Summary: Inequality and Growth: What Can the Data Say?

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Introduction and Specifications in Literature

Data on inequality from Deininger and Squire (1996) high quality, cross-country and panel structure; allows using advanced techniques on analysis. Results from previous OLS work typically found negative relationship between growth and inequality,

Benhabib and Spiegel (1998), Forbes (2000): fixed effects estimates arguing that omitted country specific effects bias OLS. Fixed effect approach yields positive relationship: increases in inequality within same country promote growth.

Barro (2000): a 3SLS approach treating country-specific error terms finds no relationship; after breaking up sample into more homogeneous, rich and poor subsamples, he finds negative relationship for poor and positive relationship in rich country sample.

→ causal interpretation of evidence not clear, as variations of inequality correlated with a range of unobservable factors associated with growth; observation of data without imposition of linear relationship eye opening; changes in inequality in either direction associated with lower growth rates; same for relationship between growth rates and inequality lagged by one period
→non-linearity may explain why different variants of linear model (OLS; fixed effects, random effects) have generated very different conclusions.

General model: $\frac{y_{it+l}-y_{it}}{l} = \alpha y_{it} + X_{it}\beta + \gamma\, g_{it} + v_i + \varepsilon_{it}$, where l is the time period (e.g. five years) **different from $\boldsymbol{\alpha}$ coefficient** , X is a matrix of controls, g_{it} is gini coefficient of country i at time t, v_i is a country specific time-invariant effect.

Problem with OLS model: estimates likely to be biased by correlation between inequality and error term.

First difference of this model, to get rid of fixed effect term:

$\frac{y_{it+l}- y_{it}}{l} - \frac{y_{it}- y_{it-l}}{l} = a(y_{it} - y_{it-l}) + (X_{it} - X_{it-l})\beta + \gamma\,(g_{it} - g_{it-l}) + \varepsilon_{it} - \varepsilon_{it-l}$, relates changes in gini-coefficient and changes in growth rates.

Using GMM estimator developed by Arellano and Bond (1991), unbiased estimator for γ can be obtained: $y_{it+l} - y_{it} = (l\alpha + 1)(y_{it} - y_{it-l}) + l(X_{it} - X_{it-l})\beta + l\,\gamma\,(g_{it} - g_{it-l}) + l\varepsilon_{it} - l\varepsilon_{it-l}$

Results from models:

Table 1. Relationship between growth and changes in Gini, linear specifications.

	Dependent Variable: $(y(t+a)-y(t))/a$							
	Perotti Specification				Barro Specification			
	Random Effects (1)	First Difference (2)	Fixed Effect (3)	Arellano and Bond (4)	Random Effects (5)	First Difference (6)	Fixed Effect (7)	Arellano and Bond (8)
Gini(t)	0.021	0.298	0.297	0.56	− 0.03	0.158	0.155	0.27
	(0.09)	(0.18)	(0.16)	(0.039)	(0.043)	(0.068)	(0.063)	(0.016)
N	128	128	128	128	98	98	98	98

Insignificant Random Effects, but general result: positive relationship. Forbes (2000): short-run positive and possibly long-run negative effect. Contrast to previous empirical results that show negative effect of inequality on growth.

Theoretical models of Inequality – Growth Relationship

Political Economy Arguments – simple model based on "Hold up"

Two groups in society A, B; wealth shared, percentage of A is g, B is 1-g. Each period, growth opportunity of size Δy (if wealth, GDP, is normed to size 1, growth opportunity is a percentage rate), random variable, independent over time drawn from distribution $F(\Delta y)$. Growth opportunity requires some policy adjustment to be implemented, which has to be agreed on by both groups in society. I.e. one group can block the realization of the growth opportunity, they can demand a "bigger share" of the growth in y that would be attributed to them via g and 1-g. If one group blocks, then growth is reduced to $a_l \Delta y$, where $l \in \{A, B\}$ and $a_l < 1$. Interpret this as the lost value, due to time lag caused by political process or so; a_l is random variable from distribution $G_l(a_l)$, known by groups in advance; a_l plays critical role.
Assume group B has chance to hold up economy, whether or not it agrees depends on how much additional "growth" it can extract for itself from group A. If A agrees to a transfer of size Δg, their payoff will be $(g - \Delta g)(1 + a_A \Delta y)$. The term$(1 + a_A \Delta y)$ is growth of cake to be distributed (assume original cake was of size 1), and $(g - \Delta g)$ is proportion of cake A gets after accepting a transfer of Δg to B. What is maximal transfer Δg?

A is indifferent, as long as: $(g - \Delta g)(1 + a_A \Delta y) \geq g$ (i.e. post-transfer share of new cake has to be at least as big as share of old cake, which was size 1). Rearanging this, we see maximal transfer has to satisfy:

$\frac{a_A \Delta y}{1 + a_A \Delta y} \geq \frac{\Delta g}{g}$ which implies $\Delta g \leq g$, so transfer is feasible. Group B will demand a transfer of size Δg iff: $(1 - g + \Delta g)(1 + a_A \Delta y) \geq (1 - g)(1 + \Delta y)$, i.e. if the post-transfer portion of the cake is bigger than it would be, without holding up the economy.

After some rearranging and using the first expression for the maximal Δg, we see that $a_A \geq 1 - g$; in this case, group B will always demand a transfer when it gets a chance; correspondingly for A one can show, that A will always hold up the economy if $a_B \geq g$.

Intuitive: each group will hold up rest, if its share of output is low, which is when they have the least stake in the growth of the overall economy. Similar results from models by Persson and Tabellini (1991): choice of high levels of redistribution, even though it hurts growth. Decision rules for A and B are also independent of Δy.

Intuitive result 1: as long as $\bar{a_l} = E(a_l)$ for both $l \in \{A, B\}$, the **expected growth rate** of this economy in any period following a distributional change is lower than when there is no conflict.
Interpret variable g as a measure of inequality: assume one group, say group A is substantially richer than the other in terms of per capita income, i.e. group B has a share of (1-g) of income, but has a much larger share of the population, so the per-capita values for group B are a lot lower. Then an increase in g will lead to an increase in inequality.
→ in any case: relationship between distributional change in either direction and expected growth rate is negative.

One possibility: take this to the data and estimate relationship of the form: $\frac{y_{it+l}-y_{it}}{l} = \alpha y_{it} + X_{it}\beta + k(g_{it} - g_{it-l}) + v_i + \varepsilon_{it}$, where k(.) is a generic function on whose structure as of now, no restriction is put.

Approach of political economy literature: derive a relationship between level of inequality and changes in inequality combined with a relationship between growth and changes in inequality to obtain a relation between growth and the level of inequality.

Expected increase in share of group A:

$$\Delta g^e = \frac{1}{2}\left(\int_g^1 \frac{a_B \Delta y}{1 + a_B \Delta y}(1-g)dG_B(a_B) - \int_{1-g}^1 \frac{a_A \Delta y}{1 + a_A \Delta y} g\, dG_A(a_A)\right)$$

The first term, is the case where B will choose to hold up A to extract higher share for itself, which is the case when $a_B \geq g$, so you integrate over the range from g to 1. The second part is the expected change in share of B, when B holds up A, which will be the case when $a_A \geq 1 - g$ (which explains the bounds on the integral).

This is a decreasing function in g, following from Leibniz Rule (or eyeballing by inspection: as g increases, domain of first integral gets smaller and factor inside, 1-g gets smaller, so the whole gets smaller; second integral, the domain becomes smaller, but g under the integral becomes larger, since there is a minus, the whole integral will not increase).

$$\frac{d\phi}{d\alpha} = \int_a^b \frac{\partial}{\partial \alpha} f(x,\alpha)\,dx + f(b,\alpha)\frac{\partial b}{\partial \alpha} - f(a,\alpha)\frac{\partial a}{\partial \alpha}\ .$$ where $b(\alpha), a(\alpha)$.

Result 2: Relation between level of inequality and expected change in inequality in this model is broadly negative. However, in this model, absolute changes are important, as changes in inequality in both directions reduce growth. So you look at:

$$|\Delta g^e| = |\frac{1}{2}\left(\int_g^1 \frac{a_B \Delta y}{1+a_B \Delta y}(1-g)dG_B(a_B) - \int_{1-g}^1 \frac{a_A \Delta y}{1+a_A \Delta y} g\, dG_A(a_A)\right)|$$

Now the changes are ambiguous. It turns out that for some intermediate values of range of g there are no planned changes in inequality (nobody blocks each other, see the earlier conditions for blocking of respective groups depends on level of g).

Result 3: The Relation between the level of inequality and expected value of the absolute changes in inequality for the economy in this model is U-shaped. The (expected) value of changes in inequality is first decreasing with inequality, then flat over a range and then increasing with inequality.

From this it follows:

Result 4: The relation between the level of inequality and future growth for the economy in this model is inverted U-shaped, i.e. there is less growth when inequality is either very high or very low.

Estimation of this model via: $\frac{y_{it+l}-y_{it}}{l} = \alpha y_{it} + X_{it}\beta + h(g_{it-l}) + v_i + \varepsilon_{it}$, where h(.) may be non-monotonic.

This is estimated with some specifications on h(.) such as quadratic or quartic later in the paper.

Wealth Effect Arguments (model is a bit strange, lecture model easier)

Wealth effect arguments start with premise that current wealth and future wealth are functionally related, $w_{t+1} = f(w_t, p)$ where p is a vector of prices including the wage rate and the interest rate. Assume $\frac{\partial f(w_t,p)}{\partial w} > 0$ and also concavity in w, so $\frac{\partial^2 f(w_t,p)}{\partial^2 w} < 0$.

Assume $G_t'(w)$ is mean preserving spread of $G_t(w)$, which is the current distribution of wealth; given this assumption, aggregate future wealth under current distribution of wealth is higher than under the mean preserving spread (I don't quite see yet why)

$$G_t = \int f(w,p)dG_t(w) > \int f(w,p)dG_t'(w)$$

→ a more equal economy grows faster than a less equal one.

To see what is reasonable to assume about f(.) we need to "unpack" it. Simple formulation of model in which everybody is identicall in all respects, except possibly in wealth; furthermore, intergenerational transmission of wealth. Capital is the only marketed factor of production and individuals live for one period. Capital markets are imperfect and individuals can thus only borrow up to λ times their wealth (they need to provide collateral), where $\lambda(r_t)$, r_t the current interest rate with $\lambda'(r_t) < 0$. Assume also for each individual, there is strictly concave production function $h(k)$ which gives the individual income for a given total investment.

We assume individual starts with certain bequest from parent, invests it during lifetime and dies at the end of the period after consuming a constant fraction $1-\beta$ of his end-period wealth, the rest is passed on to his child. The amount of investment is given by $h'(k^*) = r_t$, those who start out with enough wealth, i.e. wealth exceeding $(\lambda+1)w_t > k^*$will invest k^*, while the rest will investment all that they can, i.e. $(\lambda+1)w_t$. They will earn net income of:

$$\min\{h(k^*) + \ (w_t - k^*)r_t, h\big((\lambda+1)w_t\big) - \ \lambda w_t r^*\}$$

Out of this income, a fraction β will be left for the children. Inequality in wealth due to the fact that already wealthy people can afford optimal level of investment, whereas poorer ones can't.

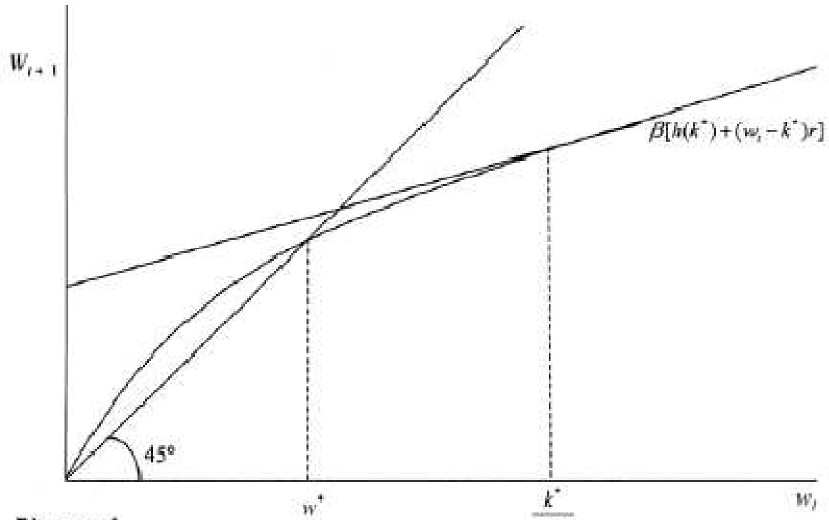

Diagram 1

Inequality in wealth is costly <> depends on the mean wealth in economy. If everybody has initial wealth above $\frac{k^*}{(\lambda+1)}$, inequality will have no effect. Intuitive: once economy is rich enough so that everyone can afford optimal investment, inequality does not matter. Estimated relationship between inequality and growth should therefore allow for an interaction term between inequality and mean income.

Two Results from this model:

Result 5: An exogeneous mean-preserving spread in the wealth distribution in this economy will reduce future wealth and by implication the growth rate (see graph, but note comment)

Result 6: Starting with any initial distribution of wealth, both inequality and the growth rate must on average go down over time, with the consequence that in the long run there is no inequality and no growth.
→ Implication from result 6: measured changes in inequality in either direction will be associated with a fall in the growth rate (similar as in the first model).

Estimation and Results (very technical, that's why short)

Remainder of the paper discusses several different estimation approaches, in which in many models the linearity assumption is rejected or disproven. They tend to find evidence of an inverse U-shaped relationship between income growth and growth of the gini-coefficient.

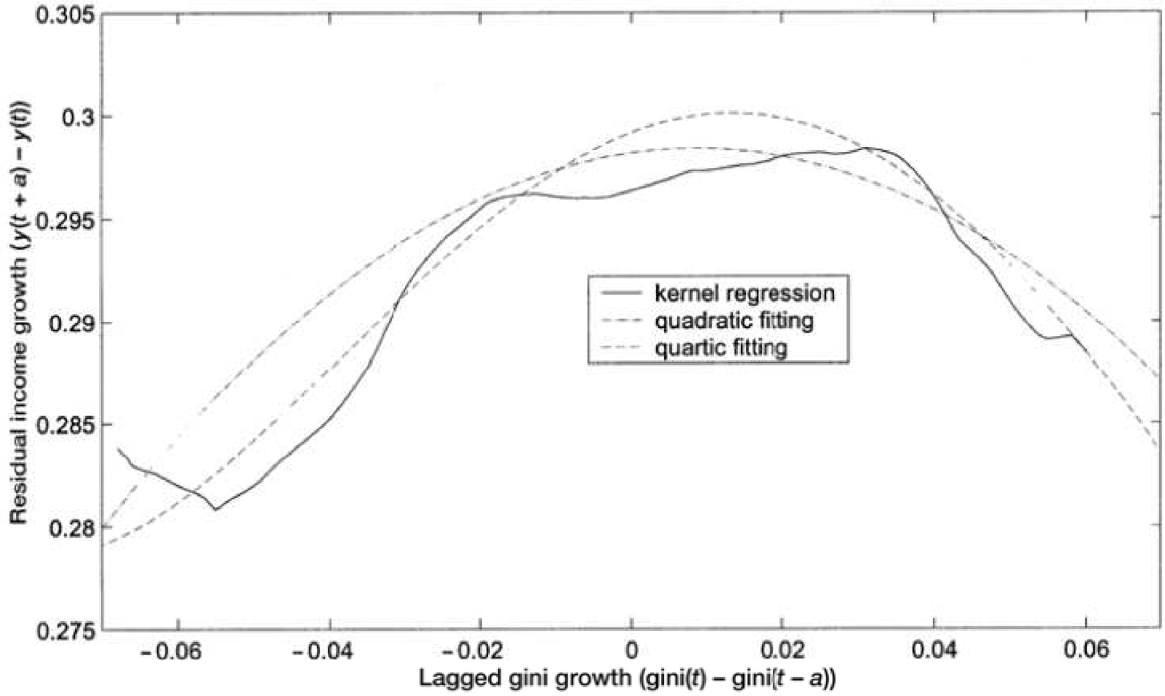

Figure 2. Relationship between income growth and lagged gini growth: partially linear model (Barro variables).