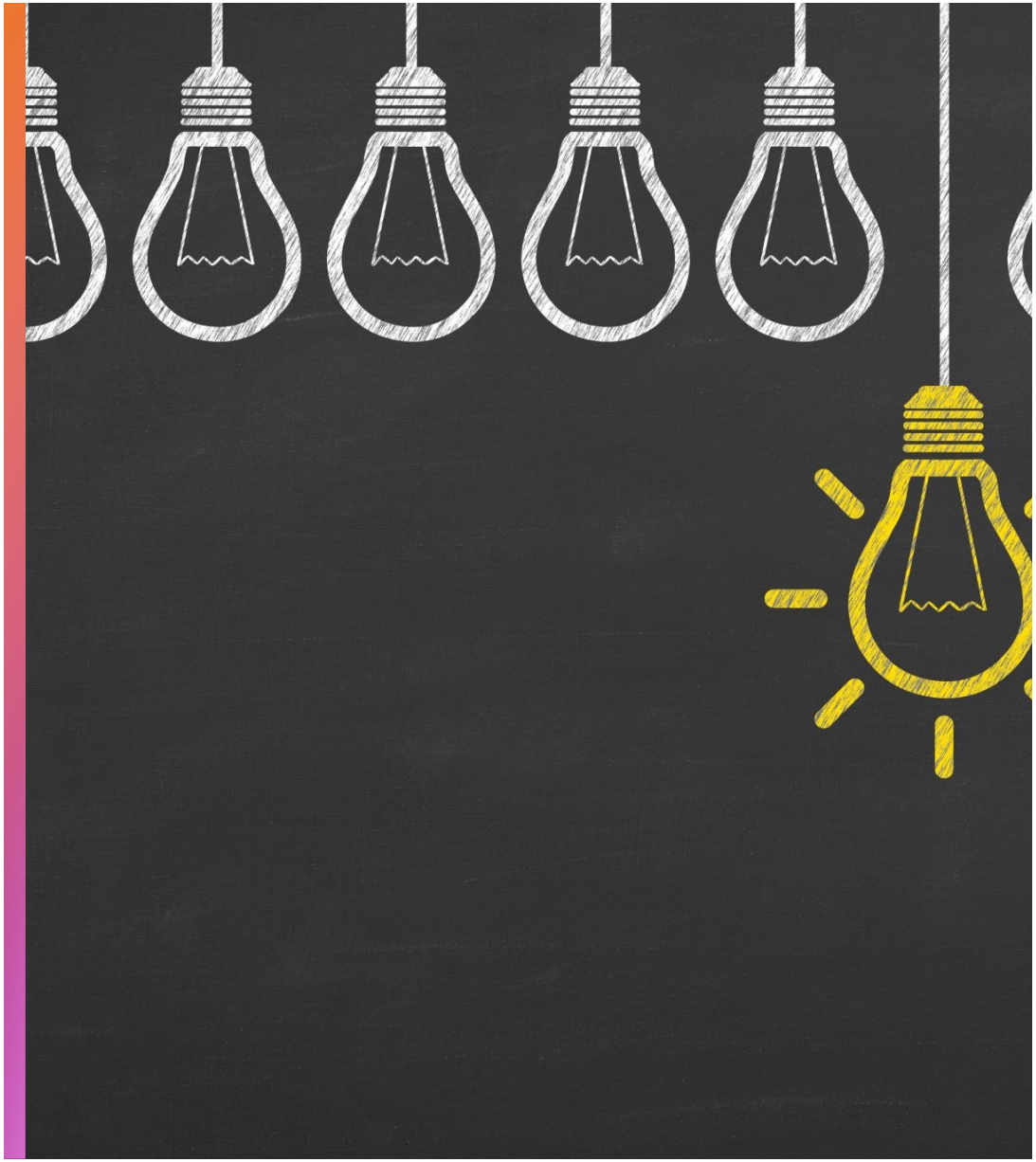
EDUCATION PRODUCTION FUNCTIONS (Part 4)

Evidence from Developing Countries



What education policies are most effective at raising enrolment and increasing learning in developing countries?

Education production function

- Formal education increases individuals' well-being primarily through their acquisition of skills, both cognitive (e.g. literacy and numeracy) and noncognitive (e.g. social and organizational skills).
- An understanding of the process by which formal education produces those skills is crucial for crafting effective education policies
- Economists characterize this process as the education production function.

- This framework provides crucial guidance on how to use education data to estimate the impact of education policies (and other causal factors) on students' acquisition of skills.

- The process by which both cognitive and noncognitive skills are learned is determined by many different factors.

Factors that determine learning, henceforth referred to as variables or inputs in the production process, can be divided into school, child and household variables.

A simple, yet flexible, learning production function is :

$$A = a(S, Q, C, H, I) \qquad (1)$$

Where A is skills learned (achievement), S is years of schooling, Q is the set of all school and teacher characteristics (quality) that affect learnings, C is all child characteristics (including ability) and H is all household characteristics that affect learning, and I is educational inputs that household contribute, such as children's daily attendance and purchase of textbooks and other school supplies.

While S and I can be grouped with child or household variables because they are under parents' control

Eq (1) shows how each variable affects learning, holding other variables constant. This qualification is important. Consider an improvement in one school quality variable, call it Q_j, such as reducing class size.

Eq (1) shows how changing Q_j affects learning for given values of the other variables.

However, changing Q_j (or any school quality variable) could change household behavior, that is change S or one or more I variables. For example , parents may keep children in school longer (increase S) or reduce education inputs (reduce I variables) in response to improved school quality.

Thus, the full impact of changing Q_j on skills (A) is not captured by that variable's impact as depicted in eq (1).

To obtain the full impact of changing school quality, one must know how changes in both the Q variables and in other variables affect S and I in eq (1) . These relationships can be expressed as:

$$S = f(Q, C, H, P) \quad (2)$$

$$I = g(Q, C, H, P) \quad (3)$$

Where P depicts the prices relevant for these household decisions, such as tuition, school supply prices, and even child wages (the price of children's time spent in school).

Inserting (2) and (3) into (1) gives another expression for A:

$$A = b(Q, C, H, P) \quad (4)$$

Which economists call a reduced form relationship.

It shows the full causal impact of school quality variables (and other variables) on learning.

- **School inputs** – funding levels, class size, teacher education, teacher experience, and availability of computers and textbooks.
- **School outputs** – family and other non-school inputs.
- The specification of the EPF is to express this basic theory mathematically.

$$A_{it} = f(S_{it}, S_{it-1}, \ldots, F_{it}, F_{it-1}, \ldots, I_{it}, \varepsilon_{it})$$

- Define education output for individual student i at time t as A_{it} which is a function of the school inputs S and family inputs F from current and all previous time periods, a fixed student contribution I_i; and an error term ε_{it}.
- The fixed student contribution is often called innate ability by economists and is akin to what psychologists consider general intelligence.

Evidence from Developing Countries

- Basic Facts concerning education in developing countries
- Review the evidence from those countries on the impact of various education policies on school attainment and learning

Education in Developing Countries
Primary enrolment rates

	Gross enrolment rates				Net enrolment rates	
	1960	1980	2000	2005	2000	2005
World	80	97	104	109		89
Country group						
Low income	65	94	102	111	85	85
Middle income	83	101	110	106	88	93
High income	109	101	102	105	95	94
Region						
Sub-Saharan Africa	40	80	77	96	56	70
Middle East/North Africa	59	89	97	102	84	91
Latin America	91	105	127	110	97	94
South Asia	41	77	98	115	83	86
East Asia	87	111	111	112	93	94
East Europe/Former Soviet Union	103	100	100	113	88	91
OECD (Organization for Economic Cooperation and Development)	109	102	102	102	97	96

Education in Developing Countries
Secondary school enrolment rates (percent of students of secondary school age)

	Gross enrolment rates				Net enrolment rates	
	1960	1980	2000	2005	2000	2005
World	29	49	67	71		67
Country group						
Low income	14	34	54	60		44
Middle income	21	51	77	81		69
High income	63	87	101	99		91
Region						
Sub-Saharan Africa	5	15	27	31		26
Middle East/North Africa	13	42	66	75		71
Latin America	14	42	86	78		65
South Asia	10	27	47	52		21
East Asia	20	44	67	73		61
East Europe/Former Soviet Union	55	93	88	92		85
OECD (Organization for Economic Cooperation and Development)	65	87	107	103		93

Gender disparities in gross primary and secondary enrolment rates (2000)

	Primary		Secondary	
	Boys	Girls	Boys	Girls
Country group				
Low income	107	98	60	47
Middle income	112	108	77	78
High income	102	101	100	102
Region				
Sub-Saharan Africa	83	71	29	24
Middle East/North Africa	101	92	71	61
Latin America	129	125	83	89
South Asia	107	90	53	39
East Asia	112	111	73	60
East Europe/Former Soviet Union	100	99	88	89
OECD (Organization for Economic Cooperation and Development)	102	102	106	108

Demand Interventions

- Policies that raise demand for education increase learning by increasing time in school.
- This is done by increasing available household income and/or reducing education costs.
- Income transfers directly raise parental income - Unconditional transfers may increase households' education spending, but such effects may be small

Based on pension reforms, find sizable (unconditional) income effects

- Edmond (2006) showed that in South Africa, receiving a generous pension (about 125% of black households' median income) increased enrolment among children living with pensioners. E.g. male pension eligibility increased rural boys' school attendance by 18 percentage points.
- Carvealho (2000) finds similar effects from Brazil's new pension scheme. For a benefit increase of R$100 (about half the minimum wage), girls' enrolment increased by 4.5 percentage points. Boys' enrolment increases were much smaller.

These findings imply that higher household income increases enrolment, which should increase learning. Thus, any economic policy that increases household incomes should increase enrolment and learning.

To ensure that income transfers increase enrolment, one could condition them on education choices.

- Conditional Cash Transfer (CCT) programs provide transfers to households only if their children are enrolled in, and regularly attending school.
- The best-known CCT program is Mexico's Programma de Educacion, Salud y Alimentacion (PROGRESA) program (now called Opportunidades).
- Schultz (2004) exploiting the randomized implementation of PROGRESA, estimates that after 3 years it raised children's years of schooling by 0.66 years.

Honduras and Nicaragua also implemented **CCT programs**, and also randomized their implementation, which facilitates assessment of their impacts on schooling.

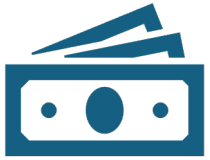
- Maluccio and Flores (2005) estimate that **Nicaragua's program**, which assisted poor children in grades 1-4, increased school enrolment rates by 13 percentage points, and increased attendance, conditional on enrolment by 20 points.
- Glewwe et al. (2004) estimate that **Hondura's CCT program** raised children's completed years of schooling from 4.2 to 4.9.

- Bourguignon, Ferreira and Leite, using microsimulation techniques, show that **Brazil's CCT program**, Bolsa Escola, induced 60% of poor, out of school 10 to 15 year olds to enrol. They also stimulated the impact of the transfer without conditionality, and found no impact on children's schooling.
- While CCT programs appear to increase demand by raising incomes, they really work through prices: CCT programs decrease the price of education.
- The price becomes negative, parents are paid for enrolling their children.
- Policies that directly reduce education prices have similar effects.

Several African countries, including Ethiopia, Ghana, Kenya, Malawi, Mozambique, Tanzania, and Uganda, recently abolished school fees.

- Kenya did this in 2003 and nearly 1 million new pupils enrolled. Primary enrolment increased by 16%, overwhelming schools and ill prepared teachers (World Bank, 2004).

Policies that directly **reduce education price** have similar effects



- **Abolishment School fees**
- **Voucher** -provide poor households funds to enroll their children in private schools
- **Transfer in kind** -To improve school age children's health

Voucher -provide poor households funds to enroll their children in private schools

Several Latin American countries have implemented **vouchers**, which provide poor households funds to enrol their children in private schools.

- Columbia's Programma de Ampliacion de Cobertura de la Education Secundaria (PUCES) awarded vouchers to over 125000 poor urban students from 1992 to 1997.
- Demand for vouchers exceeded the supply, so eligibility was determined by lottery, creating a natural experiment. Angrist et al. (2002) estimate that poor urban students given vouchers completed 0.12 additional years of schooling.

- Hsieh and Urquiola (2006) found no effect of vouchers on Chilean students' test scores, repetition rates, or years of schooling.

Transfer in kind -To improve school age children's health

- Bangladesh's Food for education program provides an in-kind subsidy equivalent to 5-10% of household income. Ravallion and Wodon (2000) estimate that this increased enrolment from 74% to nearly 100%.
- In Kenya, provision of school meals and uniforms were evaluated using randomized trials. Vermeersch and Kremer (2004) found that free breakfasts at preschools increased school participation (which combines enrolment with daily attendance) by 30%. Test scores also increased. Such programs reduce schooling costs and also improve children's nutrional status.

- Several studies show that better nutrition in the first years of life helps children stay in school and learn more per year of schooling (Glewwe and Miguel, 2008).
- Providing uniforms increased enrolment – Kremer et al. (2003) estimate that free uniforms increased pupils' participation by 15%.
- Miguel and Kremer (2004) implemented a randomized trial in an area of western Kenya with very high helminth infection rates. The program, which provided students deworming medicine, increased school enrolment and attendance at very little cost. No effect was found on learning.

Demand-side policies (Summary of empirical results)

			Impact on enrolment	Impact on learning
Unconditional transfers	Edmond (2008)	South African pension scheme	Yes	Not estimated
	Carvalho (2000)	Brazilian rural pension scheme	Yes	Not estimated
Conditional cash transfers	Schultz (2004)	Progresa, Mexico	Yes	Not estimated
	Maluccio and Flores (2005)	Nicaragua	Yes	Not estimated
	Glewwe, Olinto and de Souze (2004)	PRAF, Honduras	Yes	Not estimated
Conditional transfers in kind	Ravallion and Wodon (2000)	FFE, Bangladesh	Yes	Not estimated
	Vermeersch and Kremer (2005)	Kenya, school breakfast	Yes	Yes
	Kremer et al. (2005)	Kenya, school uniform	Yes	No
Abolition of school fees	School fees Abolition Initiative (2006)	Kenya	Yes	Not estimated
Vouchers	Angrist et al. (2001)	Colombia	Yes	Yes
	Hsieh and Urquiola (2006)	Chile	Yes	No
Health: deworming	Miguel and Kremer (2004)	Kenya	Yes	No

- Evidence from many countries indicates that higher household incomes and especially lower schooling costs greatly increase school enrolment. This should increase children’s acquisition of skills.

Supply-side Policies

Increasing the quantity of schooling services offered

Building new schools

Hiring more teachers

Increasing the quality of schooling services

Hiring more teachers

Providing material inputs

Building more schools and/or increasing the capacity of existing schools

- Reduces households' distance to the nearest school
- Long distance reduce enrolment
- Distance harmful to girls' schooling (Foster and Rosenzweig, 2004; Bommier and Lambert, 2000).
- Filmer (2004) argues that decreasing distance to schools increases enrolment, but not by much.
- Duflo (2001), using a natural experiment, showed that building new schools increased years of schooling in Indonesia by about 0.15 years.

Hiring more teachers to existing schools' capacity

- In French-speaking West Africa, several countries have recently hired additional teachers, but on different terms.
- Contract teachers have short term renewable contracts, receive little training, and are paid much less than permanent, civil service teachers.
- Senegal, Mali, and Niger have hired thousands of such teachers, permitting large enrolment increases.
- Mali hired 11,400 contract teachers between 1992 and 2004; between 1998 and 2002 they constituted 86% of newly hired primary and secondary teachers.
- PASEC(2004) estimate that this allowed 100,000 additional pupils to be enrolled, a 5% increase.

- Results using PASEC data suggest that contract teachers raise student learning as much as regular teachers do (Sy, 2007).
- Glewwe et al. (2003) implemented a randomized trial in Kenya to assess the impact of awarding teachers prizes based on student learning. They found little impact of incentives on learning.

Additional teachers may raise school quality as well as quantity.

- Banerjee et al. (2007) conducted a randomized evaluation of a program that hired young educated women from the community to teach basic literacy and numeracy skills to children falling behind in India's government schools.
- The program was very effective, increasing test scores by 0.14 standard deviations after 1 year, and 0.28 after 2 years.
- Similar results were found in Chile by Chay et al. (2005).

Increased enrolment from reduced tuition or other policies increases class size, which may reduce learning.

- Angrist and Lavy (1999) exploited an Israeli natural experiment arising from strict application of a rule that class size should not exceed 40 (which is low by sub-Saharan Africa's standards) to investigate how class size affects learning.
- They found that smaller classes improve learning; having ten fewer students increased reading scores by 2.5 points . Urquiola (2006) finds similar results for Bolivia.

Another way to improve education quality is to provide material inputs

- Two randomized trials, one that provided textbooks and another that supplied flipcharts, were conducted in Kenya.
- Neither textbooks nor flipcharts increased learning except that textbooks raised learning among the best students (Glewwe et al., 2004, 2007).
- In India, Banerjee et al., (2005) conducted a randomized evaluation to computer-assisted education.
  - Fourth graders were given 2 hours of computer time per week to play games that reinforced mathematics skills.
  - The program increased math scores by 0.47 standard deviations after 2 years.
  - These results persisted for at least 1 year after students finished the program.

Supply-side policies (Summary of empirical results)

			Impact on enrolment	Impact on learning
School construction	Duflo (2001)	Indonesia	Yes	Not estimated
Contractual teachers	PASEC (2004)	Mali	Yes	No
	Sy (2007)	Mali	Not estimated	No
Class size	Angrist and Lavy (1999)	Israel	Not estimated	Yes
	Urquiola (2001)	Bolivia	Not estimated	Yes
Teacher incentives	Glewwe, Ilias and Kremer (2003)	Kenya	No	No
Remedial education	Banerjee et al. (2005)	India	Not estimated	Yes
Traditional inputs	Glewwe et al. (2007)	Kenya	No	No
Computer-assisted education	Banerjee, Duflo and Linden (2003)	India	Not estimated	Yes

Suggestions for Future Research

1. Grade repetition is high in many countries(on average 13% in sub-Saharan Africa and 12% in Latin America, Glewwe and Kremer, 2006). Repetition is an inefficient policy for helping students who fall behind.
   - How should schools accommodate students with very different backgrouns and abilities?
   - The impact of repetition on education outcomes and alternatives to that policy merit further research

2. To pass entrance exams to secondary or post-secondary education, many public-school students in developing countries attend private tutoring classes (Dang, 2007; Dang and Roger, 2008).
   - Tutoring are often teachers from the students' own school, which may tempt teachers to reduce effort during the school day to generate demand for tutoring services.

3. The cost and benefits of contract teachers
4. The timing of education services hours per school day, days per year, and vacation times
5. Peer effects in developing countries
6. Language–Teaching in local languages,at least during the first years, facilitates initial learning but may inhibit mastering the academic language used in higher education

REFERENCES

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