Education I: Benefits of Education

14.740x: Foundations of Development Policy

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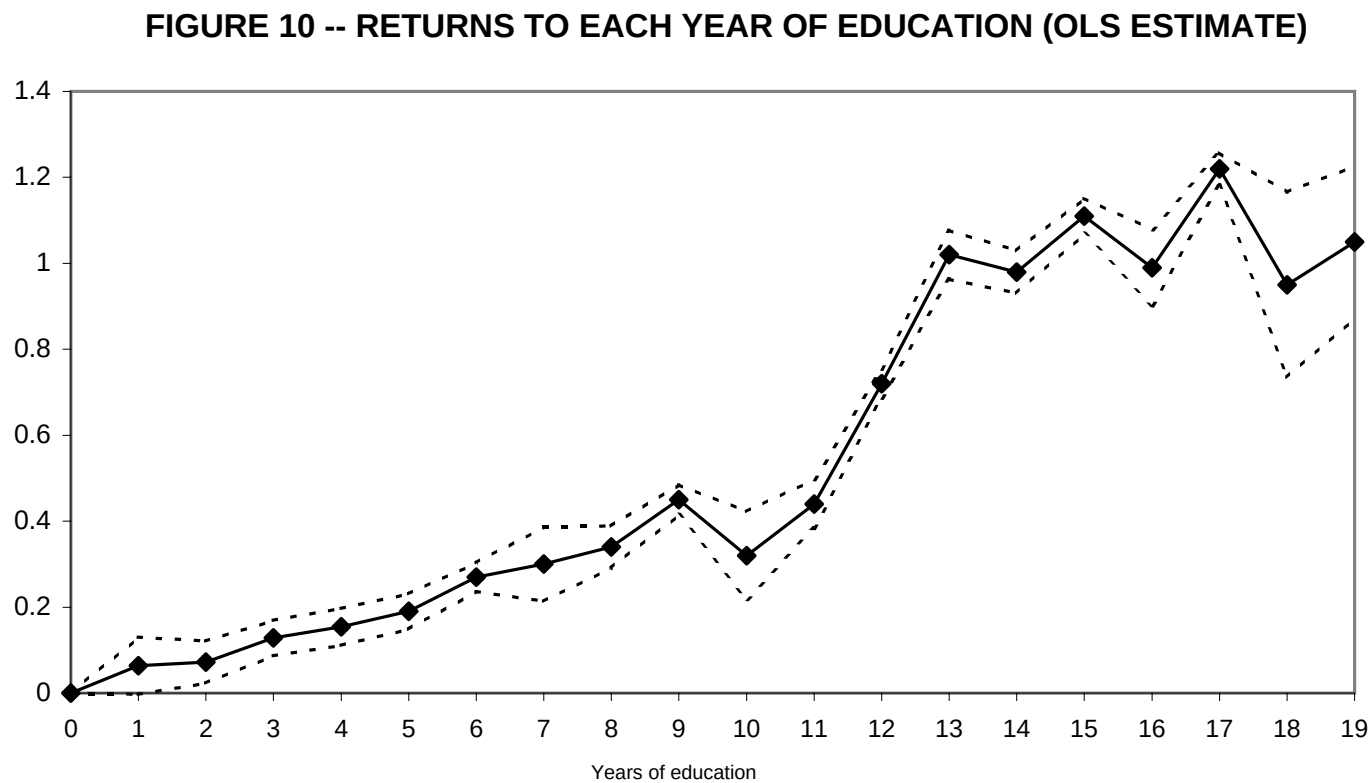
The Benefits of Education

- Why are people deciding to send their children to school?
- Education is a form of *human capital*. You *invest* in it, and you get *returns*, in the form of higher earnings, and other benefits.
- Discussion: What may those other benefits be?
  - Knowledge
  - Labor market: earnings, participation in formal labor market, profitability of own business or farm, etc.
  - Family size, Children health , etc.
  - Political Attitudes / integration
  - ....
- Economics models education as
  - Teaches you facts
  - Helps you decode information (Schultz)
  - Teaches you different values (obedience (Bowles and Gintis)–or questioning)
- Today, we will try to get some evidence on the the benefits of education.

The Benefits of Education

- There is a correlation between education and many outcomes. e.g. knowledge, earnings, fertility, health etc. ..

Log(wages) and years of education in Indonesia



Source: Duflo (2001) "Schooling and labor market consequences of school construction in Indonesia"

The Benefits of Education

- There is a correlation between education and many outcomes. e.g. knowledge, earnings, fertility, health etc. ..
- By now, we have learned to beware of correlations...
  -What is the possible bias if we interpret the relationship between education and earnings causally?
- Randomly assigning "education" to people is not possible: one's education is closely linked to other aspects of one's person.

Assigning an "instrument"

- You can randomly assign a student to a program which may lead her to get more education. What are examples of interventions like that?
- Then we can exploit the fact that that intervention affect education: if it has no direct impact on earnings (or any other outcomes you want to look at), but you see that it affects the earnings, you can infer that it affected earnings through education, and hence that education affects earning.
- Today, we going to use this insight to look formally at a tool to use a randomized experiment to estimate a relationship of interest: the method of instrumental variable.

Randomized evaluation as an instrumental Variable

- The question: How much does education improve cognitive score?
- Notation:

$$Y_i = \alpha + \beta S_i + \epsilon_i$$

  where S_i is the years of schooling for individual i, and Y_i is earnings
- Note that this formulation assumes that the effect of education is the same for all people, which is not an assumption we made last time: we also have some results on how to estimate a relationship where we don't make this assumption, but we will not cover them now)

Randomized Scholarship

- We have a randomized experiment in Ghana which makes it more likely to that students who qualify for high school actually attend: a scholarship program. Scholarship were randomly assigned to students who qualified for secondary school on a basis of a competitive test scores but had not yet joined.
- Let Z_i be a dummy variable equal to 1 if one is assigned to the treatment group (and were therefore offered the scholarship), 0 otherwise.
- Getting scholarship increases the probability to ever enroll in high school by 33% for females, 36% for males.
- (Note: A difficulty is that kids in control school also started school later, so more or them are still in school: we won't be able to look at earnings yet; we will have to survey again for later outcomes).

Scholarship and participation in Senior High School

Table 2: Survey Rate and Educational Outcomes at 5-yr Follow-up

	Female			Male		
	Treatment Mean	Control Mean	Difference (SE)	Treatment Mean	Control Mean	Difference (SE)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Survey Rate						
Surveyed in person in 2013	0.97	0.966	0.004	0.957	0.969	-0.012
			(0.012)			(0.012)
Observations	333	701		345	671	
Panel B. Educational Outcomes						
Ever enrolled in SHS	0.78	0.446	0.334	0.927	0.569	0.358
			(0.032)***			(0.029)***
Completed SHS	0.576	0.244	0.332	0.706	0.323	0.383
			(0.031)***			(0.031)***
Started and Stopped SHS	0.146	0.072	0.073	0.161	0.089	0.071
			(0.02)***			(0.021)***
Enrolled in SHS other than admission SHS[a]	0.015	0.004	0.011	0.012	0.008	0.004
			(0.006)*			(0.006)
Still enrolled in SHS	0.043	0.124	-0.081	0.048	0.149	-0.101
			(0.02)***			(0.021)***
Ever enrolled in SHS track...						

Source: Duflo et al. (2104) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Combining the two: an instrumental variable estimate of the effect of going to school on cognitive scores

Effect of treatment on participation can be measured by could be measured by:

$$E[A_i|Z_i = 1] - E[A_i|Z_i = 0] \tag{1}$$

Effect of treatment on cognitive test scores could be measured by:

$$E[Y_i|Z_i = 1] - E[Y_i|Z_i = 0] \tag{2}$$

Using our expression for Y_i, we have:

$$E[Y_i|Z_i = 1] = \alpha + \beta E[A_i|Z_i = 1] + E[\epsilon_i|Z_i = 1]$$

and:

$$E[Y_i|Z_i = 0] = \alpha + \beta E[A_i|Z_i = 0] + E[\epsilon_i|Z_i = 0]$$

Therefore

$$E[Y_i|Z_i = 1] - E[Y_i|Z_i = 0] =$$

$$\beta(E[A_i|Z_i = 1] - E[A_i|Z_i = 0])+$$

$$E[\epsilon_i|Z_i = 1] - E[\epsilon_i|Z_i = 0]$$

- What can we assume about $E[\epsilon_i|Z_i = 1] - E[\epsilon_i|Z_i = 0]$?
- What underlies this assumption, and is this justified?

Putting everything together:

$$\hat{\beta} = \frac{E[Y_i|Z_i = 1] - E[Y_i|Z_i = 0]}{E[A_i|Z_i = 1] - E[A_i|Z_i = 0]} \tag{3}$$

RCT as IV

$$\hat{\beta} = \frac{E[Y_i|Z_i = 1] - E[Y_i|Z_i = 0]}{E[A_i|Z_i = 1] - E[A_i|Z_i = 0]}$$

- Careful: never forget to check *both* conditions when thinking about using an instrument. The second condition is often not verified even when the first is.
- For example, in this example, could the scholarships per se be having an effect on cognitive scores?
- If assumptions are verified: We obtain the effect of health on knowledge by dividing the effect of the program on cognitive scores by the effect of the program on education.

$$\hat{\beta} = \frac{E[Y_i|Z_i = 1] - E[Y_i|Z_i = 0]}{E[A_i|Z_i = 1] - E[A_i|Z_i = 0]}$$

Equation 1 is the *first stage* relationship (the numerator). Equation 2 is the *reduced form* relationship (the denominator). $\hat{\beta}$ given by equation 12 is the *Wald estimate* of the effect of SHS participation. It is the simplest form of the instrumental variable estimator (Z_i is our instrument).

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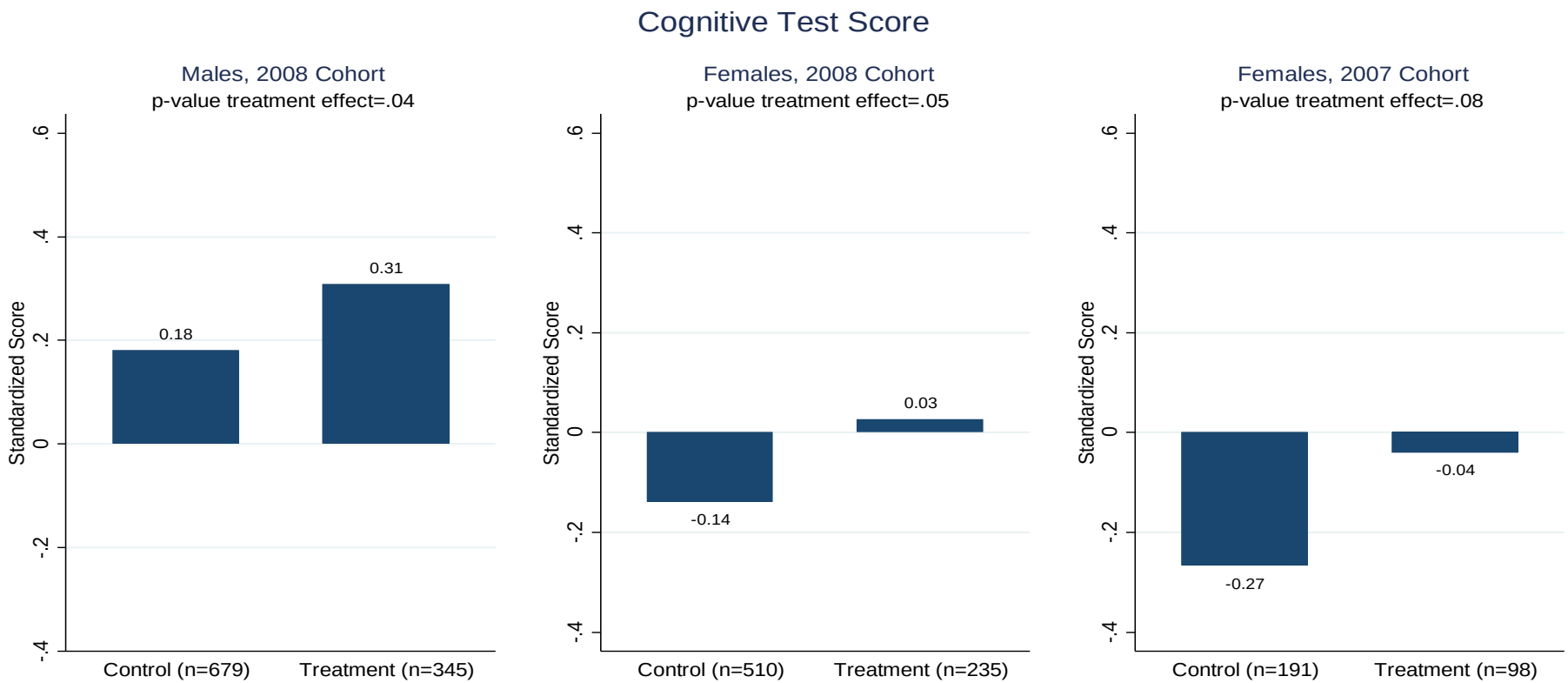
Source: Duflo et al. (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Scholarship and cognitive test scores

Figure 8: Impact of Scholarship on Cognitive Skills Test Score

Panel A. By Cohort and Gender



Source: Duflo et al. (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Let us calculate the Wald estimator ourselves, for cognitive scores.

- Effect on cognitive scores
- Effect on SHS enrollment
- Effect of SHS enrollment on cognitive scores?

The importance of the exclusion restriction

- You can see that even a "small" violation of either of the conditions for the validity of the instrument can result in very large bias. Any bias in the reduced form will be "blown up" when I divide by the first stage difference (e.g. even if there is a small difference between treated and untreated schools on test , we are going to divide this small difference by the fraction of people whose anemia status changed, which is very small: the bias will be large!).
- Let's consider some examples. Valid, no valid?
  - People are randomly selected to receive money, I use it to look at the elasticity of food consumption wrt to food expenditure
  - Doctors randomly selected to receive advice to remind their patients to get enough iron, I use it as instrument for taking iron fortification pills
  - Kids are in school that are randomly receive iron, I use being in treatment school are instrument for actually being de-wormed.

Other interesting things in these tables

see tables....

Scholarship and participation in Senior High School

Table 5: Impact on General Intelligence and Cognitive Skills

	Female			Male		
	Treatment Mean	Control Mean	Difference (SE)	Treatment Mean	Control Mean	Difference (SE)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Scores on General Intelligence Tests						
Memory for Digit Span (Forward)	7.35	7.378	-0.028	7.764	7.715	0.048
	(2.587)	(2.599)	(0.175)	(2.606)	(2.515)	(0.172)
Memory for Digit Span (Backward)	4.402	4.373	0.029	4.9	4.718	0.182
	(1.835)	(1.677)	(0.117)	(1.918)	(1.872)	(0.128)
Raven's Progressive Matrices	6.52	6.555	-0.035	7.403	7.364	0.039
	(2.512)	(2.589)	(0.173)	(2.427)	(2.572)	(0.171)
Panel B. Performance on Reading and Math Skills Test[a]						
Reading Skills						
Respondent's reaction when asked to read paragraph						
Yes, able to read	0.885	0.851	0.034	0.939	0.902	0.038
			(0.023)			(0.019)**
No, refuses to read	0	0.021	-0.021	0.012	0.014	-0.002
			(0.008)***			(0.008)
No, cannot read	0.109	0.103	0.005	0.042	0.069	-0.027
			(0.021)			(0.016)*
No, refuses (other reason)	0.006	0.022	-0.016	0.006	0.015	-0.009
			(0.009)*			(0.007)
Reading Comprehension Questions (all 0s if respondent did not read)						
Basic comprehension	0.717	0.686	0.032	0.83	0.771	0.06
			(0.031)			(0.027)**
Fact identification	0.748	0.718	0.03	0.815	0.763	0.052
			(0.030)			(0.028)*
Intermediate comprehension	0.14	0.117	0.023	0.115	0.139	-0.024
			(0.022)			(0.023)
Advanced comprehension	0.394	0.35	0.045	0.367	0.317	0.05
			(0.033)			(0.032)
Reading Ability Level (gauged by enumerator, if respondent agreed to read)						
Can read entirety with difficulty	0.381	0.431	-0.05	0.304	0.32	-0.015
			(0.036)			(0.033)
Can read well	0.432	0.352	0.08	0.521	0.462	0.059
			(0.035)**			(0.035)*
Can read very well	0.147	0.164	-0.016	0.149	0.18	-0.032
			(0.027)			(0.026)

Source: Duflo et al. (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Scholarship and participation in Senior High School

			(0.027)			(0.026)
Math Skills						
Basic Computation 1	0.947	0.907	0.04	0.924	0.932	-0.008
			(0.018)**			(0.017)
Basic Computation 2	0.947	0.948	-0.001	0.933	0.938	-0.005
			(0.015)			(0.016)
Basic Calculator Computation	0.759	0.726	0.033	0.827	0.829	-0.002
			(0.030)			(0.026)
Numeracy	0.829	0.805	0.024	0.927	0.897	0.031
			(0.026)			(0.020)
Profit calculation (easy)	0.645	0.621	0.024	0.673	0.68	-0.007
			(0.033)			(0.032)
Profit calculation (difficult)	0.153	0.106	0.047	0.176	0.195	-0.019
			(0.022)**			(0.026)
Interpreting Bar Chart						
Identifying mode	0.922	0.886	0.036	0.964	0.928	0.036
			(0.021)*			(0.016)**
Calculating sums (without help)	0.14	0.136	0.004	0.191	0.2	-0.009
			(0.023)			(0.027)
Calculating sums (with explanation)	0.673	0.649	0.024	0.748	0.734	0.014
			(0.035)			(0.033)
Calculating percentage	0.19	0.149	0.041	0.3	0.235	0.065
			(0.025)			(0.029)**
Applied math skills: Exchange rate calculation	0.467	0.384	0.083	0.633	0.572	0.061
			(0.033)**			(0.033)*
Total Standardized Score	0.021	-0.172	0.193	0.308	0.181	0.126
on Reading and Math Skills	(1.058)	(1.022)	(0.07)***	(0.912)	(0.944)	(0.063)**

Source: Duflo et al. (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Scholarship and participation in Senior High School

Table 6: Reproductive Health, Partners, Fertility

	Female			Male		
	Treatment Mean (SD)	Control Mean (SD)	Difference (SE)	Treatment Mean (SD)	Control Mean (SD)	Difference (SE)
	(1)	(2)	(3)	(4)	(5)	(6)
Reproductive Health						
Ever had sex	0.861	0.845	0.016	0.618	0.686	-0.067
			(0.024)			(0.032)**
Ever had relationship with partner >20 years older	0.093	0.127	-0.034	0.036	0.032	0.004
			(0.022)			(0.012)
Ever had relationship only for gifts/money	0.313	0.284	0.029	0.103	0.111	-0.008
			(0.031)			(0.021)
Ever had sex with commercial sex worker	N/A	N/A	N/A	0.006	0.019	-0.013
						(0.008)
If ever had sex:						
Age when first had sex	18.079	18.112	-0.033	18.598	18.555	0.043
	(1.562)	(1.756)	(0.124)	(2.561)	(2.230)	(0.198)
Number sexual partners (last 6 months)	0.629	0.708	-0.078	0.632	0.688	-0.055
	(0.540)	(0.506)	(0.038)**	(0.817)	(0.949)	(0.077)
Number sexual partners (lifetime)	1.777	2.07	-0.293	2.201	2.554	-0.353
	(0.980)	(2.811)	(0.174)*	(2.397)	(2.828)	(0.228)
Contraception use (last time had sex)	0.647	0.607	0.041	0.819	0.706	0.113
			(0.036)			(0.037)***
Ever used contraception	0.781	0.764	0.017	0.853	0.789	0.064
			(0.031)			(0.033)*
Partners						
Currently living with partner (married/cohabiting)	0.115	0.139	-0.024	0.018	0.045	-0.027
			(0.023)			(0.013)**
Ever lived with partner (married/cohabiting)	0.17	0.204	-0.034	0.03	0.06	-0.03
			(0.027)			(0.015)**
Fertility						
Ever pregnant	0.384	0.455	-0.071	0.07	0.088	-0.018
			(0.033)**			(0.019)
Ever had unwanted pregnancy (full sample)	0.324	0.39	-0.066	0.061	0.076	-0.015
			(0.033)**			(0.017)

Source: Duflo et al. (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Scholarship and participation in Senior High School

Table 7: Current Activity and Future Plans

	Female			Male		
	Treatment Mean	Control Mean	Difference (SE)	Treatment Mean	Control Mean	Difference (SE)
	(1)	(2)	(3)	(4)	(5)	(6)
Current activity / occupation						
Enrolled in formal study / training	0.074	0.144	-0.069 (0.022)***	0.064	0.177	-0.113 (0.023)***
Apprentice	0.065	0.139	-0.074 (0.021)***	0.052	0.109	-0.058 (0.019)***
Wage employee	0.235	0.135	0.100 (0.025)***	0.298	0.242	0.056 (0.03)*
Day or Seasonal Laborer	0.012	0.024	-0.011 (0.009)	0.097	0.069	0.028 (0.018)
Farming	0.068	0.074	-0.006 (0.018)	0.07	0.077	-0.007 (0.018)
Working for own or family business	0.211	0.157	0.053 (0.026)**	0.119	0.109	0.009 (0.021)
Doing nothing	0.331	0.320	0.011 (0.032)	0.289	0.200	0.088 (0.028)***
Tertiary Education/Future Plans						
Respondent currently enrolled in tertiary institution	0.006	0.004	0.002 (0.005)	0.003	0.002	0.001 (0.003)
Plans to continue to tertiary level institution	0.622	0.361	0.261 (0.033)***	0.712	0.496	0.216 (0.033)***

Source: Duflo et al. (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Scholarship and participation in Senior High School

Table 8: Labor Market and Wage Expectations

	Female			Male		
	Treatment Mean	Control Mean	Difference (SE)	Treatment Mean	Control Mean	Difference (SE)
	(1)	(2)	(3)	(4)	(5)	(6)
Labor Supply Behavior						
Minimum daily wage required to accept full day of employment (at time of survey)	8.797 (11.498)	8.009 (9.137)	0.788 (0.676)	10.139 (11.015)	11.962 (13.832)	-1.822 (0.876)**
At above minimum wage, would you accept job that...						
Requires you to move away from family?	0.854	0.854	0.001 (0.024)	0.9	0.887	0.013 (0.021)
Is labor intensive (not intellectual)?	0.563	0.556	0.007 (0.034)	0.712	0.728	-0.016 (0.030)
Likelihood (out of 10) of wage employment for average 30-yr old, if:						
He/she completed JHS	4.435	4.284	0.15 (0.135)	4.301	4.465	-0.164 (0.137)
He/she completed JHS & Vocational Training	6.705	6.843	-0.138 (0.143)	6.827	6.826	0.001 (0.139)
He/she completed SHS	7.353	7.219	0.134 (0.130)	7.367	7.248	0.119 (0.127)
He/she went to university	8.656	8.784	-0.128 (0.117)	8.764	8.727	0.036 (0.108)
Most likely wage for average 30-yr old, if:						
He/she completed JHS	102 (75)	104 (87)	-2.177 (5.656)	125 (95)	133 (97)	-7.921 (6.489)
He/she completed JHS & Vocational Training	167 (116)	176 (119)	-8.761 (8.010)	209 (137)	218 (163)	-8.825 (10.468)
He/she completed SHS	223 (149)	230 (157)	-6.271 (10.454)	261 (169)	276 (190)	-14.723 (12.373)
He/she obtained tertiary degree	784 (509)	791 (660)	-7.121 (41.733)	850 (561)	865 (638)	-15.227 (41.436)
Current monthly wage earnings of 30-yr olds in occupation that respondent sees himself/herself doing at age 30						
Minimum wage	582 (543)	559 (660)	22.952 (42.501)	977 (1827)	773 (789)	204.433 (84.143)**
Maximum wage	1106 (1287)	993 (1013)	112.774 (75.411)	2025 (4514)	1523 (2321)	501.753 (219.177)**
Most likely wage	815 (915)	752 (791)	63.444 (56.635)	1354 (2503)	1115 (1751)	239.041 (138.21)*
Expectations for own (or future) children						

Source: Duflo et al. (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"

Sources

- Duflo (2001) "Schooling and Labor Market Consequences of school construction in Indonesia: Evidence from an unusual experiment
- Duflo, Dupas, Kremer (2014) "Estimating the Impact and Cost-Effectiveness of Expanding Access to Secondary Education in Ghana"