Financing Higher Education: Comparing Alternative Policies

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Poverty is often self-perpetuating - especially in developing countries.

Pervasive inequality along with imperfect credit markets distort the incentives to invest for the poor.

Poorer households not only earn less, but also invest proportionately less - thereby hindering the earning capabilities of the future generations.

Effective anti-poverty measure must take into account these *dynamic* incentive effects (Ghatak et al, 2001; Mookherjee, 2006; Mookherjee and Ray, 2008).

Education policy may work better than direct redistributive transfers - precisely because it creates the right incentives.
This Paper

- Compare alternative policies to finance higher education from the perspective of generating dynamic incentive effects.
  - Private Education System;
  - Public Education System;
  - Traditional Tax-Subsidy System;
  - A Pure Loan Scheme;
  - Income Contingent Loans.

- Develop a framework to compare alternative policies in a dynamic set up.

- Advocate a government-sponsored Income Contingent Loan scheme in generating the right incentives from a long run perspective.
Model Structure

- Based on Galor-Zeira (1993)
  - Two periods overlapping generations with no population growth.
  - Two sectors: Technical and Non-Technical
    - Working in the technical sector requires specialized skills;
    - working in the non-technical sector does not.
  - Skill formation requires indivisible investment in higher education.
  - Credit market is imperfect.

- Extends Galor-Zeira in a specific direction:
  - Adds uncertainty in the technical skill formation process.
    - Accentuates the unskilled labour trap result of Galor-Zeira.
Risk and Returns

- **Constant Factor Returns:**
  - Imperfect credit market: borrowing interest rate \((i)\) is higher than the lending interest rate \((r)\).
  - Wage rate in the non-technical/unskilled sector is \(w_n\).
  - Wage rate in the technical/skilled sector is \(w_s\).

- **Indivisibility and Uncertainty in Skill Formation:**
  - Skill formation requires an indivisible investment in higher education, \(E > 0\).
  - Investment is risky: may fail in acquiring technical skill even after making the lump-sum investment.
    - Success with probability \(p\); earns skilled wage rate \(w_s\).
    - Failure with probability \(1 - p\); earns unskilled wage rate \(w_n\).
Households

- Overlapping generations of dynastic households.
- Each agent born with same potential abilities and preferences.
  - They differ only in terms of the wealth they inherit from their parents, $x$.
- Each agent lives for 2 periods; has one parent and one child.
- Each agent can
  - *either* work as unskilled in both periods of life,
  - *or* invest in higher education when young and be a skilled worker with probability $p$ in the second period of life.
- Agents consume only in the second period of life.
- Utility function of an agent: $u = \alpha \log c + (1 - \alpha) \log b$.
  - $c$: consumption; $b$: bequest.
  $\Rightarrow$ Agents are risk-averse.
Household Choices

- An agent has to decide whether or not to invest in technical skill formation.

- We formulate this as two separate optimization problems:
  
  (a) No investment in higher education;
  
  (b) Invest in higher education.

- Then we compare the expected indirect utilities to determine the optimal behaviour of the agent.
Private Education System

No Investment in Higher Education

- **Agent’s Problem:**

  \[
  \max_{\{c,b\}} \quad u(\cdot) = \alpha \log c + (1 - \alpha) \log b \\
  \text{subject to} \quad c + b = (x + w_n)(1 + r) + w_n.
  \]

- **Optimal consumption and bequest choices:**

  \[
  c_n = \alpha [x(1 + r) + w_n (2 + r)] , \\
  b_n = (1 - \alpha) [x(1 + r) + w_n (2 + r)] .
  \]

- **Indirect utility:**

  \[
  V_N = \epsilon + \log [x(1 + r) + w_n (2 + r)] , \\
  \quad -\epsilon \equiv \alpha \log \alpha + (1 - \alpha) \log (1 - \alpha) .
  \]
Investment in Higher Education by Borrowing

- Agent’s inheritance falls short of the investment requirement: \( x < E \).

- Agent’s Problem:

\[
\max_{\{c_s, c_f, b_s, b_f\}} E[U(\cdot)] = p [\alpha \log c_s + (1 - \alpha) \log b_s] \\
+ (1 - p) [\alpha \log c_f + (1 - \alpha) \log b_f]
\]

subject to

\[
c_s + b_s = w_s + (x - E)(1 + i), \\
c_f + b_f = w_n + (x - E)(1 + i).
\]

- Here ‘s’ and ‘f’ represent ‘success’ and ‘failure’ respectively.
Investment by Borrowing: Solution to Agent’s Problem

- Optimal consumption and bequest choices under ‘success’:
  - \( c_s = \alpha [w_s + (x - E)(1 + i)] \),
  - \( b_s = (1 - \alpha)[w_s + (x - E)(1 + i)] \).

- Optimal consumption and bequest choices under ‘failure’:
  - \( c_f = \alpha [w_n + (x - E)(1 + i)] \),
  - \( b_f = (1 - \alpha)[w_n + (x - E)(1 + i)] \).

- Indirect utility:
  \[
  V_E^B = \varepsilon + p \log [w_s + (x - E)(1 + i)] \\
  + (1 - p) \log [w_n + (x - E)(1 + i)].
  \]
Investment in Higher Education from Own Inheritance

- Agent’s inheritance is enough to fund the investment requirement: \( x \geq E \).
- Agent’s Problem:

\[
\max_{\{c_s, c_f, b_s, b_f\}} E[U(\cdot)] = p [\alpha \log c_s + (1 - \alpha) \log b_s] \\
+ (1 - p) [\alpha \log c_f + (1 - \alpha) \log b_f]
\]

subject to

\[
c_s + b_s = w_s + (x - E)(1 + r), \\
c_f + b_f = w_n + (x - E)(1 + r).
\]
Investment from Own Inheritance: Solution to Agent’s Problem

- Optimal consumption and bequest choices under ‘success’:
  - \( c_s = \alpha \left[ w_s + (x - E)(1 + r) \right] \),
  - \( b_s = (1 - \alpha) \left[ w_s + (x - E)(1 + r) \right] \).

- Optimal consumption and bequest choices under ‘failure’:
  - \( c_f = \alpha \left[ w_n + (x - E)(1 + r) \right] \),
  - \( b_f = (1 - \alpha) \left[ w_n + (x - E)(1 + r) \right] \).

- Indirect utility:
  \[
  V_E^L = \varepsilon + p \log \left[ w_s + (x - E)(1 + r) \right] \\
  + (1 - p) \log \left[ w_n + (x - E)(1 + r) \right].
  \]
Whether to Opt for Higher Education

- Compare indirect utility under no higher education

\[ V_N(x) = \varepsilon + \log [x(1 + r) + w_n (2 + r)] , \]

with indirect utility under higher education

\[ V_E(x) = \begin{cases} 
\varepsilon + p \log [w_s + (x - E) (1 + i)] \\
+ (1 - p) \log [w_n + (x - E) (1 + i)] , 
\end{cases} \quad \text{for } x < E , \]

\[ \begin{cases} 
\varepsilon + p \log [w_s + (x - E) (1 + r)] \\
+ (1 - p) \log [w_n + (x - E) (1 + r)] , 
\end{cases} \quad \text{for } x \geq E . \]
Wealth Threshold

\[ V_E(x) \]
\[ V_N(x) \]

\[ W_{Prv} \]
\[ E \]
Dynamics of Wealth Distribution

- When $x_t < W^{Prv}$,
  \[ x_{t+1} = (1 - \alpha) \left[ x_t(1 + r) + w_n (2 + r) \right]. \]

- When $W^{Prv} \leq x_t < E$,
  \[ x_{t+1} = \begin{cases} 
  (1 - \alpha) \left[ w_s + (x_t - E)(1 + i) \right], & \text{prob } p, \\
  (1 - \alpha) \left[ w_n + (x_t - E)(1 + i) \right], & \text{prob } 1 - p.
  \end{cases} \]

- When $E \leq x_t$,
  \[ x_{t+1} = \begin{cases} 
  (1 - \alpha) \left[ w_s + (x_t - E)(1 + r) \right], & \text{prob } p, \\
  (1 - \alpha) \left[ w_n + (x_t - E)(1 + r) \right], & \text{prob } 1 - p.
  \end{cases} \]
Wealth Dynamics and the Long Run

\[ x_{t+1} = (1-\alpha)w_n(2+r) \]

\[ x_t \]

\[ W^{Prv} \]

\[ E \]

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Working of the Public Education System

- Works through the following inter-generation *tax-and-transfer policy* (Glomm & Ravikumar, 1992).

- Government taxes the second-period income of old agents at the rate $\tau_t$ and transfer the tax revenue to young agents in equal amounts ($R_t$):

  $$R_t = \tau_t \cdot \left[ \int y_t \, dF_t (y_t) \right],$$

  - $F_t (y)$ is the distribution function of the second-period income.

- $\tau_t$ is endogenously determined in each period through *majority voting*.

- An young agent treats this transfer $R_t$ in exactly the same way as she treats her bequest in the private education regime.
Majority Voting

- An individual’s decision-making is a two-step procedure.
  
  I. Chooses $c_t$ that maximizes her utility for a given post tax income, $(1 - \tau_t) y_t$, treating the transfer received by her child as given.
    
    \[
    u(\tau_t; y_t) = \alpha \log [(1 - \tau_t) y_t] + (1 - \alpha) \log [\tau_t \cdot (\int z_t dF_t (z_t))].
    \]
    
  II. Votes for the tax rate $\tau_t$ that maximizes the above utility.
    
    \[
    \Rightarrow \text{Votes for } \tau^*_t = 1 - \alpha.
    \]

- Since every old agent votes for the tax rate $\tau^*_t = 1 - \alpha$, this becomes the tax rate under majority voting.
Intergenerational Dynamics and the Long Run
Working of the Tax-Subsidy System

- A lump-sum tax, \( T \), is levied on *all* agents in the first period of their lives; a subsidy \( sE \) is received by *only* those who opt for higher education.

- Subsidy rate, \( s \), is fixed; government decides the lump-sum tax so as to maintain a balanced budget:

\[
T_t = sEf_t,
\]

- \( f_t \) is the proportion of population opting for higher education.

- Note that in any period \( t \), \( T_t \) and \( f_t \) are determined endogenously.
Reverse Redistribution

- Those who do not study pay a tax but receive no subsidy; those who study pay the same tax and receive a subsidy.
- This implies a *net transfer* to those who study:

\[ sE - T_t = sE (1 - f_t) \geq 0 \text{ since } 0 \leq f_t \leq 1. \]

- Reverse redistribution is regularly found in empirical studies:
  - US: Peltzman (1973), Radner & Miller (1970), Bishop (1977);
  - Ireland: Tussing (1978);
  - Australia: Hope & Miller (1988);
Reverse Redistribution in India

Participation Rate by Income for Govt/Govt Aided Institutions

![Graph showing participation rate by income for Govt/Govt Aided Institutions over consumption expenditure deciles for the years 2007-08 and 1995-96.]

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Introduction
Private Education System
Public Education System
Traditional Tax-Subsidy System
A Pure Loan Scheme
Income Contingent Loans

How It Works?
Whether to Opt for Higher Education
Dynamics of Wealth Distribution

Reverse Redistribution in India ...

Table 16: Distribution of Amount of Taxes Collected during the Financial Year 2011-12

<table>
<thead>
<tr>
<th>Nature of Taxes</th>
<th>Amounts Collected up to December 2011 (in crore rupees)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate Income Tax</td>
<td>2,14,446</td>
<td>35.17</td>
</tr>
<tr>
<td>Personal Income Tax (including FBT, STT, BCTT, Other taxes)</td>
<td>1,09,509</td>
<td>17.96</td>
</tr>
<tr>
<td>Central Excise Duty</td>
<td>1,05,411</td>
<td>17.28</td>
</tr>
<tr>
<td>Customs Duty</td>
<td>1,12,670</td>
<td>18.48</td>
</tr>
<tr>
<td>Service Tax</td>
<td>67,706</td>
<td>11.11</td>
</tr>
</tbody>
</table>

Note: The first two constitute direct taxes and the next three are the indirect taxes.
Whether to Opt for Higher Education

Compare indirect utility under no higher education

\[ V_t^N (x) = \varepsilon + \log \left( (x - T_t) (1 + r) + w_n (2 + r) \right), \]

with indirect utility under higher education

\[ V_t^E (x) = \]

\[
\begin{cases} 
\varepsilon + p \log \left[ w_s + (x - ((1 - s) E + T_t)) (1 + i) \right] & \text{for } x < (1 - s) E + T_t, \\
+ (1 - p) \log \left[ w_n + (x - ((1 - s) E + T_t)) (1 + i) \right] & ,
\end{cases}
\]

\[
\begin{cases} 
\varepsilon + p \log \left[ w_s + (x - ((1 - s) E + T_t)) (1 + r) \right] & \text{for } x \geq (1 - s) E + T_t, \\
+ (1 - p) \log \left[ w_n + (x - ((1 - s) E + T_t)) (1 + r) \right] & ,
\end{cases}
\]
Wealth Threshold under Tax-Subsidy System
Dynamics of Wealth Distribution

- When $x_t < W_t^{TS}$,
  \[ x_{t+1} = (1 - \alpha) \left[ (x_t - T_t) (1 + r) + w_n (2 + r) \right]. \]

- When $W_t^{TS} \leq x_t < (1 - s) E + T_t$,
  \[ x_{t+1} = \begin{cases} 
  (1 - \alpha) \left[ w_s + (x_t - ((1 - s) E + T_t)) (1 + i) \right], & \text{prob } p, \\
  (1 - \alpha) \left[ w_n + (x_t - ((1 - s) E + T_t)) (1 + i) \right], & \text{prob } 1 - p. 
\end{cases} \]

- When $(1 - s) E + T_t \leq x_t$,
  \[ x_{t+1} = \begin{cases} 
  (1 - \alpha) \left[ w_s + (x_t - ((1 - s) E + T_t)) (1 + r) \right], & \text{prob } p, \\
  (1 - \alpha) \left[ w_n + (x_t - ((1 - s) E + T_t)) (1 + r) \right], & \text{prob } 1 - p. 
\end{cases} \]
Wealth Dynamics and the Long Run

\[ x_{t+1} \]

\[(1-\alpha)w_r (2+r)\]

\[(1-\alpha)[w_r (2+r) - T_t (1+r)]\]
Working of the Pure Loan Scheme

- A pure loan scheme is a policy designed to neutralise the effects of capital market imperfections.
- The government, a credible agency, can borrow from the international capital market at the lenders’ interest rate $r$.
  - It then passes the education loan amount, $E$, to the agent at the same interest rate $r$.
- But the agent has to repay the amount $E(1 + r)$ irrespective of whether she succeeds or fails in higher education.
Whether to Opt for Higher Education

- Compare indirect utility under no higher education

\[ V_N (x) = \varepsilon + \log [x(1 + r) + w_n (2 + r)] , \]

with indirect utility under higher education

\[ V_E (x) = \varepsilon + p \log [w_s + (x - E) (1 + r)] + (1 - p) \log [w_n + (x - E) (1 + r)] . \]

- Note that \( V_E (x) \) takes the same form irrespective of whether \( x \geq E \), or \( x < E \).
Wealth Threshold under Pure Loan Scheme

- $V(\cdot)$ exhibits *decreasing absolute risk aversion* – differences in inherited wealth levels imply different attitudes towards risk.
Dynamics of Wealth Distribution

- When $x_t < W^{PLS}$,
  \[ x_{t+1} = (1 - \alpha) \left[ x_t (1 + r) + w_n (2 + r) \right] . \]

- When $W^{PLS} \leq x_t$,
  \[ x_{t+1} = \begin{cases} 
  (1 - \alpha) \left[ w_s + (x_t - E) (1 + r) \right] , & \text{prob } p, \\
  (1 - \alpha) \left[ w_n + (x_t - E) (1 + r) \right] , & \text{prob } 1 - p, 
  \end{cases} \]
Wealth Dynamics and the Long Run

\[ x_{t+1} = (1-\alpha)w_n(2+r) \]

\[ W_{PLS} \]

Tridip Ray (ISI, Delhi) Financing Higher Education: Comparing Alternative Policies
Working of Income Contingent Loans

- Available only for higher education (NOT a consumption loan).
- No collateral is required. Money is transferred directly to the educational institution.
- Repayment is in the form of taxation.
- Repayment is made (in the second period) only if the agent is successful.
  - Exempted from repayment in case of failure.
- Government balances budget intertemporarily.
  - Suppose $L_0$ agents take the loan. Then
    \[ \tau w_s p L_0 = L_0 E (1 + r), \]
    \[ \Rightarrow p \tau w_s = E (1 + r). \]
Investment in Higher Education by Borrowing through ICL

- If an agent opts for the ICL, she has to borrow the entire education loan amount $E$; she has no other choice.
  - But she is free to lend her inheritance $x$ in the credit market.

- In case of success, she has to make the repayment $\tau w_s = \frac{E(1+r)}{p}$. But, in case of a failure, she does not have to make any repayment.

- Hence her budget constraints become

$$c_s + b_s = w_s - \tau w_s + x(1+r) = w_s - \frac{E(1+r)}{p} + x(1+r),$$

$$c_f + b_f = w_n + x(1+r).$$
Investment through ICL: Solution to Agent’s Problem

- Optimal consumption and bequest choices under ‘success’:
  \[c_s = \alpha \left[ w_s - \frac{E(1+r)}{p} + x(1+r) \right],\]
  \[b_s = (1-\alpha)\alpha \left[ w_s - \frac{E(1+r)}{p} + x(1+r) \right].\]

- Optimal consumption and bequest choices under ‘failure’:
  \[c_f = \alpha [w_n + x(1+r)],\]
  \[b_f = (1-\alpha) [w_n + x(1+r)].\]

- Indirect utility:
  \[V_E(x) = \epsilon + p \log \left[ w_s - \frac{E(1+r)}{p} + x(1+r) \right] + (1-p) \log [w_n + x(1+r)].\]
Whether to Opt for Higher Education

- Compare indirect utility under no higher education

\[ V_N(x) = \varepsilon + \log [x(1 + r) + w_n(2 + r)] , \]

with indirect utility under higher education

\[ V_E(x) = \varepsilon + p \log \left[ w_s - \frac{E(1 + r)}{p} + x(1 + r) \right] \\
+ (1 - p) \log [w_n + x(1 + r)] . \]
Income Contingent Loans Vs. Pure Loans Scheme

- Let $y$ denote life-time income of an agent with inheritance $x$.
- Under success, $y_s^{ICL} < y_s^{PLS}$:
  \[
y_s^{ICL} = w_s + x(1+r) - \frac{E(1+r)}{p} < w_s + x(1+r) - E(1+r) = y_s^{PLS}.
  \]
- Under failure, $y_f^{ICL} > y_f^{PLS}$:
  \[
y_f^{ICL} = w_n + x(1+r) > w_n + x(1+r) - E(1+r) = y_f^{PLS}.
  \]
- But their expected values are the same:
  \[
p \cdot y_s^{ICL} + (1-p) \cdot y_f^{ICL} = pw_s + (1-p) w_n + x(1+r) - E(1+r) = p \cdot y_s^{PLS} + (1-p) \cdot y_f^{PLS}.
  \]
Since $V_E(\cdot)$ is strictly concave, it follows that
\[ V^\text{ICL}_E(x) > V^\text{PLS}_E(x), \text{ for all } x. \]

Hence the wealth threshold under ICL, is strictly lower than the wealth threshold under PLS:
\[ W^\text{ICL} < W^\text{PLS}. \]

Intuition: ICL provides an insurance against failure.
Dynamics of Wealth Distribution

- When $x_t < W^{ICL}$,
  \[ x_{t+1} = (1 - \alpha) \left[ x_t (1 + r) + w_n (2 + r) \right]. \]

- When $W^{ICL} \leq x_t$,
  \[
  x_{t+1} = \begin{cases} 
    (1 - \alpha) \left[ w_s - \frac{E (1 + r)}{p} + x (1 + r) \right], & \text{prob } p, \\
    (1 - \alpha) \left[ w_n + x (1 + r) \right], & \text{prob } 1 - p.
  \end{cases}
  \]
Wealth Dynamics: Unskilled Labour Trap Removed
Wealth Dynamics: Unskilled Labour Trap Remains
Under failure, not only exempted from repayment, but also receives a subsidy (lump-sum), \( S \).

Subsidy is funded through additional tax to the successful so that government budget is balanced.

- Suppose \( L_0 \) agents take the loan. Then

\[
\tau w_s p L_0 = L_0 \left[ E (1 + r) + (1 - p) S \right],
\]

\[
\Rightarrow p \tau w_s = E (1 + r) + (1 - p) S.
\]
Modified ICL...

- Under success, $y_s^{ICL'} < y_s^{ICL}$:

$$y_s^{ICL'} = w_s + x(1 + r) - \frac{E(1+r)}{p} - \frac{(1-p)S}{p} < w_s + x(1 + r) - \frac{E(1+r)}{p} = y_s^{ICL}.$$ 

- Under failure, $y_f^{ICL'} > y_f^{ICL}$:

$$y_f^{ICL'} = w_n + x(1 + r) + S > w_n + x(1 + r) = y_f^{ICL}.$$ 

- But their expected values are the same:

$$p \cdot y_s^{ICL'} + (1 - p) \cdot y_f^{ICL'} = pw_s + (1 - p)w_n + x(1 + r) - E(1 + r) = p \cdot y_s^{ICL} + (1 - p) \cdot y_f^{ICL}.$$
Modified ICL: Unskilled Labour Trap Removed

\[ x_{t+1} = (1-\alpha)w_n(2+r) \]

\[ W^{ICL}, W^{ICL'} \]

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