

Distributional Growth Accounting: Education and the Reduction of Global Poverty, 1980-2019

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Motivation: Education and the Global Poverty Debate

Past decades: major improvements in educational attainment.

Debated role of education in reducing poverty:

- 1) Positive but heterogeneous returns to schooling.
- 2) “Learning crisis” in developing countries.
- 3) Other major transformations: globalization, technology, economic reforms, government transfers...

Policy relevance: over 95% of poor children enrolled in public schools.

This Paper

How much of global poverty reduction can education explain?

Contribution 1 = Distributional Growth Accounting: growth accounting with imperfect substitution *à la* Goldin & Katz (2007).

- 1) Aggregate implications: endogenous returns to schooling.
- 2) Distributional implications: education affects relative wages.
- 3) Validation with new evidence from three natural experiments.

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Contribution 2 = Application to Global Poverty Reduction:

- 1) New education & earnings microdata, 95% of world population.
- 2) New estimates of returns to schooling by country and level.
- 3) Growth accounting by global income group.

This Paper: Education and Global Poverty Reduction

Takeaway: Private Returns to Schooling Can Explain

- 1) 45% of global economic growth since 1980.
 - 2) 60% of growth among the world's poorest 20%.
- ⇒ Education policy at the center of global economic progress.

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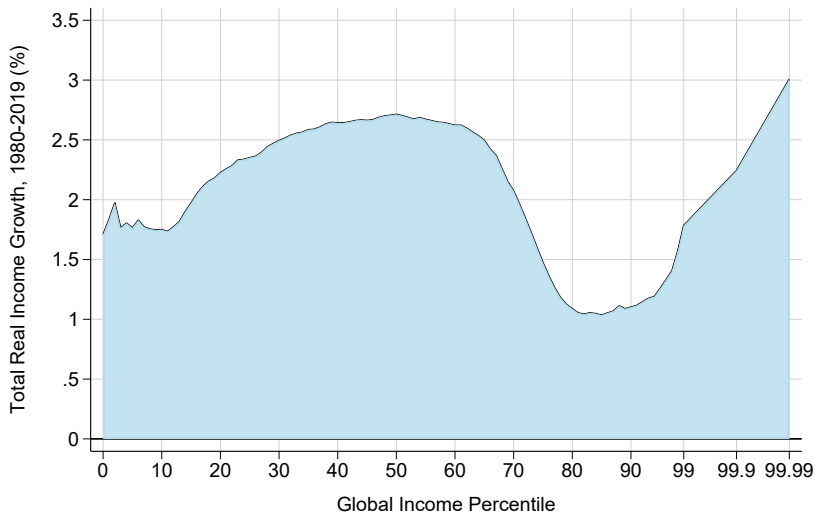
⇒ Education policy at the center of global economic progress.

Methodological Implications: standard accounting underestimates contribution of education to poverty reduction by a factor of 3.

⇒ Need for micro-macro methodologies incorporating general equilibrium effects of public policies.

The Distribution of Global Economic Growth, 1980-2019

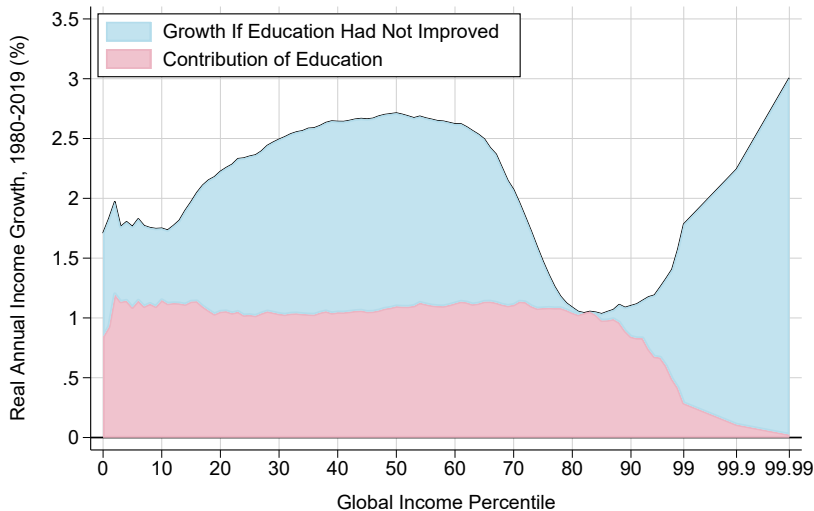
Total Per Capita Income Growth by Percentile in the World as a Whole, 1980-2019



Source: World Inequality Database.

The Distribution of Global Economic Growth, 1980-2019

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Source: World Inequality Database; this paper (private returns to education).

Contribution to the Literature

1) Human Capital and Development (Hall & Jones 1999; Bils & Klenow 2001; Caselli & Coleman 2006; Gennaioli et al. 2013; Jones 2014; Barro & Lee 2015; Hendricks & Schoellman 2018; Rossi 2022)

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- Distributional growth accounting = combine these 2 perspectives.
- First estimate of contribution of education to poverty reduction.

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→ Role of education.

4) Returns to Schooling (Card 2001; Duflo 2001; Deming 2023)

→ Build from micro evidence to draw aggregate implications.

Outline

1. Distributional Growth Accounting
2. Data and Methodology
3. Education and the World Distribution of Income

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Setup

Output is produced by combining labor, capital, and technology:

$$Y^t = F(K^t, H^t) = K^{t\alpha} (z^t H^t)^{1-\alpha} \quad (1)$$

Workers are imperfectly substitutable:

$$H^t(A^t, L^t) = \left(A_1^t L_1^t^{\frac{\sigma-1}{\sigma}} + A_2^t L_2^t^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (2)$$

Share of output growth accounted for by each input:

$$1 = \underbrace{\frac{\alpha \Delta \ln(K)}{\Delta \ln Y}}_{\text{Physical Capital}} + \underbrace{\frac{(1-\alpha) \Delta \ln(z)}{\Delta \ln Y}}_{\text{TFP}} + \underbrace{\frac{(1-\alpha) \Delta \ln(H)}{\Delta \ln Y}}_{\text{Education + Skill Bias}} \quad (3)$$

Total versus Independent Effects of Education

Two ways to evaluate the contribution of education to growth.

Total effect of education: effect of education given skill-biased technical change = how much lower would growth have been if education had not improved?

$$\text{Share}_L^{A^{2019}} = (1 - \alpha) \frac{\ln H(A^{2019}, L^{2019}) - \ln H(A^{2019}, L^{1980})}{\ln Y^{2019} - \ln Y^{1980}} \quad (4)$$

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Independent effect of education: effect of education absent skill-biased technical change = how much growth would education have generated if only education had improved?

$$\text{Share}_L^{A^{1980}} = (1 - \alpha) \frac{\ln H(A^{1980}, L^{2019}) - \ln H(A^{1980}, L^{1980})}{\ln Y^{2019} - \ln Y^{1980}} \quad (5)$$

Total versus Independent Effects of Education

Total effect = effect that education actually had given changes in labor demand since 1980.

→ Estimation only requires 2019 microdata = how much lower incomes would be today if education had not improved.

Independent effect: effect that education would have had if labor demand had remained fixed.

→ Estimation requires 1980 microdata = effect of increasing education while holding 1980 technology fixed.

This paper: focus on total effect over 1980-2019 + independent effect for subsample of countries over 2000-2019.

Aggregate and Distributional Effects of Education

Returns to schooling:

$$r(A^t, L^t) = \ln \left(\frac{w_2^t}{w_1^t} \right) = \ln \left(\frac{A_2^t}{A_1^t} \right) - \frac{1}{\sigma} \ln \left(\frac{L_2^t}{L_1^t} \right) \quad (6)$$

Aggregate implications: total contribution of education to growth greater than in the standard growth accounting model.

→ *Intuition: returns to schooling would be higher today if education had not improved, because there would be fewer skilled workers.*

Distributional implications: education reduces inequality.

→ *Intuition: inequality would be higher today if education had not improved, because the relative wage of skilled workers would be higher.*

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Starting Point: World Distribution of Income in 2019

Individual Survey Microdata Covering 95% of World Population:

- National sources: 55 countries - 55% of world population.
- ILO database: 95 countries - 40% of world population.

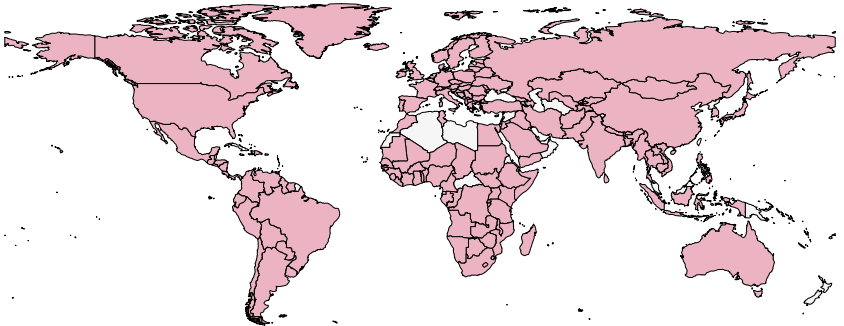
Variables:

- Individual labor income = wages + self-employment income.
 - Educational attainment, age, gender.
 - Occupation, industry, hours worked, other sociodemographics.
- **First microdatabase on the world distribution of income.**
- Avenues for future research: labor supply, structural change...

Survey Microdata Coverage

Descriptive Statistics

Survey Years



Methodology - Outline

1) Reduce education back to 1980 levels in each country.

→ Example: 10% of sample from tertiary to secondary.

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2) Reduce earnings using returns to schooling.

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3) General equilibrium effects.

→ Example: increase relative wage of tertiary-educated workers.

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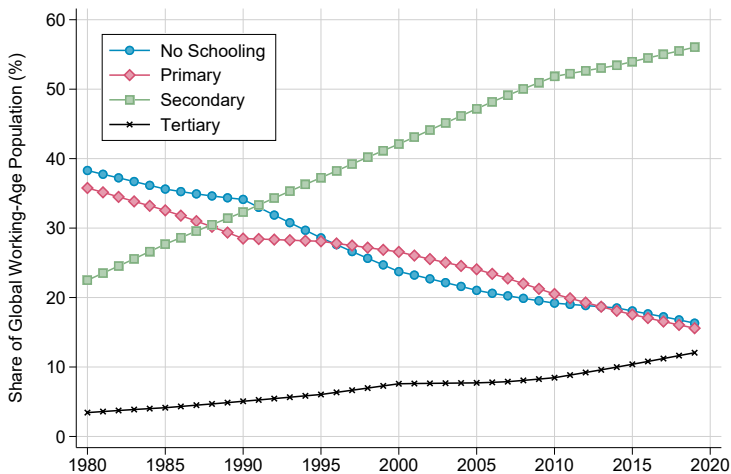
→ Example: increase relative wage of tertiary-educated workers.

4) Compare actual to counterfactual growth rates.

→ Share of growth explained by education: $\frac{g_t^P - \tilde{g}_t^P}{g_t^P}$

1) Bring Education Back to 1980 [Detail](#) [By Region](#) [Compo](#)

Educational Attainment of the World's Working-Age Population, 1980-2019



2) Returns to Schooling

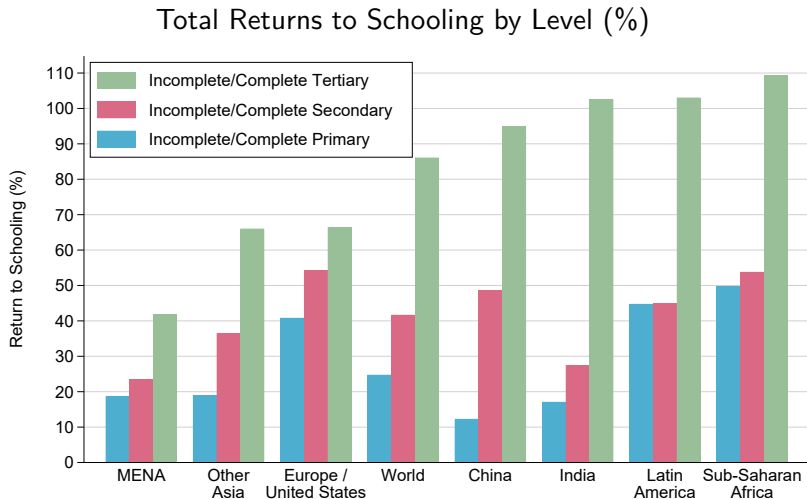
Benchmark = OLS Mincerian returns by education level:

$$\ln y_{ic} = \alpha_c + \beta_c^{pri} D_{ic}^{pri} + \beta_c^{sec} D_{ic}^{sec} + \beta_c^{ter} D_{ic}^{ter} + X_{ic} \beta_c + \varepsilon_{ic} \quad (7)$$

Robustness = IV returns: compilation of estimates from 62 papers studying large-scale schooling policies.

IV returns $\geq$ OLS returns $\Rightarrow$ OLS lower bound. [Comparison](#)

2) Reduce Earnings Using Returns to Schooling [Maps](#)



3) Solving the Model

Returns to schooling:

$$r(A^t, L^t) = \ln \left(\frac{w_2^t}{w_1^t} \right) = \ln \left(\frac{A_2^t}{A_1^t} \right) - \frac{1}{\sigma} \ln \left(\frac{L_2^t}{L_1^t} \right) \quad (8)$$

Solving the model:

- 1) Calibrate σ from literature (8 for no schooling/primary, 6 for primary/secondary, 4 for secondary/tertiary).
- 2) Recover A^{2019} from observed returns $r(A^{2019}, L^{2019})$ and labor supply $L^{2019} \rightarrow H(A^{2019}, L^{2019})$ fully specified.
- 3) Calculate counterfactual labor aggregator $H(A^{2019}, L^{1980})$ and counterfactual distribution of wages $w_j(A^{2019}, L^{1980})$.

Validation Using Three Natural Experiments

New quasi-experimental evidence from 3 major policies:

- 1) Indonesia school construction program, 1973-1978.
 - 2SLS: regional variation in school construction (Duflo 2001).
- 2) India district primary education program, 1994-2004.
 - RD: district literacy cutoff used for allocation (Khanna 2023).
- 3) U.S. compulsory schooling laws, 1875-1961.
 - 2SLS: cohort-level required years of schooling (Acemoglu & Angrist 2000; Clay et al. 2021).

Existing studies = individual returns to schooling.

This paper = new evidence on aggregate and distributional effects of schooling at the regional level.

Data:

- 1) SUSENAS survey 1993-2019: district-level consumption.
- 2) Treatment: exposure to 1970s INPRES program (Duflo 2001).

Empirical Specification:

$$\log y_{rt}^q = \gamma_0 + \gamma_1 S_{rt} + X_{rt}\beta + \delta_r + \delta_t + \varepsilon_{rt}$$

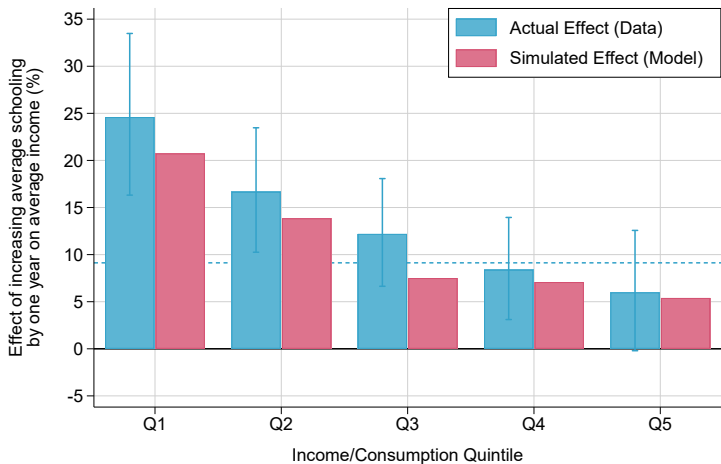
y_{rt}^q average consumption of quintile q in district r at time t .

Schooling S_{rt} instrumented by regional exposure to the program.

Interpretation: effect of average years of schooling in Bali, instrumented by program exposure, on bottom 20% consumption in Bali.

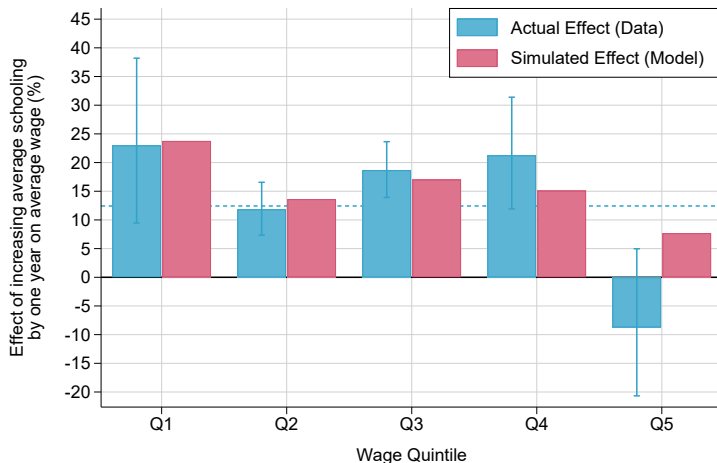
Validation 1 - Indonesia: Results

Effect of Increasing Average District Education by One Year on Real Earnings by Income Quintile: Data vs. Model



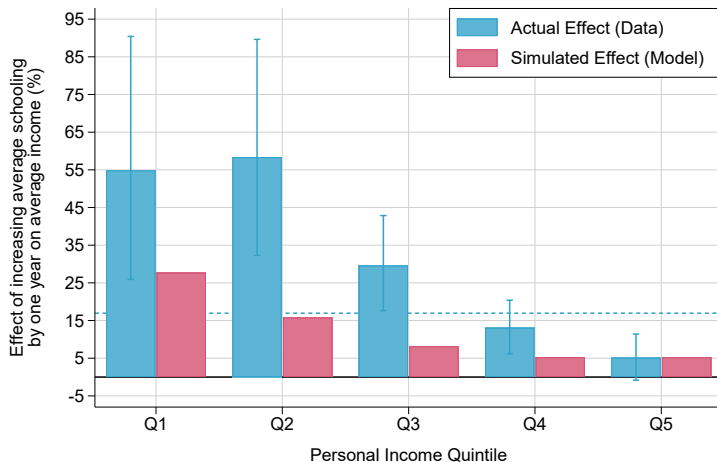
Validation 2 - India: Results [Detail](#)

Effect of Increasing Average District Education by One Year on Real Earnings by Income Quintile: Data vs. Model



Validation 3 - United States: Results [Detail](#)

Effect of Increasing Average State Education by One Year
on Real Earnings by Income Quintile: Data vs. Model

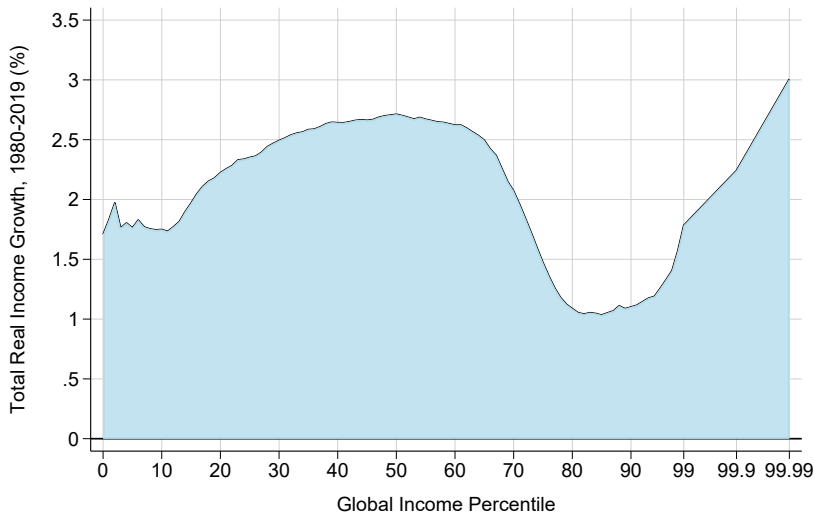


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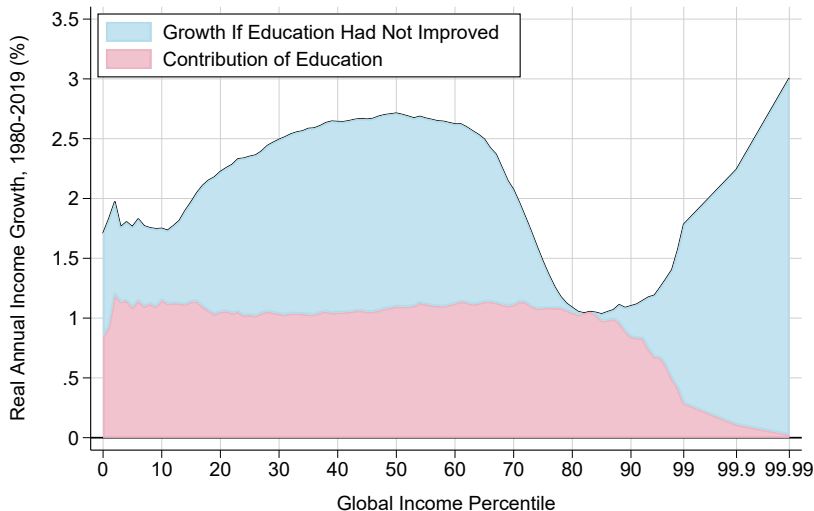
The Distribution of Global Economic Growth, 1980-2019

Annual Income Growth by Global Percentile, 1980-2019



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Distributional Growth Accounting Results

Table 1: Distributional Growth Accounting, World, 1980-2019

	Annual Income Growth (%)	Contribution of Education (pp.)	Share of Growth Explained (%)
Full Population	1.6%	0.7	45%
Bottom 50%	2.4%	1.1	43%
Bottom 20%	1.9%	1.1	58%
Next 30%	2.6%	1.0	41%
Middle 40%	1.5%	1.1	69%
Top 10%	1.6%	0.5	30%
Top 1%	2.0%	0.2	9.9%
Top 0.1%	2.5%	0.07	2.9%

Notes. The table reports actual real annual income growth rates, the total contribution of education, and the corresponding share of growth explained by education for different groups of the world distribution of income.

From Standard to Distributional Growth Accounting

Share of Growth Explained by Education by Methodology



From Standard to Distributional Growth Accounting

Share of Growth Explained by Education by Methodology



Independent Effect of Education since 2000

Extension: separate total and independent effects since 2000:

- 1) Collect surveys fielded around 2000 in 109 countries.
- 2) Estimate skill-biased technical change 2000-2019 = ΔA .
- 3) Compare independent and total effects of education.
- 4) Difference between independent and total effects = role of skill-biased technical change in *amplifying* benefits of schooling.

Takeaways:

- 1) Relative demand for skilled labor rapidly increased in Europe and Northern America, but not in other world regions.
- 2) SBTC accounts for 0-30% of the total effect of education on worldwide growth, but 0-5% for the world's poorest 20%.

→ SBTC not major contributor to global poverty reduction since 2000.

Sensitivity to:

- 1) Alternative returns to schooling (OLS vs. IV).
- 2) Alternative elasticities of substitution.
- 3) Capital income affected by schooling.
- 4) Alternative income distribution data (WID vs. WB).
- 5) Heterogeneous schooling expansion by characteristic.
- 6) Changes in education quality.

→ Education explains 60-100% of global bottom 20% growth.

Conclusion

This Paper: Education Explains

- 1) 45% of global economic growth since 1980.
 - 2) 60% of growth among the world's poorest 20% individuals.
- Education policy at the center of global economic progress.
- Education policy should be designed jointly with labor policy.

Future Work:

- 1) Other dimensions of human capital (experience, training, innovation, externalities...).
- 2) Distributional growth accounting beyond education (globalization, structural transformation, technology...).

Thank You!

Table 2: Sensitivity to Alternative Specifications

	Share of Growth Explained, 1980-2019	
	World Average	Global Bottom 20%
Benchmark Specification	45%	58%
IV Returns to Schooling	51%	71%
Alternative Degrees of Substitutability		
High Substitutability: $\sigma_1 = 5, \sigma_2 = 8, \sigma_3 = \infty$	41%	47%
Low Substitutability: $\sigma_1 = 2, \sigma_2 = 4, \sigma_3 = 6$	53%	78%
Very Low Substitutability: $\sigma_1 = 1.5, \sigma_2 = 2.5, \sigma_3 = 4$	62%	109%
Alternative Production Functions		
CES With Alternative Nesting Structure	44%	55%
CES With No Nest	43%	57%
CES With Imperfect Substitution Between Age Groups	44%	57%
Physical Capital Affected by Education	62%	67%

Returns to Schooling: OLS vs. IV [Go Back](#)

Return Per Additional Year of Schooling (%): OLS vs. IV

