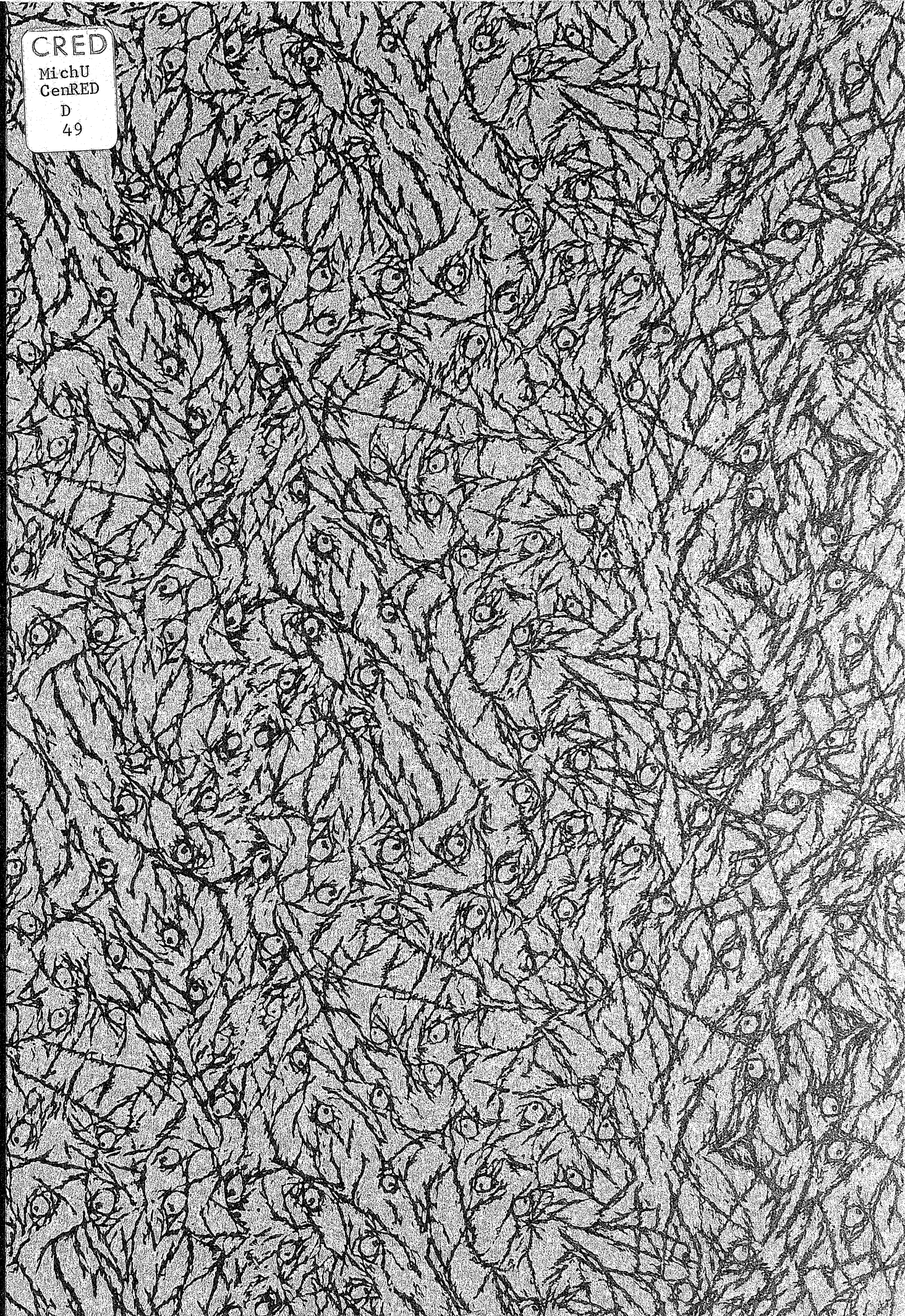An Evaluation of Expatriate Labor Replacement

in the Ivory Coast

by

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ABSTRACT

An Evaluation of Expatriate Labor Replacement

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This study addresses several problems of educational policy posed by the replacement of highly skilled expatriates in the Ivory Coast's labor force. Conceptualizing expatriate replacement as an import-substitution activity in which Ivorian labor substitutes for previously imported labor services, the authors apply a modified DRC analysis to evaluate Ivorian secondary and university educational programs necessary to train the local labor.

The results indicate that training for purposes of expatriate replacement is an economically desirable activity with most potential for gain being at the upper secondary and lower university levels.

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Cette étude porte sur plusieurs problèmes de politique scolaire posés par le remplacement des expatriés hautement qualifiés de la force ouvrière de la Côte d'Ivoire. En concevant le remplacement de la main-d'oeuvre importée, par la main-d'oeuvre ivoirienne,comme une activité de substitution des importations, les auteurs appliquent une analyse modifiée du DRC (Coût des Ressources Domestiques) pour évaluer les programmes ivoiriens d'éducation secondaire et universitaire nécessaire à la formation de la main-d'oeuvre locale.

Les résultats indiquent qu'une formation ayant pour but le remplacement d'expatriés est une activité économiquement désirable et que le plus important potentiel de profit se situe au niveau secondaire le plus haut et universitaire le plus bas.

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I. Introduction

The Ivory Coast is one of the few African countries that have
experienced sustained economic growth since independence. In the period
1960-1970, its compound annual growth rate of real income was seven
percent, industrial production grew at a rate of eleven percent per
annum, and exports more than tripled. This remarkable growth record was
based upon economic policies that, among other things, encouraged the
participation of foreign capital and labor in the development process.[1]
As a consequence of these liberal policies, the foreign presence has
become a pervasive element throughout the Ivorian economy. About 700,000
Africans from neighboring countries (mainly Upper Volta and Mali) provide
unskilled labor to family farms, to lumbering activities, to modern
plantations, and to the industrial sector.[2] Some sixty percent of the
unskilled jobs in the modern sector are held by these African migrants.[3]
Non-African capital and labor are also important. Foreign interests
own eighty-five percent of private industrial capital in the country.
Expatriate labor (mainly French) numbers about twenty thousand and
occupies seventy percent of the managerial and technical positions in the
modern sector labor force. Table 1 gives further information on the non-
African presence in the Ivory Coast.

This large foreign presence is not an anomaly to Africa. Migrant
Africans and foreign capital are commonly found throughout the continent

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[1]For "priority" firms meeting certain conditions, a liberal investment
code allows duty free import of intermediate goods for ten years and duty
free import of machinery and equipment. New firms are also exempted from
profit taxes for five years, and granted other less significant concessions.
Additionally, there are no exchange restrictions within the franc zone.
Profits and savings of foreign capital and labor can be freely repatriated.

[2]This estimate is conservative, being based upon 1965 data in Louis
Roussel, Côte d'Ivoire 1965 Population (Ministère du Plan, Abidjan, 1967),
p. 27. Probably the number of African migrants today considerably exceeds
700,000.

[3]SETEF, L'Image Base 1970: L'Emploi, Dossiers pour le Long Terme,
Elaboration d'un Scénario Référential du Développement Ivorien, (Paris, 1973),
pp. 81-84.

while expatriate labor is significant in most French speaking nations, and, to a lesser degree, in the English speaking ones as well. However, no other West African nation has such a large concentration of expatriate labor as does the Ivory Coast. This expatriate population represents potential social and economic problems for Ivorian policy makers. Trained Ivorians and expatriates will shortly begin to compete for employment as the Ivorian educational structure continues to expand and produce larger numbers of trained Ivorians. Eventually, the expatriates will have to be phased out. Ivorian policy makers project this replacement to begin in the 1980's and continue through the 1990's. This paper addresses several problems of educational policy posed by expatriate replacement.[1] In particular, it states the problem in terms of the training needed by Ivorians to replace the expatriate population, then poses the following questions: (1) By comparison with alternative resource allocations, is training of Ivorians for purposes of expatriate replacement economically desirable? (2) Are there differences in the economic desirability of expatriate replacement among occupations? (3) If so, do these differences indicate the manner in which educational resources should be allocated between secondary and university education? (4) Do social and private rates of return to education differ? and (5) If so, what conclusions can be drawn relating to governmental and individual contributions to educational finance?

We will primarily apply a modified DRC methodology to respond to these questions.[2] With this methodology, the process of expatriate replacement will be likened to an import-substitution activity in which previously imported labor services are replaced by locally produced (trained) Ivorian labor. At a later point, we will analyze this training for Ivorization using a more conventional internal rate of return approach.

From the application of these two methodologies, it will be seen that training for expatriate replacement is generally an economically desirable activity -- calculated DRC coefficients were quite low and internal rates

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[1] We do not intend to underestimate the importance of foreign capital and migrant Africans to the Ivorian economy. However, they present different problems than expatriate labor and should rightly be analyzed separately.

[2] The literature on DRCs has mushroomed in the past few years. Two seminal articles are: Anne O. Krueger, "Some Economic Costs of Exchange Control: The Turkish Case," JPE, (Oct. 1966), 75(5), pp. 466-480; Michael Bruno, "The Optimal Selection of Export-Promoting and Import-Substituting Projects," in Planning the External Sector: Techniques, Problems and Policies, (New York, United Nations, 1965).

Table 1: Some Indicators of Foreign Influence in the Ivory Coast

Labor	a.	Estimated expatriate labor force, 1972[1]	17,000
	b.	Expatriate wage bill/total industrial sector wage bill, 1970[2]	38.3%
	c.	Expatriate wage bill/value added in a sample of 22 manufacturing firms, 1971[3]	17.5%
	d.	Expatriate labor/total modern sector employment (including government), 1971[4]	8.5%
	e.	Expatriate managers/total management labor force, 1971[5]	76.8%
	f.	Expatriate technicians/total technician labor force, 1971[5]	74.8%
	g.	Expatriate supervisors/total supervisory labor force, 1971[5]	39.0%
	h.	Expatriate skilled office workers/total skilled office labor force, 1971[5]	15.3%
Capital	a.	Percentage foreign ownership of 100 largest firms, 1970[6]	83.8%
Aid	a.	Total foreign aid for current expenditures on goods and services, 1972[7]	$US 41 million
	b.	of which technical assistance personnel[7]	$US 24 million
Foreign Exchange	a.	Repatriated savings of expatriates, 1972[8]	$US 75 million
	b.	Repatriated profits from foreign direct investment, 1972[8]	$US 42 million
	c.	Repatriated savings and profits/total exports, 1972[8]	19.7%

Notes:

[1]Estimated using the 1970 number (15,980) and assuming a 500 per year increase in 1971-72. This value of 500 corresponds to the estimate given in Paul Cacheux and Yves Cologuegnes, L'Aide Aux Pays En Voie de Développement, (Faculté des Sciences Economiques, Université d'Abidjan, 1973), pp. 61-2.

[2]SETEF, L'Image Base 1970--Economie, Dossiers Pour le Long Terme, Elaboration d'un Scenario Référentiel du Développement Ivorien, (Paris, 1973), Annex Table A-30.

[3]Sample data taken from firm level data collected in conjunction with a World Bank research project on incentives in West Africa.

[4]Estimated modern sector employment taken from data in Ministère du Plan, Le Secteur Privé et Para-Public en Côte d'Ivoire, 1971: Resultat de l'Enquête Main d'Oeuvre, (Abidjan, 1972), and République de Côte d'Ivoire, Budget Général de Fonctionnement--Gestion 1971, (Abidjan, 1971).

[5]Ministère du Plan, Le Secteur Privé..., 3e Partie, "Tableaux Statistiques."

[6]SETEF, p. 18.

[7]Ministère des Finances et de l'Economie, La Balance des Paiements de la Côte d'Ivoire 1972, (Abidjan, 1974), pages 15-20, Tables VII and X.

[8]Ibid., Tables VI and IX.

of return high. When expatriate employment was classified more finely on
an occupational basis, it will be noted that replacement of expatriates
in some occupations offers distinctively greater potential for economic
gain than replacement in others. Educational expenditures in the Ivory
Coast will be seen to correspond to these distinctions. Finally, the
observed differences between social and private returns to education will
suggest that students should assume a greater burden of educational
finance.

In the next section, we briefly outline the reasons behind the growth
of the expatriate labor force in the Ivory Coast and provide some detail
on the occupational and educational requirements for their replacement.
The DRC and the internal rate of return measures then are applied to our
problems of evaluating training for Ivorization. Section IV presents and
discusses our results and a final section outlines the ramifications of
the analysis upon Ivorian educational and development policy. Annexes
B to E provide data and details of the calculations used in the text.

II. Non-African Participation in the Ivorian Economy.

A. Extent, Rationale, and Prospects. Table 1 describes the extent of
expatriate involvement in the Ivorian economy. In the early 1970's,
estimates of their participation in the modern sector labor force ranged
from seven to eight and one-half percent.[1] Most expatriates were
employed in managerial or technical positions but their representation
was still high in supervisory and skilled office work. Thanks to their
preponderance in the upper echelons of the occupational hierarchy, they
received more than one-third of the total wage bill in the private
manufacturing sector in spite of their relatively small numerical represen-
tation. Their average wage was significantly higher than that of Ivorians --

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[1]Information on the total number of expatriates is politically
sensitive and estimates must be based upon fragmentary evidence. In
addition, Ivorian labor force data are subject to error because of the
data-collection procedures utilized. All these considerations give some
indeterminancy to the estimates.

FCFA 1.8 million yearly versus FCFA 230,000 in 1971.[1] Even within the same occupations, expatriate salaries were approximately double those paid to Ivorians.[2]

In 1970, the expatriate working population was about sixteen thousand. Today, it probably numbers twenty thousand. This population represents a three fold increase over a 1961 estimate of seven thousand[3] or about a seven and one-half percent compounded annual rate of increase in the period 1961-1975. Their importance in the modern sector labor force has not declined since independence. In fact, during the period 1965-70, expatriate employment grew at a marginally faster rate than Ivorian employment in the modern sector (47.7 percent versus 46.8 percent).

The growth of the expatriate population was the consequence of a deliberate policy that recognized skill deficiencies in the Ivorian labor force at independence. At that time, the Ivory Coast did not possess a university, nor did it have extensive secondary or vocational education facilities. In 1961, there were only 11,000 secondary school students and 850 university students (studying abroad) and only 270 secondary school students received the equivalent of the American high school diploma that year.[4] These enrollments were very small in comparison to the Ivorian

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[1] Planning Ministry, Le Secteur Privé et Para-Public en Côte d'Ivoire, 1971, Resultats de l'Enquête Main d'Oeuvre, volume 2, Tables 26 and 28, Abidjan, 1973, and J. Chevassu and A. Valette, Note Sur la Repartition des Effectifs et des Salares dans le Secteur Moderne à Fin 1971, (ORSTOM, Centre de Petit Bassam, Abidjan, 1974), mimeo. Chevassu and Valette report higher average expatriate wages than the Planning Ministry study. In their sample, upper management received FCFA four million annually (25 percent larger than the Plan survey), technicians FCFA 3.1 million, supervisors FCFA 2.4 million and skilled office workers FCFA 1.5 million. Despite these differences, we will rely on the Planning Ministry survey as a data source for our estimates because of its wider coverage.

[2] Approximate wage differential based upon data in Enquête Main d'Oeuvre, volume 2, Tables 79 and 104 and Chevassu and Valette, op. cit., p.11.

[3] Authors' estimate based upon data in Ministère du Plan, Premiers Eléments Pour Une Africanisation de l'Emploi et de l'Economie, (Abidjan, n.d.), mimeo, République de Côte d'Ivoire, Budget Général de Fonctionnement, (various years, 1961-1970, Abidjan), and Cacheux and Cologuegnes, L'Aide Aux Pays en Voie de Développement.

[4] République de France, Secretariat d'Etat Pour les Affaires Etrangères, Structures et Statistiques de L'Enseignement Pour 14 Etats Africains et Malagaches, Volume 1, "Tableaux d'Ensemble Par Etat 1951-1970,"(Paris, 1970).

15-24 year old population of about 700,000 in 1961.[1] Moreover, during the decade prior to independence, only 965 students graduated from secondary school. In view of these educational deficiencies, Ivorian policy makers realized that development could be pursued only through the utilization of foreign qualified labor. Eventually it was hoped that massive expenditure upon education would overcome these manpower deficiencies.[2] In the interim, as the educational system was expanding, imported skilled labor was essential to the Ivory Coast's economic development.

High wages and benefits must be paid to induce expatriates to come to the Ivory Coast to work in either the private or public sector. The Ivorian labor code legislates an indemnity for all expatriates recruited abroad equal to 40 percent of their home country salary. They are given transport for themselves and their families to and from their home country once a year, and receive five days of paid vacation per month of service (versus two days per month for Africans).[3] It is also common practice for firms to provide housing either directly in company-owned residences or indirectly through rent subsidies. Other miscellaneous benefits directly or indirectly received by the expatriate (pensions, social insurance, etc.) increase the wage bill further.[4] A typical expatriate probably can expect to receive, directly or indirectly, an income of at least twice, if not three times that which he would have earned in France.

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[1]Estimated from data in Louis Roussel, Côte d'Ivoire 1965: Population.

[2]Ivorian education expenditures rose from 3.9 to 5.3 percent of GDP between 1960 and 1970. They now comprise one-third of the government's current budget. Educational investment expenditure is about seven percent of the capital budget. Foreign aid, capital and current, is twenty percent of total educational expenditure. République de Côte d'Ivoire, Budget Général de Fonctionnement, various years, Ministère du Plan, Loi-Programme des Investissement Publics Pour les Années 1973-1974-1975.

[3]For details, see Association Interprofessionnelle de la Côte d'Ivoire, Memento de la Legislation du Travail, (Abidjan, n.d.), Chambre d'Industrie de Côte d'Ivoire, Code du Travail, (Abidjan, n.d.).

[4]A convenient rule of thumb is that expatriate fringe benefits are 100 percent of his salary. For an African, they are 40 percent. Bureau du Développement Industriel, Coût des Facteurs en Côte d'Ivoire, (Abidjan, 1974).

Despite their high cost, the Ivorian dependence upon expatriate workers is expected to continue through 1970s, although their importance may fall over time. Ivorian policy recognizes this continued need.

"Obviously, we cannot maintain a rhythm of development slower than that of the past few years simply to limit the expatriate presence to its current level. That would signify the abandonment of our principal economic objective -- take-off. . . ."[1]

The 1971-75 Development Plan estimates that the rate of expatriate population increase will slow over the 1970s.[2] By 1980, the educational system is programmed to be producing sufficiently large numbers of trained students to allow Ivorians to fill new positions opened by economic growth, as well as to begin the replacement of the existing stock of expatriate labor. But even then, the replacement process will be slow in order to avoid abrupt adjustments in educational programs once replacement is achieved.[3] According to this scenario, expatriate labor will remain a fixture in the Ivorian economy for another ten to twenty years.

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[1] Ministère du Plan, _Programme de Développement d l'Education et de la Formation: 1971-1975_, (Abidjan, 1969), p. 3, authors' translation.

[2] Ministère du Plan, _Plan Quinquennal de Développement Economique, Social, et Culturel, 1971-1975_, (Abidjan, 1971), p. 410, predicts an increase of 3,400 expatriates in upper and middle management jobs during the period 1971-1980.

[3] Louis Goreux has used an elaborate programming model of education and employment in the Ivory Coast to demonstrate that rapid growth in educational facilities in order to quickly replace all expatriates could result in a massive discontinuity in enrollments. The problem hinges around the existing stock of expatriate labor and the capacity of the Ivorian economy to absorb additional qualified Ivorians once replacement of the expatriate stock has occurred. If enrollments and production of the educational system were to increase rapidly in order to replace the expatriates quickly, it is possible that enrollments would have to be drastically cut back once replacement occurs. If not, there would be a likelihood of unemployment of highly skilled labor. This discontinuous enrollment pattern with its implied unemployment problem is obviously not a politically feasible solution. Instead, in Goreux's model, replacement occurs more slowly so that once the expatriates are completely eliminated, the economy will have developed to the extent that its labor absorptive capacities equal educational output. The gradual approach to expatriate replacement practiced by the Ivory Coast reinforces one's feeling that this model is accepted by Ivorian planners. Louis Goreux, "A Programming Model of Education in the Ivory Coast," draft working paper, (I.B.R.D., Washington, 1974), mimeo.

B. Occupational and Educational Requirements of Expatriate Replacement.
Replacement of the non-African work force, already begun in some occupations,
will accelerate in the 1980s as larger numbers of Ivorians are educated.
From Table 1, it is apparent that significant opportunities for replacement
are available in only four broad occupational groups: management,
technicians,[1] supervisors, and skilled office labor. Of these four groups,
the absence of Ivorians at the highest levels is most noticeable. Some
replacement has occurred in the two lower levels, but there has been no
appreciable change in the percentage representation of expatriates in
managerial and technical levels during the 1960s and early 1970s.[2]

In the Ivorian labor market, there is, in principle, a high degree of
correspondence between occupations and educational levels. Knowing these
occupation-educational relationships, Ivorian educational planners attempt
to control entry and channel students along vocational or general education
paths dictated by projections of future manpower demand. In principle
then, these relationships can be used to determine training needs for
purposes of replacement.[3] We postulate two different occupation-education
equivalencies.

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[1]The term "technician" is used here in the broader French sense to
include all employees with specialized training, e.g., accountants.

[2]SETEF, L'Image Base 1970: L'Emploi, Dossiers Pour le Long Terme,
Elaboration d'un Scénario Référentiel du Développement Ivoirien, pp.81-84.

[3]The Ivorian educational system in which our local replacements are
trained consists of compulsory primary education through six grades, then
a controlled-entry secondary school and university program. Ivorian general
secondary education is modeled after the French system. It is separated
into a four-grade segment (premier cycle), followed by a three-grade
terminal program (deuxième cycle). A diploma is awarded at the completion
of both the premier cycle (brevet d'études premier cycle), and the deuxième
cycle (baccalauréat). At the beginning of the second cycle, students
face a bewildering series of educational options. They may continue in
secondary general education towards the baccalauréat or move into long or
short cycles in vocational, agricultural, or teacher training programs.

	Hypothesis One	Hypothesis Two
Management	Secondary and University diplomas	Secondary and University diplomas
Technicians	Secondary diploma	Secondary diploma plus two years University
Supervisors	Six years secondary	Secondary diploma
Skilled Office Labor	Four years secondary	Four years secondary

The first hypothesis approximately corresponds to Ivorian educational planning guidelines.[1] Hypothesis two is a slightly upgraded relationship that probably better indicates increased educational requirements likely to occur as improved technology is made available to the Ivory Coast over the next twenty years.[2] These two relationships represent the training programs to be analyzed in our discussion of expatriate removal in the remainder of this paper.

III. DRCs and IRR Models to Evaluate Expatriate Replacement.

A. Introduction. In this section we will present two methods of evaluating the educational programs for Ivorization given by the occupation-education hypotheses of Section II above. Most of our efforts will be expended upon discussion of the DRC model since its novel uses here should be carefully detailed. This measure then will be contrasted with an internal rate of return (IRR) methodology. However, the standard IRR model which calculates private and social profitabilities of education will be modified slightly here to make it more comparable to the DRC model. Rather than solving for the internal rate of return, we will formulate it as a cost-benefit model of training.

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[1] Ministère du Plan, Programme de Développement de l'Education et de la Formation 1971-75, passim.

[2] It should be noted that these relationships are not always strictly observed in practice. In 1971, only 31 percent of workers in the upper management occupational category had ten or more years of post-primary education. For middle management, the same value was 38 percent (Enquête Main d'Oeuvre -- 1971, volume 2, page 39). We shall retain our hypotheses in spite of this lack of correspondence between them and the actual 1971 educational distribution. Casual observation suggests that they correctly represent the educational level of the expatriate population.

The two methods approach the problem of Ivorization in slightly different manners. As commonly applied, DRCs evaluate existing or planned economic activities under conditions in which foreign exchange is a constraint upon economic development.[1] Calculated DRC coefficients indicate relative efficiencies of alternative foreign exchange producing activities and isolate areas in which a country's comparative advantage may lie, given the existence of distortions between international and domestic rates of transformation implied by the foreign exchange constraint. Activities can be ranked without the introduction of a shadow exchange rate. With the IRR method, however, the ranking of activities depends upon the value of the shadow exchange rate.[2]

Before turning to the details of these two models, several further general comments are in order. We conceptualize expatriate labor replacement as an import-substitution activity. The product to be replaced is an imported flow of expatriate labor services. The replacement is a similar flow of Ivorian labor. The import-substitution activity to be analyzed is the educational process that provides the Ivorian labor with the training necessary to be able to replace expatriates. Costs and returns of this activity will accrue over two periods of time -- the training period and the period in which replacement occurs. Conceptualized in this manner, DRCs are as applicable to this educational process as to industrial or

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[1]Foreign exchange problems have not been troublesome in the Ivory Coast but they are projected to occur in the future. The Ivory Coast is included on the United Nations Emergency Operation's list of countries "Most Seriously Affected" by recent world economic developments. Essentially this classification means that the country has a per capita income of less than $US 400 and that its projected balance of payments deficit for 1974 and 1975 will not be smaller than five percent of imports, "Economic Problems Worsening for 'Most Seriously Affected'," IMF Survey, Volume 4, No. 8 (April 28, 1975, Washington, D.C.), pp. 117 and 121-122. Furthermore the Ivorian external public debt and its debt service both increased at an annual compounded rate of eighteen percent between 1965 and 1973. Of 22 middle income countries, it ranked third in per capita loan commitments, per capita debt service, and per capita outstanding debt. I.B.R.D., World Debt Tables External Public Debt of LDCs, publication EC-167/74, (Washington, D.C.), Tables 1b and 5e.

[2]Deepak Lal, Methods of Project Analysis: A Review, World Bank Occasional Staff Papers Number 16, (Johns Hopkins University Press, Baltimore, 1974), provides a succinct summary and comparison of the two methods.

agricultural activities.[1]

Our analysis of this Ivorization process is marginal in nature in the sense that we focus upon evaluation of the replacement of a marginal unit of expatriate labor services, given the current occupational and educational structure of the Ivory Coast.[2] This approach implies that we analyze the educational requirements needed to replace one expatriate in each occupation. However, for various reasons, more than one Ivorian may need to be trained to replace one expatriate. Our discussion must then be framed in terms of expatriate equivalents. Our method of determining these equivalencies is outlined in section C below.

Finally, our analysis excludes all possibilities of external effects and income distribution considerations. These factors certainly must be important in the Ivorian case but data were simply not available to be able to include them in our models.

B. A DRC Model of Expatriate Replacement. As stated earlier, DRCs are commonly applied to evaluate alternative economic activities under conditions of foreign exchange scarcity. For our problem, we may think of the DRC coefficient as a cost-benefit ratio. The denominator will measure net marginal units of foreign exchange saved per expatriate replaced. The numerator will measure the net opportunity costs of domestic resources expended in training an Ivorian to replace the expatriate. The term "net" is important to this description of our DRC coefficients. Both costs and benefits of Ivorization consist of domestic resource and foreign exchange

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[1] Since this paper is a by-product of a World Bank research project that measured DRC coefficients in other sectors of the Ivorian economy, we will be able to compare our results to those of other foreign exchange saving or producing activities and thus obtain a relative ranking of resource allocations at the margin to education, industry, and agriculture.

[2] Because of its marginal nature, the model cannot identify structural changes resulting from education nor can it provide a composite view of the educational process. For these purposes it would be necessary to use our model in conjunction with a more dynamic model such as that of Goreux mentioned earlier. An example of a major problem that could be treated with a dynamic model, but not with ours, is the possibility that production of the proper combination of Ivorians for the more skilled occupations may result in over-production at lower levels due to the form of the educational pyramid.

elements. These elements first are separated, then assigned either to the numerator (domestic resources) or the denominator (foreign exchange). Thus, domestic resource benefits are netted from domestic resource costs in the numerator and foreign exchange costs are netted from foreign exchange benefits in the denominator.

To see this process more clearly, consider the benefits first. Ivorization implies that income previously paid to expatriates is diverted to Ivorians. Since we may assume that expatriate labor is similar to any other tradeable (and in this case imported) input, the benefits of the import substitution activity of Ivorization consist of this diverted income. However, as opposed to a tradeable physical input, imported labor services are paid for in both foreign exchange and domestic resources. Therefore, this benefit must be separated into these two elements, one entering the numerator, the other the denominator.

The foreign exchange element entering the denominator consists of S_t, the expatriate's savings,[1] plus M_t, his expenditure on fully traded goods (valued in border prices)[2] and his direct spending outside the Ivory Coast.[3] The domestic resource element of this diverted income, D_t, is the return to domestic factors of production included in the value of non-traded goods and services consumed by the expatriate. These domestic resource costs are subtracted from the numerator. The tax component of the replaced expatriate's income (income taxes, import duties and consumption taxes) are not included in this analysis. Taxes are not a cost from the Ivorian point of view. Hence, no corresponding tax benefit results when the expatriate is replaced by an Ivorian.[4]

On the cost side, we separate costs into those incurred during the training and the replacement periods. During training, the direct costs

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[1] Since no capital controls exist between France, the source of most expatriate labor, and the Ivory Coast, it can be assumed that all savings are or could be repatriated.

[2] Including the border value of the tradeable component of expenditure on non-traded goods and services.

[3] Includes spending on vacations in the home country and indirect income payments abroad (pensions, transport, etc.).

[4] Note that we consider the spending and savings of the expatriate as a cost to the Ivorian economy rather than treating his income as an opportunity cost in the sense of output foregone. However, the spending and savings of Ivorian replacements are not considered as costs since the purpose of the cost-benefit analysis is to maximize Ivorian income.

consist of C_t, domestic resources (land, labor, and capital), and FX_t, foreign exchange (imported labor services,[1] traded goods, etc.). Indirect costs are E_t, alternative earnings foregone by the Ivorian during the training program. All these costs incurred during training are defined as costs per successful student.[2]

During the replacement period, there is only one cost. This is the income earned by the Ivorian had he not been trained and had he not replaced the expatriate. The value of the opportunity cost of these alternative earnings is denoted by A_t. We must include this cost in our analysis since we utilize the total income diverted from an expatriate to an Ivorian as a benefit of replacement. To keep our analysis consistent, we include as cost not only the costs incurred during the training but also the Ivorian's expected total income in alternative employment if he were not trained.

The domestic resource costs, C_t, E_t, and A_t, are added to the numerator of our DRC ratio while the foreign exchange cost, FX_t, is subtracted from the denominator. Therefore our numerator represents the domestic resource component of costs from which D_t, domestic resource benefits are netted out. The denominator consists of $M_t + S_t$, the foreign exchange portion of income formerly paid expatriates, minus FX_t, the foreign exchange costs of training the local replacement.

These concepts are summarized in Equation (1) below in which costs and benefits are discounted over the training period ($t = 1, \ldots, m$), and the replacement period ($t = m+1, \ldots, n$).

$$(1) \qquad DRC_j = \frac{\displaystyle\sum_{1}^{m} \frac{C_t + E_t}{(1+i)^t} + \sum_{m+1}^{n} \frac{A_t}{(1+i)^t} - \sum_{m+1}^{n} \frac{D_t}{(1+i)^t}}{\displaystyle\sum_{m+1}^{n} \frac{M_t + S_t}{(1+i)^t} - \sum_{1}^{m} \frac{FX_t}{(1+i)^t}}$$

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[1] These costs are especially significant in the Ivory Coast where ninety percent of the post-primary school system is staffed by expatriate personnel.

[2] Since dropout and failure rates in the Ivory Coast are high and since we are concerned with costs of successfully training an Ivorian to replace an expatriate, we must adjust our training costs to represent costs per successful student rather than costs per student. This adjustment is explained in Annex B.

Where: DRC_j: Estimated DRC coefficient for expatriate replacement in the jth occupation.

C_t: Sum of domestic resource training costs per successful trainee in time t.

E_t: Foregone earnings per successful trainee in time t.

A_t: Alternative earnings per Ivorian replacement in time t.

D_t: Expenditure on domestic resources per expatriate in time t.

S_t: Savings per expatriate replaced in time t.

M_t: Expenditure on tradeables in border prices per expatriate in time t.

FX_t: Foreign exchange training costs per successful trainee in time t.

i: Discount rate.

t = 1, . . ., m (educational period), m+1, . . ., n (working lifetime until retirement).

C. Ivorian and Expatriate Equivalents. Equation (1) is formulated on the assumption that one trained Ivorian can replace one expatriate worker. This assumption may not be justified. Salary and wage differentials on the order of two to one exist between Ivorians and Europeans in all occupational categories.[1] Probably socio-cultural factors entering hiring decisions account for some of these differentials. More likely they are caused by real productivity differences due to higher levels of experience of the expatriate labor force.[2] Ivorian firms have a choice of hiring a trained, but not experienced, Ivorian or a stream of renewable experienced expatriate labor services. Over his working lifetime the Ivorian will have a productivity represented by the area under his learning curve represented by Equation (2).

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[1] Enquête Main d'Oeuvre -- 1971, Volume 2, Tables 79 and 104.

[2] Because of the recent establishment of the Ivorian educational structure and the long gestation period of training, most Ivorians working in skilled occupations are relatively inexperienced in comparison to their expatriate counterparts.

$$(2) \qquad W_I = \int_{m+1}^{n} W_{m+1} t^{\alpha} dt$$

In the same period of time, a renewable stream of experienced expatriate labor services could be hired at a constant wage, W_e.[1] A comparison of the Ivorian's lifetime productivity to that of the expatriate labor stream will provide us with an equivalency ratio giving the number of Ivorians needed to be trained to replace one unit of this expatriate labor stream. Equation (3) defines this ratio while Figure 1 demonstrates these different concepts.

$$(3) \qquad R = \frac{W_e(n-(m+1))}{\int_{m+1}^{n} W_{m+1} t^{\alpha} dt}$$

Figure 1: <u>Lifetime Productivities: An Ivorian and an Expatriate Labor Stream</u>
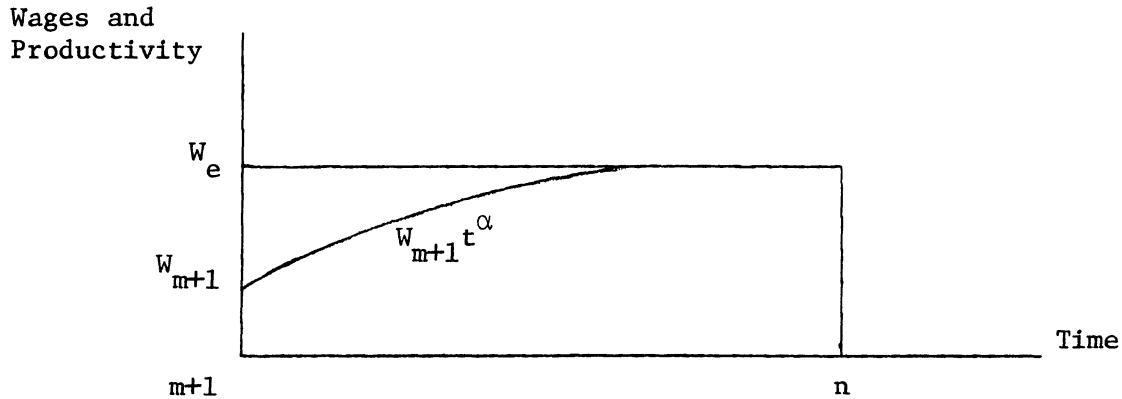
This equivalency ratio, R, is then applied to Equation (1) to obtain an expression giving the DRC coefficient for training R Ivorians to replace one expatriate. Equation (4) incorporates this measure. Note that only the "costs" are multiplied by R since more than one Ivorian now needs to be trained. The "benefits" remain unchanged; only one expatriate is replaced.

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[1]Our analysis is simplified by the assumption of a constant expatriate wage. Obviously, there will be some learning-by-doing as expatriates accustom themselves to working in an African context. Their wages should rise over time also. A more exacting analysis would have adjusted for this consideration. Unfortunately, our data do not permit this refinement.

$$(4) \quad DRC_j = \frac{R \left(\sum_{1}^{m} \frac{C_t + E_t}{(1+i)^t} + \sum_{m+1}^{n} \frac{A_t}{(1+i)^t} \right) - \sum_{m+i}^{n} \frac{D_t}{(1+i)^t}}{\sum_{m+1}^{n} \frac{S_t + M_t}{(1+i)^t} - R \left(\sum_{1}^{m} \frac{FX_t}{(1+i)^t} \right)}$$

DRC coefficients calculated from Equation (4) should be interpreted as giving the cost in domestic resources per unit of foreign exchange saved in the replacement of a marginal unit of expatriate labor in each occupation. When this ratio is less than one, replacement is an efficient import-substitution activity at the official exchange rate. That is, it is less expensive to produce a worker locally than to import an expatriate laborer. If the exchange rate is overvalued the DRC coefficient would be divided by the ratio of the shadow to the official exchange rate, and would have the same interpretation.

D. A Cost-Benefit Model of Expatriate Replacement. The standard method of evaluating training programs is to calculate their internal rates of return. It is not necessary here to dwell upon the utilization of this methodology; one can find many examples of its use in the well-developed human capital literature on training and education.[1] For our problem, the benefit of training is the lifetime earnings stream expected following training. Costs are all direct training costs, C_t and FX_t, alternative earnings during the training period, E_t, plus alternative earnings had the Ivorians not been trained.

An expression equating these costs and benefits is solved for the internal rate of return, which is then compared to the accounting rate of interest to determine the social profitability of each training unit. The analysis can be restated in terms of the ratio of costs and benefits, which is used in conjunction with the decision rule that investment in training is socially profitable as long as the ratio of costs to benefits is less than one.

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[1]For a bibliography, see W. D. Wood and H. F. Campbell, Cost-Benefit Analysis and the Economics of Investment in Human Resources -- An Annotated Bibliography, Industrial Relations Centre, Bibliography Series Number 5, (Queen's University, Kingston, Ontario, 1970).

As in all social cost-benefit calculations costs and benefits should be valued in terms of a set of shadow prices. For a developing country the most important shadow price is often that of foriegn exchange, as this is frequently the most distorted price. Assuming both foreign exchange costs and benefits (the latter in the form of expatriate replacement) the cost-benefit ratio ($SCBT_j$) can be formulated in an analagous manner to the DRC coefficient considered above (equation 5).

$$(5) \quad SCBT_j = \frac{R \left(\sum\limits_{1}^{m} \frac{C_t + E_t}{(1+i)^t} + \sum\limits_{m+1}^{n} \frac{A_t}{(1+i)^t} + S\sum\limits_{1}^{m} \frac{FX_t}{(1+i)^t} \right)}{\sum\limits_{m+1}^{n} \frac{D_t}{(1+i)^t} + S\sum\limits_{m+1}^{n} \frac{S_t + M_t}{(1+i)^t}}$$

where S is the ratio of the shadow to the official exchange rate.

The discounted costs in the numerator of this expression are (per Ivorian) respectively domestic resource training costs, foregone earnings during train-ing, alternative earnings in the absence of training and the foreign exchange costs of training. Foreign exchange is valued at the shadow rather than the official rate by multiplying by the coefficient of the foreign exchange premium, S. All these costs are multiplied by the number of Ivorians needed to replace an expatriate, R.

The denominator expresses the discounted benefits on the assumption that expatriate salaries are equal to their marginal productivity, and are (respec-tively) expatriate consumption of non-traded goods and services, expatriate saving and expatriate expenditure on fully traded goods at border prices.

It will be noted that not all of the total expatriate income is included in the benefits, as the tax component is omitted. The reason for this is that-- as pointed out above--taxes on the expatriates' income and consumption are not a cost to the Ivorian economy, so that the economy gains from the import of expatriate labor by paying a price in terms of domestic resources and foreign exchange, which is less than that labor's marginal productivity. When the im-ported expatriate labor is replaced, this gain is lost, and so must be deducted from the benefits.

When costs are equal to benefits for the chosen discount rate and foreign exchange premium, $SCBT_j = DRC_j = 1$. Both ratios can be used with the decision

rule that investment in training is socially profitable when the coeffi-
cients are less than one. This rule also corresponds to the rule that the
investment is socially profitable when the internal rate of return exceeds
the discount rate.[1] The relationship between the three indicators is
discussed in Annex A.

Since in the DRC coefficient domestic benefits are deducted in the
numerator, and foreign exchange costs are deducted from foreign exchange
benefits in the denominator, it is possible that either the numerator or
denominator (or both) may be negative. In this study it will be seen that
while net foreign exchange earnings are always positive, there are a number
of cases in which the domestic resource benefits (foregone expatriate
consumption of domestic services and non-tradeables) exceed domestic costs.
In these cases the appropriate ranking is in descending order of the absolute
value of the negative coefficients, followed by the positive coefficients
in ascending order.

While the DRC and the social cost-benefit ratio give the same decision
rules for given values of the shadow exchange rate and the discount rate,
they do not necessarily provide the same ranking. The reason is that they
are concerned with two different (although related) questions. Whereas the
cost-benefit ratio evaluates activities when the object is to minimize the
present value of a stream of costs in relation to the present value of a
stream of benefits, the DRC evaluates these activities when the object is
to minimize discounted net domestic costs in relation to a discounted stream
of net foreign exchange earnings. Because of the netting of domestic
benefits from costs in the numerator and of foreign exchange costs from
benefits in the denominator of the DRC coefficient, an activity may be
exceptionally efficient at earning foreign exchange and yet may rank lower
in terms of the benefits received for a marginal cost outlay, or the opposite
may be the case.

While this difference may appear to introduce some ambiguity into the
evaluation of activities by the two methods, it should be recalled that for
a given discount rate and shadow price for foreign exchange, both coefficients
give the same decision rule. Thus rankings of activities with DRC and

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[1]As pointed out by Bruno in a general context. Michael Bruno, "Domestic
Resource Costs and Effective Protection: Clarification and Synthesis",
Journal of Political Economy, Vol. 80 No. 1. January (February, 1972).

cost-benefit coefficients of less than unity really indicate priorities to be given to expansion at the margin, since if the shadow prices are correct all these activities should be undertaken. Conversely a ranking of activities with coefficients in excess of unity gives an indication of priorities for contraction. It should also be emphasized once again that these priorities relate to marginal changes only; otherwise, if the level of all activities could be expanded or contracted indefinitely the shadow prices would alter, thus changing the cost-benefit and DRC coefficients and the sets of activities falling within the accept and reject regions.

In the Ivory Coast private and social returns to training differ since education is provided freely to students accepted in the various educational programs. An approximate expression for the private returns to education (denoted as $PCBT_j$) can be obtained by removing the variables C_t and FX_t from the numerator of equation (5) and adding a component T_t to the benefits in the denominator (equation (6)). T_t represents the indirect tax component of the replaced expatriates' income. This adjustment is made on the assumption that the individual disregards indirect taxes on his consumption when evaluating increases in his income, but allows for direct taxes which reduce his disposable income. Since direct (i.e., income taxes) in the Ivory Coast are zero or negligible on the low incomes which would be earned in the absence of training, E_t and A_t can be taken as approximately equal to disposable incomes and no adjustment to them is necessary.[1]

$$(6) \qquad PCBT_j = \frac{R \left(\sum\limits_{1}^{m} \dfrac{E_t}{(1+i)^t} \quad \sum\limits_{m+1}^{n} \dfrac{A_t}{(1+i)^t} \right)}{\sum\limits_{m+1}^{n} \dfrac{D_t + S_t + M_t + T_t}{(1+i)^t}}$$

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[1] We recognize that the private money rate of return to education calculated in this way may not accurately reflect individual evaluations due to differences between individual discount rates and the social rate employed and to the possibility that individual utility is not a linear function of income. However, our purpose is merely to show the large excess of the private money return over the social return to training. We do not believe that plausible alternative assumptions concerning individual utility functions would greatly alter our broad conclusions.

As formulated above, the cost-benefit method closely resembles the DRC measure. However, it has a broader applicability and could be used to evaluate programs in which foreign exchange costs and benefits do not appear or are of only minor importance. The DRC measure, on the other hand, concentrates attention on foreign exchange as a development constraint, and has the advantage of allowing comparisons with DRC cross section studies of industry, agriculture and other sectors. While in principle these DRC coefficients could be reformulated as cost-benefit coefficients or internal rates of return, in practice this may not be feasible.[1] As pointed out above, the ranking of activities by their DRC coefficients also has the advantage that no estimate need be made of the shadow exchange rate.

E. <u>Summary</u>. These two methods will be applied to the four occupations in which Ivorization is to occur. Each occupation will be analyzed under our two occupation-education hypotheses and under two assumptions relating to the continuation of foreign aid to education. For the latter point, we first assume that marginal increments of educational effort are financed by Ivorian resources, then we take the pattern of educational aid as given and assume its continuation. Each of these measures will be calculated at three different discount rates -- 5, 11, and 17 percent, although we believe the central value of 11 percent to be most plausible.[2] The results of these calculations are given below. Details on the calculations are found in Annexes C - E.

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[1]For most existing DRC cross section studies, access to the original data would be necessary.

[2]This rate is the central value of an estimate of a shadow discount rate in the Ivory Coast based upon 1971 data. The range was eight to fourteen percent. Garry Pursell, "Notes on the Shadow Discount Rate for the Ivory Coast," project working paper, (I.B.R.D., Washington, D.C., December 1974). pp. 53-57.

IV. Results

A. Estimates of Variables Included in our Evaluation Measures.

1. The Equivalency Ratio: This ratio compares an Ivorian's life-
time productivity to that of an experienced expatriate in the same time span.
It was calculated by first estimating time streams of income and comparing
these streams to the average wage paid expatriates in each occupation over the
same time period. The data used to estimate income streams were found in the
Ivorian Planning Ministry's 1971 labor force survey.[1] Our estimates will err
somewhat since these data gave average yearly wages by length of service in
the enterprise and did not include prior experience.

Regression techniques were applied to these data to estimate equation (7)
below:

$$(7) \qquad W_t = W_{m+1} t^{\alpha} \qquad \text{or} \qquad \ell n W_t = \ell n W_{m+1} + \alpha \ell n t$$

We were unable to estimate equation (7) for supervisory personnel due to
perverse data. For that occupation, less experienced workers received higher
wages than more experienced labor. Probably educational differences of in-
experienced and experienced labor in this category explain this phenomenon.[2]
Income streams for supervisors were estimated instead from weighted averages
of parameters for skilled office labor and technicians. The weights were
based upon average school leaving age differences.

The equivalency ratios were calculated upon the assumption that the max-
imum Ivorian wage is that of an experienced expatriate and that the Ivorian
working lifetime is 42 years minus the time spent in secondary school.[3] The
two income streams were compared over the period in which the Ivorian actually
replaced the expatriate, i.e., the Ivorian's working lifetime. Table 2 reports
our estimated income stream equations and equivalency ratios under both edu-
cation-occupation hypotheses.

2. Direct Training Costs: We estimated the variables C_t and FX_t, direct
domestic resource and foreign exchange educational cost per successful student
in two steps. First, average educational costs per student were determined
and decomposed into their foreign exchange, domestic resource, and tax elements

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[1] L'Enquête Main d'Oeuvre--1971, Vol. 2, pp. 135 and 162.

[2] Unfortunately, data were not available to isolate the effects of educational
levels upon incomes within an occupation.

[3] Official retirement age is 55 and the average secondary school entry age
is thirteen.

Table 2: Elements of the Equivalency Ratio Estimates

A. Income Streams (FCFA Thousands)

1. Management $W_t = 2132.7t^{.17461}$ $r^2 = .724$
                                                    $t = 2.808$

2. Technicians $W_t = 1863.5t^{.07623}$ $r^2 = .531$
                                                    $t - 2.128$

3. Supervisors: Hypothesis 1 $W_t = 1390.6t^{.06550}$

                 Hypothesis 2 $W_t = 1304.7t^{.05673}$

4. Office Workers $W_t = 444.9t^{.04403}$ $r^2 = .594$
                                                    $t - 2.422$

B. Equivalency Ratios

	Time Required to Reach Mean Expatriate Income	Ivorian Total Income[1] (FCFA Millions)		Expatriate Income[2] (FCFA Millions)		Equivalency Ratios	
		H_1	H_2	H_1	H_2	H_1	H_2
1. Management	5.81	80.735	80.445	83.259	82.969	1.031	1.031
2. Technicians	19.43	75.148	68.839	78.362	72.054	1.043	1.047
3. Supervisors	never	58.374	50.176	66.313	63.602	1.136	1.267
4. Office Workers	never	32.813	32.813	45.322	45.322	1.381	1.381

[1]From evaluation of $\int_{m+1}^{n} W_{m+1} t^{\alpha} dt$ where n is the Ivorian's working lifetime with the exception that the maximum yearly income received is no larger than the average expatriate income. After that point in time, expatriate and Ivorian incomes are equal. The time period at which incomes equalize is given in the first column.

[2]Average expatriate yearly income multiplied by the Ivorian's working lifetime. There averages are: management FCFA 2,900,000; technicians FCFA 2,336,388; supervisors FCFA 1,909,388; office workers FCFA 1,221,300.

following the procedure outlined in Annex C. Then we discounted these costs
and applied probabilities of success and failure to obtain discounted values
of costs per <u>successful</u> student in each educational unit. Annex B explains
this procedure in greater detail.

The first step—estimation and decomposition of average educational costs
was done in three stages: (1) Data collected on average educational costs
were separated into charges attributable to personnel, non-tradeable and trade-
able inputs, and amortization; (2) we then decomposed these charges into their
domestic resource, foreign exchange and tax elements[1] and, (3) since foreign
aid is important to Ivorian educational finance, we isolated aid contributions
to each element. Table 3 reports the results of this procedure.

Because of the importance of foreign aid, we calculated two versions of
FX_t: one assumes the continuation of the present pattern of aid; the other
assumes that Ivorian resources would finance marginal increments in educational
effort. The need for these two measures is apparent from the data of Table 3.
In secondary education, ninety percent of the teaching staff is expatriate.
Most foreign teachers (the overwhelming majority are French) are paid partially
by the donor countries under technical assistance programs while the Ivory
Coast contributes salary supplements and housing and other services. In higher
education, aid consists of foreign-financed teachers, scholarships, and France's
direct subsidy to the university's operating budget. Again the Ivory Coast
contributes salary supplements and housing to the expatriate staff.

In Table 3, the foreign exchange costs under the assumption of the con-
tinuation of the present pattern of aid are total foreign exchange costs minus
all aid (paid in foreign exchange). Without aid, these costs are simply the
sum of the column entitled "foreign exchange costs". For secondary and higher
education, they are, respectively, FCFA 41,500 and FCFA -213,200 with aid con-
tinuation and FCFA 82,100 and FCFA 245,900 without further aid. The assumption
that aid will partially finance marginal educational expenditure produces a
negative foreign exchange cost for higher education. There, foreign aid fi-
nanced local salaries and non-tradeables (which have no foreign exchange cost)
as well as expatriate salaries.

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[1]With one major exception—total Ivorian salaries are counted as a domestic
resource cost on the assumption that they are equal to alternative earnings in
non-educational non-governmental occupations, which in turn are equal to their
marginal productivity. This obviously crude assumption could be refined by
valuing the Ivorian educational labor at appropriate shadow prices.

Domestic resource costs with or without aid continuation are the sum of elements of the domestic resource column (FCFA 104,700 and FCFA 539,200). Here we assume that additional teachers required for educational expansion will be recruited abroad. Their incomes, paid either by aid or local resources,[1] must be separated into foreign exchange, domestic resources and taxes.[2]

Scholarships are included as a cost in our formulation. They later will be subtracted from earnings foregone during training (see discussion below). With this treatment, scholarships will not affect our estimates of DRC; and SCBT;[3] the increased direct educational costs (due to the inclusion of scholarships) are cancelled by the netting of scholarships from foregone earnings during training. However, this treatment will give a better estimate of PCBT; since private costs of education accurately represent foregone earnings.

The annual average educational costs per student then were converted into discounted costs per _successful_ student following the procedure outlined in Annex B. With this method, we assume that failures within an educational unit can replace an expatriate in the next lowest occupational level. Failure costs then were assigned to the immediately preceding educational level.

3. _Foregone and Alternative Earnings_: The calculation of E_t, foregone earnings during the training period and A_t, earnings had the trainee not received any training was straightforward except for several assumptions relating to unemployment and underemployment of the various occupational categories in the Ivorian economy.[4] These assumptions were necessary to adjust actual wages to shadow wage rates. As mentioned above, foregone earnings are net of scholarships so we can obtain an accurate estimate of private costs of education. Details on these assumptions as well as our calculations are found in Annex D.

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[1] However, if Ivorians were hired as teachers, then their income would not need to be separated into domestic resources, foreign exchange, and taxes since the purpose of the cost-benefit analysis is to maximize Ivorian incomes. Our assumption (recruiting teachers from abroad) is more realistic and reflects the shortage of Ivorian teachers.

[2] For both foreign aid hypotheses, taxes (including import duties and value added tax) are not treated as a cost. See the earlier discussion of the DRC model for details on this point.

[3] Except when scholarships are partially paid by foreign aid.

[4] As noted in Annex D, all Ivorians trained to the level at which they can replace expatriates are assumed to find employment.

TABLE 3

DECOMPOSITION OF EDUCATIONAL COSTS PER STUDENT YEAR INTO
TAX, DOMESTIC RESOURCES, AND FOREIGN EXCHANGE, 1971

Category (FCFA Thousands)	Domestic Resources	Taxes	Foreign Exchange	Total
1. Secondary Education				
a) Personnel				
Local Salaries	34.7	---	---	34.7
Expatriate Salaries	13.8	20.7	41.5	75.9
Expatriate Housing, etc.	9.7	4.1	12.6	26.4
b) Scholarships	5.5	---	---	5.5
c) Non-Tradeables	1.1	0.3	0.6	2.0
d) Tradeables	7.5	3.8	5.4	16.7
e) Amortization	32.4	3.6	22.0	58.0
Total	104.7	32.5	82.1	219.2
of which aid				40.6
2. Higher Education				
a) Personnel				
Local Salaries	58.8	---	---	58.8
Expatriate Salaries	110.6	74.1	148.2	333.0
Expatriate Housing, etc.	36.4	15.3	47.4	99.1
b) Scholarships	258.7	---	---	258.7
c) Non-Tradeables	10.8	3.5	3.8	18.1
d) Tradeables	22.5	11.7	18.7	53.0
e) Amortization	41.3	4.6	27.8	73.7
Total	539.2	109.2	245.9	894.4
of which aid				459.1

Source: See Annex C.

4. <u>Income Diverted from Expatriates to Ivorians</u>: The "benefits" from Ivorization in our DRC methodology consist of income previously paid the expatriate. Consider this income to be "saved" in the sense that it no longer is used to maintain an expatriate in the Ivory Coast. Instead, it is diverted to an Ivorian. This "saving" can be decomposed into its foreign exchange, $M_t + S_t$, and domestic resource cost, D_t, components. Table 4 presents our estimated decomposition of these two components of incomes received by an expatriate in each occupation. Note that income consists of salaries directly received in the Ivory Coast and indirect payments in kind. The foreign exchange components of direct income are savings and the border value of tradeable goods entering an expatriate's consumption. Foreign exchange in indirect income includes transportation to and from the expatriate's home country, retirement benefits paid in the home country, and the border value of tradeables in the expatriate's housing allowance. The domestic resource component consists of factor services and non-tradeables entering the expatriate's consumption and housing allowance. Taxes, both direct and indirect, are excluded from the analysis.

Row one of Table 4 reports average expatriate earnings in 1971 for each occupation.[1] It has been estimated that 26 percent of income received is transferred out of the Ivory Coast either for purposes of savings or vacations.[2] Row 2 gives this value. Row 3 is the residual spent in the Ivory Coast. From that value, income taxes were deducted (Row 3a).[3] The remainder consists of consumption of domestic resources (3b), indirect taxes (3c), and the c.i.f. value of tradeables (3d).

The percentages of a typical expatriate's consumption spent in foreign exchange, domestic resources and taxes were estimated using detailed market basket data published by the Ivory Coast employers' association[4] and applying the TVA and tariff[5] applicable to each item of the market basket.

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[1]Taken from Ministère du Plan, <u>Enquête Main d'Oeuvre</u>, Vol. 2, Tableau 28.

[2]Planning Ministry project files use this percentage. However, this value may be an understatement. In 1972, average repatriated transfers per expatriate employees were $4,400 or approximately FCFA 1.1 million (calculated from <u>Balance des Paiements</u>, Table IX, using an assumption of an expatriate labor force of 17,000).

[3]Using the tax schedule found in <u>Code Général des Impôts</u>.

[4]<u>Consommation Familiale Européene</u>.

[5]Ministère des Finances et de l'Economie, <u>Tarif Douanier</u>, (Abidjan, 1971).

Table 4: Decomposition of Expatriate Income into its Foreign Exchange and Domestic Resource Components--1971

Yearly values, FCFA thousands	Management	Technicians	Supervisors	Office Workers
1. Average Expatriate Income[1]	2,900.0	2,336.4	1,909.4	1,221.3
2. Vacation and Savings[2]	754.0	607.5	496.4	317.5
3. Total Income Spent in Ivory Coast [=(1)-(2)]	2,146.0	1,728.9	1,413.0	904.8
a. of which Income Taxes	312.6	223.5	156.4	36.5
b. of which domestic factor services and non-tradeables	531.7	436.6	364.4	251.5
c. of which indirect taxes	458.4	376.4	314.2	216.8
d. of which cif value of traded goods [.56 x ((3)-(3a))]	843.4	692.5	578.0	399.0
4. Transportation to/from Home Country	450.0	450.0	450.0	0.0
5. Retirement and Benefits Paid in Home Country [.068 x (1)]	197.2	158.9	129.8	83.0
6a. CIF Value of Traded Goods Provided in Housing Allowance	813.0	813.0	813.0	0.0
6b. Value of Domestic Resources in Housing Allowance	1,288.1	1,288.1	1,288.1	0.0
Total Domestic Resource Costs [=(3b)+(6b)]	1,819.8	1,824.7	1,652.5	251.5
Total Foreign Exchange Costs [=(2)+(3d)+(4)+ (5)+(6a)]	3,057.6	2,721.9	2,467.2	799.5

[1]Average expatriate income from Enquête Main d'Oeuvre-1971, Vol. 2, Tableau 28, P. 54.

[2]Vacation and savings based upon Planning Ministry estimate of 26 per cent of total income. Both are assumed to be spent or saved abroad.

To estimate the foreign exchange element of payment in kind, a sample of 22 firms employing 469 expatriates was selected from the Ivory Coast manufacturing sector.[1] Using detailed accounting data, it was found that the average transportation allowance per expatriate was approximately FCFA 450,000[2] and that retirement benefits paid in the expatriate's home country were 6.8 percent of average expatriate income in the sample. Both of these items were considered to be entirely foreign exchange costs. Housing was estimated at FCFA 2.4 million per year (FCFA 2.0 million housing plus FCFA 0.4 million utilities). To these values were applied estimated coefficients for non-tradeables and amortization.[3]

The sum of rows 2, 3d, 4, 5, and 6a is $S_t + M_t$, the total yearly foreign exchange cost for each occupation to maintain an expatriate in the Ivory Coast. Similarly, the sum of rows 3b and 6b is D_t, the total yearly domestic resource cost of expatriates in each occupation.

5. <u>Indirect Taxes, T_t</u>: Indirect taxes to be included in the private cost-benefit ratio consist of TVA and duties in expatriate consumption and in their housing allowance. The former is given by line (3c) of Table 4. The latter was calculated by subtracting the border value of traded goods and the domestic resource content of the housing allowance from the total housing allowance (2.4 million FCFA). The annual total indirect tax payments are: managers FCFA 756,500, technicians FCFA 674,500, supervisors FCFA 612,300 and office labor FCFA 216,800.[4]

B. <u>Calculation of the DRC Coefficients and Cost-Benefit Ratios</u>.

1. <u>Introduction</u>: Each evaluation measure was calculated for three different discount rates--5, 11, and 17 percent. For purposes of comparability, the cost-benefit ratios, as well as the DRC coefficients are given in ratio form.

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[1]These firms were included in the authors' wider sample of Ivory Coast manufacturing firms in their study of incentives in Ivorian manufacturing for the Development Research Center of the World Bank.

[2]No transportation or housing allowances were imputed to office labor since these workers were usually women, probably working wives hired locally, who receive housing and transport under their husbands' allowances.

[3]Estimated for the study cited in footnote three above.

[4]Office labor is assumed to receive no housing benefits.

Costs enter the numerator; benefits enter the denominator; and a value of unity represents the point at which costs and benefits are equal.[1] The coefficients DRC_j show the economic desirability of training for purposes of Ivorization in terms of domestic resources expended to divert income from foreign to local labor. The ratios $SCBT_j$ and $PCBT_j$ specify the social and private profitability of training, in this case for purposes of expatriate replacement.

2. <u>Calculation of the DRC_j Coefficients</u>: Using the methodology outlined in Section III, we have calculated DRC coefficients for each of the four occupations in which expatriates are represented in the Ivory Coast. Table 5 reports our results.[2]

In most cases, the DRC estimates suggest that training for purposes of expatriate replacement is a highly desirable activity. For supervisors and technicians, the DRC coefficients are negative at discount rates of five and eleven percent. Even at discount rate of seventeen percent, the DRCs for these two occupations are considerably less than one. For office labor and management training, the coefficients are acceptable except at the seventeen percent discount rate. For management, high training costs and the long educational period combine to give coefficients less satisfactory than those for supervisors and technicians. As the discount rate increases, there is a rapid decrease in diverted income benefits entering the numerator and denominator. For office labor, our assumption that drop-outs in the first unit of secondary school cannot replace expatriates is the primary cause of the high DRC coefficients. Costs per <u>successful</u> student are relatively high in this unit since failure rates are high and their costs could not be pro-rated with the next lowest occupation level.

The continuation of aid in its present pattern provides acceptable DRCs for all occupational training except office labor. As expected, aid continuation has its most noticeable effect in those occupations requiring university training (technicians and management). Aid to higher education covers approximately fifty percent of direct training costs.

The negative rates shown in the table should be interpreted differently than negative rates in other DRC analyses.[3] Rather than reflecting negative

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[1]However, if the exchange rate is overvalued, a calculated DRC coefficient greater than one will be acceptable. Likewise, if positive external effects from education exist, $SCBT_j$ or $PCBT_j$ could be greater than one and still be acceptable.

[2]Annex E summarizes intermediate results of these calculations.

[3]See Annex A for discussion of the interpretation of the DRC coefficients.

foreign exchange earnings, they are the result of negative domestic resource costs in the numerator, i.e., the total domestic resource costs of training $(C_t + A_t + E_t)$ are less than the domestic resource income benefits (D_t) diverted from expatriates to Ivorians.

For various reasons,[1] we are not very confident of our estimates of R, the equivalency ratio. To check on the sensitivity of our estimate to changes in the equivalency ratio, we calculated a hypothetical equivalency ratio which, when inserted in Equation (4), would equate the DRC coefficient to unity at a discount rate of eleven percent. In Table 6, our equivalency ratios R are compared to these hypothetical values.[2] Except for skilled office labor, the estimated equivalency ratios can err considerably and still allow estimated DRC coefficients to be less than one. Therefore, the conclusions concerning the desirability of training for expatriate replacement in supervisory, technical or managerial personnel are not likely to be significantly altered unless the estimated equivalency ratios are highly prone to error.[3]

3. <u>Calculation of the Cost-Benefit Ratios</u>: Tables 7 and 8 present our estimated private and social cost-benefit ratios of training for the four

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[1]Mainly limited degrees of freedom, data reflecting only experience in the firm, larger wage differentials than implied by our estimates.

[2]This hypothetical equivalency ratio, R* is given by the expression below:

$$R^* = \frac{\displaystyle\sum_{m+1}^{n} \frac{S_t + M_t + D_t}{(1+i)^t}}{\displaystyle\sum_{1}^{m} \frac{C_t + E_t + FX_t}{(1+i)^t} + \sum_{m+1}^{n} \frac{A_t}{(1+i)^t}}$$

[3]Political pressure to Ivorianize could conceivably lead to the employment of Ivorians at wages considerably above the firms' perceptions of marginal productivities. If our basic hypothesis is invalidated for this reason, the estimated equivalency ratios in Table 6 nevertheless provide some useful indications of maximum equivalency ratios above which investment for expatriate replacement would not be economically profitable. For skilled office labor, supervisors and technicians it should be possible to check this by studying empirical indicators of Ivorian and expatriate work efficiency. However, it must be admitted that management skills are less likely to be quantifiable in this way. That is, is it really plausible that two poor Ivorian managers can really substitute for one competent expatriate manager?

Table 5: Domestic Resource Cost Coefficients for Education

Occupation	Occ'n – Ed'n Hypothesis	Aid?	5%	11%	17%
Office Labor	H_1	No	.322	.762	1.589
		Yes	.306	.679	1.270
	H_2	No	.385	.896	1.848
		Yes	.321	.790	1.447
Supervisors	H_1	No	-.477	-.332	-.085
		Yes	-.469	-.2445	-.078
	H_2	No	-.408	-.1768	.269
		Yes	-.395	-.1632	.230
Technicians	H_1	No	-.382	-.1801	.157
		Yes	-.370	-.169	.161
	H_2	No	-.397	-.127	.494
		Yes	-.383	-.116	.405
Managers	H_1	No	-.276	.158	1.326
		Yes	-.264	.139	1.002
	H_2	No	-.261	.180	1.385
		Yes	-.248	.157	.990

Table 6: A Comparison of Hypothetical and Estimated Equivalency Ratios

Occupation	Occ'n – Ed'n Hypothesis	Aid?	Hypothetical R	Estimated R	Percentage Difference
Skilled Office Labor	H_1	No	1.616	1.381	17.0%
		Yes	1.770	1.381	28.2%
	H_2	No	1.473	1.381	6.7%
		Yes	1.610	1.381	16.6%
Supervisors	H_1	No	4.315	1.136	279.0%
		Yes	4.723	1.136	315.8%
	H_2	No	3.389	1.267	167.5%
		Yes	3.845	1.267	203.5%
Technicians	H_1	No	3.061	1.043	193.5%
		Yes	3.435	1.043	229.3%
	H_2	No	2.688	1.043	157.7%
		Yes	3.092	1.043	196.5%
Management	H_1	No	1.866	1.039	79.6%
		Yes	2.157	1.039	107.6%
	H_2	No	1.832	1.039	76.3%
		Yes	2.145	1.039	106.4%

occupations in which expatriates are represented. The private and social cost-benefit ratios differ in that the former does not include edcuational costs borne by the state (C_t and FX_t) and is not calculated at different shadow exchange rates.[1]

The conclusions which can be drawn from Tables 7 and 8 closely correspond to those from our estimated DRC coefficients. The occupations of supervisors and technicians give the lowest ratio of costs to benefits at every discount rate and shadow price of foreign exchange. Again office labor and management training is socially desirable if the discount rate is less than seventeen percent even if foreign exchange is not overvalued. With an overvalued exchange rate, both types of training become marginally acceptable if the present pattern of aid is continued. From a private point of view, all occupations are attractive, having cost-benefit estimates significantly less than one.

The rankings of training by order of social and private attractiveness correspond approximately to the similar ranking on the basis of the DRC co-efficients in Table 5. The returns to supervisory and technician training are nearly identical; they are followed by management and office labor training. Using a DRC or social cost-benefit ratio, one would question the desirability of office labor training at a discount rate of seventeen percent. Management training is marginally acceptable when evaluated at a seventeen percent discount rate under either measure.

V. Conclusions: Implications for Ivorian Educational Policy

A. Introduction. The estimated DRC coefficients and cost-benefit ratios given in Tables 5, 7 and 8 can be used to provide responses to the questions posed earlier. They indicate that resource allocation to secondary and university education in the Ivory Coast is in general economically desirable. The DRC coefficients confirm that training for expatriate replacement is an economically efficient import-substitution activity. The cost-benefit analysis also shows that investment in education has high private and social returns. Viewed more closely on an occupation by occupation basis, our estimates correspond to the actual distribution of Ivorian budgetary resources between secondary and higher education. Finally since private returns to education are markedly higher than social returns, consideration should perhaps be given to alternative

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[1] It is assumed that individuals do not evaluate foreign exchange at its shadow exchange rate in their private decision-making.

Table 7: Social Cost-Benefit Ratios for Education, Various Discount Rates and Shadow Exchange Rates

Occ'n - Ed'n Hypothesis	Aid?	S=1.0 i=5%	11%	17%	S=1.15 5%	11%	17%	S=1.30 5%	11%	17%
Office Labor										
H_1	No	.533	.855	1.297	.488	.787	1.199	.452	.732	1.119
	Yes	.497	.780	1.171	.373	.593	1.068	.414	.654	.985
H_2	No	.582	.938	1.414	.533	.866	1.306	.493	.803	1.218
	Yes	.543	.858	1.278	.493	.781	1.166	.452	.718	1.074
Supervisors										
H_1	No	.145	.263	.444	.136	.248	.419	.1281	.235	.398
	Yes	.135	.241	.401	.125	.224	.374	.117	.210	.351
H_2	No	.196	.374	.657	.184	.352	.620	.173	.334	.590
	Yes	.175	.329	.577	.162	.305	.536	.151	.285	.502
Technicians										
H_1	No	.187	.341	.568	.154	.319	.534	.164	.301	.505
	Yes	.169	.304	.517	.137	.280	.468	.144	.261	.436
H_2	No	.183	.398	.767	.171	.366	.723	.161	.347	.686
	Yes	.161	.339	.667	.148	.313	.671	.137	.291	.576
Management										
H_1	No	.241	.553	1.139	.224	.518	1.068	.211	.489	1.009
	Yes	.213	.478	1.001	.163	.440	.924	.180	.408	.859
H_2	No	.253	.563	1.159	.236	.527	1.089	.222	.497	1.026
	Yes	.218	.481	.994	.199	.441	.915	.183	.407	.849

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Table 8:   Private Cost-Benefit Ratio for Education

Occupation	Occ'n - Ed'n Hypothesis	Aid	i =5%	i = 11%	i=17%
Office Labor	H_1	No,Yes	.305	.425	.593
	H_2	No,Yes	.333	.472	.656
Supervisors	H_1	No,Yes	.087	.138	.216
	H_2	No,Yes	.111	.187	.307
Technicians	H_1	No,Yes	.111	.185	.288
	H_2	No,Yes	.100	.190	.336
Managers	H_1	No,Yes	.139	.288	.573
	H_2	No,Yes	.153	.311	.593

educational financing schemes by which individuals are required to bear a
larger portion of educational costs.

These general conclusions are strengthened by certain conservative as-
sumptions and, in some respects, our conservative use of the data.

Firstly, there is ample evidence to suggest that our expatriate salary
values are too low.[1] If so, then our estimates will understate repatriated
savings, the tradeable content of consumption, fringe benefits paid in the
home country, and the domestic resource costs of expatriate consumption, all
of which enter our DRC analysis as benefits.[2] Consequently, our DRC estimates
will be high. Secondly, we use the official retirement age of 55 to define the
end of the income stream. This age appears low by standards of more developed
countries, and, in fact, fragmentary data indicate that more highly skilled
personnel in the Ivory Coast work beyond the official retirement age.[3] To the
extent that this longevity exists, our results will be biased upward since
they will understate actual diverted income benefits of expatriate replacement,
underestimate expected income streams, and overstate the equivalency ratio.[4]
Additionally, no occupational mobility was assumed. Of course, some mobility
will exist as learning-by-doing occurs or as workers pursue governmental or
firm-sponsored training programs. Existence of occupational mobility implies
that our income stream estimates are too low and, consequently, that both our

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[1]Chevassu and Valette, op. cit., p. 11, report expatriate salaries in each
occupational category higher than those of the Planning Ministry labor force
survey data: management FCFA 3.9 million versus FCFA 3.0 million, technicians
FCFA 3.1 million versus FCFA 2.3 million, supervisors FCFA 2.4 million versus
FCFA 1.2 million. However, we used the Planning Ministry data because of its
wider coverage and because we were not certain of the components of Chevassu
and Valette's salary values.

[2]Further evidence to corroborate this contention is found in a comparison
of our estimated repatriated savings in the highest occupational category (FCFA
720,000) to that given by the 1972 balance of payments data, La Balance des
Paiements, p. 18 and Table XI. Using these data and our estimated expatriate
labor force population, we calculated repatriated savings per expatriate to
be FCFA 1.1 million in 1972. In our analysis, either we underestimated the
savings propensity, expatriate income levels, or the expatriate population. If
either of the former two variables is incorrect, then our estimated DRCs will
be too large.

[3]L'Enquête Main d'Oeuvre--1971, Vol. 2, Table 4, reports that ten percent
of management personnel, four percent of technicians, and three percent of super-
visors are older than 55.

[4]Note, however, that marginal contributions to benefits beyond age 55 will
not affect the analysis greatly since they are heavily discounted. For example,
the eleven percent discounting factor for age 56 is .0112 (= $1/1.11^{43}$).

DRC and cost-benefit estimates again will be too high.

These possible errors are on the conservative side and would strengthen the general conclusions of the analysis. As regards our assumption that Ivorian wages reflect Ivorian productivity,[1] however, it has been argued that Ivorians are paid less than their marginal productivity or alternatively, that they are paid more. The first argument implicitly or explicitly assumes that monopolistic and/or monopsonistic power of foreign firms enables the expatriate management to pay Ivorian wages which are less than the efficiency equivalent of expatriate wages. The second argument is that not only do profit maximization and long run competitive pressures give a basic tendency to the equating of wages and marginal productivities, but that political pressures to Ivorianize (especially at higher levels) lead to the payment of Ivorian wages well in excess of marginal productivities.

While there is some ad hoc evidence to support both of these propositions, we are unable to judge which effect may have been more important. On the one hand there are doubtless some pockets of protected expatriate controlled economic power in which "easy life" considerations may have prevailed over profit maximization resulting from expatriate replacement. On the other hand the pressure to Ivorianize is undoubtedly important, but it has not assumed the same intensity in the Ivory Coast as indigenization programs in many other developing countries.

B. Education and Expatriate Replacement: An Efficient Import-Substitution Activity. Most of our DRC coefficients in Table 5 are less than one in the discount rate range of five to seventeen percent. In general then, one can conclude that past and future resource allocation to secondary and university education has been and will remain economically justifiable. The fact that the shadow exchange rate almost certainly exceeds the official rate makes this conclusion even more convincing.

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[1]Wage differences by nationality are significant. The Planning Ministry labor survey reports that expatriates are paid on average 110 percent more than Ivorians in the same occupation, L'Enquête Main d'Oeuvre--1971, Vol. 2, Tables 79 and 105. Chevassu and Valette's data, op. cit., p. 11, gives wage differences of about 120 percent. Ivorians may be paid less because they are believed to be less efficient or because there are socio-cultural factors influencing salary decisions (usually made by expatriates). Chevassu and Valette, op. cit., suggest these two alternatives based upon their firm level interviews. Alternatively, as argued in this paper, Ivorians may actually be less efficient because they lack the experience of their expatriate counterparts. This alternative is very likely, given the embryonic stage of development of the educational structure and the period required for on-the-job training.

Having calculated DRCs of training for expatriate replacement, it is valuable to proceed one step further and compare these estimates to those of other foreign exchange generating activities in the Ivorian economy. In a very approximate manner, we can use this comparison to determine if resource allocation at the margin is best directed toward the educational, agricultural, or industrial sectors. We are in a position to make such a comparison using preliminary results of research in progress at the World Bank's Development Research Center.

Dirck Stryker has calculated DRCs for the agricultural sector using a measure similar to ours.[1] His estimates for the southern zone, the most prosperous agricultural region of the Ivory Coast ranged from .48 to 1.29 with the majority centered around a mean of .73. Coffee and cocoa, the Ivory Coast's two largest agricultural exports, had the lowest values (.40-.67 depending upon the methods of production used). In the central region, the coefficients were slightly above one for two crops and below one for cotton. In the northern region, DRCs for most products were close to unity.[2]

Our DRCs calculated at an eleven percent rate of discount fall in the range for agricultural products. DRCs for supervisors and technicians are appreciably lower than the two lowest values of the DRC coefficients for Ivorian agriculture (coffee and cocoa). Therefore, we may conclude that marginal educational expenditure for expatriate replacement ranks approximately the same or slightly better than agricultural activities in their foreign exchange generating or saving capabilities.

The authors have estimated DRCs for the manufacturing sector elsewhere.[3] The results of these calculations indicate that education for expatriate replacement is a more efficient activity than most manufacturing activities. For a sample of 83 manufacturing firms the weighted average DRC was 1.33. Nine of the 83 firms had negative foreign exchange earnings and twelve had coefficients in excess of 3.0.[4]

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[1] Dirck Stryker, "Incitations Economiques et Coûts Réels dans l'Agriculture", Chapter II of Incitations et Coûts Réels en Côte d'Ivoire, project working document, (World Bank, Washington, D.C., 1975), pp. 1-50.

[2] Ibid., Tableaux V, VI, VII. His calculations use a discount rate of 11%.

[3] Garry Pursell and Terry Monson, "Structure des Incitations et Coûts Réels dans l'Industrie", Chapter III of Incitations et Coûts Réels en Côte d'Ivoire, op. cit., pp. 51-137.

[4] Ibid., Tableau III.11. Calculated using a discount rate of eleven percent.

Our education DRCs are definitely superior to the average of the industrial sector although some industrial activities compare favorably to our estimates. Nonetheless, we can generally state that marginal expenditure upon education is a better allocation of Ivorian resources than upon industry.[1] In short, education for expatriate replacement is an efficient import-substitution activity.

C. <u>Allocation of Resources within the Educational Structure</u>. Viewing our DRC and cost benefit estimates for each occupation, one is immediately struck by the negative DRC coefficients and low cost-benefit ratios for the occupations of supervisor and technician. The negative DRCs indicate that the training costs plus alternative earnings, $C_t + E_t + A_t$, are less than the domestic resources consumed by the expatriates to be replaced. They imply that educational resources are best allocated to upper secondary levels in the Ivory Coast. University education--at least for management training--has DRC coefficients less than one at lower discount rates but the coefficients are not nearly as favorable as those estimated for supervisors and technicians. Office labor training is marginally acceptable at the current exchange rate and at discount rates less than seventeen percent. It is a marginal activity at best when the occupation-education relationship is upgraded (hypothesis 2). The social cost-benefit ratios for training reinforce these conclusions. Again, skilled office labor is the least desirable of the four occupations. Managerial training is desirable at the highest discount rate only if aid is maintained.

The allocation of Ivorian educational financing in the 1960s and early 1970s reflects an Ivorian estimation of costs and benefits that closely corresponds to our estimated DRCs and social cost-benefit ratios. Clearly, our estimates indicate that resources should be channeled to secondary schools, rather than to the university. In fact, most Ivorian resources are directed toward the primary and secondary levels. For 1970, the Ivory Coast devoted three and one-half times more funds to secondary schools than to the university. However, France and other donor countries have a different conception of educational returns and have divided aid evenly between the university and other forms of education. Consequently, the university is predominantly financed by foreign aid while secondary education is financed by local sources.

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[1]Of course, education cannot be treated in a vacuum. The returns to education depend upon employment opportunities in other sectors. Investment in industry or agriculture is needed to provide these jobs.

One aspect of university financing is troublesome. France's share of the university budget is scheduled to decline over time as the Ivory Coast assumes a greater portion of its operating costs.[1] In view of our estimates for university training, it may be an unwise practice to allocate larger amounts of Ivorian educational resources to university training. This conclusion is tempered by the possibility that an upgrading of the occupational-education relationship will occur over time (as in hypothesis two). In that case, two year university training will become more attractive and resource allocation to that level would become more desirable.

D. Private and Social Returns to Education. The structure of educational finance in the Ivory Coast is such that individuals bear little, if any, of the direct training costs C_t and FX_t. Consequently, private cost-benefit ratios are at least fifty percent lower than social cost-benefit ratios. These differences imply that individuals enrolled in all levels of education, but especially those in upper secondary (deuxième cycle) and university programs should be compelled to reimburse the state for a portion of direct educational costs. This conclusion is especially true at the university level where students now only pay modest direct costs (for subsidized food and housing facilities), and may receive sizeable scholarships (FCFA 35,000 monthly in 1975).[2]

As the educational structure now exists, a highly selective system determines entrance to secondary school. In principle, once gaining admittance, students are channeled into various occupational programs. In practice, this channeling process does not work. Students tend to remain in the university preparatory program until they succeed or fail. Such a system is wasteful of resources in that it is costly and may not provide the correct education demanded by economic growth. A selective tuition system should be applied at the upper levels of the educational structure to provide a more efficient alternative to the existing structure and to generate some savings for the state. Under such a program, variable tuitions could be tools to attract students into training deemed essential and to dissuade students from non-essential education.

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[1] The Ivory Coast's share is estimated at 70 percent in 1975, Ministère du Plan, Programme de Développement de l'Education et de la Formation, 1971-1975, (Abidjan, 1969), p. 111.

[2] Various loan programs would have to be implemented to overcome capital market imperfections and ensure the success of such a proposal.

This suggestion seems preferable to the administratively controlled channeling that now functions imperfectly.

E. <u>Summary</u>. In this paper, we have applied DRC analysis in a novel fashion to evaluate educational programs. This methodology, along with the more conventional cost-benefit approach, confirms that education is economically desirable in the Ivory Coast and that resource allocation to the upper secondary level is especially warranted. Lower secondary education is useful in so far as it performs a conduit function for higher levels of training. The importance of university education will probably increase as the occupational-educational structure is upgraded through technological development. Finally, consideration should be given to instituting a system of tuition charges in order to equate social and private rates of return in upper secondary and university education.

Annex A: Relation between the DRC and Cost-Benefit Coefficients

This relationship can be more easily seen by replacing the rather complicated expressions for costs and benefits in the text (Equation 5) as follows:

$$C_d = \text{domestic costs} = C_t + E_t + A_t;$$

$$C_f = \text{foreign exchange costs} = S \; FX_t;$$

$$B_d = \text{domestic benefits} = \frac{1}{R} D_t;$$

$$B_f = \text{foreign exchange benefits} = S\frac{1}{R} (S_t + M_t).$$

Where i is the social discount rate, t = 1...n the number of years, and S is the ratio of the shadow to the official exchange rate, the expressions for the social cost benefit ratio (SCBT) and for the DRC are then:

$$SCBT \; = \; \frac{\sum\limits^{n} \dfrac{C_d + SC_f}{(1+i)^t}}{\sum\limits^{n} \dfrac{B_d + SB_f}{(1+i)^t}} \tag{1}$$

$$DRC \; = \; \frac{\sum\limits^{n} \dfrac{C_d - B_d}{(1+i)^t}}{s \cdot \sum\limits^{n} \dfrac{B_f - C_f}{(1+i)^t}} \tag{2}$$

When SCBT = 1,

$$\sum\limits^{n} \frac{C_d + SC_t}{(1+i)^t} \; = \; \sum\limits^{n} \frac{B_d + SB_f}{(1+i)^t} \tag{3}$$

and so

$$\sum\limits^{n} \frac{C_d - B_d}{(1+i)^t} \; = \; S \cdot \sum\limits^{n} \frac{B_f - C_f}{(1+i)^t}$$

i.e., DRC = 1. When $(C_d - B_d) > 0$ and $(B_f - C_f) > 0$ it can be similarly shown that if SCBT < 1, DRC < 1 and when SCBT > 1, DRC > 1.

Since the internal rate of return (r) is the solution of (3) for i, when costs equal benefits r = i. If costs exceed benefits r < i, and if benefits exceed costs i > r.

From inspection it is apparent that changes in the discount rate i will not necessarily preserve the same ranking of a given set of activities for either the cost-benefit ratio or the DRC, since the resulting transformation is non-linear. Rankings will also not necessarily be preserved for different values of S in the case of the cost-benefit ratio, for the same reason. However, changing the foreign exchange premium does not alter DRC rankings, since this is equivalent to multiplying a given set of coefficients by a constant term.

If $(C_d - B_d) \leq 0$, the DRC can take values from zero to minus infinity. Since this means that foreign exchange is earned at a negative net domestic cost, such activities should be ranked in descending order of their negative coefficients.

It is also possible for net foreign exchange earnings to be negative. While this is common in studies of manufacturing activities, there are no cases in this study.

As a ranking device the cost-benefit ratio has the disadvantage that it changes value for a given internal rate of return according to different rules for netting benefits and costs, e.g., it will alter if a cost item is deducted from both numerator and denominator. The problem has been avoided in this study by ensuring that the same netting procedures are followed in the calculation of each coefficient.

Annex B: Educational and Occupational Assumptions

1. <u>Education-Occupation Hypotheses</u>. The correspondences postulated in
Section II will be taken very strictly. We assume that each succeeding level
of education comprises a unit that must be successfully completed before one
can be employed in the next highest occupation. Drop-outs and failures with-
in a unit are able to replace an expatriate at the occupation corresponding to
the student's highest attained grade. For example, failures during grades one
to four of secondary school cannot replace any expatriate since they lack the
requisite education for our lowest occupation (skilled office work). However,
under hypothesis 1, failures in grades five or six can replace a skilled ex-
patriate office worker. Similarly, failures in grade seven can replace super-
visors and failures in university can replace an expatriate technician. This
assumption implies that replacement costs will be high for skilled office la-
bor, since failures in the first educational unit are lost to the Ivorization
process. At higher educational levels, failures are capable of replacing ex-
patriates at the immediately preceding level. Therefore, beyond the first four
years of secondary school educational costs can be pro-rated between successes
and failures.

An additional implication of the strict occupation-education correspondence
is that the educational level attained determines a person's occupation category
over his lifetime. There is no occupational mobility. Of course this implica-
tion is unrealistic. Promotions between occupations will occur as on-the-job
learning takes place or as enterprises provide further training. Unfortunately,
upward occupational mobility data were not available to refine our analysis further.

2. <u>Adjustments for Drop-Outs and Failures</u>. In our models of Section III,
educational costs and foregone earnings during the training period were stated
in terms of per <u>successful</u> student in each educational unit. Our data, origin-
ally given in per student costs and earnings, had to be adjusted for educational
success and failure probabilities within units. These probabilities, based
upon educational statistics for secondary education and estimates for the Faculty
of Economics at the University of Abidjan for the period 1971-1975,[1] are found
in Annex Table B-1.

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[1] Secondary education probabilities were calculated from data given in Mini-
stère des Finances et de l'Economie, "Situation de l'Enseignement", yearly sup-
plements to the <u>Bulletin Mensuel de Statistique</u>, (Abidjan, 1965-72). Higher edu-
cation probabilities were taken from Université d'Abidjan, Faculté des Sciences
Economiques, <u>Rapport Preliminaire sur l'Evolution Prévisible des Etudiants de la
Faculté</u>, (Abidjan, 1973), mimeo. Since most students entering technician and
management positions require training in economics and business and since this
training is provided in the Faculty of Economics, success probabilities in that
discipline, and not of those of the entire university, are relevant to our
discussion.

Annex Table B-1: Pass-Fail Probabilities in Ivory Coast Secondary
                  and Higher Education.

Secondary

Grade: j =	6	5	4	3	2	1	T
P(Success in j)	.767	.722	.696	.436	.679	.700	.428
P(Failure in j)	.233	.278	.304	.564	.321	.300	.572

Higher

Grade: j =	4	3	2	1
P(Success in j)	.500	.600	.800	.900
P(Failure in j)	.500	.400	.200	.100

Sources: Secondary probabilities calculated from 1964-1971 educational
          data given in "Situation de l'Enseignement," op. cit.

          Higher education probabilities based upon estimates for the
          Economics Faculty at the University of Abidjan in Rapport
          Préliminaire Sur l'Evolution Prévisible des Etudiants de la
          Faculté, op. cit.

From these probabilities, we calculated drop-out and success rates in each year of each educational segment.[1] To calculate these rates, it was necessary to make the following assumptions of admissible repeats.[2]

Assumptions of Admissible Repeats

Occupation	Occupation-Education Hypothesis	
	One	Two
Skilled Office Labor	Two non-consecutive repeats	Two non-consecutive repeats
Supervisors	One repeat	Two non-consecutive repeats
Technicians	One repeat	One repeat
Management	Two non-consecutive repeats	One repeat

With these assumptions, the minimum length of time a student may spend in training for management is eleven years (no repeats in secondary or university education); the maximum time is seventeen years. For the other occupations, except skilled office labor, the minimum and maximum lengths of time depend upon the occupation-education hypothesis chosen.

In Annex Table B-2, we present our drop-out and success rate probabilities. The column entitled "Successful Completion of Unit in t" gives the probability that a student will complete an educational unit in t years. For example, our estimates indicate that 16.8 percent of students entering the first cycle of secondary school finish in four years; 23.2 percent finish in five years; and 11.2 percent finish in six years. A total of 51.2 percent of students entering the unit successfully complete four years of secondary education. The column entitled "Drop-Outs in t" provides the percentages dropping out in each year following our assumptions of allowable repeats. The third column, "Portion Continuing in t", estimates the percentages of beginning students remaining in the program in the period t.

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[1] We had to calculate drop out and success rates in each year in order to determine the total average cost of producing a successful student in the educational segment. Students dropping out or completing the educational unit do not require further educational expenditure.

[2] These assumptions are based on age distributions of students in each educational unit. For university education, they correspond to allowable repeats under various scholarship programs.

Annex Table B-2:   Drop-Out and Success Rates for Each Education Unit[1]

	Year t =	Occupation-Education Hypothesis One			Occupation-Education Hypothesis Two		
		Successful Completion of Unit in t	Drop-Outs in t	Portion[2] Continuing in t	Successful Completion of Unit in t	Drop-Outs in t	Portion[2] Continuing in t
1) Skilled	1	.000	.000	1.000	.000	.000	1.000
Office	2	.000	.054	1.000	.000	.054	1.000
Labor	3	.000	.059	.946	.000	.059	.946
	4	.168	.065	.887	.168	.065	.887
	5	.232	.160	.654	.232	.160	.654
	6	.112	.150	.262	.112	.150	.262
TOTALS		.512	.488		.512	.488	
2) Supervisors	1	.000	.000	1.000	.000	.000	1.000
	2	.475	.103	1.000	.000	.103	1.000
	3	.295	.127	.372	.203	.061	.897
	4	--	--		.243	.176	.633
	5	--	--		.092	.123	.215
TOTALS		.770	.230		.537	.463	
3) Technicians	1	.428	.000	1.000	.000	.000	1.000
	2	.245	.327	.572	.300	.250	1.000
	3	--	--		.270	.180	.450
TOTALS		.673	.327		.570	.430	
4) Management	1	.000	.000	1.000	.000	.000	1.000
	2	.000	.250	1.000	.720	.040	1.000
	3	.000	.080	.750	.216	.024	.240
	4	.216	.052	.670	--	--	
	5	.259	.013	.402	--	--	
	6	.117	.013	.130	--	--	
TOTALS		.592	.408		.936	.064	

Notes: ·

[1]Calculated from the probabilities of Annex Table B-1.

[2]Defined as 1.000 minus the cumulated successes and drop-outs through the end of the previous period.

We use these drop-out and success rates to transform our data from costs per student to costs per <u>successful</u> student in each educational unit. These costs then form the domestic resource, foregone earnings, and foreign exchange costs of equations (4) to (6) in the text. To illustrate our method, let C_{jt} be the annual average domestic resource cost per student in educational unit j in time t, N_j be the number of students in a cohort entering the unit and N_{jt} be the number of students in the cohort N_j remaining in the educational unit in time t. Then the total discounted cost of educating the cohort is:

$$C_j = \sum_{t=1}^{n} \frac{N_{jt} C_{jt}}{(1+i)^t}$$

and the total cost per typical member of the cohort is:

$$c_j = \frac{C_j}{N_j} = \sum_{t=1}^{n} \frac{\frac{N_{jt}}{N_j} \cdot C_{jt}}{(1+i)^t}$$

The expression N_{jt}/N_j is given in Table B-2 under the column entitled "Portion Continuing in t"; C_{jt} is derived in Annex C.

The next step is to assign costs to failing and succeeding students. We assumed above that failures in unit one are lost to the expatriate replacement process while failures in succeeding levels are not. Therefore all costs in unit one are assigned to successful students while costs in the other levels are pro-rated between successes and failures. Knowing that $N_j = S_j + F_j$ or $1 = S_j/N_j + F_j/N_j = s_j + f_j$ where S_j, F_j are the number of students in cohort N_j who pass or fail the unit, then costs for a successful student in each level are:

		Costs of successfully completing prior units		Costs of successfully completing unit		Costs of unsuccessful try at next unit
Unit 1:	Office labor	0	+	c_1/s_1	+	$c_2 f_2$
Unit 2:	Supervisors	c_1/s_1	+	$c_2 s_2$	+	$c_3 f_3$
Unit 3:	Technicians	$c_1/s_1 + c_2 s_2$	+	$c_3 s_3$	+	$c_4 f_4$
Unit 4:	Management	$c_1/s_1 + c_2 s_2 + c_3 s_3$	+	$c_4 s_4$	+	0

An identical method was applied to FX_j and E_j to obtain success and failure adjusted costs for each unit.

Annex C: Foreign Exchange and Domestic Resource Components

1. <u>Educational Costs</u>. Various Ivorian budgetary sources[1] were used to calculate secondary and higher education costs per student. The year 1971 was chosen as a reference point because employment data were available from the 1971 Planning Ministry labor force survey.

Several problems were faced in separating educational costs into their foreign exchange and domestic resource components. One was simply identifying and imputing costs to the proper educational level. This problem was due to the manner in which common personnel and maintenance charges (<u>Dépenses Communes de Personnel et d'Entretien</u>) were entered in the budget. These charges, attributable to maintenance of the expatriate population (housing, supplemental salaries, etc.), were not imputed directly to the Ministry in which the expatriate worked but rather were cited as a separate item. It was necessary to determine the Education Ministry's share of these costs since most secondary school teachers were expatriates. A second problem was the actual separation of educational costs into their domestic resource and foreign exchange components. This separation was accomplished by decomposing these costs into salaries, tradeable and non-tradeable inputs, and amortisation, all evaluated in domestic prices. In turn, we separated each element into its domestic resource, tax, and foreign exchange component,[2] following coefficients estimated from national income accounts information,[3] supplemental firm level data,[4] and Ivorian tax codes.[5] Details on this procedure are discussed below.

a. <u>Secondary Education</u>. The government budget reports National Education Ministry credits by division (primary, secondary, etc.) and by type of

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[1] République de Côte d'Ivoire, <u>Budget Général de Fonctionnement--Gestion 1971</u> and <u>Loi de Finances Rectificative 1971</u>, (Abidjan, 1971), and Ministère du Plan, <u>Loi--Programme des Investissements Publics pour les Années 1973-1974-1975</u>, (Abidjan, 1973).

[2] We use the Corden method of DRC analysis and account for tradeable components of non-traded inputs, W.M. Corden, <u>The Theory of Protection</u>, (Oxford University Press, London, 1971).

[3] Ministère du Plan, <u>Comptes de la Nation 1971</u> and <u>1972</u>, (Abidjan, 1973 and 1974).

[4] Collected in the authors' study of incentives in the manufacturing sector.

[5] Ministère des Finances et de l'Economie, <u>Code Général des Impôts</u>, (Abidjan, 1974) and <u>Tarif Douanier</u>, (Abidjan, 1971).

purchase (personnel, water, telephone, etc.). Those funds directly assigned the secondary education division (établissements secondaires) were credited to their associated expenditures.[1] In Annex Table C-1, this operation is given in column (1). Items allocated to the ministry's central services were pro-rated to secondary education on the basis of its share of total functional credits (primary, secondary, and higher education).[2] This imputation is shown in column (2) of Table C-1. Finally, a significant portion of the government budget (15 percent in 1971) was entered under the rubric "Dépenses Communes de Personnel d'Entretien". These items were assigned to secondary education on the basis of its share of total expatriate government workers (1231/2151 = .572). Column (3) gives these common charges, column (5) provides a per student break- down of these costs. Annex Table C-2 gives greater detail on expatriate com- mon charges attributed to taxes, domestic resources, and foreign exchange.

Amortisation costs (Annex Table C-3) were based upon approximate school construction costs given in planning documents.[3] These investment costs were divided into construction (85 percent) and furniture and equipment (7-1/2 per- cent each) on the basis of fragmentary evidence on educational construction costs.[4] Vehicle costs were taken from the 1971 budget and allocated to amorti- sation. To each element in turn was applied amortisation coefficients estimated by the authors in their study of incentives in manufacturing,[5] to obtain the tax, domestic resource, and foreign exchange components of amortisation.[6]

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[1]Unfortunately, it was impossible to divide secondary education expenditure more finely due to lack of detailed data. There is some evidence that secondary education costs vary with the level of education, with the first cycle being less costly than the second cycle. See: A. Achio, Ressources Humaines et Per- spectives d'Emploi--Côte d'Ivoire, 1968-1975, (Ministère du Plan, Abidjan, 1968), pp. 176-186, and J. Hallak and R. Poignant, Les Aspects Financiers de l'Educa- tion en Côte d'Ivoire, UNESCO, International Institute for Education Planning, African Monograph No. 8, (Paris, 1966).

[2]The portion of total functional funds going to secondary education was .329.

[3]Loi-Programme des Investissements, passim.

[4]Ministère du Plan, Programme de Développement de l'Education et de la For- mation 1971-1975, (Abidjan, 1969), passim, and Hallak and Poignant, op. cit.

[5]Estimated from Comptes de la Nation 1972.

[6]These estimates were also used in higher education. As such, they may understate construction costs since university investment is thought to be higher per student than secondary education investment. See: Programme de Développe- ment de l'Education, p. 72, 110-114 for comparison.

Table C-1: <u>Summary of Budgeted Secondary School Expenditures, 1971</u>[1]

FCFA Millions Item	(1) Allocated in Budget	(2) Imputed From Ministry Overhead	(3) Imputed From Common Charges	(4) Total	(5) Per Student[2] FCFA
Local Salaries	1766.4	93.6	69.9	1929.9	34,688
Water/Electricity	--	52.7	--	52.7	947
Office Supplies	--	12.8	--	12.8	230
Technical Supplies	--	3.1	--	3.1	56
Clothing	--	0.3	--	0.3	5
Maintenance Buildings	--	1.6	9.9	11.5	207
Maintenance Autos	--	2.6	--	2.6	47
Gas and Oil	--	3.4	--	3.4	61
Diverse	756.4	3.0	150.9	910.3	16,362
Local Transport	--	--	20.3	20.3	365
TOTAL	2,522.8	173.1	251.0	2,946.9	52,968

Average per
Student[2] (FCFA) 45,344.7   3,093.3   4,511.5

Notes:

[1]Excluding expatriate charges and amortisation.

[2]Based upon 1971 enrollment of 55,636 in public secondary schools.

Source: République de Côte d'Ivoire, <u>Budget Général de Fonctionnement</u> --
         <u>Gestion 1971</u> and <u>Loi de Finances Rectificative 1971</u>,(Abidgan, 1971).

Table C-2: National Budget Expenditures on Expatriates in the Education

Ministry: Totals and Division into Local, Tax, and Foreign

Exchange Components -- 1971

FCFA Millions	Taxes	Local	Foreign Exchange	Total
1. Ivorian Contribution to Expatriate Salaries	594.9	399.1	1191.7	2185.7
2. Housing, Hotels, and Utilities	131.4	599.4	361.7	1092.5
3. Other Benefits (Transport, etc.)	120.9	--	420.0	540.9
4. Total	847.2	998.5	1973.4	3819.1
5. Average per Expatriate (FCFA)	618,800	729,400	1,441,500	2,789,700
6. Average Expatriate Cost per Student[1] (FCFA)	13,691	16,139	31,895	61,725

Notes:

[1] Based upon 1971 enrollment of 55,636 in public secondary schools.

Source: Calculated from, "dépenses communes" in République de Côte
d'Ivoire, Budget Général de Fonctionnement -- Gestion 1971, and
Loi de Finances Rectificative 1971, (Abidjan, 1971).

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Table C-3: <u>Secondary School and Higher Education[1] Amortisation Costs Per Student Year Subdivided into Tradeable and Local Components--1971.</u>

(FCFA)	Costs Per Student Year[2]	Tradeables[3]	Taxes[3]	Local[3]
1. Construction	42,500	9,710	3,280	29,510
2. Furniture	7,500	5,030	247	2,223
3. Equipment	7,500	6,735	77	668
4. Vehicles[4]	500	500	--	--
TOTAL	58,000	21,975	3,604	32,421

Notes:

[1] Excludes dormitory and restaurant facilities for higher education.

[2] Costs per student year based upon approximate school contruction cost per student of FCFA one million from data given in Ministère du Plan, <u>Loi Programme des Invest-issements Publics Pour les Années 1973-1974-1975</u>, (Abidjan, 1973). Eighty-five percent of this cost was assumed to finance construction and seven and one-half percent each for furniture and equipment (authors' estimates based upon educational planning documents, especially <u>Les Depenses d'Education...</u>). Construction costs were depreciated over twenty years; furniture and equipment over ten years.

[3] Authors' estimates from national income accounts data assuming no import duties or value-added taxes, a profits tax of ten percent, and autos being imported directly.

[4] Based upon vehicle costs given in <u>Budget Général de Fonctionnement-Gestion 1971.</u>

Finally, tradeable and non-tradeable inputs were separated. To each were applied coefficients for their local, tax, and foreign exchange components.[1] Then all items were expressed in per student equivalents. Annex Table C-4 provides the detailed breakdown while Table 3 of the text summarizes total per student domestic resource, tax, and foreign exchange costs.

b. Higher Education. It was difficult to finely classify the elements of higher education expenditures since the budget of University of Abidjan does not enter the national budget directly. The government budget indicates its direct budget subsidies to various activities of the University; other donor countries (predominantly France) contribute the remainder of operating costs. Using a method similar to that of secondary education, we have imputed elements found in the government budget and estimates of these other contributions to the various foreign exchange, tax, and local components of expenditures. These estimates are found in Annex Tables C-5 and C-6 which follow. Below we give a short description of our method used in arriving at the estimates of Table C-5.

1) Column 2: From the 1971 budget, items imputable to higher education are: (a) funds directly budgeted to the Office of Higher Education (Direction de l'Enseignement Supérieur); (b) the Higher Education Office's share of central ministry expenses, and (c) the Higher Education Office's share of budgeted governmental common charges. In addition, scholarships to higher education are taken from the transfer and subsidy account of the general government budget.

2) Columns 3 and 4: The 1971 budget for the University of Abidjan was FCFA 510 million. The French contribution was FCFA 311 million;[2] the Ivorian share 199.[3] These budget values include only local personnel and material costs. For lack of a detailed breakdown, coefficients for secondary education are applied to these amounts.

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[1] Again estimated from Comptes de la Nation 1972.

[2] UNESCO, Côte d'Ivoire, Education et Développement, (Paris, 1973), Volume 1, p. 67.

[3] Consisting of a FCFA 173.3 million contribution to the University plus FCFA 25 million to the research center and student groups.

Table C-4: Detailed Decomposition of Educational Costs Per Student-Year in Secondary Education

(FCFA)	Total	Domestic Resources	Taxes	Foreign Exchange
1) Personnel[1]				
a) Local Salaries	34688	34688	--	--
b) Ivor. Cont. to A.T.	35322	6449	9612	19256
c) Ivor. Indirect Cont. to A.T.	26397	9687	4078	12633
d) Aid Element of A.T.	40645	7420	11061	22158
e) Scholarships	5505	5505	--	--
Subtotal	142557	63749	24751	54047
2) Non Tradeables				
a) Postal	431	324	2	87
b) Water	296	207	50	38
c) Electricity	651	247	111	293
d) Bldg. Main	207	105	50	52
e) Auto Maint.	47	26	10	11
f) Local Transport	365	201	58	106
Subtotal	1979	1110	281	587
3) Tradeables				
a) Office Supplies	230	69	35	126
b) Tech. Supplies[2]	56	--	--	56
c) Gas/Oil	61	23	29	9
d) Diverse[3]	16362	7363	3763	5236
Subtotal	16709	7455	3827	5427
4) Amortisation[4]				
a) Construction	42500	29510	3280	9710
b) Furniture	7500	2223	247	5030
c) Equipment	7500	668	77	6735
d) Vehicles	500	--	--	500
Subtotal	58000	32401	3604	21975
TOTAL	219245	104715	32463	82036

Notes:

[1] The average expatriate income in secondary education excluding Ivorian indirect contributions (housing, etc.) was FCFA 3,433,468.

[2] To calculate this item, it was assumed that all was imported, subject to a 5 percent duty plus TVA and a 30 percent commercial margin applied.

[3] Vehicles and technical supplies imported directly by the government duty free.

[4] See Annex Table C-8.

Table C-5: <u>Costs Per Student Year of Higher Education -- 1971[1]</u>

(FCFA Millions) (1)	From 1971 Budget (2)	From 1971 Ivorian Cont. (3)	University Budget French Cont. (4)	Aid (5)	Misc. (6)	Total (7)	Total/ Student[2] (8)
1) Personnel							
a) Local Salaries	65.9	129.3	202.1	--	--	397.3	119,777
b) Ivorian Salary Payments to Expatriates	33.9	--	--	--	--	33.9	10,221
c) Ivorian Indirect Contributions to Expatriates	25.3	--	--	303.4	--	328.7	99,096
d) Aid	39.3	--	--	829.4	--	868.7	261,893
SUBTOTAL	164.4	129.3	202.1	1132.8		1628.6	490,987
2) Scholarships	260.0	--	--	123.5	--	383.5	115,616[3]
3) Postal/Telephone	.5	1.5	2.4	--	--	4.4	1,326
4) Water	.4	1.1	1.7	--	--	3.2	964
5) Electricity	.8	2.4	3.8	--	--	7.0	2,110
6) Office Supplies	5.1	0.9	1.3	--	--	7.3	2,201
7) Technical Supplies	5.6	0.2	0.3	--	--	6.1	1,839
8) Clothing	.2	--	--	--	--	0.2	60
9) Building Maintenance	2.2	0.8	1.2	--	--	4.2	965
10) Auto Maintenance	1.7	0.2	0.3	--	--	2.2	663
11) Gas and Oil	1.2	0.2	0.3	--	--	1.7	512
12) Local Transport	--	1.5	2.3	--	--	3.8	1,146
13) Diverse	4.2	61.0	95.3	--	88.3	248.8	48,388
TOTAL	446.3	199.1	311.0	1256.3	88.3	2301.0	666,777 (809,911)

Notes: [1] Excluding amortisation except C.N.O.U.   [2] 1971 enrollment was 3317

[3] However, scholarships to Ivorians are estimated at FCFA 258,750 per year. The total in parentheses includes this additional amount.

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Table C-6: Detailed Decomposition of Educational Costs
Per Student-Year in Higher Education

(FCFA)	Total	Domestic Resources	Taxes	Foreign Exchange
1) Personnel				
a) Local Salaries	58,848	58,848	---	---
b) Expatriate Salaries	333,043	110,640	74,156	148,346
c) Expatriate Housing, etc.	99,096	36,362	15,207	47,420
Subtotal	490,987	205,850	89,363	195,766
2) Scholarships	258,750	258,750	---	---
3) Non-Tradeables				
a) Postal	1,326	1,021	27	278
b) Water	964	675	164	125
c) Electricity	2,110	801	359	950
d) Bldg. Maintenance	965	492	232	241
e) Auto Maintenance	663	392	119	152
f) Local Trans.	1,146	608	206	332
g) Dorm Rental[1]	10,914	6,767	2,401	1,746
Subtotal	18,088	10,756	3,508	3,824
4) Tradeables				
a) Office Supplies	2,201	660	335	1,206
b) Tech. Supplies	1,839	---	---	1,839
c) Clothing	60	18	17	25
d) Gas/Oil	512	107	241	164
e) Diverse	48,388	21,775	11,128	15,485
Subtotal	53,000	22,560	11,721	16,719
5) Amortization				
a) Construction	42,500	29,510	3,280	9,710
b) Furniture	7,500	2,223	247	5,030
c) Equipment	7,500	668	77	6,735
d) Vehicles	500	---	---	500
e) CNOU[2]	15,706	8,849	483	5,874
Subtotal	73,706	41,250	4,587	27,849
TOTAL	894,531	539,166	109,179	245,886

[1] In 1971, 41% of students using CNOU dormitory facilities were in buildings rented by the university. If half the aid to CNOU was allocated for housing, then 20.5% was used for rental. Our estimated rental coefficients are applied to this value to obtain the estimates here.

[2] Includes the remainder of housing subsidies to which amortization coefficients of Table C-8 were applied. See also note 1 above.

3) Column 5: France and other donor countries provided professors for the various academic departments. In 1972, the French cost was estimated at FCFA 1060 million.[1] Enrollment in 1972 was 26 percent greater than in 1971. Therefore expatriate salaries in 1971 were estimated at 74 percent of the 1972 value (or FCFA 784.4 million). Other donor countries provided approximately fifteen professors. With an estimated annual cost of FCFA three million each, the total then becomes FCFA 829.4 million. The Ivorian indirect contribution is calculated using coefficients for secondary education (.3659 of Ivorian and French direct contributions to assistance technique).[2]

Donor countries also grant scholarships. Assuming that the average scholarship is FCFA 345,000 per year,[3] and that 75 percent of enrolled Ivorians receive scholarships, the total scholarship bill was FCFA 383.5 million (.75 x 345,000 x 1,976). Since the Ivorian government budgeted FCFA 260 million, the remainder (FCFA 123.5 million) was given by aid donors.

4) Column 6: Miscellaneous includes the lodging portion[4] of the subsidy to the food and housing division of the University (Centre National des Oeuvres Universitaires). This subsidy was FCFA 166.6 million and covered 70.6 percent of its operating expenses.[5] The remainder was financed by student fees. This value was arbitrarily divided evenly between food and lodging. Lodging is entered here as diverse expenditures. In Table C-6, it is broken into rent and amortisation.

In calculating the domestic, tax and foreign exchange components of these costs in Table C-6, we again divided total expenditures into personnel,

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[1]Karl Englund, Rapport Annuel sur l'Assistance au Développement--Côte d'Ivoire 1972, (UNDP, Abidjan, 1973), mimeo, p. 7.

[2]Our calculations are substantially higher than estimated in most planning documents and may be subject to error. See: Ministère du Plan, Programme de Développement de l'Education et de la Formation 1971-1975, (Abidjan, 1969), p. 111 for an estimate of FCFA 120 million.

[3]FCFA 25,000 per month for ten months plus supplements of FCFA 95,000 (Education Ministry estimates). In 1974, scholarships rose by 40 percent to FCFA 485,000.

[4]Food costs are excluded in our formulation since the student's eating habits probably are the same whether in school or not. However, lodging may be much better for students than non-students and we include all of its costs in the analysis.

[5]UNESCO, op. cit., p. 67.

non-tradeables, tradeables, and amortisation. To each in turn was applied our national accounts' coefficients. Housing caused a further complication since it was not given separately in the C.N.O.U. subsidy. We assigned 41 percent of the housing subsidy to rents[1] and the remainder to amortisation.

2. Salaries, Non-Tradeables and Amortisation.

a. Salaries:

1) Consumption: A typical market basket of goods consumed by expatriates[2] was decomposed into tax, domestic resource, and tradeable components using coefficients based upon estimated commercial margins in the national accounts data, indirect taxes (TVA and duties) and estimated domestic resources included in each item. Annex Table C-7 reports our results. Foreign exchange elements were 46 percent of consumption.

2) Direct Taxes on Income: Income taxes were estimated using Ivorian tax schedules.[3] Average tax rates ranged between nine and fifteen percent for most expatriates.

3) Savings: Savings and vacations have been estimated at twenty-six percent of income.[4] This estimate may be low for various reasons discussed in the text. Nonetheless, it was taken as an average for all expatriates. All savings and vacation pay were treated as foreign exchange.

The total foreign exchange element of income received was the sum of savings and consumption of tradeables. To calculate the latter, we first subtracted savings (26 percent), and income taxes (9-15 percent) from income received. From this remainder that is consumed in the Ivory Coast, 46 percent was foreign exchange (Table C-7).

b. Income in kind: For income received in kind, we used detailed accounting data from a sample of 22 manufacturing firms. In this sample,

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[1] UNESCO, ibid., reported that 41 percent of students using C.N.O.U. dormitory facilities were housed in rental units.

[2] Association Interprofessionelle des Employeurs de la Côte d'Ivoire, Consommation Familiale Européene, (Abidjan, 1973), mimeo.

[3] Ministère des Finances et de l'Economie, Code Général des Impôts, (Abidjan, 1974).

[4] From estimates in various Planning Ministry studies.

Table C-7:   Coefficients for Expatriate Consumption

Category	Taxes (%)	Local (%)	Foreign Exchange	Total Category/ Total Consumption
a) Food	18	23	59	18
b) Drink	33	22	45	5
c) Household Items	26	22	52	5
d) Servants	20	80	--	5
e) Clothing	30	15	55	12
f) Personal Services Toilet Articles	26	30	44	6
g) Leisure and Entertainment	22	28	50	28
h) Education	--	63	37	4
i) Transport	30	4	66	16
TOTAL	25	29	46	100

transportation allowances per expatriate were approximately FCFA 450,000, and retirement and other benefits in the home country were 6.82 percent of income. Both of these items were assigned as foreign exchange costs.

The authors estimate that housing provided by the firm costs FCFA 2.4 million per year per expatriate. To this cost, we applied estimated coefficients for amortisation and utilities (Tables C-8 and C-9), using the assumption that amortisation could be roughly divided into construction costs--50%; materials and equipment--20%; furniture--10%; local profit--20%.

As an example of our calculations, consider an expatriate with an income of FCFA three million. Total foreign exchange costs of maintaining this expatriate are savings (26%) and the tradeable content of consumption (income minus savings minus income taxes all multiplied by 46 percent) plus transport (FCFA 450,000) plus retirement (6.82% of income) plus tradeables in housing (FCFA 813,000) for a total FCFA 3,105,132.

c. Non-Tradeables and Amortisation: Annex Tables C-8 and C-9 give our estimates for non-tradeables and amortisation. Both these tables were originally calculated for the authors' study of incentives in Ivorian manufacturing. Each applies equally as well to the calculations of this study. For amortisation, two rates for equipment are shown. These refer to firms importing capital goods under special tax considerations (régime prioritaire) and others (régime de droit commun). For expatriate housing, the non-priority rate was applied to our estimated amortisation costs. The coefficients found on this table were adjusted for cases where the government imports directly or allows duty-free entry on imported goods in educational investment.

Table 4 of the text summarizes our estimated decomposition of expatriate incomes into taxes, domestic resources, and foreign exchange for the four occupations.

Table C-8: Coefficients for Amortization

		Foreign Exchange	Import Duty	Domestic Resources
Construction		.21	.08	.71
Equipment	P	.88	.02	.10
	NP	.81	.10	.09
Vehicles		.65	.12	.23
Furniture		.57	.15	.28

P – Priority firms exempt from import duty on machinery and equipment.

NP – Non-priority firms.

The duty on machinery for priority firms comes from depreciation, fuel, etc., in transport and installation of the equipment.

Table C-9: Coefficients for Non-Tradeables

National Accounts Branch	Foreign Exchange	TVA	Duty and Fuel Taxes	Domestic Resources
Repairs & maintenance - garages	.23	.15	.5	.57
Repair - electrical and mechanical equipment	.41	.15	.10	.34
Electricity	.45	.15	.02	.38
Water supply - Abidjan	.13	.15	.02	.70
Repairs & maintenance - buildings & grounds	.25	.15	.09	.51
Road transport	.29	.0	.11	.60
PTT	.21	.0	.02	.77
Rent of buildings	.16	.15	.06	.67
Insurance	.15	.15	.04	.66
General business services	.08	.15	.02	.75
Commercial margins	.12	.15	.03	.70

Sources: Estimated from national accounts data and supplemented by firm level data and information on import duties and other taxes.

Annex D: Foregone and Alternative Earnings

Data from the 1971 Labor Force Survey[1] formed the basis of our estimates
of earnings patterns during and after training. The discussion of the equiva-
lency ratio estimates in the text summarizes these income streams for each oc-
cupation. (Section IV.A). However, it was necessary to adjust these estimates
to account for scholarship payments[2] during training and to adjust for unem-
ployment and underemployment possibilities. The discussion which follows ex-
plains these adjustments.

1. Foregone earnings: For want of accurate unemployment data, we made
several assumptions relating to the opportunity costs of foregone earnings
during training for each occupation. These assumptions were:

a. Skilled office training: Foregone earnings are those of an unskilled
office worker minus a 25 percent unemployment adjustment and the scholarship.

b. Supervisory training: Foregone earnings consist of a weighted av-
erage of skilled office worker wages (75%) and unskilled wages (25%) minus the
scholarship. That is, all workers successfully completing four years of sec-
ondary education find employment, but only seventy-five percent as skilled of-
fice workers. The remaining twenty-five percent are employed as unskilled of-
fice workers.

c. Technicians: Under occupation-education hypothesis one, foregone
earnings are a weighted average of skilled office wages (25%) and supervisory
wages (75%) minus the scholarship. Under occupation-hypothesis two, we assume
that all students receiving a baccalauréat are or can be employed as super-
visors because they receive one more year of education than under hypothesis
one. Therefore, under hypothesis two, foregone earnings during technician
training are those earned by supervisors minus the scholarship.

d. Management: Under occupation-education hypothesis one, foregone
earnings represent a weighted average of technician wages (75%) and super-
visory wages (25%) minus scholarships. Under occupation-education hypothesis
two, we assume all students completing two years of university training are
capable of finding employment at the educational level at which they are trained
(technicians).

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[1] Enquête Main d'Oeuvre--1971.

[2] Scholarships in secondary school are FCFA 5,505 annually; in university,
they are FCFA 258,750.

The rather high rate of unemployment expected in alternative employment during the first cycle of secondary education is based upon very fragmentary evidence of unemployment in the late 1960s. Unemployment data in the Ivory Coast are very rudimentary. Urban unemployment estimates vary from seven[1] to twenty-five percent.[2] However, in late 1969, recorded unemployment of those workers with primary and secondary education numbered 35,340.[3] Total employment in modern sector occupations for which these unemployed might have been qualified was 77,354 in 1970.[4] Recorded unemployment as a percentage of recorded modern sector employment plus recorded unemployment was 31.36 percent.[5] In light of these figures, an educated guess of a 25 percent unemployment rate seems reasonable for unskilled office labor.

With our assumptions, there is no unemployment for workers having four or more years of secondary education. However, we allow for the possibility that our occupation-education hypothesis one may be too low. Not all trainees may find work at the level for which they were trained. The large increases in secondary school enrollment indicate that the occupation-education relationships may rise in the near future and provide support to our assumptions under hypothesis one.

Annex Table D-1 below summarizes our estimated foregone earnings.

2. <u>Alternative Earnings</u>: In a manner analogous to that of foregone earnings during training for skilled office employment, we assume that alternative earnings consist of unskilled office worker wages[6] minus a twenty-five percent unemployment adjustment. In turn these earnings were discounted and summed over the replacement period. Annex Table D-2 below presents our estimates for various discount rates.

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[1] Reported in A. Achio, <u>Le Problème du Chomage en Côte d'Ivoire</u>, Ministère du Plan, (Abidjan, 1970), mimeo.

[2] Estimated in Bangoura Moktar, <u>Population et Développement Economique: Un Exemple--La Côte d'Ivoire</u>, (OECD Development Center, Paris, 1973), mimeo.

[3] Achio, <u>op</u>. <u>cit</u>., p. 12.

[4] Data from the Office de Main d'Oeuvre for semi-skilled and skilled blue collar and office workers.

[5] This percentage corresponds to a thirty percent rate implied for Abidjan in SETEF, <u>L'Image Base 1970 Emploi, Formation, Education</u>, Paris 1973, pp. 122-160, <u>passim</u>.

[6] These earnings are given in <u>Enquête Main d'Oeuvre--1971</u>, volume 2, p. 135.

Annex Table D-1: Net Foregone Earnings
During the Educational Period

	Year					
FCFA Thousands	1	2	3	4	5	6
Office Labor						
Hypothesis 1 & 2	137.2	144.7	144.7	160.6	160.6	178.0
Supervisors						
Hypothesis 1	375.8	393.3	394.7	---	---	---
Hypothesis 2	375.8	393.3	394.7	404.5	408.1	---
Technicians						
Hypothesis 1	1099.0	1178.8	---	---	---	---
Hypothesis 2	1046.0	1098.3	1129.9	---	---	---
Managers						
Hypothesis 1	1399.1	1539.7	1609.1	1656.2	1695.7	1722.2
Hypothesis 2	1604.7	1706.0	1767.6	---	---	---

Annex Table D-2: Present Value of Alternative Income Streams

		Year Flow Begins	Present Value of Flow (FCFA '000s)		
			5%	11%	17%
1) Management:	H_1	13.29	1340.2	364.3	123.6
	H_2	13.39	1333.1	361.0	122.0
2) Technicians:	H_1	8.46	1838.1	619.9	267.4
	H_2	11.16	1541.0	459.5	172.8
3) Supervisors:	H_1	7.27	1974.0	688.9	320.8
	H_2	8.69	1816.9	607.1	259.4
4) Skilled Office Labor:	H_1	4.89	2297.9	916.5	474.4
	H_2	4.89	2291.9	916.5	474.4

Annex E: Calculation of the Evaluation Measures

In the following series of tables, we present our estimates of the variables utilized in calculating the DRC coefficients and the cost-benefit ratios. In each table, column one identifies the occupation, column two, the occupation-education hypothesis, column three, the assumption of continuation of aid; and columns four to six, the values of the variable at each discount rate expressed in thousands of FCFA.

Annex Table E-1: C_t , Domestic Resource Training Costs

(1) Occ'n	(2) Occ'n Ed'n Hyp.	(3) Aid	(4) 5%	(5) 11%	(6) 17%
Office Labor	H_1	No, Yes	924.3	785.0	677.2
	H_2	No, Yes	1013.4	846.5	720.7
Supervisors	H_1	No, Yes	1061.4	881.3	746.5
	H_2	No, Yes	1387.2	1066.7	854.8
Technicians	H_1	No, Yes	1591.4	1164.0	903.4
	H_2	No, Yes	1543.8	1154.2	905.4
Managers	H_1	No, Yes	1813.4	1280.7	967.2
	H_2	No, Yes	2111.8	1435.7	1050.5

Annex Table E-2: FX_t, Foreign Exchange Training Costs

Occupation	Occ'n Ed'n Hypoth.	Aid?	5%	11%	17%
Office Labor	H_1	No	725.1	615.7	531.0
	H_1	Yes	365.9	311.1	268.0
	H_2	No	795.1	663.7	565.7
	H_2	Yes	404.4	335.5	285.3
Supervisors	H_1	No	832.7	691.1	585.4
	H_1	Yes	420.4	349.2	295.6
	H_2	No	972.7	773.2	629.6
	H_2	Yes	270.3	260.1	240.1
Technicians	H_1	No	1062.4	835.1	662.0
	H_1	Yes	240.8	256.3	245.6
	H_2	No	1044.1	814.5	652.9
	H_2	Yes	225.5	220.6	208.4
Management	H_1	No	1188.1	972.6	691.1
	H_1	Yes	153.0	210.2	220.3
	H_2	No	1303.2	943.0	718.9
	H_2	Yes	16.2	114.2	162.5

Annex Table E-3: A_t, Alternative Earnings

Occupation	Occ'n Ed'n Hypoth.	Aid?	5%	11%	17%
Office Labor	H_1, H_2	No, Yes	2279.9	916.5	474.4
Supervisors	H_1	No, Yes	1974.0	688.9	320.8
	H_2	No, Yes	1816.9	607.1	259.4
Technicians	H_1	No, Yes	1838.1	619.9	267.4
	H_2	No, Yes	1541.0	459.5	172.8
Management	H_1	No, Yes	1340.2	364.3	123.6
	H_2	No, Yes	1333.1	361.0	122.0

Annex Table E-4: E_t, Earnings Foregone During Training

Occupation	Occ'n Ed'n Hypoth.	Aid?	5%	11%	17%
Office Labor	H_1	No, Yes	1416.4	1183.9	1008.3
	H_2	No, Yes	1752.4	1414.9	1170.9
Supervisors	H_1	No, Yes	2175.6	1698.5	1365.9
	H_2	No, Yes	2525.4	1881.8	1457.2
Technicians	H_1	No, Yes	3999.7	2696.1	1934.6
	H_2	No, Yes	2880.2	2079.6	1570.3
Management	H_1	No, Yes	4638.5	3030.3	2116.7
	H_2	No, Yes	4635.2	2948.4	2017.3

Annex Table E-5: $M_t + S_t$, Foreign Exchange Savings

Occupation	Occ'n Ed'n Hypoth.	Aid?	5%	11%	17%
Office Labor	H_1, H_2	No, Yes	10,537.3	4,304.2	2,178.7
Supervisors	H_1	No, Yes	28,326.3	10,234.0	4,626.1
	H_2	No, Yes	25,943.1	8,787.0	3,698.8
Technicians	H_1	No, Yes	29,060.0	9,960.2	4,233.0
	H_2	No, Yes	24,572.5	7,417.6	2,758.9
Management	H_1	No, Yes	24,103.6	6,605.2	2,213.2
	H_2	No, Yes	23,949.1	6,534.2	2,179.2

Annex Table E-6: D_t , Domestic Resource Savings

Occupation	Occ'n Ed'n Hypoth.	Aid?	5%	11%	17%
Office Labor	H_1, H_2	No, Yes	3,314.8	1,354.0	685.4
Supervisors	H_1	No, Yes	18,972.6	6,854.6	3,098.5
	H_2	No, Yes	17,376.4	5,885.4	2,477.4
Technicians	H_1	No, Yes	18,413.5	6,311.1	2,682.2
	H_2	No, Yes	15,570.1	4,700.1	1,748.1
Management	H_1	No, Yes	14,345.8	3,931.2	1,317.2
	H_2	No, Yes	14,253.9	3,889.0	1,297.0

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