

From Physical to Human Capital Accumulation: Inequality in the Process of Development

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- Provides an intertemporal reconciliation between conflicting viewpoints about the effect of inequality on economic growth
- Generates novel testable predictions that may resolve empirical disputes about the relationship between inequality and growth

The Classical Approach

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 - ⇒ enhances the development process

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- Inequality increases the fraction of society for which investment in human capital is suboptimal
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 - ⇒ slows down the development process

A Unified Theory of Inequality and Development

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- Later stages of development: the return to human capital increases due to capital-skill complementarity and human capital became the prime engine of growth \implies
 - Inequality, due to credit constraints, is harmful for growth

Central Argument

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Fundamental asymmetry between:

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- Physical capital accumulation may benefit from the concentration of wealth among individuals whose marginal propensity to save is larger

Inequality and Physical and Human Capital Accumulation

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- **Inequality** stimulates economic growth in stages of development in which **physical capital** accumulation is the prime engine of growth
- **Inequality** is harmful for economic growth in stages of development in which **human capital** accumulation is the prime engine of economic growth and credit constraints are still binding

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\Rightarrow Inequality is harmful for growth

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- A positive effect of inequality on growth underlined by the **Classical Approach** reflects early stages of industrialization when physical capital accumulation was the prime engine of growth
- A negative effect of inequality on growth underlined by the **Modern Approach** reflects later stages of development when human capital accumulation becomes a prime engine of growth, and credit constraints are still binding

The Basic Structure of the Model

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- Two factors:
 - Physical capital (PC)
 - Human Capital (HC)

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- The level of HC: Outcome of education decisions, subject to borrowing constraint

Production of Final Output

The output produced at time t :

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$k_t \equiv K_t/H_t$

Factor Prices

Demand for factors of production at time t

$$r_t = f'(k_t) \equiv r(k_t)$$

$$w_t = f(k_t) - f'(k_t)k_t \equiv w(k_t)$$

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 - Parental income \Rightarrow Inv't in HC

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Individual i of Generation t : Wealth

Second period wealth:

$$l_{t+1}^i = w_{t+1} h_{t+1}^i + x_{t+1}^i$$

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h_{t+1}^i – efficiency units of labor

x_{t+1}^i – inheritance

Individual i of Generation t : Budget Constraint

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b_{t+1}^i – transfers to the offspring

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$$s_{t+1}^i = b_{t+1}^i - e_{t+1}^i$$

- Inheritance

$$x_{t+1}^i = s_t^i R_{t+1} = (b_t^i - e_t^i) R_{t+1}$$

Individual i of Generation t : Human capital formation

Efficiency units of labor in period $t + 1$

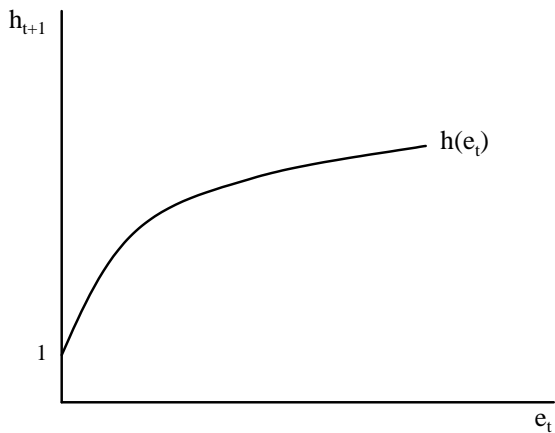
$$h_{t+1}^i = h(e_t^i)$$

Individual i of Generation t : Human capital formation

Efficiency units of labor in period $t + 1$

$$h_{t+1}^i = h(e_t^i)$$

e_t^i – expenditure on education

Individual i of Generation t : Human capital formation

Optimal Inv't in Education of Member i of Generation t

In the absence of borrowing constraints:

$$e_t^i = \arg \max [w_{t+1} h(e_t^i) + (b_t^i - e_t^i) R_{t+1}]$$

Optimal Inv't in Education of Member i of Generation t

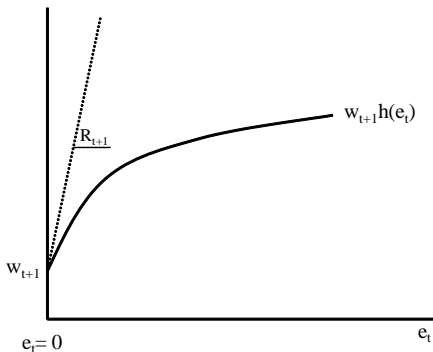
In the absence of borrowing constraints:

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e_t is unique and identical across members of generation t

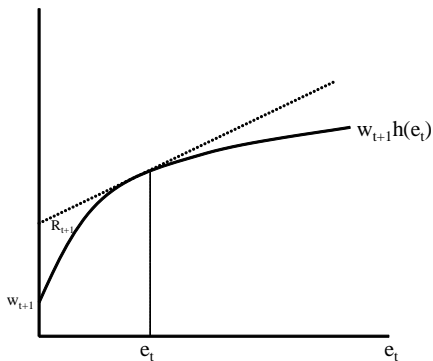
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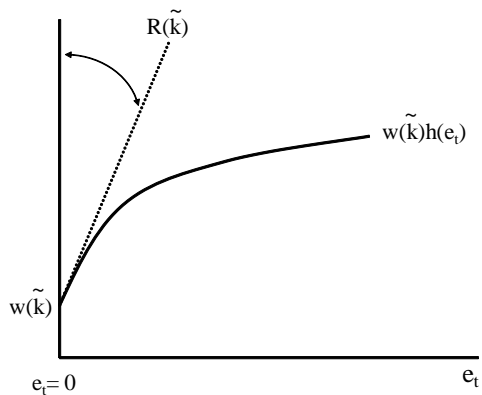
$$e_t = 0 \quad \text{if} \quad R_{t+1} > w_{t+1}h'(0)$$



Optimal Inv't in Education of Member i of Generation t

$$e_t > 0 \quad \text{if} \quad w_{t+1}h'(e_t) = R_{t+1}$$



Optimal Inv't in Education of Member i of Generation t 

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$$e_t = e(k_{t+1}) \begin{cases} = 0 & \text{if } k_{t+1} \leq \tilde{k} \\ > 0 & \text{if } k_{t+1} > \tilde{k} \end{cases}$$

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where

$$e'(k_{t+1}) > 0 \quad \text{if } k_{t+1} > \tilde{k}$$

Borrowing Constraint of Member i of Generation t

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$$e_t^i = \min[e(k_{t+1}), b_t^i]$$

Preferences and Transfers of Member i of Generation t

- Preferences:

$$u_t^i = (1 - \beta) \log c_{t+1}^i + \beta \log(\bar{\theta} + b_{t+1}^i)$$

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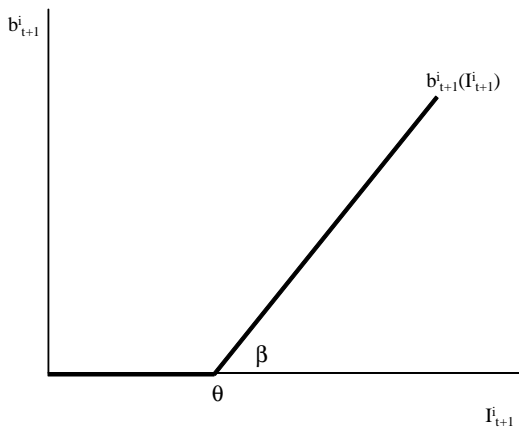
- Preferences:

$$u_t^i = (1 - \beta) \log c_{t+1}^i + \beta \log(\bar{\theta} + b_{t+1}^i)$$

- Optimal transfer to offspring:

$$b_{t+1}^i = b(l_{t+1}^i) \equiv \begin{cases} \beta(l_{t+1}^i - \theta) & \text{if } l_{t+1}^i \geq \theta \\ 0 & \text{if } l_{t+1}^i \leq \theta \end{cases}$$

where $\theta \equiv \bar{\theta}(1 - \beta) / \beta$

Optimal transfer of a member i of generation t 

Saving of Member i of Generation t

$$s_t^i = \begin{cases} b_t^i & \text{if } k_{t+1} \leq \tilde{k} \\ b_t^i - e_t^i & \text{if } k_{t+1} > \tilde{k} \end{cases}$$

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Saving rate s_{t+1}^i / l_{t+1}^i is increasing in l_{t+1}^i

Initial Wealth Distribution

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- Capitalists (R)
 - Fraction λ of all adult individuals
 - Equally own the *initial* capital stock
- Workers (P)
 - Fraction $1 - \lambda$ of all adult individuals
 - No ownership over the *initial* capital stock

Factor Accumulation

$$\begin{aligned}K_{t+1} &= \int_0^1 s_t^i di = \lambda(b_t^R - e_t^R) + (1 - \lambda)(b_t^P - e_t^P) \\ &= K(b_t^R, b_t^P, k_{t+1})\end{aligned}$$

$$\begin{aligned}H_{t+1} &= \int_0^1 h_{t+1}^i di = \lambda h(e_t^R) + (1 - \lambda)h(e_t^P) \\ &= H(b_t^R, b_t^P, k_{t+1})\end{aligned}$$

The Capital-Labor Ratio

$$k_{t+1} = \frac{K_{t+1}}{H_{t+1}} = \frac{K(b_t^R, b_t^P, k_{t+1})}{H(b_t^R, b_t^P, k_{t+1})}$$

\Rightarrow

$$k_{t+1} = \kappa(b_t^R, b_t^P)$$

The Evolution of Transfers within group $i = R, P$

$$b_{t+1}^i = \max\{\beta[w_{t+1}h(e_t^i) + (b_t^i - e_t^i)R_{t+1} - \theta], 0\}$$

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 \implies

$$b_{t+1}^i = \phi(b_t^i, k_{t+1})$$

There exists \hat{k} , a critical level of k below which individuals who do not receive parental transfers (i.e., $b_t^i = e_t^i = 0$) do not transfer income to their offspring:
 $w(\hat{k}) = \theta$

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$$b_{t+1}^i = \phi(0, k_{t+1}) \begin{cases} = 0 & \text{if } k_{t+1} \leq \hat{k} \\ > 0 & \text{if } k_{t+1} > \hat{k} \end{cases}$$

The Evolution of Transfers within Group $i = R, P$

$$\begin{aligned} b_{t+1}^i &= \phi(b_t^i, k_{t+1}) = \phi(b_t^i, \kappa(b_t^R, b_t^P)) \\ &\equiv \psi^i(b_t^R, b_t^P) \end{aligned}$$

The dynamical system

$\{b_t^P, b_t^R\}_{t=0}^{\infty}$ such that:

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$\{b_t^P, b_t^R\}_{t=0}^{\infty}$ such that:

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The Process of Development

- Regime I: PC Accumulation ($k \leq \tilde{k}$)

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 - Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

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 - Stage II of Regime II ($\hat{K} < K < K^*$)

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 - Stage III of Regime II ($K > K^*$)

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Early stages of development ($k \leq \tilde{k}$)

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- Transfers within Group R \uparrow

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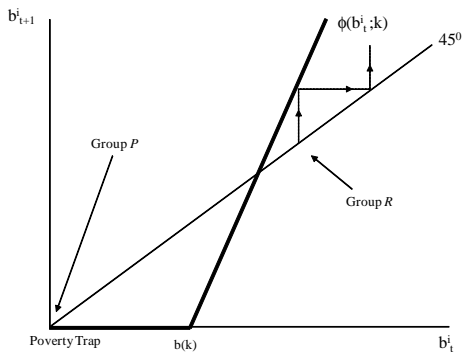
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- No Transfers within Group P
- Transfers within Group R \uparrow
- Wages \uparrow

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- K is the main engine of growth: $\rho^{HC} < \rho^K$
- No investment in education
- No Transfers within Group P
- Transfers within Group R \uparrow
- Wages \uparrow
- Income inequality \uparrow

The Conditional Dynamical System: Regime I



Regime I: Effect of Inequality

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 - Aggregate intergenerational transfers \downarrow

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- A transfer of wealth from Group R to P \implies
 - Aggregate consumption \uparrow
 - Aggregate intergenerational transfers \downarrow
 - Rate of capital accumulation \downarrow

Regime II: Human Capital Accumulation

Mature stages of development: $(k > \tilde{k})$

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- HC is the engine of growth: $\rho^{HC} \geq \rho^K$

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

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Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

- Members of group P

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

- Members of group P
 - No intergenerational transfers

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

- Members of group P
 - No intergenerational transfers
 - No investment in education

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

- Members of group P
 - No intergenerational transfers
 - No investment in education
- Members of group R

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

- Members of group P
 - No intergenerational transfers
 - No investment in education
- Members of group R
 - Transfers \uparrow

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

- Members of group P
 - No intergenerational transfers
 - No investment in education
- Members of group R
 - Transfers \uparrow
 - Expenditure on education \uparrow

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

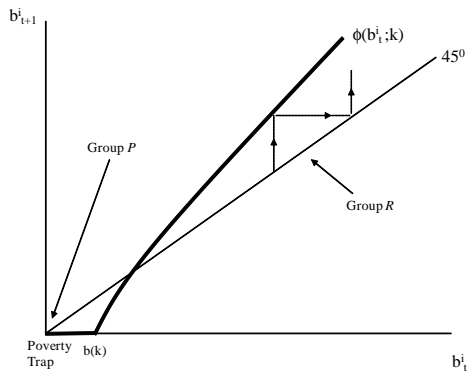
- Members of group P
 - No intergenerational transfers
 - No investment in education
- Members of group R
 - Transfers \uparrow
 - Expenditure on education \uparrow
- Wages \uparrow

Stage I of Regime II: HC Accumulation by group R

Stage I of Regime II ($\tilde{K} < K \leq \hat{K}$)

- Members of group P
 - No intergenerational transfers
 - No investment in education
- Members of group R
 - Transfers \uparrow
 - Expenditure on education \uparrow
- Wages \uparrow
- Income inequality \uparrow

The Conditional Dynamical System: Stage I of Regime II



Stage II of Regime II : HC Accumulation by the Poor

Stage II of Regime II ($\hat{K} < K < K^*$)

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 - Start to transfers
 - Start to acquire education

Stage II of Regime II : HC Accumulation by the Poor

Stage II of Regime II ($\hat{K} < K < K^*$)

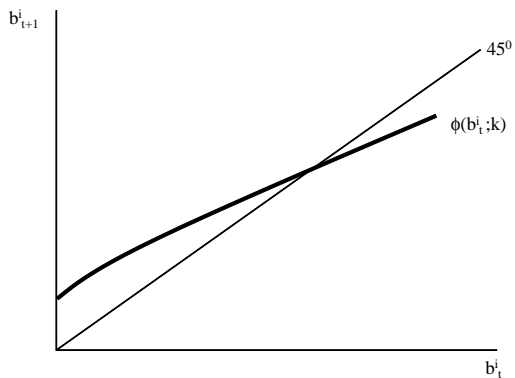
- Members of group P (credit constrained): $\rho^{HC} > \rho^K$
 - Start to transfers
 - Start to acquire education
- Members of group R (not credit constrained): $\rho^{HC} = \rho^K$

Stage II of Regime II : HC Accumulation by the Poor

Stage II of Regime II ($\hat{K} < K < K^*$)

- Members of group P (credit constrained): $\rho^{HC} > \rho^K$
 - Start to transfers
 - Start to acquire education
- Members of group R (not credit constrained): $\rho^{HC} = \rho^K$
 - Invest optimally in human and physical capital

Conditional Dynamical System: Stage II-III of Regime II



Stage II of Regime II: Effect of Inequality

- More equality is beneficial for the process development

Stage II of Regime II: Effect of Inequality

- More equality is beneficial for the process development
 - A transfer of wealth from group R to group P allows (due to credit constraint) a more efficient allocation of aggregate investment between HC and PC

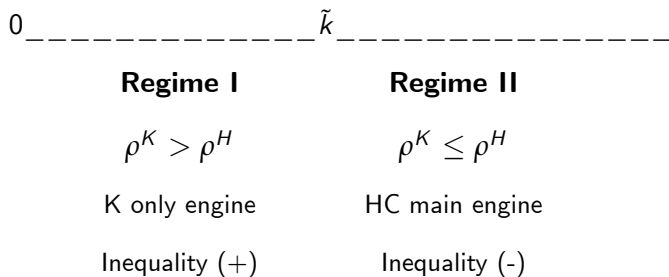
Stage III of Regime II : Credit Constraints are not Binding

- All individuals are not credit constrained: $R^{HC} = R^K$

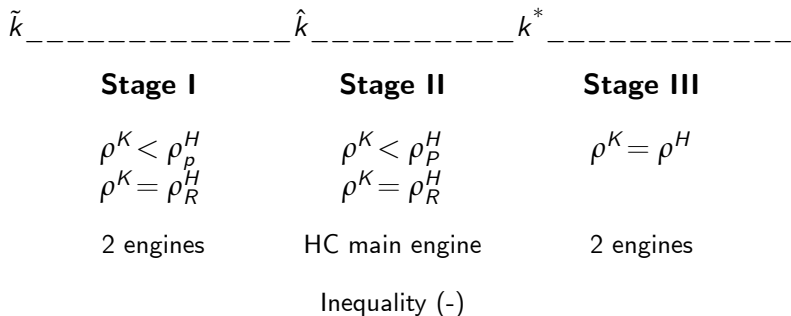
Stage III of Regime II : Credit Constraints are not Binding

- All individuals are not credit constrained: $R^{HC} = R^K$
- Inequality has no effect on the process of development

The changing Role of Inequality in the Development Process



Effect of Inequality in Regime II



Testable Implications

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The CMI approach

- The effect on inequality depends on the country's level of income. Inequality is beneficial for poor economies and harmful for rich ones

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- The effect on inequality depends on the country's level of income. Inequality is beneficial for poor economies and harmful for rich ones

The Unified Approach

- The effect of inequality on growth depends on the relative return to human and physical capital. The higher is the relative return to human capital the more harmful is inequality for economic growth

Implications for DC and LDCS

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 - Inequality is harmful for economic growth in stages of development in which human capital accumulation is the prime engine of economic growth

Implications for DC and LDCS

- The replacement of physical capital accumulation by human capital accumulation as a prime engine of economic growth has changed the impact of inequality on the process of development
 - Inequality stimulates economic growth in stages of development in which physical capital accumulation is the prime engine of growth
 - Inequality is harmful for economic growth in stages of development in which human capital accumulation is the prime engine of economic growth
- Int'l capital inflow to LDCs and the adoption of skilled-biased technologies may place economies directly in the second stage in which inequality is harmful

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