: sensitivity analysis

dep. var. Gini	inc	net inc	obs>1	exUSA	exGBR	exTWN	exIND
lagged growth (sum)	.0245	.0338	.0620	.0371	.0250	.0183	.0100
	[0.757]	[0.826]	[0.255]	[0.590]	[0.742]	[0.805]	[0.901]
long-run growth	.0269**	.0701**	.0817**	.0338**	.0247***	.0190***	.0101**
	{0.026}	{0.043}	{0.025}	{0.042}	{0.006}	{0.006}	{0.039}
obs	210	117	233	202	213	218	219
countries	24	17	23	30	30	30	30
Sargan(p-val)	0.9848	0.9456	0.9895	0.3619	0.8300	0.7408	0.6597
LM1(p-val)	0.0074	0.0054	0.0060	0.0098	0.0040	0.0030	0.0092
LM2(p-val)	0.0711	0.0810	0.1345	0.0499	0.0519	0.0539	0.1085

Notes: All regressions include a whole set of year dummy variables. Estimation by Arellano-Bond estimator, one-step results with robust standard errors. In square brackets below the coefficients, p-values of the test that the sum of lagged growth coefficients is zero; in curly brackets below the coefficients, p-values of the test that all lagged growth coefficients are simultaneously zero. In the column 'exUSA', the maximum number of lags of the dependent variable used as instruments is 2; in the column 'inc', the maximum number of lags of the dependent variable used as instruments is 4; in the column 'obs>1', the maximum number of lags of the dependent variable used as instruments is 5; in all the other columns, the maximum number of lags of the dependent variable used as instruments is 3. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Growth equation: controls

dep. var. growth	[1]	[2]	[3]	[4]	[5]
lagged Gini (sum)	-.0501	-.0347	-.0538	-.0566	-.0582
	[0.718]	[0.790]	[0.704]	[0.684]	[0.682]
adj. openness($\times$100)	.1026**				-.0048
	[0.041]				[0.942]
price of investment($\times$100)		.0161			.0035
		[0.559]			[0.894]
inflation			-.0424***		-.0425***
			[0.000]		[0.001]
public expenditure($\times$100)				.0793	.0071
				[0.521]	[0.959]
long-run Gini	-.0519**	-.0358**	-.0485***	-.0586**	-.0449***
	{0.029}	{0.026}	{0.006}	{0.018}	{0.004}
obs	290	290	278	290	278
countries	40	40	40	40	40
Sargan(p-val)	0.4168	0.4102	0.0633	0.4337	0.0682
LM1(p-val)	0.0023	0.0031	0.0068	0.0027	0.0059
LM2(p-val)	0.9424	0.9201	0.0656	0.9639	0.0637

Notes: All regressions include a whole set of year dummy variables. Estimation by Arellano-Bond estimator, one-step results with robust standard errors. All controls are dated t. In square brackets below the coefficient of lagged Gini (sum), p-values of the test that the sum of the lagged Gini coefficients is zero, below the other coefficients, p-values of the test that it is zero; in curly brackets below the coefficients of long-run Gini, p-values of the test that all the lagged Gini coefficients are simultaneously zero. In columns [3] and [5], the maximum number of lags of the dependent variable used as instruments is 4; in all the other columns, the maximum number of lags of the dependent variable used as instruments is 5. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Inequality equation: controls

dep. var. Gini	[1]	[2]	[3]	[4]	[5]
lagged growth	.0098	.0084	.0084	.0095	.0103
	[0.877]	[0.899]	[0.910]	[0.886]	[0.895]
adj. openness($\times$100)	-.0042				.0015
	[0.795]				[0.960]
price of investment($\times$100)		.0212			.0163
		[0.193]			[0.263]
inflation			.0091		.0117
			[0.490]		[0.311]
public expenditure($\times$100)				.1342	.1534
				[0.271]	[0.221]
long-run growth	.0118**	.0100**	.0111**	.0117**	.0131**
	{0.019}	{0.018}	{0.024}	{0.012}	{0.039}
obs	241	241	229	241	229
countries	31	31	31	31	31
Sargan(p-val)	0.9873	0.9810	0.9948	0.9891	0.9910
LM1(p-val)	0.0023	0.0029	0.0018	0.0023	0.0026
LM2(p-val)	0.0584	0.0601	0.0940	0.0610	0.1167

Notes: All regressions include a whole set of year dummy variables. Estimation by Arellano-Bond estimator, one-step results with robust standard errors. All controls are dated t. In square brackets below the coefficient of lagged growth (sum), p-values of the test that the sum of the lagged growth coefficients is zero, below the other coefficients, p-values of the test that it is zero; in curly brackets below the coefficients of long-run growth, p-values of the test that all the lagged growth coefficients are simultaneously zero. In all the columns, the maximum number of lags of the dependent variable used as instruments is 5. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Growth equation: rich vs. poor

dep. var. growth	[1]	[2]	[3]	[4]
lagged Gini(sum){oecd}	.3710**	.4746***	.5937**	.5129***
	[0.040]	[0.007]	[0.014]	[0.008]
lagged Gini(sum){other}	-.3867**	-.2128	-.2290	-.0730
	[0.024]	[0.185]	[0.131]	[0.680]
adj. openness(×100)		.0142		-.0074
		[0.823]		[0.912]
inflation		-.0397***		-.0364***
		[0.001]		[0.003]
price of investment(×100)		.0041		0.0009
		[0.873]		[0.964]
public expenditure(×100)		.0164		-.0051
		[0.912]		[0.967]
long-run Gini {oecd}	.3675**	.4678***	.5742***	.4361***
	{0.010}	{0.003}	{0.008}	{0.002}
long-run Gini {other}	-.3697***	-.1909***	-.2312***	-.0963***
	{0.000}	{0.001}	{0.000}	{0.002}
obs	290	278	290	278
countries	40	40	40	40
Sargan(p-val)	0.1012	0.0720	0.9997	0.9924
LM1(p-val)	0.0146	0.0056	0.0044	0.0056
LM2(p-val)	0.9904	0.0947	0.9883	0.1428

Notes: All regressions include a whole set of year dummy variables. Estimation by Arellano-Bond estimator in all columns, one-step results with robust standard errors. All controls are dated t. In square brackets below the coefficients, p-values of the test that the sum of the lagged Gini coefficients is zero; below the other coefficients, p-values of the test that it is zero; in curly brackets below the coefficients of long-run Gini, p-values of the test that all the lagged Gini coefficients are simultaneously zero. In columns [1] and [2], only the lagged dependent variable is instrumented; maximum number of lags of the dependent variable used as instruments is 4. In columns [3] and [4] both lagged dependent and Granger-causing variables are instrumented; the maximum number of lags of the dependent and the explanatory variables used as instruments is, respectively, 2 and 1. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Inequality equation: rich vs. poor

dep var: Gini	[1]	[2]	[3]	[4]
lagged growth(sum) {oecd}	.0097	.0679	.0308	.0732
	[0.926]	[0.594]	[0.745]	[0.528]
lagged growth(sum) {other}	-.0039	-.0014	-.0075	-.0060
	[0.955]	[0.985]	[0.919]	[0.939]
adj. openness($\times$100)		.0032		-.0081
		[0.925]		[0.754]
inflation		.0119		.0112
		[0.198]		[0.134]
price of investment($\times$100)		.1689		.0084
		[0.193]		[0.463]
public expenditure($\times$100)		.1690		.2205**
		[0.032]		[0.028]
long-run growth {oecd}	.0136	.1010	.0693	.1335
	{0.410}	{0.594}	[0.371]	{0.459}
long-run growth {other}	-.0055**	-.0021**	-.0169***	-.0109**
	{0.015}	{0.048}	{0.009}	{0.015}
obs	241	229	241	229
countries	31	31	31	31
Sargan(p-val)	0.9999	0.9999	1.0000	1.0000
LM1(p-val)	0.0019	0.0027	0.0024	0.0034
LM2(p-val)	0.0540	0.1356	0.0590	0.1291

Notes: All regressions include a whole set of year dummy variables. Estimation by Arellano-Bond estimator in all columns, one-step results with robust standard errors. All controls are dated t. In square brackets below the coefficients, p-values of the test that the sum of the lagged growth coefficients is zero; below the other coefficients, p-values of the test that it is zero; in curly brackets below the coefficients of long-run growth, p-values of the test that all the lagged growth coefficients are simultaneously zero. In columns [1] and [2], only the lagged dependent variable is instrumented; the maximum number of lags of the dependent variable used as instruments is 6. In columns [3] and [4] both lagged dependent and Granger-causing variables are instrumented; the maximum number of lags of the dependent and the explanatory variables used as instruments is 2. The Sargan test comes from the one-step homoskedastic estimator. LMk is a test for k-order autocorrelation in the first-differenced residuals.

Data				
code	Freq.	Percent	Freq.	Percent
ARM	2	0.69	1	0.41
AUS	1	0.34	-	-
BGR	4	1.38	3	1.24
BLR	2	0.69	1	0.41
BRA	9	3.1	6	2.49
CAN	10	3.45	8	3.32
CHN	15	5.17	14	5.81
CIV	2	0.69	1	0.41
COL	1	0.34	-	-
CZE	5	1.72	4	1.66
DNK	5	1.72	3	1.24
ESP	3	1.03	2	0.83
EST	4	1.38	3	1.24
FIN	6	2.07	5	2.07
GBR	29	10	28	11.62
GHA	2	0.69	-	-
HND	4	1.38	3	1.24
HUN	3	1.03	2	0.83
IND	24	8.28	22	9.13
IRN	2	0.69	1	0.41
ITA	9	3.1	8	3.32
JAM	4	1.38	3	1.24
JPN	16	5.52	14	5.81
KOR	2	0.69	1	0.41
LKA	1	0.34	-	-
NGA	1	0.34	-	-
NLD	4	1.38	2	0.83
NOR	6	2.07	5	2.07
NZL	1	0.34	-	-
PAK	3	1.03	1	0.41
PAN	1	0.34	-	-
POL	16	5.52	15	6.22
PRT	1	0.34	-	-
RUS	2	0.69	1	0.41
SVK	8	2.76	7	2.9
SVN	1	0.34	-	-
SWE	15	5.17	14	5.81
TWN	24	8.28	23	9.54
USA	40	13.79	39	16.18
VEN	2	0.69	1	0.41
Total	290	100	241	100

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