Inequality and Growth: Differential saving rates
Kaldor 1957

Workers

$$c_w = w$$

Capitalists

$$c_k = (1 - s)rk$$
$$\dot{k} = srk$$

Output

$$y = Ak^{\alpha}$$

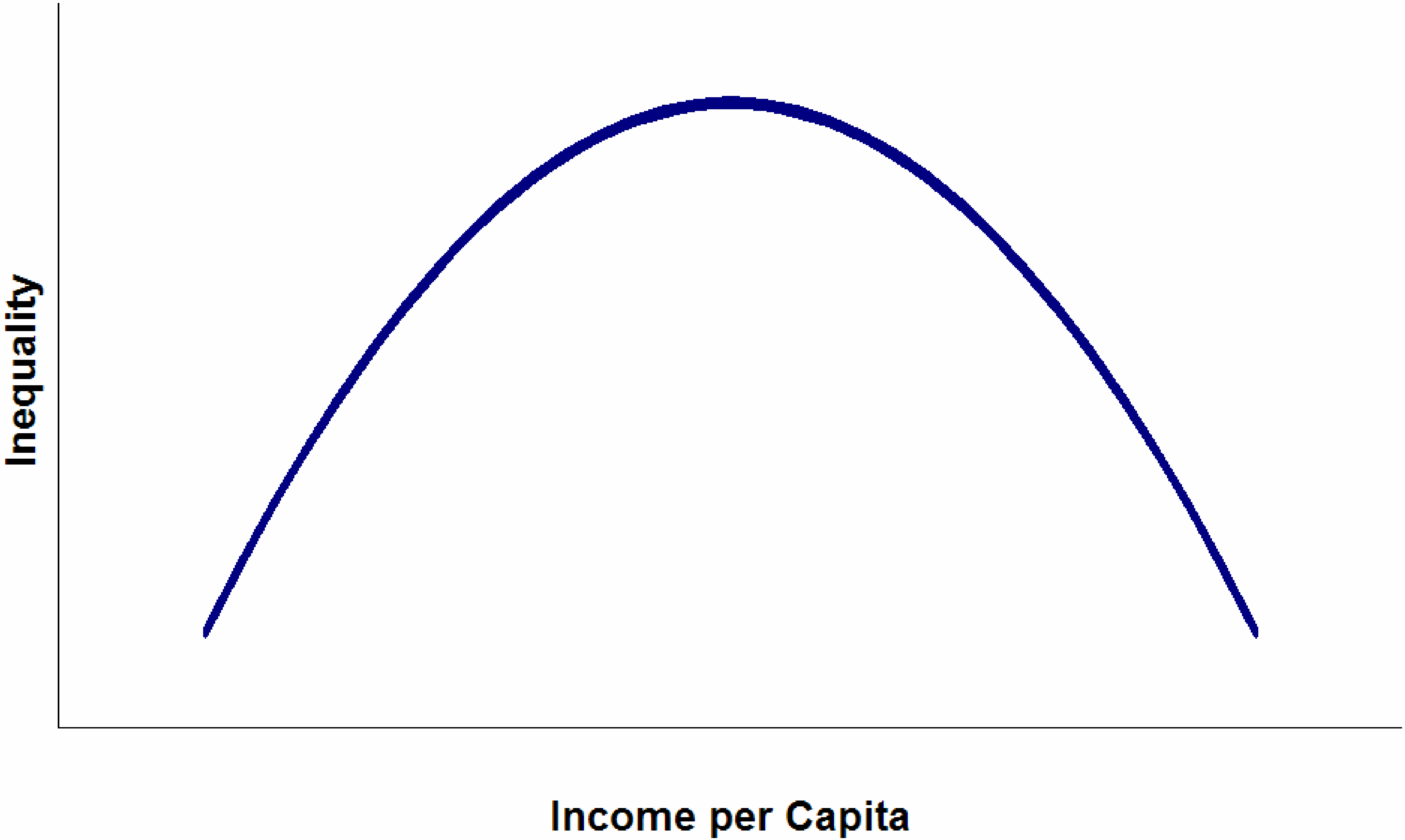
Growth

$$g = \alpha\frac{\dot{k}}{k} = \alpha sr$$

The higher the income of the capitalists, the faster the rate of growth

Inequality and Development: The Kuznets Hypothesis

Kuznets 1955:
when we look at developed and developing countries we find an inverted-U relationship between inequality and income


Inequality
Income per Capita

Hypothesis: Economic progress is initially accompanied by rising inequality but these disparities go away as all benefit from progress

Basic story:

- two sectors, with higher wages in the modern sector
- development –> some labour moves to modern sector –> greater inequality
- eventually: all workers are in modern sector –> inequality falls

Education and Imperfect Capital Markets

Galor and Zeira

Model implies that countries with greater initial wealth inequality will have (i) a more unequal long-run distribution of wealth (ii) a lower level of output

A number of questions

- Is this mechanism restricted to human capital?
- Does inequality affect growth when capital markets are perfect?
- It is a model in which development is captured by number of educated individuals. What about sectoral changes à la Kuznets?

The Effects of Inequality on Growth: An $A - K$ Formulation

Traditional view –> *trade-off* between productive efficiency/growth and redistribution

Two main considerations

1. *investment indivisibilities*
2. *incentive* considerations

New approach based on credit market imperfections

Three mechanisms

- The opportunity-enhancing effect of redistribution
- The incentive effects of redistribution
- Political economy

The opportunity-enhancing effect of redistribution

Discrete-time version of the $A - K$ model
One good
Continuum of OLG families, $i \in [0, 1]$
Intertemporal utility of individual i born at t

$$U_t^i = \ln c_t^i + \rho \cdot \ln d_t^i$$

Production

$$y_t^i = (k_t^i)^\alpha (A_t)^{1-\alpha}$$

where

$$A_t = \int_0^1 y_{t-1}^i di = y_{t-1}$$

Inequality: Individuals differ in their initial endowments of capital

$$w_t^i = \varepsilon_t^i \cdot A_t$$

ε_t^i is an i.i.d shock with mean one, so that

$$\int_0^1 w_t^i di = A_t$$

Individual i can either "consume" her endowment or invest it

Capital market imperfections: Credit simply is unavailable

Redistribution: ex ante redistribution of endowments

$$\widehat{w}^i = w^i + \beta(A - w^i), \quad 0 < \beta < 1$$

No credit restrictions

Individuals solve

$$\max_{b^i,k^i} \left\{ \ln(w^i + \beta(A - w^i) + b^i - k^i) \right.$$
$$\left. +\rho \ln(y^i - \underbrace{rb^i}) \right\}$$

The first-order conditions are

$$A^{1-\alpha}(k^i)^\alpha - rb^i = \rho r(w^i + \beta(A - w^i) + b^i - k^i)$$

and

$$r = \alpha \left(\frac{A}{k^i}\right)^{1-\alpha}$$

Which yield

$$k = \frac{\rho\alpha}{1+\rho\alpha} A = s \cdot A$$

The steady-state growth rate is

$$g = \ln\left(\frac{y_t}{y_{t-1}}\right) = \ln\left(\frac{k^\alpha A^{1-\alpha}}{A}\right) = \alpha \ln s$$

Distribution and redistribution have no impact on growth

No borrowing

Individual i choose k^i so as to:

$$\max_{k^i} \left\{ \ln(w^i - k^i) + \rho \cdot \ln y^i \right\}$$

which yields

$$k^i = \frac{\rho\alpha}{1+\rho\alpha} w^i = s \cdot w^i$$

Then,

$$y = \int_0^1 y^i di = \int_0^1 A^{1-\alpha} s^\alpha (w^i)^\alpha di$$

Hence:

$$g = \alpha[\ln s - \ln A] + \ln \int_0^1 (w^i)^\alpha di$$

Theorem: Let u be a concave function. Let X and Y be two random variables, such that the expectations $Eu(X)$ and $Eu(Y)$ exist and are finite, and such that Y is obtained from X through a mean-preserving spread. Then $Eu(X) \geq Eu(Y)$.

More inequality is bad for growth when capital markets are highly imperfect

No borrowing and redistribution

Individual i's problem is

$$\max_{k^i} \left\{ \ln(w^i + \beta(A - w^i) - k^i) + \rho \cdot \ln y^i \right\}$$

which yields

$$k^i = s \cdot ((1-\beta)w^i + \beta A).$$

As β increases, investments by the poor (rich) increase (decrease)

The "*opportunity creation*" effect dominates

$$y = \int_0^1 y^i di = \int_0^1 A^{1-\alpha} s^\alpha ((1-\beta)w^i + \beta A)^\alpha di$$

and

$$g = \alpha[\ln s - \ln A] + \ln \int_0^1 ((1-\beta)w^i + \beta A)^\alpha di$$

Using the concavity of the $z \mapsto z^\alpha$ function

$$\frac{dg}{d\beta} > 0$$

More redistribution is good for growth when capital markets are highly imperfect

The incentive effects of redistribution

Aghion-Bolton (1997)
Challenge the view that the incentive effect of redistribution is always be negative

OLG families, indexed by $i \in [0, 1]$
Utility of individual i

$$U_t^i = d_t^i - c(e_t^i)$$

where the effort cost is $c(e^i) = A_t \frac{(e^i)^2}{2}$

As before

$$w_t^i = \varepsilon_t^i \cdot A_t$$

The production technology

1. *fixed* and indivisible capital outlay equal to $k_t^i = \varphi \cdot A_t$
2. the (conditional) output from investment is

$$y_t^i = \begin{cases} \sigma \cdot A_t \text{ with probability } e_t^i \\ 0 \text{ with probability } 1 - e_t^i, \end{cases}$$

Outcomes y_t^i are i.i.d. across individuals

Individuals with initial endowments $w_t^i < \varphi A_t$ will borrow $b_t^i = \varphi A_t - w_t^i$ from wealthy individuals

The source of capital market imperfection will be moral hazard with limited liability

Assumptions

1. efforts e^i are not observable
2. a borrower's repayment to his/her lenders cannot exceed his/her second period output y_t^i

First-Best

If either (a) or (b) were violated → all agents exert first-best effort

$$e^* = \arg\max_e \{e(\sigma A) - c(e)\} = \sigma$$

Growth rate is unaffected by distribution

$$g = \ln \frac{\int_0^1 y_t^i \cdot e^i di}{y_{t-1}} = \ln \frac{\sigma A_t \cdot \int_0^1 \sigma di}{A_t} = \ln \sigma^2$$

Imperfect capital markets

Optimal repayment schedule $R(w^i)$ is such that

$$\begin{aligned} R(w^i) &= (\varphi A - w^i)\rho \quad \text{if project succeeds,} \\ &= 0 \quad\quad\quad\quad\quad \text{if project fails,} \end{aligned}$$

A borrower will choose her effort e^i to maximize

$$\max_e \left\{ e(\sigma A - \rho(\varphi \cdot A - w^i)) - A\frac{e^2}{2} \right\}$$

$$e^i = \sigma - \rho\varphi + \rho \cdot \frac{w^i}{A} = e(\rho, w^i)$$

The lower a borrower's initial wealth, the *less* effort she will exert

Redistributing wealth towards borrowers will have a *positive* effect on their effort *incentives*

Lump-sum taxation

Tax $t^i < w^i - \varphi A$ on the endowment of individuals with $w^i > \varphi A$, and redistribute the revenue amongst borrowers

This, will

1. not affect the effort e^* supplied by the wealthy, as $w^i - t^i > \varphi A$
2. increase the effort supplied by any subsidized borrower

Unambiguously positive *incentive* effect on growth,

$$g = \ln \frac{\int e^i \cdot \sigma A}{A} = \ln \sigma + \ln \int_0^1 e^i di$$

with efforts e^i either increasing or remaining constant as a result of redistribution.

Political economy
Benabou (1996)
Inequality $\rightarrow$ political game $\rightarrow$ redistribution $\rightarrow$ growth

OLG model with the tax rate being endogenously determined through majority voting

Log-linear investment tax scheme,
$$k^i(\tau) = (k^i)^{1-\tau} \cdot (\widetilde{k})^{\tau},$$
with $\widetilde{k}$ determined by the balance budget condition:
$$\int_0^1 k^i(\tau) di = \widetilde{k}$$

Log-linear investment tax scheme,
$$\begin{aligned} \log k^i(\tau) &= (1-\tau)\log k^i + \tau \log \widetilde{k} \\ &= \log k^i - \tau(\log k^i - \log \widetilde{k}) \end{aligned}$$

No borrowing constraints
Given the investment tax rate τ, individual i will

$$\max_{b^i,k^i}\{\ln(w^i+b^i-k^i)+\rho\ln(\overbrace{(k^i(\tau))^{\alpha}w^{1-\alpha}}^{=y^i}-rb^i)\}$$

where average wealth $w = A$

F.o.c. + loan market-clearing condition $\int_0^1 b^i di = 0$, yield the investment and net borrowing decisions:

$$k^i = \frac{\rho\alpha(1-\tau)}{1+\rho\alpha(1-\tau)}w$$

$$b^i = \frac{\rho}{1+\rho}(w - w^i)$$

Substititing we get intertemporal utility for individual i

$$\begin{aligned} U^i(\tau) &= V(\tau) + (1+\rho)\ln\Big[1 \\ &\quad + (\frac{w^i}{w} - 1)\frac{1+\rho\alpha(1-\tau)}{1+\rho}\Big] \end{aligned}$$

where $V(\tau)$ is the intertemporal utility of the individual with average wealth w (and $\widetilde{k}$)

$$\begin{aligned} V(\tau) &= (1+\rho)\ln w + \ln(1 - s(\tau)) \\ &\quad + \rho\alpha \ln s(\tau) \\ s(\tau) &\equiv \frac{\rho\alpha(1-\tau)}{1+\rho\alpha(1-\tau)} \end{aligned}$$

$V(\tau)$ decreasing with τ : -ve *incentive* effect
The preferred tax rate is defined by the f.o.c. $U'^i(\tau) = 0$

1. Individuals with $w^i < w$ prefer $\tau^* > 0$
2. The poorer the individual, the higher τ^*

Can show that intertemporal utilities $U^i(\tau)$ are single-peaked for $w^i < w$

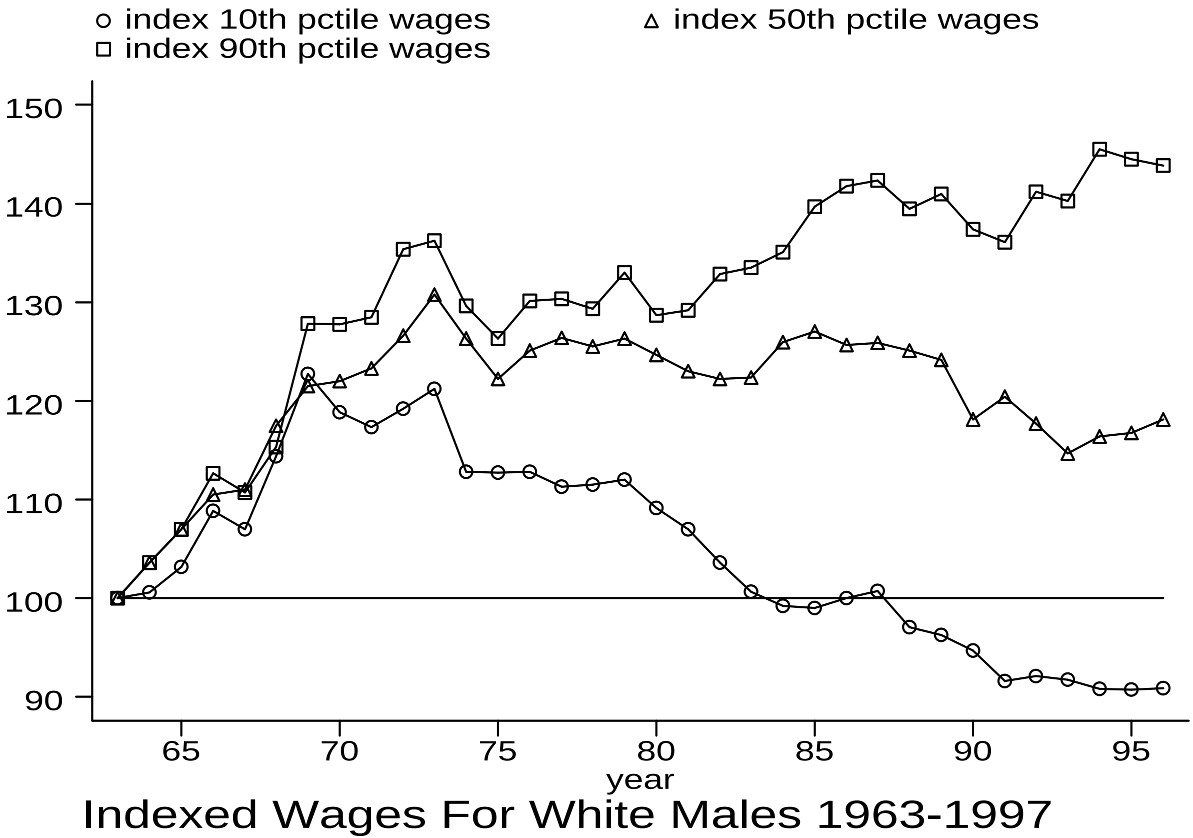
- equilibrium tax rate τ will be chosen by the median voter
- $\uparrow$ wealth inequality $\rightarrow \downarrow$ median wealth relative to average $\rightarrow \uparrow$ redistribution rate τ

Growth rate

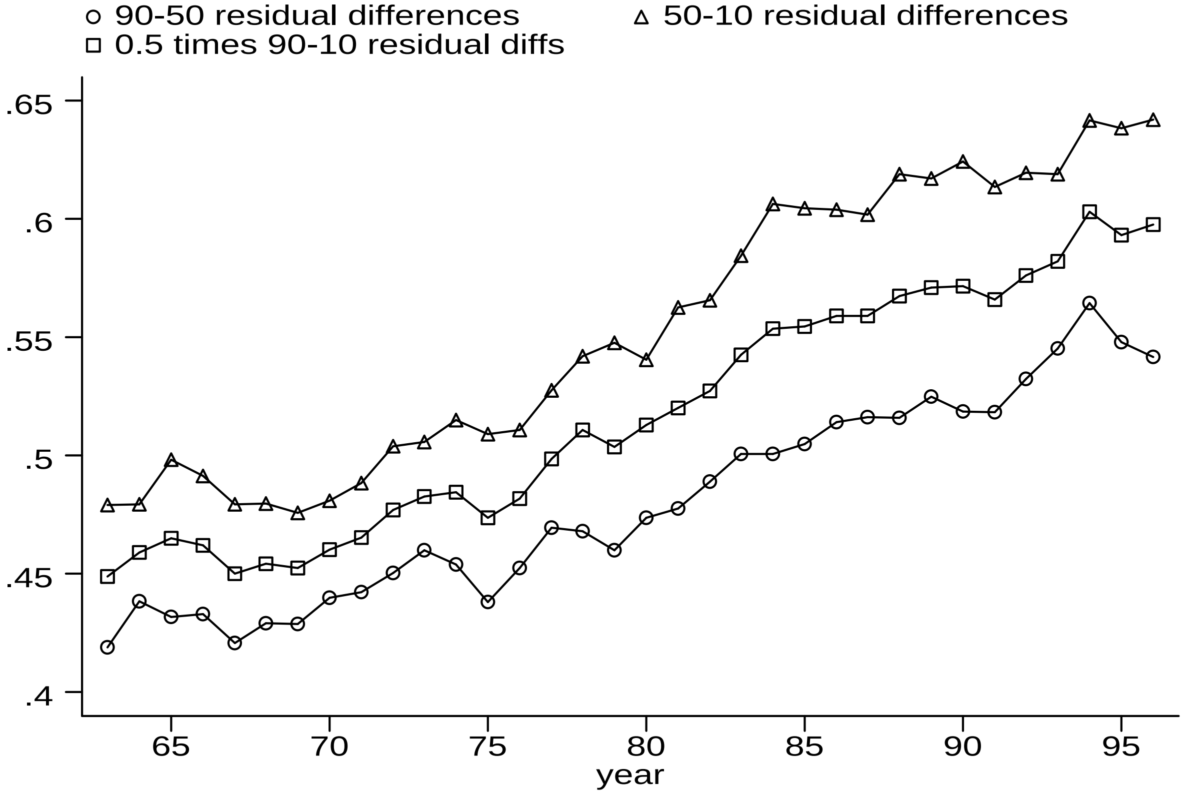
$$g = \alpha \ln s(\tau) = \alpha \ln \frac{\rho\alpha(1-\tau)}{1+\rho\alpha(1-\tau)}$$

More inequality will lead to more redistribution and therefore to lower growth

Wages and Growth:
Skill-Biased Technical Change

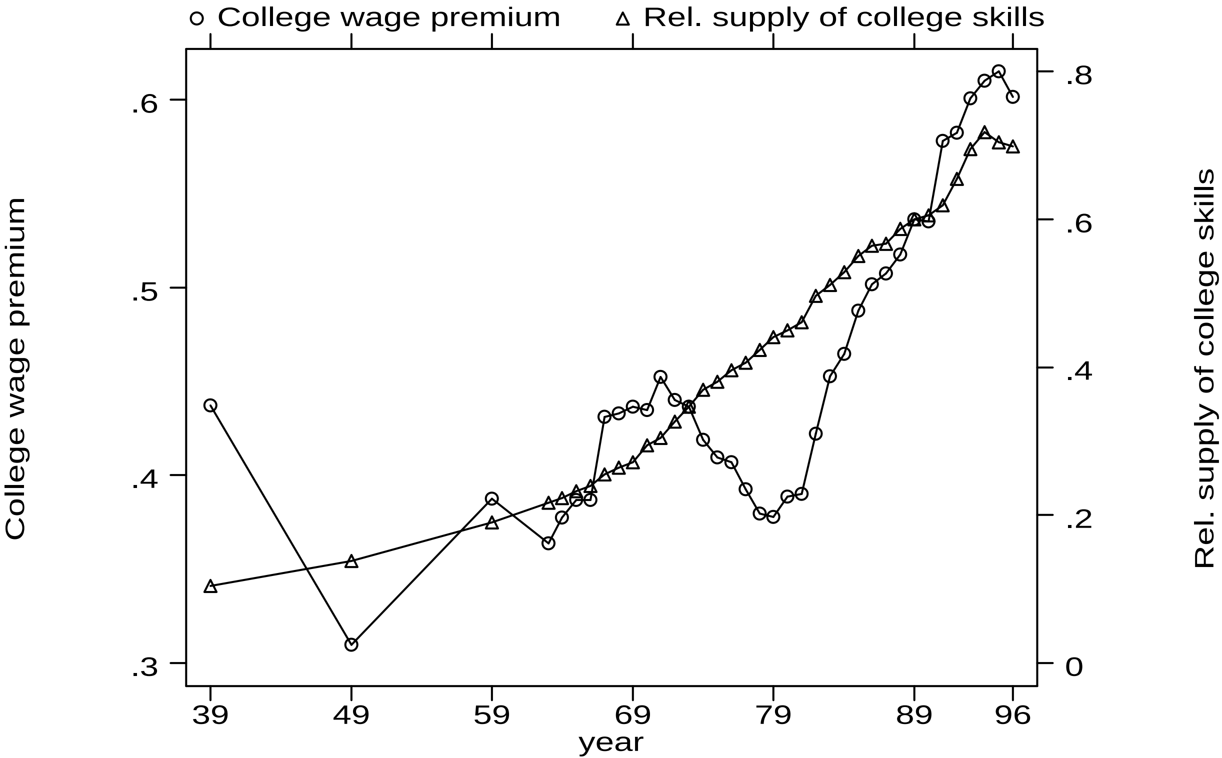


Changes in the indexed value of the 90th, 50th and 10th percentiles of the wage distribution for white males (1963 values normalized to 100).

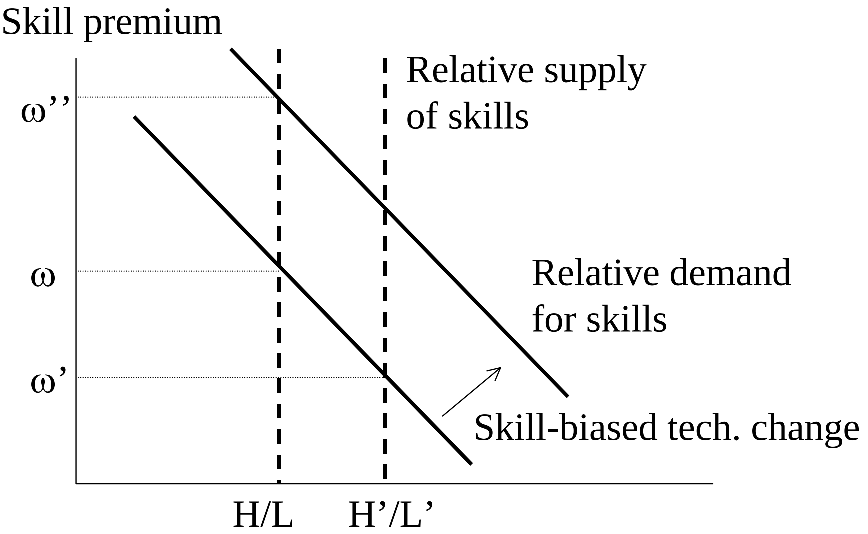


Residual inequality measures for white males 1963-1997

90-50, 50-10 and 0.5×90-10 differentials from log weekly wage regressions for white males aged 18-65.



Relative Supply of College Skills and College Premium


Skill premium
Relative supply
of skills
ω’’
ω
Relative demand
for skills
ω’
Skill-biased tech. change
H/L
H’/L’

Wages and Growth:
Skill-Biased Technical Change

Final output is now produced with both intermediate good *and unskilled labour*,

$$y_t = \ln(z + A_t \cdot x_t),$$

We have capital-skill complementarity
The productivity of intermediaries, A_t, increases by a factor $\gamma > 1$ each time an innovation occurs.

Intermediaries: one unit of skilled labour
Innovations: Poisson arrival rate λn_t

$$L = x_t + n_t$$

The research-arbitrage equation is

$$w_t = \lambda \cdot \frac{\pi_{t+1}}{r + \lambda n_{t+1}},$$

where w_t is the wage in manufacturing

Assume that innovations are nondrastic

$$\pi_{t+1} = (\gamma - 1)\, w_{t+1} \cdot x_{t+1}$$

Equilibrium wage of *skilled* workers= m.v.p. of intermediaries

$$w_t = \frac{1}{\gamma} \cdot \frac{A_t}{z + A_t x_t}.$$

Equilibrium unskilled wage

$$w_t^u = \frac{1}{z + A_t x_t}.$$

Then

$$\frac{w_t}{w_t^u} = \frac{A_t}{\gamma}$$

The wage premium increases over time as more and more productive robots compete with unskilled labour

Has Technical Change Become Skill-Biased?

Acemoglu (1998)

Researchers can target their effort to innovations that complement either skilled or unskilled labour

Education expansion since 1960s → profitable to invent machinery to be used by skilled workers → technical change *became* skill-biased

Conclusion on theoretical mechanisms linking growth and distribution

- There are circumstances under which an exogenous progressive redistribution of wealth may enhance economic efficiency and accelerate growth
- Growth is not necessarily distribution neutral. Several arguments support the Kuznets curve hypothesis.
- How does this fit with the evidence?
- Crucial problem: Asymmetry between wealth and income redistribution

Empirical evidence on the relationship between distribution and growth

- Empirical literature dominated by cross-country studies :
  - Income inequality as a function of development level : Kuznets curve in the 1970's; "Growth is good for the poor" (Dollar-Kraay 2002)
  - Growth as a function of initial income inequality in the growth regression literature of the 90s

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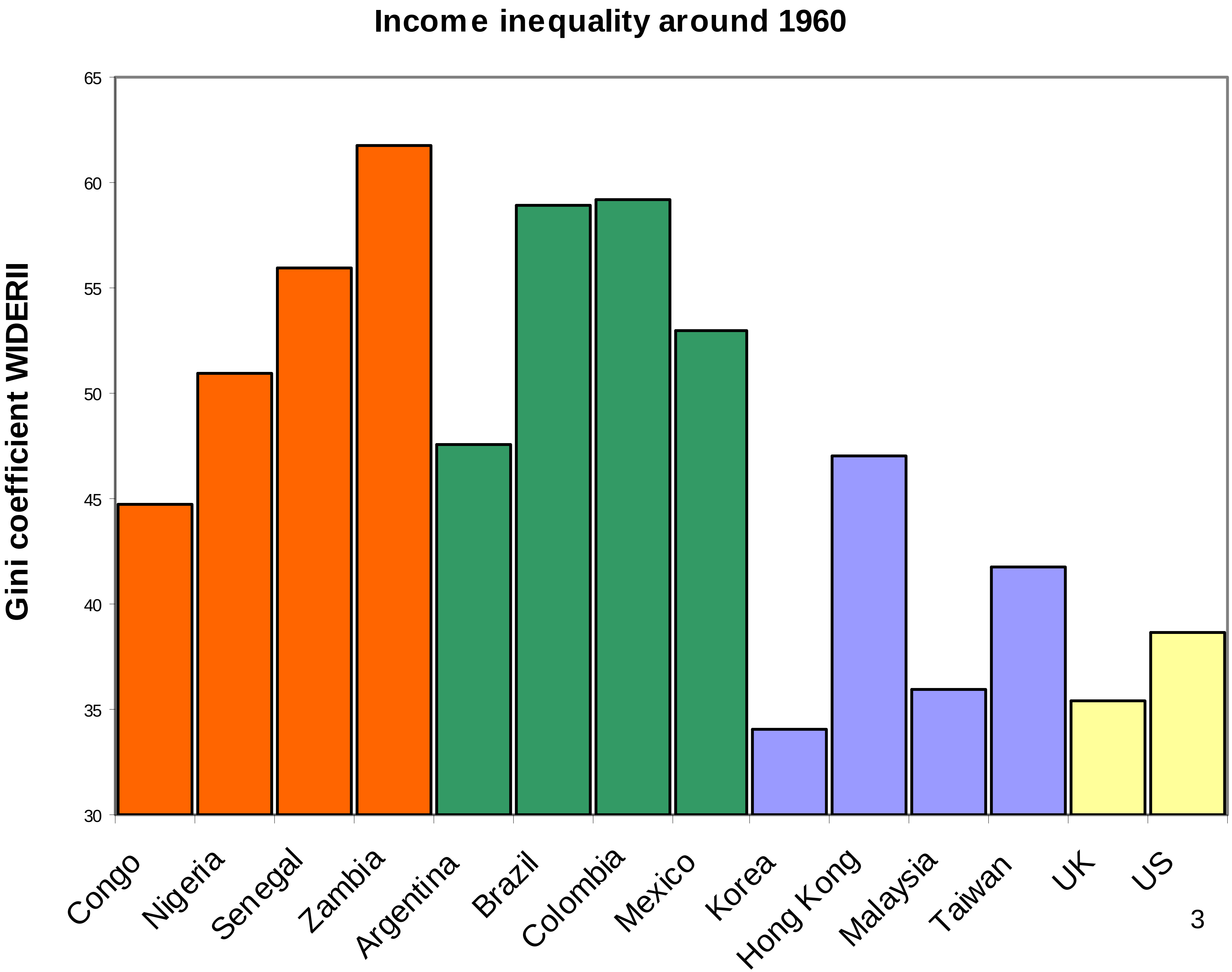
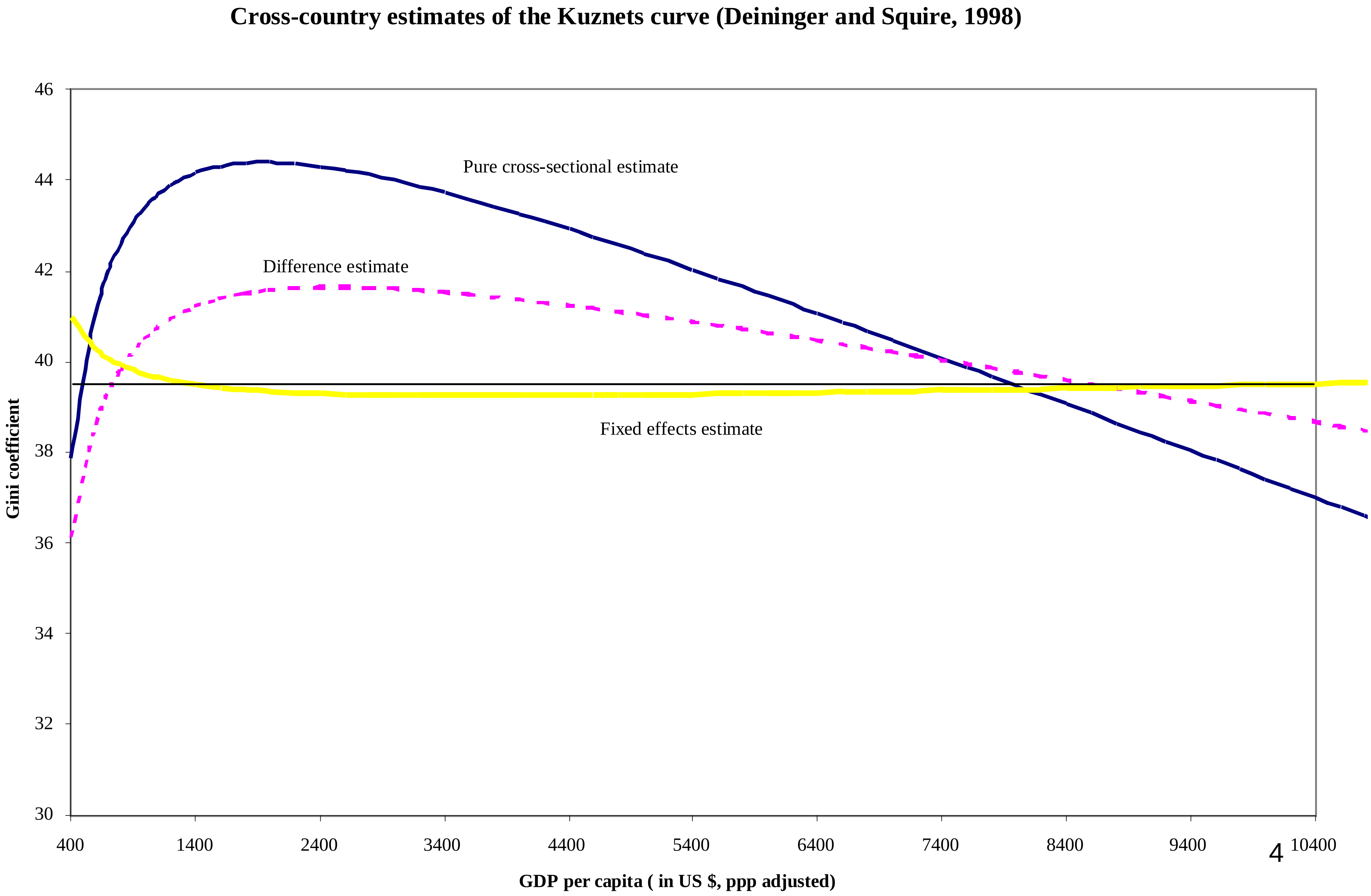


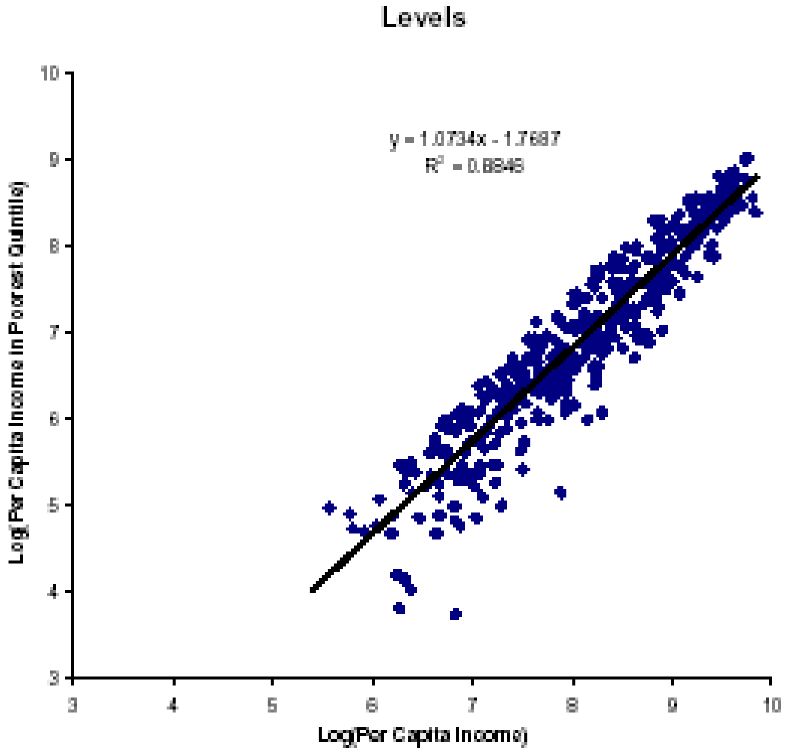
Income inequality around 1960
Gini coefficient WIDERII
65
60
55
50
45
40
35
30
Congo
Nigeria
Senegal
Zambia
Argentina
Brazil
Colombia
Mexico
Korea
Hong Kong
Malaysia
Taiwan
UK
US

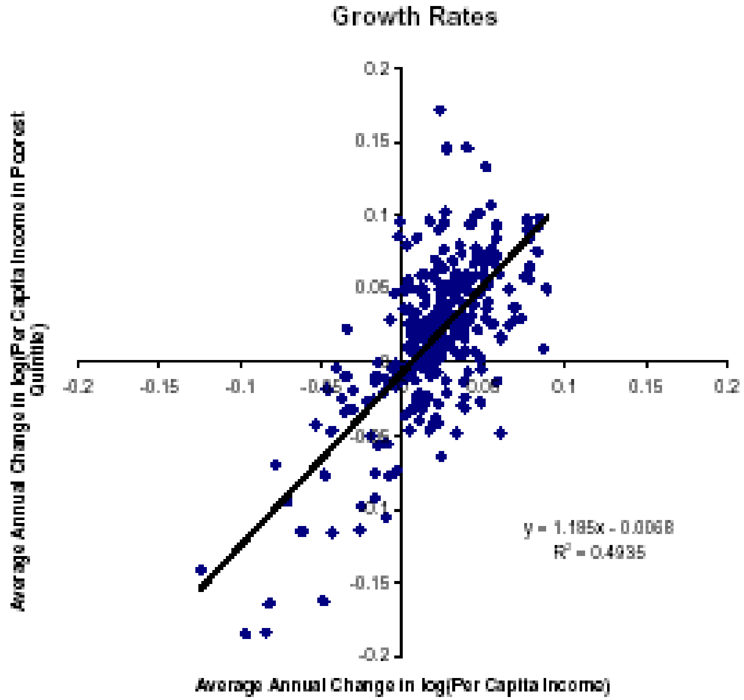
Cross-country 1



Cross-country 2

Dollar-Kraay : « Growth is Good for the Poor »





See Dollar and Kraay (2002)

Cross-country 3

Selected cross-country estimates of the effect of income inequality on the rate of growth

Dependent variable = average annual growth rate on indicated period

Explanatory variable	**Deiniger and Squire (1998) (60-92)**				**Forbes (65-95)**	**Forbes (2000) (5-year periods) 65-95**	
	OLS	**OLS**	**OLS**	**OLS**	**OLS**	**RE**	**AB**
Inequality (Gini-DS)	-0.047	-0.019			-0.05	0.13	0.13
	2.80	*0.95*			*1.67*	*2.17*	*2.18*
Inequality of land distribution			-0.034	-0.022			
			4.07	*1.95*			
Initial gdp per capita	-0.302	-0.205	-0.288	-0.264	-0.2	0.17	-0.47
	3.70	*2.23*	*4.39*	*3.49*	*0.67*	*2.83*	*5.88*
Investment rate	x	x	x	x			
Regional dummies		x		x			
Education levels					x	x	x
PPP-I					x	x	x
Nr. of countries	87	87	64	64	63	45	45
Nr of observations	87	87	64	64	63	180	135
R^2	0.378	0.468	0.549	0.564	0.4	0.49	

Perotti 1996

	Growth	Growth	MarTax
Equality	0.118		-0.096
	(2.84)		(-0.19)
GDP	-0.002	-0.004	-0.021
	(-1.77)	(-2.39)	(-1.50)
MarTax		0.090	
		(3.61)	
Other variables	Yes	Yes	Yes
Obs.	67	49	49
R^2	0.30	0.22	0.30

Cross-country 5

Growth regressions with income distribution effects: structural models (FB, 1996)

	This study			
Independent variable	**Growth**	**Growth**	**Investment**	**School enrol.**
Income inequality		-0.327	1.093	-0.470
		3.500	*2.130*	*0.280*
Investment	0.082	0.130		
	1.610	*2.840*		
School enrollment rate	3.700	3.740	0.192	
	2.810	*3.320*	*3.370*	
Initial GDP per capita	-1.120	-0.598	0.126	0.125
	3.020	*1.700*	*0.080*	*2.660*
Latin-America			-0.113	
			3.380	
Africa				-0.165
				1.710
R^2	0.312	0.512	0.456	0.456
Sample	36	36	36	36

Cross-country evidence: Conclusion

- Growth → Distribution
  - Unsurprising lack of evidence on Kuznets curve : many factors affecting change in distribution, including distribution policies
  - Does not mean that causes for international differences in income distribution cannot be identified explained
  - Initial analysis by Kuznets probably based on rudimentary data (general problem of data quality and comparability)

- Distribution → Growth
  - Unsurprising lack of evidence : theory does not necessarily imply that more inequality in ***income*** distribution leads to slower growth
  - Few exogenous changes in distributional characteristics
  - Danger of generalizing from very partial evidence (S. Korea, Taiwan, Brazil, South Africa, ..)

Conclusion on "Inequality and Growth"

- Relationship between growth and distribution of ***income*** is complex and likely to be highly country-specific

- No conclusive evidence on a systematic relationship between growth and income inequality

- Not surprising, given the complexity of the effects of growth on distribution and the misunderstanding of the theoretical arguments relating growth to inequality

- From the latter point of view it is the inequality in wealth and access to credit (or labor) market that may have an impact on growth

- Role of case studies? Consider subsets of countries?