

Structural Change and Family Investments in Children

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Motivation

- Two most important demographic and economic changes in the last century
 - 1 Large decline in fertility and rise in human capital in nearly all countries
 - 2 As countries develop, structural transformation (ST) reallocates labor out of agriculture
- This paper: How does ST affect the within-family allocation of education resources?

This Paper: ST Changes the Production Organization

- Ag./Rural sector: households farm collectively
 - One 'entrepreneur's' human capital matters the most
 - ⇒ Rural parent better off educating one top child and having more children
- Non-Ag./Urban sector: individuals work for wages with rewards to human capital
 - Every child's human capital matters
 - ⇒ Urban parent tends to educate all children and have fewer
- As a result, ST changes the distribution of human capital within a household.

We Document Three Key New Facts

1. Within-family inequality in human capital is larger in poorer economies, both across countries and over time within a country.
2. Within-family inequality is higher in rural than in urban areas, and this rural-urban gap narrows with development.
3. Higher within-family inequality is associated with lower transitions from farm to non-farm employment.

Our Theory of the Facts in a Two-sector OLG Model

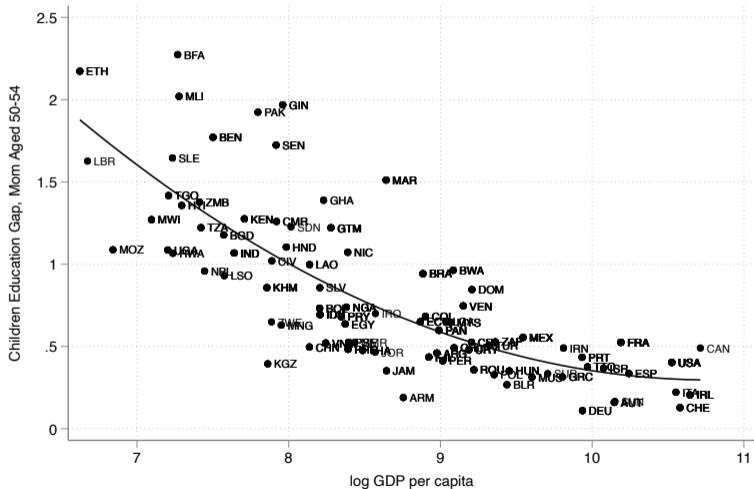
- Urban sector expands with ST
- ⇒ Farm households respond to better urban opportunities and increases the expected migration probabilities
- ⇒ Farm households educate the non-top children more and lower fertility
- ⇒ Rural sibling education inequality ↓ and rural-urban within-family inequality gap ↓

The Facts

Constructing Measure of Within-family Human Capital Inequality

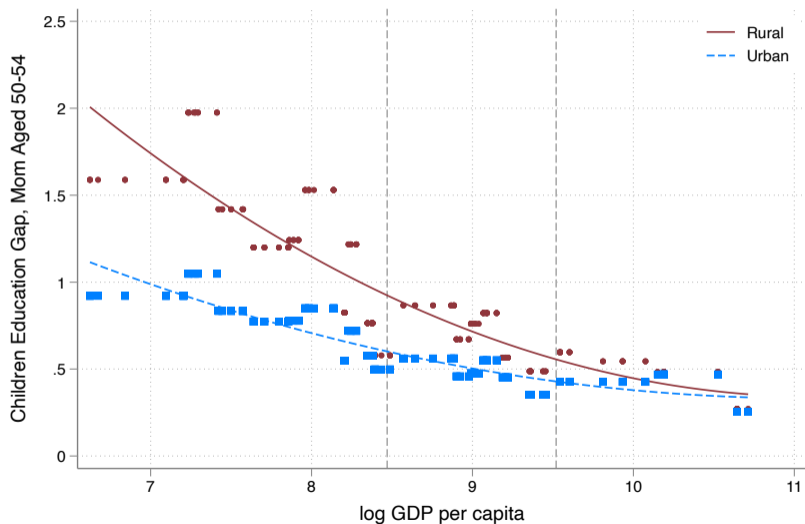
- Use nationally representative or full count surveys of households
- Sources: censuses and labor force surveys from IPUMS-International and historical data from IPUMS-USA
- Full dataset: 324 country-year surveys, covering 95 countries, and spanning 1960 to 2020
- Challenge: identify the sibling-link and their completed education
- Within-family inequality in human capital among siblings who have the same *momloc* and *poploc*, Edu. Gap =
$$\frac{s_{max} - \bar{s}_{others}}{\bar{s}}$$

Fact 1) Education Gap Among Siblings with Development

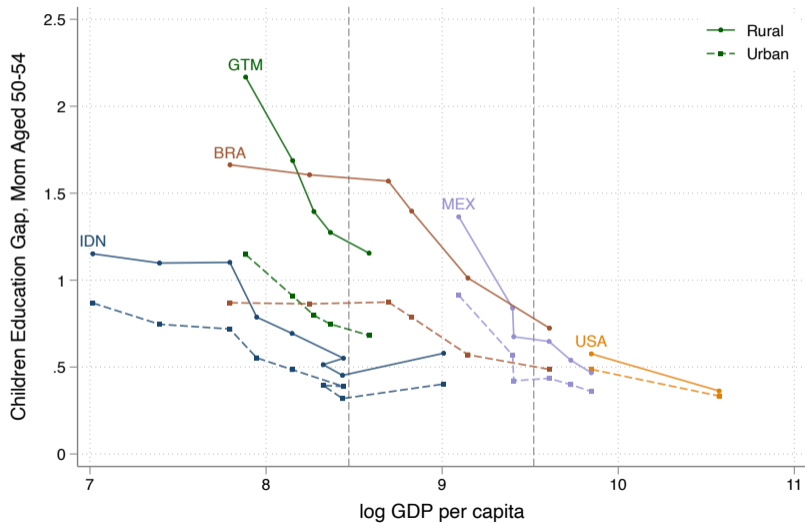


Sons only

Facts 2) Education Gap Among Siblings by Rural and Urban



Facts 1&2 Education Gap Among Siblings Over Time

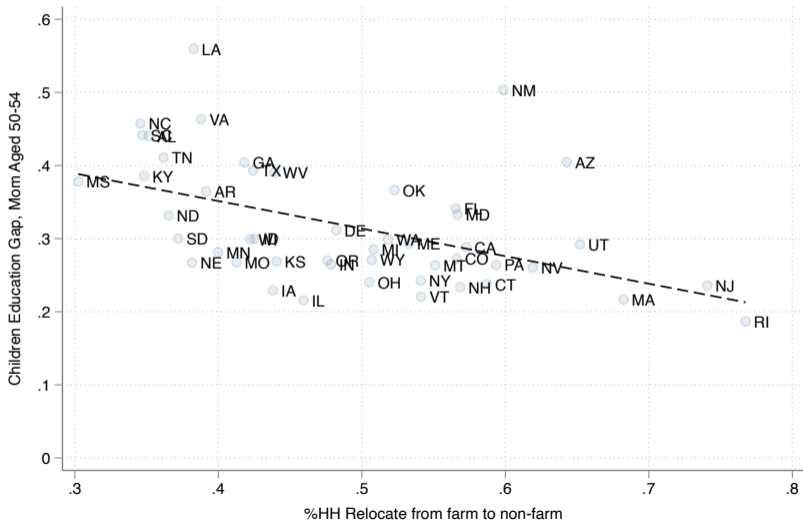


Fact 3) Historical Evidence of the Mechanism from the US

Linked U.S. Decennial Censuses of 1910 and 1940, 24 million persons

- Full count data from IPUMS digitized in collaboration with Ancestry.com (Ruggles et al., 2025)
 - IPUMS Multigenerational Longitudinal Panel (MLP) version 2.0: Individuals are linked by names, genealogy, and other identifying information
 - Farm-household identifier exists in both years
- ⇒ Define 'migration' = 1 if farm household in 1910, but non-farm in 1940
- Years of schooling only available for all persons in 1940
- ⇒ Assign children in 1910 the years of schooling as reported in 1940

Migration Probability and Edu. Gap Across States, US 1910



Mechanism: Migration Probability and Edu. Gap, Farm Households in 1910

Siblings' education gap	(1)	(2)	(3)
State migration prob.	-0.468*** (0.019)	-0.288*** (0.018)	-0.289*** (0.018)
HH num. children		0.021*** (0.001)	0.021*** (0.001)
HH ave. schooling		-0.033*** (0.001)	-0.034*** (0.001)
HH sons' share			-0.030*** (0.006)
Observations	53395	53395	53395

Toy Model with Analytical Results

A Stylized OLG Model

- Two periods of life:
 - Young (y): obtain edu. using parental investment and work for income
 - Old (o): work to finance consumption and invest in children
- Two sectors of rural (r) and urban (u) and no migration for now
- Parental preferences:

$$U = \ln(c^o) + \eta \ln(n) + \beta \frac{1}{n} [\ln(c_1^y) + \dots + \ln(c_n^y)], \quad \eta > 0, \quad \beta > 0.$$

- Parental labor supply with n_k children

$$l^o = (1 - vn_k - \mu(s_1^y)^{\kappa} - \dots - \mu(s_{n_k}^y)^{\kappa}),$$

- Children's human capital $h(s) = s^{\sigma_k}$, $\sigma_k > 0$

Family Production in the Rural Sector (Yang, 1997; Chen, 2020)

- Joint family production on the farm for now,

$$\text{Young: } Y_r^y = A_r s_{\max}^{\sigma_r} \sum_{k=1}^{n_r} l_k^y$$

$$\text{Old: } Y_r^o = A_r (s^o)^{\sigma_r} l_r^o$$

- Joint output is shared equally by the children $y_r^y = \frac{Y_r^y}{n_r} = A_r s_{\max}^{\sigma_r}$
- The parent consumes her own production $y_r^o = Y_r^o$
- Consumption per child and parent:

$$c_r^y = p_r y_r^y / p$$

$$c_r^o = p_r y_r^o / p$$

- p_r , price of rural output; p , price of final consumption goods

Modern Production in the Urban Sector

- Constant returns to scale production function:

$$Y_u = A_u \left(\sum_{j=1}^{N_u} h(s_j) L_j \right)$$

- Wage rate of a worker with schooling s

$$w_u(s) = p_u A_u h(s) = p_u A_u s^{\sigma_u}, \quad (1)$$

- p_u , price of urban output
- Consumption per person:

$$c_u = p_u A_u s^{\sigma_u} / p$$

Simple Model Prediction

Proposition 1

Even if the costs of raising and educating children and the return to schooling are identical between the rural and urban sectors, the sibling education differences are larger in the rural sector. Moreover, $\bar{s}_r^y < \bar{s}_u^y$ and $n_r > n_u$.

- Rural: Invest in only one child's education to internalize the externality of knowledge sharing
- Urban: Invest equally in the schooling of all children and face the standard quantity-quality trade-off (e.g. Becker and Lewis, 1973; Becker and Tomes, 1976)
- Given the same number of children, average schooling in urban and rural equals, but very different distributions

Dynamic Model and Quantitative Analysis

Dynamic Model with Structural Change

- L_t : population born at period t
- λ_t : the fraction of the population that is rural ($1 - \lambda_t$ urban)
- $s_{r,1}^o$ and $s_{u,1}^o$: education levels of the initial old population L_0

Dynamic Model with Structural Change

- L_t : population born at period t
- λ_t : the fraction of the population that is rural ($1 - \lambda_t$ urban)
- $s_{r,1}^o$ and $s_{u,1}^o$: education levels of the initial old population L_0
- P_t : endogenous migration probability in equilibrium
- Rural parents make migration decisions at the household level Top child migration
- Rural parents choose fertility and schooling to maximize expected utility:

$$\max_{n_t, s_{max,rt}, \rho_t} U^o = \mathbb{P}_t U_{ru,t}^o + (1 - \mathbb{P}_t) U_{rr,t}^o$$

- In equilibrium, $U_{ru,t}^o(n_t, s_{max,rt}, \rho_t) = U_{rr,t}^o(n_t, s_{max,rt}, \rho_t)$.

Production

- Rural-sector production function

$$\text{Young: } y_r^y = A_r h(s_{\max}) \left[\sum_{i=1}^{n_r} \frac{1}{n_r} (s_i^y)^{\sigma_r} l_i^y \right]$$

$$\text{Old: } Y_r^o = A_r h(s^o) [(s^o)^{\sigma_r} l_r^o]$$

- The human capital of the top children acts as the TFP/managerial quality
- Efficiency-unit input of child k , $s_k^{\sigma_r} l_k^y = s_k^{\sigma_r}$
- Aggregate production function (Comin et al., 2021)

$$\alpha^{\frac{1}{\varepsilon}} Y_t^{\frac{\omega_r(1-\varepsilon)}{\varepsilon}} (Y_{rt})^{\frac{\varepsilon-1}{\varepsilon}} + (1-\alpha)^{\frac{1}{\varepsilon}} Y_t^{\frac{\omega_u(1-\varepsilon)}{\varepsilon}} (Y_{ut})^{\frac{\varepsilon-1}{\varepsilon}} = 1.$$

General Equilibrium

A competitive general equilibrium is defined by a sequence of fertility and education choices $(n_{rt}, s_{rt}, \rho_t, n_{ut}, s_{ut})$ and prices (p_{rt}, p_{ut}, p_t) , such that:

- i) urban and rural parents make optimal fertility and education investment choices to maximize expected family utilities
- ii) given \mathbb{P}_t , fertility, and investment decisions, the labor markets clear;
- iii) given prices, the goods market clears;
- iv) given the prices p_{rt}, p_{ut}, p_t , the final-good producer minimizes the production cost.

Calibration to Match the 1960 Brazilian Economy

Parameter		Value
Panel A: Pre-Assigned Parameters		
ε	Elasticity of substitution of goods	0.197
ω_r	Income elasticity of rural good	1
ω_u	Income elasticity of urban good	3.678
β	Altruism	1
η	Fertility preference	1
Panel B: Calibrated Parameters		
α	Agricultural demand	0.774
ν	Cost of number of children	0.086
μ	Cost of quality per child	0.0057
σ_r	Return to schooling in rural	0.019
σ_u	Return to schooling in urban	0.250
κ	Curvature of schooling cost	1.145
g_{A_r}, g_{A_u}	Growth rate of productivity	1.702

Moments in the Model vs Data

Moment	Data	Model
Rural employment share (%)		
previous period – 1935	70.0	69.6
current period – 1960	56.7	56.9
Rural fertility	5.35	5.38
Urban fertility	4.55	4.53
Rural schooling	1.16	1.16
Urban schooling	3.53	3.52
Education gap	0.79	0.79

Quantitative Experiment I

- Understanding the contribution of structural change
- Suppose we shut down structural change in 1960 (i.e., $g_{A_r} = g_{A_u} = 0$)

Moment	Baseline	No structural change S.S.
Migration probability (%)	22.0	7.6
Rural employment share (%)	56.9	58.6
Rural fertility	5.38	5.55
Urban fertility	4.53	4.53
Rural schooling	1.16	0.74
Urban schooling	3.52	3.52
Education gap	0.79	1.52

Quantitative Experiment II

- Simulate the economy forward for the period 1960–2010
- Allowing for two changes over time:
 - rural productivity growth (annualized $g_{A_r} = 4.22\%$) \Rightarrow ag. employment share
 - skill-biased technological change (annualized $g_{\sigma_r}, g_{\sigma_u} = 1.42\%, 3.62\%$) \Rightarrow edu.
- Compare the model's prediction on fam4mily decisions with data

Structural Change and Family Decisions in the Model

	1960		2010	
	Data	Model	Data	Model
Rural employment share (%)	56.7	56.9	15.1	15.1
Urban schooling	3.53	3.53	8.76	8.76
Rural schooling	1.16	1.16	5.82	5.82
			Non-targeted	
Rural fertility	5.35	5.38	3.80	3.88
Urban fertility	4.55	4.55	2.79	3.23
Education gap	0.79	0.79	0.24	0.41

Role of ST and SBTC during 1960 and 2010 in Brazil

Model Education Gap

Benchmark	Slow ST as pre-1960	No SBTC	Only $g_{\sigma_r} = 0$
0.41	1.36	0.27	0.13

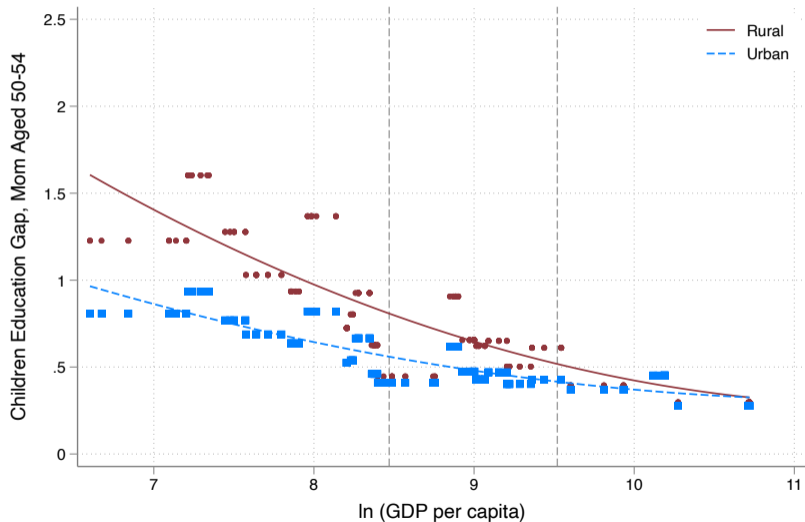
- Faster structural change contributes to the decline in the education gap
- SBTC tends to exacerbate the education gap

Conclusions

- We document declining within-family education gaps with development and structural change.
- A dynamic model with rural–urban asymmetries and migration rationalizes this pattern.
- Structural change leads to lower fertility, higher schooling, and more equal sibling investments.
- Education policy should account for production structure and labor mobility.

Thank you!

Facts 2) Education Gap Among Sons by Rural and Urban



% of Only Top Child Migrate HHs Cond't on Any Migration

