

Part IIIB: Signaling Model; HC and Development

David A. Díaz

UNC Chapel Hill

Review: Human Capital Theory

- Firms observe individual productivity
 - Wages are higher for more productive individuals;
 $w = w(S; A)$
 - Attend school \Rightarrow increase productivity \Rightarrow increase wages
 - Individuals attend school only if schooling raises their productivity

The Importance of Information

- What do firms know about a job candidate?
 - Education
 - Previous experience
 - Information from references
 - What do candidates know about themselves?
 - All of the above, plus
 - Work ethic
 - Intelligence
 - etc.

The Importance of Information

- Basic idea of signaling:
 - Workers try to present employers with information that makes them look as productive as possible ("signals of productivity")
 - Signaling may be costly: Time spent in school, unpaid internships, extracurriculars, etc.
 - Firms hiring workers try to take signals presented by potential worker to estimate productivity

Job Market Signaling

- Is it possible to describe an economic environment where
 - ① schooling does not directly increase productivity and
 - ② firms pay well-educated workers higher wages?
- Yes!
- Note: This does not mean schooling doesn't increase productivity. Rather, it just means that increasing productivity is not the only way schooling can increase wages

Job Market Signaling

- Suppose there are two types of workers:
 - High productivity make up a proportion $(1 - q)$ of the population
 - Low productivity make up q of the population
- Productivity differences between the workers exist since birth and *do not depend on how much schooling a worker gets*
- For illustrative purposes, assume high-ability workers have a present value of lifetime productivity = \$300,000
- Low-ability workers have PV of lifetime productivity = \$200,000

Job Market Signaling

- Case 1: Perfect information
 - Employers observe which workers are high-ability and low-ability
 - Pay high-ability workers \$300,000, low-ability workers \$200,000 over the life cycle
 - Not often the case. In real-world, there is **asymmetric information**

Job Market Signaling

- Case 2: “Pooling equilibrium”

- No information about productivity available to firms and they do not observe a worker's type
- Firms will pool all applicants together and treat them equally
- Average wage will be a weighted average of the two worker type productivities:

Average salary =

$$(300,000)(1 - q) + 200,000q = 300,000 - 100,000q$$

- Good for low-ability workers, bad for high-ability workers and firms

Job Market Signaling

- Case 3: “Separating Equilibrium”
 - Firms do not observe a worker’s type
 - High-productivity workers may be able to signal their productivity to firms through some form of information (e.g., a threshold education level)
 - Assumption: Costs to obtain signaling information is higher for low-productivity workers
 - Merit-based scholarships awarded to high productivity individuals
 - Lower-productivity individuals may need to put in greater effort to obtain degree
 - Lower-productivity individuals may incur greater psychic cost to obtain degree

Job Market Signaling

- Assume costs to obtain a degree are as follows
 - \$80,000 for high-productivity individuals
 - \$160,000 for low-productivity individuals
- Firms pay \$300,000 to those with a degree, \$200,000 to those without a degree
- Is it worth it for individuals to get a degree?
 - Yes, but only for the high-productivity type!
- Education level is a perfect signal of worker productivity, even though firms do not actually observe this

Job Market Signaling

Example

Suppose that there are two types of workers in an economy, low-productivity and high-productivity. Firms follow the rule of thumb that workers who obtain at least \bar{y} of college are assumed to be highly productive and are paid a lifetime salary of \$400,000. Workers with less than \bar{y} years of education are assumed to be low-productivity and are paid \$250,000. High-productivity workers have a cost of \$25,000 for each year of college, while low-productivity workers have a per year cost of \$30,001. What is the range of \bar{y} that firms can choose as the threshold education level so that only high-productivity workers go to college?

HC Theory vs Signaling

- Consider two individuals, John and Allie, who are seemingly identical in every way except that
 - John completed 3.99 years of college
 - Allie completed 4 years of college
- What does Human Capital Theory say about their earnings?
- What does Signaling Theory say about their earnings?
- In a signaling framework, individuals can be rewarded for passing threshold level of education
 - Referred to as a “Sheepskin Effect”

HC Theory vs Signaling

- Very difficult to empirically separate productivity-enhancing component of schooling from “sheepskin effect”
 - Under both frameworks, one would observe that more education leads to higher earnings
- Policy implications much different under each framework

Readings

- Borjas 6.9

Human Capital and Development

- How can education improve the welfare of individuals in low-income countries?
 - ① Productivity-enhancing component increases private returns to schooling
 - ② Both private and social returns to schooling estimated to be high in developing countries
 - ③ Education may also aid individuals adopting new technologies
⇒ greater productivity
 - ④ Education can be a means to improve health outcomes
- Mixed evidence on the causal effect of education on overall economic growth

Human Capital and Development - Trends

- Tremendous increase in overall school enrollment rates since 1960 across developing countries (Glewwe & Kremer, 2006)

Table 1
Primary school gross enrollment rates (percent of students of primary school age)

Area	1960	1970	1980	1990	2000
World	80	87	97	102	104
<i>Country group</i>					
Low-income	65	77	94	102	102
Middle-income	83	103	101	103	110
High-income	109	100	101	102	102
<i>Region</i>					
Sub-Saharan Africa	40	51	80	74	77
Middle East/North Africa	59	79	89	96	97
Latin America	91	107	105	106	127
South Asia	41	71	77	90	98
East Asia	87	90	111	120	111
East Europe/Former Soviet Union (FSU)	103	104	100	98	100
Organization for Economic Cooperation and Development (OECD)	109	100	102	103	102

Note. Countries with populations of less than 1 million are excluded.

Sources: UNESCO (2002), World Bank (2003).

Human Capital and Development - Trends

Table 2
Primary school enrollment, repetition, and grade 4 survival rates (percents)

Area	Gross enrollment 2000	Net enrollment 2000	Repetition 2000	On-time enrollment 2000	Grade 4 survival 1999
<i>Country group</i>					
Low-income	102	85	4	55	80
Middle-income	110	88	10	61	88
High-income	102	95	2 ^a	73 ^b	98 ^b
<i>Region</i>					
Sub-Saharan Africa	77	56	13	30	76
Middle East/North Africa	97	84	8	64	96
Latin America	127	97	12	74	86
South Asia	98	83	5	—	55
East Asia	111	93	2	56	97
East Europe/FSU	100	88	1	67 ^a	97 ^b
OECD	102	97	2 ^a	91 ^a	99 ^b

Note. Countries with populations of less than 1 million are excluded.

Source: UNESCO (2003).

^aData are based on between 25 percent and 50 percent of the total population of the country group or region.

^bData are based on between 10 percent and 25 percent of the total population of the country group or region.

Human Capital and Development - Trends

Table 3
Secondary school gross enrollment rates (percent of students of secondary school age)

Area	1960	1970	1980	1990	2000
World	29	36	49	55	67
<i>Country group</i>					
Low-income	14	21	34	41	54
Middle-income	21	33	51	59	77
High-income	63	74	87	92	101
<i>Region</i>					
Sub-Saharan Africa	5	6	15	23	27
Middle East/North Africa	13	25	42	56	66
Latin America	14	28	42	49	86
South Asia	10	23	27	39	47
East Asia	20	24	44	48	67
East Europe/FSU	55	64	93	90	88
OECD	65	77	87	95	107

Note. Countries with populations of less than 1 million are excluded.
Sources: UNESCO (2003), World Bank (2003).

Human Capital and Development - Trends

- School attainment and literary rates have also increased since 1960s

Table 4
Average years of school of adults, age 15+

Area	1960	1970	1980	1990	2000
<i>Country group</i>					
Low-income	1.6 ^a	2.2 ^a	3.7	4.6	5.2
Middle-income	2.8	3.5	4.2	5.1	5.9
High-income	7.4	7.9	9.2	9.5	10.1
<i>Region</i>					
Sub-Saharan Africa	1.7	2.0	2.3	3.0	3.4
Middle East/North Africa	1.4	2.2	2.9	4.1	5.4
Latin America	3.2	3.7	4.4	5.3	6.0
South Asia	1.5	2.0	3.0	3.8	4.6
East Asia	2.5 ^b	3.4 ^b	4.6	5.6	6.2
East Europe/FSU	6.5 ^b	7.6 ^b	8.5 ^b	9.0 ^b	9.7 ^b
OECD	7.3	7.8	9.1	9.5	10.1

Note. Countries with populations of less than 1 million are excluded.

Source: Barro and Lee (2001).

^aData are based on between 25 percent and 50 percent of the total population of the country group or region.

^bData are based on between 10 percent and 25 percent of the total population of the

Human Capital and Development - Trends

Table 5
Literacy rate among adults, age 15+

Area	1960	1970	1980	1990	2000
<i>Country group</i>					
Low-income	32 ^a	44	54	63	70
Middle-income	62	68	75	80	85
High-income	95 ^a	96 ^a	97 ^a	98 ^a	98 ^a
<i>Region</i>					
Sub-Saharan Africa	24 ^b	41	54	67	77
Middle East/North Africa	33 ^b	54	66	76	83
Latin America	67	84	90	93	95
South Asia	26	43	52	61	69
East Asia	54 ^b	83	91	95	97
East Europe/FSU	93 ^b	99	100	100	100
OECD	95	98	99 ^b	100 ^b	100 ^b

Note. Countries with populations of less than 1 million are excluded.

Source: UNESCO (2003).

^aData are based on between 25 percent and 50 percent of the total population of the country group or region.

^bData are based on between 10 percent and 25 percent of the total population of the country group or region.

Human Capital and Development - Trends

- Gender disparities in access to education are significant in certain regions

Table 6
Gender disparities in gross primary and secondary enrollment rates, 2000

Area	Primary		Secondary	
	Boys	Girls	Boys	Girls
<i>Country group</i>				
Low-income	107	98	60	47
Middle-income	112	108	77	78
High-income	102	101	100	102
<i>Region</i>				
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/FSU	100	99	88	89
OECD	102	102	106	108

Note. Countries with populations of less than 1 million are excluded.
Source: World Bank (2003).

Human Capital Demand

- Human capital investments in schooling respond to (among other things) the price of education
- Basic framework: Continue schooling as long as $MRR \geq MC$
- Knowing how individuals respond to changes in the price of education (e.g., how sensitive individuals are to changes in prices) is important when designing policy
 - Subsidies and grants
 - Scholarships
 - Conditional cash transfers
 - Etc.

Human Capital Demand

- Kremer, et al. (2009)
- Study randomized trial in Kenyan primary schools
 - Treatment schools enacted scholarship program for girls who scored well on academic exams
 - Scholarship paid for school fees and provided a grant

Human Capital Demand

- Girls showed substantial exam score gains
- Positive program effects among girls with low pretest scores who were unlikely to win
- Boys (who were ineligible for the award) show slightly higher test scores
- These positive externalities are likely to be due to higher teacher attendance or positive peer effects among students (or both)
- Find no evidence for weakened intrinsic motivation

Human Capital Demand

- Schultz (2004)
- *Progresa* conditional cash transfer program in Mexico

Table 1

Monthly payments for Progresa program eligible families for children who attend at least 85% of days^a

Educational levels of students eligible for payments	July–December 1998 ^b
<i>Primary school—both sexes</i>	
3rd Year	70
4th Year	80
5th Year	105
6th Year	135
<i>Secondary school</i>	
1st Year	200
	210
2nd Year	210
	235
3rd Year	225
	255

Source: Progresa staff.

^a Excluding those days for which medical or parent excuses were obtained, accumulated over the last 2 months.

^b Corresponds to school year first-term, September to December, 1998.

Human Capital Demand

- Randomized trial: Program was randomly allocated among an initial group of localities
- Evaluation: Compare mean enrollment rates of those eligible for assistance in the treatment and control villages
(Difference-in-differences)

Human Capital Demand

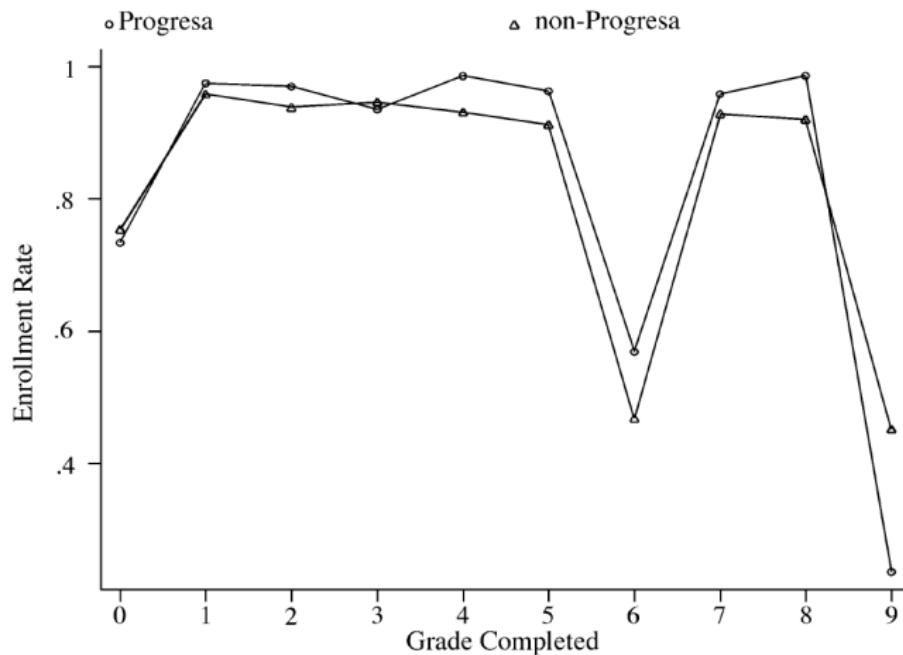


Fig. 3. Girls' enrollments in Progresa and non-Progresa localities over time.

Human Capital Demand

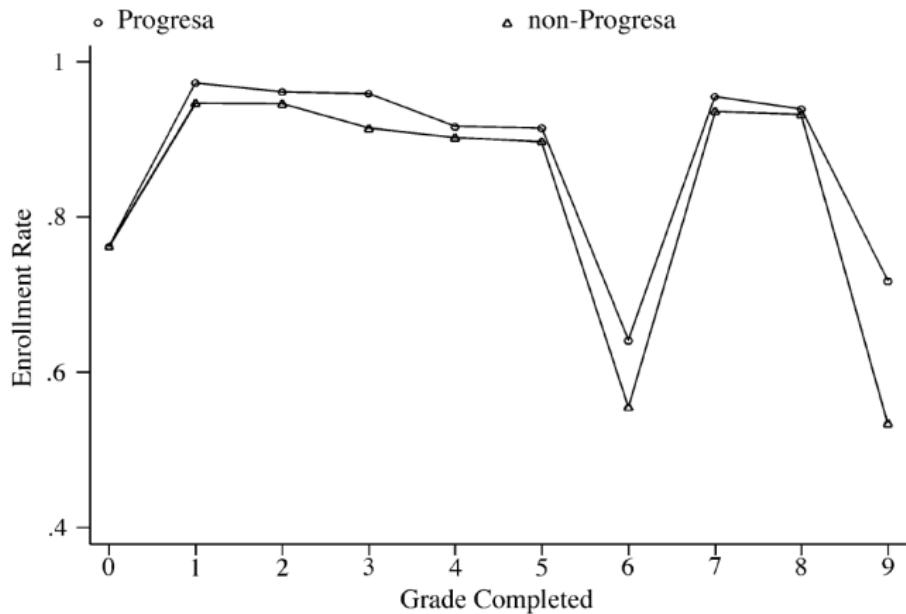


Fig. 4. Boys' enrollment in Progresa and non-Progresa localities over time.

Human Capital Demand

- Framework assumes individuals know the true *MRR* to schooling when making optimal choice
- May not always be true, especially in developing countries (Jensen, 2010)
 - Decision to drop out often made at a younger age
 - Little information may available on labor market earnings
 - Perceived returns influenced by surroundings - rural individuals may not true potential realize returns in urban sector

Human Capital Demand

- Intervention: Students at randomly selected schools were provided information about the returns to education
- Relative to those not provided with the information, students reported a higher perceived return to education when re-interviewed
- Treatment group completed an average of .20 more years of schooling than control group over next 4 years
- Heterogenous effects: Large effect among poor students, but no effect on the poorest students

HC Supply & Political Economy

- Focus so far has been on the quantity of education (e.g., enrollment or years completed)
- Quality of education is also important in order to enhance productivity
- In general, the quality of education in developing countries is very low

HC Supply & Political Economy

Table 7
Mean mathematics and reading achievement, TIMSS and PIRLS studies

Country	Mathematics (TIMSS), 1999		Reading (PIRLS), 2001
	Grade 7	Grade 8	Grade 4
France	—	—	525
Japan	—	579	—
UK (England)	—	—	553
US	—	502	542
Argentina	—	—	420
Belize	—	—	327
Chile	—	392	—
Colombia	—	—	422
Indonesia	—	403	—
Iran	—	422	414
Jordan	—	428	—
Korea (South)	—	587	—
Kuwait	—	—	396
Malaysia	—	519	—
Morocco	337	—	350
Philippines	345	—	—
South Africa	—	275	—
Thailand	—	467	—
Tunisia	—	448	—
Turkey	—	429	449

Source: IAEEA (2000, 2003).

HC Supply & Political Economy

Table 8
Mathematics and reading achievement of 15-year-olds, PISA study

Country	Mathematics	Reading	
	Mean score	Mean score	Percent with very low skills
France	517	505	4.2
Japan	557	522	2.7
United Kingdom	529	523	3.6
United States	493	504	6.4
Argentina ^a	388	418	22.6
Brazil	334	396	23.3
Chile ^a	384	410	19.9
Indonesia ^a	367	371	31.1
Mexico	387	422	16.1
Peru ^a	292	327	54.1
South Korea	547	525	0.9
Thailand ^a	432	431	10.4

Note. Data are for the year 2000.

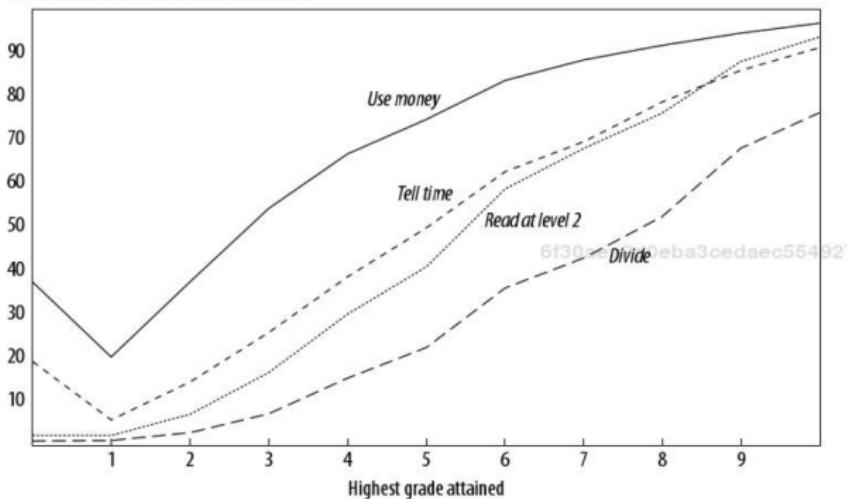
Source: OECD and UNESCO (2003).

^aData are for the year 2002.

HC Supply & Political Economy

Figure 1-6. Learning achievement profiles by grade attainment in Uttar Pradesh show shockingly low learning levels, even for grade 2-level skills.

Percent of students who have mastered skill



Source: Author's calculations based on ASER 2008 survey data.

HC Supply & Political Economy

Table 1-3. Children in Uttar Pradesh show little progress from grade 4 to grade 5 in reading.

<i>Level of reading mastery</i>	<i>Grade 4</i>		<i>Grade 5</i>	
	<i>Percent at level</i>	<i>Cumulative</i>	<i>Percent at level</i>	<i>Cumulative</i>
Nothing (does not recognize letters)	7.6		4.6	
Recognizes letters but cannot read words	20.8	28.3	14.5	19.2
Reads words but cannot read a paragraph	17.9	46.3	14.5	33.7
Reads simple sentences but not a story	23.1	69.4	22.6	56.3
Can read a short, grade 2–level story	30.6	100.0	43.7	100.0

Source: Author's calculations, based on ASER 2008 survey data.

HC Supply & Political Economy

- Contributing causes:

- Lack of infrastructure
- Lack of resources (e.g., materials, teachers)
- Low teacher quality
- Low teacher effort

Healthcare

- Health is part of human capital
- Health, education, and learning intimately related
- Das, et al., 2008
- Healthcare has improved drastically in developing countries
- *Quality* of healthcare still very low
- Similar issues: low quality doctors, low effort, lack of access for poor individuals
- Spillovers: Miguel & Kremer (2004)

Readings

- Das, et al. (2008). The Quality of Medical Advice in Low-Income Countries. *The Journal of Economic Perspectives*
- Jensen (2010). The (Perceived) Returns to Education and the Demand for Schooling. *The Quarterly Journal of Economics*
- Kremer, et al. (2009). Incentives to Learn. *The Review of Economics and Statistics*
- Miguel & Kremer (2004). Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities
- Schultz (2004). School Subsidies for the Poor: Evaluating the Progresa Poverty Program. *Jounal of Development Economics*