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This report describes modifications to educational measurements and reports the results of a case study in the Ivory Coast. Estimates of returns to education in developing countries appear to be optimistically high when high failure rates and educational screening are not taken into account. When the standard internal rate of return (IRR) methodology is modified to incorporate these possibilities, estimated returns fall as much as 50% when applied to the Ivory Coast. The results suggest that (1) the modified methodology should be applied in other parts of the world with similar educational and labor market characteristics and (2) estimates not accounting for these factors most likely exaggerate true educational returns.

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A Note on Measuring Educational Returns in LDCs

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ABSTRACT

A Note on Measuring Educational Returns in LDCs

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The standard internal rate of return methodology is modified to account for high failure rates and educational screening common in many LDCs. When the modified procedure is applied to the Ivory Coast, estimated educational returns fell by 25 to 50 percent. These results suggest that rates of return to education in LDCs estimated using the standard methodology may greatly exaggerate its true economic value.

* * *

La présente étude analyse les bénéfices économiques de l'éducation en utilisant la méthodologie du taux de rendement interne. Elle modifie la dîte méthodologie pour tenir compte de deux phénomènes dans les PVD; d'abord de la sélection poussée des étudiants par les commisions d'orientation, et deuxièmement du taux élevé d'échecs des étudiants lors des études supérieures. Cette modification réduit les estimations du rendement économique de 25 à 50%, suggérant ainsi que la méthode classique pourrait surestimer considérablement sa vraie valeur économique.

I. Introduction

Estimates of returns to education in LDCs will tend to be over-optimistically high if the estimation procedure does not account for non-zero failure probabilities and educational screening. In this note, we outline a method of modifying the standard internal rate of return (IRR) methodology to incorporate these possiblities, then apply our modified procedure to estimate returns to various levels of secondary and university education in the Ivory Coast. When compared to the standard procedure, our modifications lowered educational returns in the Ivory Coast by as much as fifty percent. Section II below describes our modifications while Section III reports the results of our case study.

II. Estimating Educational Returns When Failure Rates are High

The standard IRR methodology is summarized by Equation (1) below. Educational costs, $C_{i,t,}$ consist of an individual's foregone earnings and direct private educational expenses summed over the period required to complete the i^{th} educational unit ($t = 1,\ldots, m_i$). For Social IRR calculations, the average educational subsidy per student is added to private costs. Benefits, $\Delta Y_{i,t}$, are an individual's expected incremental income summed over his working lifetime ($t = m_i +,1,\ldots, n$).

(1) "Standard" IRR:
$$\sum_{1}^{n} \frac{\Delta Y_{i,t} - C_{i,t}}{(1 + r)^t} = 0$$

As commonly applied, this procedure implicitly assumes that failure rates are zero since the period during which costs are incurred is equated with the number of years comprising an educational unit. When failure and repeat possibilities exist, this assumption must be modified so that the educational period represents the average length of time required to complete the unit. In addition, high failure rates, common to many LDCs, are often characteristic of educational systems which play screening roles. If screening exists, further modifications of the IRR methodology are necessary. Students failing in any educational unit are restricted to the incremental income streams of the previous unit that

they successfully completed. Therefore, costs incurred while unsuccessfully attempting further education must be assigned to prior units of education. These failure costs are comprised of two elements. Firstly, failing students forego earnings and incur direct educational costs, both of which must be pro-rated to the prior educational level. Secondly, failing students not only forego income while in school, they also postpone their entry into the labor force and may incur costs of foregone experience accumulation in the occupation in which they will eventually be employed. By entering the labor force later, they may earn lower incomes in any given year of their working lifetime than their cohorts, who did not continue their education.

The adjustment of the educational period is conceptually straightforward although it may be empirically difficult.[1] If $\bar{m}_1$ is the average time required to complete unit i, then the educational period is lengthened by a factor $\bar{m}_i - m_i$, while the working lifetime is shortened by the same factor. Alternatively, one could estimate a weighted average return by calculating a separate r for students completing unit i in m_i years, in $m_i + 1$ years, etc., then weight these returns by the percentage of students in each category.

The second adjustment pro-rates educational costs of screened students to the previous unit. To see this pro-rating process more clearly, consider the composition of a cohort of N_i students successfully completing unit i. Of that number, E_i enter the labor force immediately, S_{i+1} sucessfully complete the next unit i + 1, and F_{i+1} are those students who, for one reason or another, are unsuccessful in unit i + 1. If $F_{i+1,t}$ represents the number of failing students remaining in unit i + 1 in time t, then failure costs pro-rated to unit i are

(2) Failure Costs in Unit i + 1:

$$\sum_{\bar{m}_i}^{m'_{i+1}} \frac{\frac{F_{i+1,t}}{N_i} \cdot C_{i+1,t}}{(1+r)^t}$$

Here m'_{i+1} is $\bar{m}_i$ plus the maximum number of years that unsuccessful students can remain in unit i + 1. An alternative method of pro-rating these costs is to consider the costs incurred during the average length of time spent by a failure in unit i + 1, then multiply this value by $\frac{F_{i+1}}{N_i}$, the failing percentage of the N_i cohort. This adjustment will be important when the proportion of students continuing in unit i + 1 is large, when the failure rate is high and when many repeats are allowed in the screening process.

The final adjustment accounts for foregone experience accumulation while failing a unit. Suppose that earnings paths for individuals with education levels i and i - 1 are given by the learning curves in Figure 1 below. Then the curve ΔY_E describes incremental income of those workers E_i who enter the labor force immediately after graduation from unit i. Those workers opting for an unsuccessful attempt at unit i + 1 enter the labor force at time $\bar{m}^F_{i+1}$, the average length of time spent completing unit i, $\bar{m}_i$, plus the average length of time spent failing unit i + 1. If failures receive absolutely no knowledge in unit i + 1 that influences their lifetime productivity paths, they can expect to earn continuously lower incomes (since they are less experienced) than their cohorts E_i in any given year over their lifetime. The curve ΔY_{F+1} describes their income stream; it is simply ΔY_E transposed to the origin $\bar{m}^F_{i+1}$. The shaded difference $\Delta Y_E - \Delta Y_{F+1}$ in the period $t = \bar{m}^F_{i+1}, \ldots, n$ is the loss per unsuccessful student F_{i+1}. Pro-rated to those successfully completing unit i, this lifetime earnings loss is:

(3) Lifetime Earnings Loss to Missed Experience:

$$\frac{F_{i+1}}{N_i} \sum_{\bar{m}^F_{i+1}}^{n} \frac{\Delta Y_{E,t} - \Delta Y_{F+1,t}}{(1 + r)^t}$$

An alternative method of calculating these costs would be to make separate estimates for drop-outs in each time period, then calculate an average using appropriate weightings as was done in (2) above.

Again, this effect will be significant when the proportion of students continuing in unit i + 1 is large, when the failure rate is high, and when the screening process is slow. Additionally, it will be significant only if the difference between the slopes of Y_i and Y_{i-1} is large. Obviously, foregone experience losses will be important only to those occupations in which experience contributes greatly to lifetime earnings.

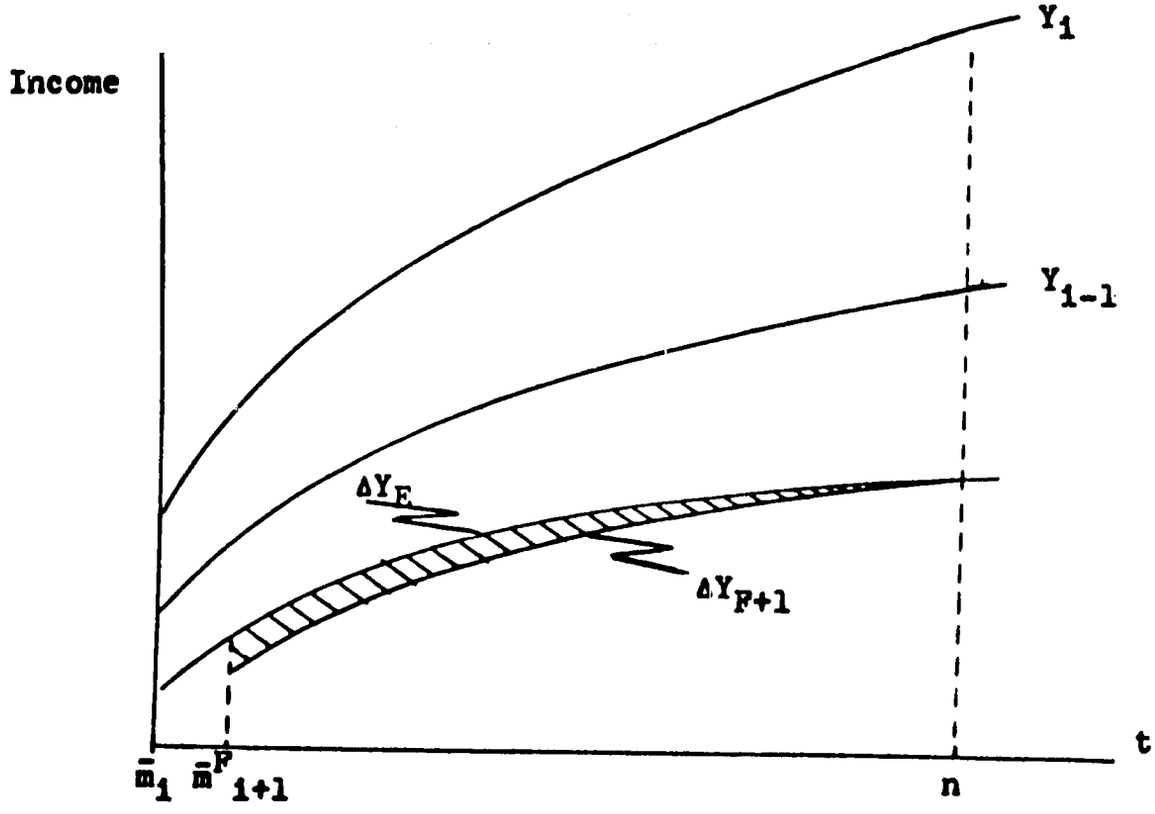
Equation (3) is strictly correct only if (1) failures in unit i + 1 are identical in all respects to those workers opting not to continue their education and (2) failures receive absolutely no knowledge which might influence their lifetime productivity path while unsuccessfully attempting unit i + 1. With these assumptions, the learning curve differentials ΔY_E and ΔY_{F+1} are identical except for their origins. These assumptions are strong and unrealistic since there are likely to be qualitative ability differences between workers E_i and F_{i+1}. Workers F_{i+1} attempt unit i + 1 because they have a higher subjective probability of completing the unit than do workers E_i. In other words, they are probably more able than their cohorts who enter the labor force immediately. To the extent that such ability differences exist, the earnings pattern Y_i represents an average and the difference $\Delta Y_E - \Delta Y_{F+1}$ will be smaller. It is also likely that productivity and earnings will be positively influenced even though a student is unsuccessful in school. Consequently, this experience loss may be again less acute that portrayed in Figure 1. Unfortunately, data for our case study require these assumptions; our adjustment for experience losses is likely to be too large.

(4) Adjusted internal rate of return:

$$\sum_{\bar{m}_i}^{n} \frac{\Delta Y_{i,t}}{(1+r)^t} - \sum^{\bar{m}_i} \frac{C_{i,t}}{(1+r)^t} + \sum_{\bar{m}_i}^{m'_{i+1}} \frac{\frac{F_{i+1,t}}{N_i} \cdot C_{i+1,t}}{(1+r)^t}$$

$$+ \frac{F_{i+1}}{N_i} \sum_{\bar{m}_{F_{i+1}}}^{n} \frac{\Delta Y_{E,t} - \Delta Y_{F+1,t}}{(1+r)^t} = 0$$

Figure 1: Lifetime Earnings Losses Due To Foregone Experience Accumulation



The first component of (4) represents the gross benefits of incremental education i during the average adjusted working period $t = \bar{m}_i^*$ to n. The second gives costs incurred during the adjusted educational period $\bar{m}_i^*$. The third and fourth elements are the prorated failure costs in unit i + 1 to unit i. In a sense, we may think of these latter elements as representing the costs of providing information to unsuccessful students during the screening process.

III. An Application of the Standard and Adjusted Approaches

The Ivory Coast has an educational system and a labor market that justify the use of the adjusted model. Failure rates are high and access to higher income streams is formally (in the case of government employment) or informally (private sector) contingent upon possessing the proper diploma. Furthermore, given occupational wage differentials, private returns to education appear to be large enough to induce students to remain in school until they obtain a university degree or fail along the way. Failure costs should be significant.

Data were available[2] to allow estimation of Equations (1) and (4) for four levels of secondary and university education and their corresponding occupational equivalents. The occupations are broadly classified as management, technicians[3], supervisors and skilled office labor. We used two sets of education-occupation equivalents. One generally corresponds to current educational requirements used by Ivorian manpower planners. The other is a somewhat more realistic and upgraded version likely to follow technological advance as the country further develops. These equivalents given below form the units for our analysis.

Occupation	Current	Upgraded
Management	University Degree	University Degree
Technicians	High School Diploma (7 yrs.)	Two Years College
Supervisors	Six Years High School	High School Diploma
Office Labor	Four Years High School	Four Years High School

From age-income data by occupation, we estimated income streams, foregone earnings and income losses from late starts in acquiring experience.

Budgetary information was available to estimate direct educational costs. Private costs were assumed to be zero since all education is free. Educational statistics were used to estimate failure, drop-out, and success probabilities. We defined the number of allowable failures, in any unit as two in non-consecutive years, a figure closely corresponding to rules of thumb used to determine scholarship eligibility.

Table 1 compares returns estimated using the standard and modified procedures. Columns 3 and 5 give private and social returns with a zero failure probability. These unadjusted estimates indicate the high pay-off to completion of secondary education, especially the units comprising the final three years (deuxiéme cycle). Unadjusted private returns to university education are lower but still attractive. Columns 4a - 4c and 6a - 6c report the modified results in three steps. First, the educational period was lengthened to allow for failures and repeats (4a, 6a). Then these calculations were adjusted for pro-rated failure costs in the next unit, (4b, 6b). Finally, we added on-the-job experience losses to arrive at the final adjusted estimates (4c, 6c). Estimates of private and social returns to university education only required adjustment for the longer educational period since we assume that the four year university diploma is the terminal degree. Therefore, our estimates overstate the true return to university education to the extent that we neglect the few students who continue beyond this level.

The final adjusted estimates lower the standard IRR estimates by as much as fifty percent. The most significant modification was the extension of the educational period. When failure and repeat possibilities were introduced, our estimates fell by at least twenty-five percent. This effect is most important for completion of secondary school under the current occupation-education equivalents (row 3) and is due mainly to a relatively small wage differential between supervisors and technicians[4] and a fairly high failure probability in the next unit (40 percent).

Screening costs in the next unit (foregone earnings and educational expenses) lowered educational returns, but by a smaller amount than the extension of the educational period. Their most noticeable effect is in the upper secondary levels (rows 2, 3, and 6) and again is caused by relatively high failure rates plus high foregone earnings.

Table 1: Standard and Adjusted Internal Rates of Return to Education in the Ivory Coast

(1)	(2)	(3)	Private Returns (4a)	(4b)	(4c)	(5)	Social Returns (6a)	(6b)	(6c)
ccupation	Incremental Years Education	Standard IRR	Standard with longer Educational Period	(4a) plus failure costs	(4a) plus Experience losses	Standard IRR	Standard with longer Educational Period	(6a) plus failure costs	(6b) plus Experience losses
					(Percent)				
urrent Occupation-ducation Equivalents									
) Office Labor	4 years secondary	30.9	23.9	21.4	19.5	15.5	12.1	10.8	9.8
) Supervisors	2 years secondary	72.2	44.0	36.7	35.8	52.8	33.0	27.5	26.8
) Technicians	1 year secondary	44.1	21.2	13.2	12.7	38.3	18.6	11.1	10.5
) Management	4 years university	9.0	6.6	6.6	6.6	6.1	3.9	3.9	3.9
pgraded Occupation-ducation Equivalents									
) Office Labor	4 years secondary	30.9	23.9	21.4	19.5	15.5	12.1	10.8	9.8
) Supervisors	3 years secondary	47.4	34.0	28.2	27.5	35.7	25.9	19.1	18.7
) Technicians	2 years univeristy	19.2	12.4	11.8	10.9	12.6	8.2	7.5	7.0
) Management	2 years university	17.1	11.8	11.8	11.8	12.6	6.6	6.6	6.6

The final modification for losses of on-the-job experience had an almost imperceptible influence. It lowered rates of return by at most one percentage point. We can conclude that, for this case study at least, foregone experience is not an important screening cost.

In general, the ranking of levels of education by degree of private attractiveness in the Ivory Coast contrasts rather sharply with results in other LDCs (e.g., Clark and Fong (1), Krueger (3)), although it corresponds to estimates in developed countries (e.g., Hanoch (2)). In most LDCs, returns to education continuously increase as the level of education rises. For the Ivory Coast, educational returns peak with completion of secondary school then fall rather precipitously for university education. The primary reason for the lower returns to university education here is a relatively small wage increment expected upon completion of a university program. This small differential represents an excess demand problem in the middle of the white-collar occupational hierarchy peculiar to the Ivory Coast and is due in part to the presence of expatriate labor. Historically, expatriates have been significantly represented in all four occupational groups studied here. In recent years, pressure to nationalize the labor force has eliminated most expatriates from the office labor category. This pressure is now being felt at the supervisory level and has created a wide wage differential between supervisory and office labor occupations that does not exist between higher levels. Technical and managerial personnel are still predominantly foreign (75 percent) and their wages are determined exogenously. That is, wages in these categories are those of the expatriate's home country plus a transfer premium. They do not reflect the shortage of highly skilled Ivorians. As Ivorization pressure moves up the occupational ladder, returns to higher education may increase or, alternatively, returns to secondary education may fall as the excess demand pressure is relieved.

IV. Summary

The procedure outlined in this note modifies the IRR methodology to account for educational failure and screening. When applied to the Ivory Coast, estimated educational returns fell by as much as fifty percent. These results suggest that (1) our modified methodology should be applied in other parts of the world with similar educational and labor market characteristics and (2) estimates not accounting for these factors should be viewed with caution, since they most likely exaggerate true educational returns.

FOOTNOTES

1. Anne O. Krueger (3) describes some empirical problems encountered in delivering these averages.

2. Data used here are described in further detail in Monson and Pursell (4).

3. The term technician is a translation of the French term cadre which describes occupations requiring at least a high school diploma (baccalauréat) with specialized training, e.g., computer programmers, accountants, etc.

4. Estimated annual starting wages were office labor - FCFA 444,900 ($1,900), supervisors - FCFA 1,390,600 ($6,000), technicians - FCFA 1,863,500 ($8,100), management - FCFA 2,132,700 ($9,300). The beginning wage differential between adjoining occupations are supervisor-office labor 213 percent, technician-supervisor 34 percent, management-technician 14 percent.

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