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THE DEMAND FOR MANPOWER - AN EAST AFRICAN CASE STUDY.\*

I.

The hardest task of the manpower planner, both in theory and in practice, is the choice of the basis on which he calculates manpower requirements at a future date. Given projections of the level (and structure) of future output, and of its rate of growth, should he assume that the number of (say) graduates is to grow at the same rate? Faster? Slower? In any case, is national income (or more precisely, G.D.P. at constant prices) the only variable to which graduate requirements should be related? If not, to what else?

The very nature of these questions, and the way they have been put, betrays the fact that manpower planning, as it is practiced today, is but a bastard child of economics. It counts men against output rather than benefits against costs; it implicitly assumes that the production function (from which the demand for graduates is derived) permits no substitution of one factor for another when relative factor prices change, hence the demand for graduates is not a function of their price. The answers it gives are exact and precise, but leave the Angle-Saxon trained economist with a queer taste in his mouth: they represent no maxima, optima or equilibria, nor any equality of marginal this with marginal that. At first sight, manpower planning may appear virtually indefensible as a respectable exercise in economic analysis.<sup>1</sup>

Unfortunately for respectable economic analysis, it cannot answer the questions the manpower planner asks, which are nonetheless real and must be answered. How much should we spend on the education and training of how many people, if we wish to raise the level of per capita incomes by x per cent in y years? Our analytical tools are still largely of the Marshallian, "natura non facit saltum" kind, contemplating marginal changes in one or at most a few, variables, set in a world of perfect competition with ceteris remaining paribus. Thus the 'rates of return' or 'benefit-cost' approaches to educational planning, even if they manage to find the partial derivative of today's aggregate production-function with respect to education, can only do so (if at all) for comparatively small changes and under very special assumptions. They are simply not meant to answer questions which may involve quintupling university enrolments in a decade, or quadrupling the ratio of School Certificate holders to population in 15 years.

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1. Not entirely, though, Economics can come in when the manpower planner finds that certain jobs can be down-graded from 'graduate' to 'non-graduate' without loss of output; or when he argues that a school place created may not be the same as a school-place filled, nor a qualification obtained the same as a qualification used, unless the wage structure makes private and public benefits coincide.

Yet, what is the purpose of development planning in a poor country, if not to make nature jump through hoops?<sup>2</sup>

The following pages therefore represent an unrepentant manpower-planning approach, written in the knowledge that many a child conceived on the wrong side of the blanket yet lived to achieve respectability, if not eminence.

## II

The approach of the present paper may become clearer if it is realized that it was first written in answer to a specific and practical question of manpower planning in East Africa. The authors were asked by the Uganda Planning Secretariat to suggest an appropriate way of forecasting the long run growth in the needs for high-level manpower, given the present stocks of such manpower and the planned rates of economic growth. Historical data on this theme are virtually non-existent in East Africa, nor are there detailed studies of high-level manpower at the micro-level. Yet the question required an early answer, and was obviously important for co-ordinating plans for schools, scholarships and expatriate recruitment with plans for the rest of the economy. Indeed the feasibility of the economic plans might, to a large extent, be dependent on the availability of skilled and educated manpower. The importance of this constraint could only be assessed by some quantitative estimate of the interrelationship between manpower and output.

In the absence of local data, information from other countries had to be used or the analysis had to be entirely theoretical. As regards the empirical approach, two formulations were available to us.

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2. For a brief but balanced discussion of some of these issues, see Wm. G. Bowen 'Assessing the Economic Contribution of Education: an Appraisal of Comparative Approaches', in "Economic Aspects of Higher Education", Ed. Seymour E. Harris, O.E.C.D. Paris 1964. These problems, particularly the ones which relate to the difficulties of manpower planning, are also discussed at some depth in Chapter VI of the Robbins Report on Higher Education, pp. 70-74. The Commissioners reach the reluctant conclusion that, with manpower-planning in its present undeveloped state, they are unable to make specific forecasts of future demand for graduate manpower though they recommend (Ch. XVII, paras 805-6 and App. IV Part II) the intensification of research to improve the reliability of manpower demand estimates. Yet, one cannot help feeling that the fact that their "recommendations for the provision of (university) places are based essentially on estimates of potential supply" (Report, P. 73, para 182) may resemble a tailor who, in the absence of absolutely reliable information about the shape, size, age and sex of his future customers, refuses to use even the fragmentary information that is available, before cutting his coat(s) according to his cloth. The risks in delaying seem to us to be greater than those he avoids by waiting. This view is reinforced by the Commission's own (and in the circumstances, surprising), favourable comments on manpower-planning in the Soviet Union (p. 74, para 194).

Professor Harbison has suggested a rule of thumb which states that if output(GDP) is to grow by x per cent per year, the stock of "top-level" manpower should grow by 2x, "second-level" by 3x and total employment by  $\frac{1}{2}x$  per cent per year.<sup>3</sup> This rule had already been applied twice in East Africa, in a study by Guy Hunter<sup>4</sup> and in the manpower forecasts of the 1964-69 Kenya Development Plan. However over-simplified this rule might appear, as it had already been used, it deserved serious evaluation.

Secondly there were some recent studies by Prof. Tinbergen's Netherlands Economics Institute, based on regression analysis of high-level manpower and national income in over 20 developed and developing countries. These studies had produced two equations linking the required stocks of top-level and second level manpower with GDP and population. Could these data and methods be applied in East African conditions?

The need to answer, with limited data, a practical planning question was thus our starting point. We first consider whether there is a simple ascertainable relationship between stocks of high-level manpower and national product; then we discuss the relative merits of the Harbison and Tinbergen formulations; and finally we choose what to us appears the most sensible procedure as the basis for a preliminary projection of Uganda's future requirements.

### III

The first need is to define "high-level manpower." For economic purposes, a strictly logical definition should encompass all those who do high-level work, defined in terms of responsibility, technical skill involved, leadership etc. To start by specifying high-level manpower in terms of a particular level of education is to beg many questions which still need investigation. To what extent is formal education a necessary preparation for high-level work? Can long experience or rapid specific training adequately substitute for general education? When examination qualifications are used by employers are they used merely as conventional selection methods, or do they really indicate the minimum educational requirements of a job? Such questions lie at the heart of manpower planning and are of enormous importance to developing countries, equally short of skilled and educated manpower, and of the resources needed to increase their supply.

Nevertheless, whether by convention or by necessity, educational qualification are essential for most "high-level" jobs and for purposes of linking economic and educational plans, categories of high-level jobs have to be identified with the educational qualifications of the persons who normally fill them. Thus although in our present study, we adopt the definition of Category I and II manpower given in Table I below, we shall identify Category I manpower with persons educated to university level or with equivalent forms of higher education and Category II manpower with persons having completed secondary schooling (school certificate or G.C.E. 'O' level) plus some further vocational training. The practical case for such linking of high-level manpower and educational attainment can be strongly argued in underdeveloped countries where manpower is young, promotion rapid, and experience short, but it is nevertheless an assumption rather than a proven fact and should be treated as such.<sup>5</sup>

3. F.H. Harbison: "The strategy of Human Resources Development in Modernising Economies," Policy Conference on Economic Growth and Investment in Education, Vol. III (OECD, Paris, 1962) p.15. The same assumptions are implicit in Harbison's Nigerian Manpower study, published in the Ashby Report "Investment in Education," Lagos, 1960.
4. "Education for a Developing Region", Allen and Unwin 1963, p.59
5. For an excellent treatment of this problem, cf R.S. Eckaus: "Economic Criteria for Education and Training" Review of Economics and Statistics May 1964. Lack of data precluded us from using his admirable methods.

Such matters of definition are even more tenuous when comparisons are made between different countries, as will be seen in Table 1 below. The data show the estimated stocks of Category I and II manpower in relation to GDP in a number of developed and developing countries. It must be realized that not only can definitions of high-level manpower vary, but so can the qualities of graduates and secondary school leavers also. But, while admitting these differences, what can be deduced from Table I about the requirements of high-level manpower in relation to economic growth?

TABLE I.

Manpower Coefficients—an Inter-Country Comparison  
(Ratio of number of persons educated to "Category I" or "Category II" level per \$100.000 of GDP.)

	"Cat.I"/Y ratio	"Cat.II"/Y ratio	Cat.II:I ratio	GDP per capita
India (1955)	2.6	10.7	4.1	67
Greece (1961)	2.5	15.7	6.3	307
Italy (1951)	2.2	5.0	2.3	493
Costa Rica (1950)	2.0	7.5	3.8	348
Spain (1961)	1.8	5.2	2.9	324
Turkey (1961)	1.6	3.9	2.4	201
Kenya (1961)	1.5	4.2	2.8	85
U.S.A. (1950)	1.4	6.3	4.5	2324
Canada (1951)	1.2	5.0	4.2	1767
Brazil (1950)	1.1	5.7	5.2	252
Colombia (1950)	1.0	8.2	8.2	301
France (1954)	0.9	3.3	3.7	1089
Tanganyika (1961)	0.9	2.5	2.9	52
Uganda (1961)	0.9	2.4	2.7	65
Zambia (1964)	0.6	2.0	3.4	220
Venezuela (1950)	0.45	1.5	3.3	715

Source: Cols. 1 & 2: O.E.C.D. data of L.J. Emmerij, quoted in OECD document DAS/PD 63.13, of 18.4.63, except for Greece, Spain and Turkey, which is given in OECD document DAS/PD 63.56 of 9.9.63. Zambia: calculated from data made available to U.N. Economic Survey Mission, 1964. East Africa: calculated from GDP data (EACSO Econ. & Stat. Review Sept. 1963 and manpower data given in Hunter: "Education for a Developing Region", Allen & Unwin, 1963.

Col.4: P.G.Clark & C.R. Frank: Stages of Development and Internationally-Agreed Trade Policies, EDRP 20, 19.2.64

G.D.P. Per capita figures include estimated subsistence income. These figures do not invariably refer to the same year as G/Y in Col.1. It is likely however, that correction of this would affect the ranking of countries by G.D.P. per capita.

Definition: Cat. I: a) Professional men and technologists whose work clearly requires a university degree or equivalent training and b) senior administrators and managers carrying considerable policy and financial responsibility.

Cat.II: Technicians, teachers with secondary education, junior administrators and managers, supervisors of clerical staff and of skilled men, fully trained nurses, senior members of the external service with diploma or post school certificate qualifications or the experience and ability to hold equivalent posts.

It is clear that there is no simple relationship between manpower and GDP. The coefficients of high-level manpower to GDP (the manpower equivalent of capital output ratio) vary widely from country to country, with no obvious pattern between developed and developing countries. This is however, largely as we might expect from a priori reasoning. Consider for instance the Category I coefficient ( $\frac{G}{Y}$ ), which may be expanded by the identity:

$$\frac{G}{Y} = \frac{G}{P} \cdot \frac{P}{Y} = \frac{G}{P} \cdot \frac{1}{Y/P}$$

- where G is the number of graduates, P is population and Y is national Income.

We may expect  $\frac{G}{P}$  (the proportion of Category I manpower in the whole population) to be positively correlated with  $\frac{Y}{P}$  (per capita income), partly because advanced structures of production require more Category I manpower, and partly because richer countries can afford to educate a larger proportion of their population. Thus, there is no a priori reason to expect that countries with higher capita income will also rank high in  $\frac{G}{Y}$ . Their relatively high  $\frac{G}{Y}$  will tend to pull them up, their relatively high  $\frac{Y}{P}$  will tend to pull them down, and conversely with poor countries.

In other words, in a correlation of  $\frac{G}{Y}$  and  $\frac{Y}{P}$  we would expect most 'normal' countries, whether rich or poor, to be bunched in the middle; countries which will rank high will be those with an above average  $\frac{G}{P}$  but a below-average  $\frac{Y}{P}$  (e.g. India, Burma), while low-ranking countries will be those with a below-average  $\frac{G}{P}$  but an above-average  $\frac{Y}{P}$  such as Kuwait or Zambia. (For the 12 underdeveloped countries in Table 1, between the Spearman rank correlation coefficient  $\frac{G}{Y} + \frac{Y}{P}$  is 0.126; the addition of 4 developed countries reduces  $\frac{G}{Y} + \frac{Y}{P}$  this to 0.088.)

IV.

We may now turn to examine the Harbison rule of thumb concerning the increases in high-level manpower required to sustain a target increase in GDP. Harbison's rule can be stated as follows:

$$\frac{\Delta G}{G} = \frac{2\Delta Y}{Y}$$

G standing for "Category I" manpower,  
S " " " " " II "  
Y " for Gross Domestic Product.

$$\frac{\Delta S}{S} = \frac{2\Delta Y}{Y}$$

To the best of our knowledge, the empirical evidence (if any) on which this formulation is based has never been published. Indeed, in some places where Harbison himself refers to it, the discussion is sufficiently qualified to suggest that the rule may be intuitive rather than empirical.<sup>6</sup>

6. e.g. F.H. Harbison "The Strategy of Human Resource Development in Modernizing Economies", in Policy Conference on Economic Growth and Investment in Education Vol.III (OECD, Paris 1962) p.16..

It is interesting to note that this 2:1 ratio again recurs in Harbison & Myers: "Education, Manpower and Economic Growth", p.207, but this time in the form of a theoretical example, rather than an empirical finding suggested in Harbison's previous works. In vain does the reader look to find, among the numerous tables and computations or in the text, references to the countries on whose apparent experience Harbison based his famous 2:1 growth ratio. The statistics are virtually all school enrolment figures rather than numbers of graduates, and it is impossible to use them for the kind of comparisons one would like to make. The authors refer to the difficulty of finding reliable figures of graduate stocks (which is undeniable) but this still leaves the reader wondering on what evidence Harbison based his earlier generalisations. Harbison still asserts (ibid p.200) that at the lower levels of development, graduates and other "High Level Manpower" need to grow faster than output, but he does not say why.

But even intuitive orders of magnitude must be taken seriously, particularly when (in East Africa alone) a national plan, an interterritorial manpower study and an influential publication have each proceeded on the Harbison assumption.

The discussion of the evidence presented in Table I has already shown the absence of any simple relationship between  $G$  and  $Y$ . While it is a cross-section comparison of several countries rather than a time-series, it does suggest that as  $G$  and  $Y$  grow, the former does not grow significantly faster than the latter, otherwise there would have been a better correlation between  $\frac{G}{Y}$  and per capita incomes.

We had three further reasons for doubting the Harbison "rule" even before considering any alternative formulation for which evidence was available.

(i) A formulation of the relationship between  $G$  and  $Y$  along these lines implies nothing about the appropriate number of Category I and Category II manpower at any level of  $Y$ , only about their relative rates of growth. It is implausible to assume that the required rate of growth of graduates is independent of their absolute number.

(ii) The long-run implications of the rule appear most improbable. If, for instance, Uganda, with her present ratio of 1:1,000 between graduates and working population, adopted the Harbison formula, pursuing at the same time a policy of vigorous growth, leading to an 8% increase of per annum in GDP, while population grew at 2½% p.a., in 31 years the ratio of graduates to working population would rise to 3%, or that of the U.K. in the mid-1950-s. Over the same period, GDP per capita would have trebled, to about £74 - that of Ghana around 1960. It seems unlikely, on the face of it, that Uganda needs to reach the educational level of Britain (with per capita incomes over £400) in order to equal Ghana's present level of output per head.

(iii) The assumption that in the course of economic growth  $G$  rises faster than  $Y$  also suggests that  $G/Y$  will be highest in those countries with the highest per capita incomes and vice versa.<sup>7</sup> This was not borne out by the data in Table I, nor did it seem likely on a priori reasoning.

We may also look at the question from another angle, by asking whether it is reasonable to assume for any productive sector that, as its output grows, the number of graduates employed within that sector grows faster.

In so far as graduates perform administrative and managerial functions, one would expect the contrary. Doubling value added (or turnover) does not usually need a doubling on the number of directors, accountants, etc. When graduates perform technical functions, we may again expect their number to grow slower than output, or at most at the same rate, assuming constant technology. It is true that technology often changes as per capita income rises, and this will affect manpower requirements.

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7. Strictly speaking, the Harbison 'rule' only implies that  $\frac{G}{Y}$  rises as  $Y$  rises: there is no mathematical need for  $Y/P$  to rise also. The context of Harbison's discussion, however, clearly assumes rising per capita incomes, and consequently a comparison of  $G/Y$ 's with  $Y/P$ 's is a legitimate test of the "rule".

But it is not always obvious which way it will affect them. The substitution of Comets and Boeings for Dakotas has diminished the number of pilots needed per passenger-mile, and the development of computers has certainly diminished the number of mathematicians per calculation performed. Both in the past and the future, technological change seems to mean the substitution of machines for men doing comparatively routine work. As far as the most highly skilled men are concerned, changing technology will affect the type of man needed and his training, but it is not obvious why, as a result of it, their numbers should grow faster than output. Indeed, the contrary may well be true.

There may be, of course, a type of technological change which means the substitution of graduates (rather than machines) for unskilled, semi-skilled and skilled (but non-graduate) labour. If this were going on a vast scale (and it would have to happen principally in the Government and Services sectors, which employ most graduates), Harbison might still prove to be right. Yet, in so far as there is technical change in these areas book-keepers and wages-clerks are being replaced not by chartered accountants but by computers; building workers are displaced more by mechanised pre-fabrication than by architects; second-rate musicians less by the rapidly rising number of first rate ones than by their recordings (i.e. capital), etc. It would, of course, be better to produce irrefutable quantitative evidence than to cite these examples, but the balance of the argument against the proportion embodied in the "Harbison rule of thumb" still seems to be clear.

It is true that as both incomes and educational opportunities expand, the educational qualifications attached to particular jobs tends to rise.<sup>8</sup> But this is not properly to be regarded as substitution. In the aggregate, what tends to happen is that as less qualified workers retire from the labour force, their younger replacements are generally better educated. It is unlikely that rising educational standards are a significant cause of unemployment, compared to capital/labour substitution and lack of effective demand. It probably is true to say that the least well-educated bear the brunt of fluctuation in employment; except that in highly unionised economies, where dismissals are relatively difficult, this burden is shared by recent school-leavers (who are probably better educated than the average employee with a job!)

V.

Studies of the relation between high-level manpower, national income and per capita income by Prof. Tinkergen's Netherlands Economic Institute have produced the following relationships:-

$$G = 52(Y \cdot 10^{-6})^{1.202} \left(\frac{Y}{P}\right)^{-0.164} \dots\dots\dots 1.$$

$$S = 163.7(Y \cdot 10^{-6})^{1.314} \left(\frac{Y}{P}\right)^{-0.655} \dots\dots\dots 2.$$

- where: Y is GNP in 1957 U.S. dollars

$\frac{Y}{P}$  is GNP/ capita in 1957 U.S. dollars

G is manpower stock educated to university level

S is manpower stock with 12 years of education.

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8. For a clear illustration of this, see R.S.Eckaus, op.cit.



These equations have been derived from regression analysis of data from over 20 developed and underdeveloped countries.<sup>9</sup> Although fuller details of the study are not yet available, the preliminary paper by the Institute states that the  $R^2$  coefficient was 0.845 for the first equation, and 0.857 for the second.

A formulation of this type lends itself to two uses:

- (i) Substitution of actual values for  $Y$  and  $\frac{Y}{P}$  into the equation, and comparison of the resultant solution for  $G$  with its known value may be used as a test of whether a country has the 'right' number of graduates.
- (ii) differentiating the equation with respect to time, and substituting projected values for the growth rates of  $Y$  and  $P$ , one can calculate the "appropriate" growth rate for  $G$ .

Before attempting these two steps with East African data, we must discuss

(a) the legitimacy of using a cross-country regression equation, referring to a point of time, for purposes of projecting a time-series for one country;

(b) the logical and economic implications of the equations themselves.<sup>10</sup>

(a) The drawing of any operational conclusion with respect to one country from an equation of this kind is open to a number of objections. First, the equation assumes that the 'graduates' of one country are the equivalents of graduates of another country on the average, and that consequently differences in the stock of graduates as between different countries are due to differences in  $Y$  and  $P$ , and not (to any significant extent) to differences in the quality of the graduates themselves.

Secondly, reflecting as it does the actual stock of graduates in a number of countries, the equation represents not the economic demand for graduates (i.e. the least number required to produce a given level of GNP), but the outcome of the intersection of a series of supply and demand schedules. Before assuming, therefore, that this state of affairs was, from an economic point of view, optimal, it would be desirable to have independent evidence that such equilibrium did, in fact, exist in the countries covered by the equation (i.e. that the number of graduates broadly corresponded to the number of jobs requiring a degree or its equivalent). Can we, without such empirical evidence, assume that this is likely to have been the case? Yes, if it seems probable that there are strong economic forces driving  $G/Y$  (the number of graduates per unit of output i.e. the manpower equivalent of the capital - output ratio) to a minimum. For all the theoretical shortcomings of the (physical) capital-output ratio, it is widely used for its practical convenience, largely on the simple logic that, because investment is rarely undertaken without the intention to use the resulting asset, there will be forces tending to minimise the ratio of capital to output in every sector. At first sight graduate-output ratios may appear to rest on even weaker foundations than physical capital - output ratios. There is an undeniable "consumption-element" in higher education:

9. "Financial Aspects of Educational Expansion in Developing Regions." Prepared for a recent Conference of the OECD Study Group on the Economics of Education. Sept. 1964

10. In this paper we shall use the first equation only.

it is neither wholly demanded (by its recipients) nor wholly supplied with an eye to its economic effects alone, which means that some of it is never fully utilised in productive activity.<sup>11</sup> Further, the aggregate supply of graduates cannot quickly be increased or diminished in response to shifts in demand, making persisting shortages or surpluses (and hence non-optimal  $\frac{G}{Y}$  ratios) possible. But against this, it can be argued that graduate manpower is alert to its own opportunity-cost and moves relatively freely not only within one country, but across frontiers;<sup>12</sup> that skilled manpower - unlike physical assets - can be retrained in response to changes in demand (after all, physicians have been retrained as farmers in Israel). Finally, there is good reason to assume that, within any one country the supply of opportunities for higher education and the demand from students for such opportunities is sensitive to changes in the demand of the economy for graduates (for upward changes, at any rate), though usually with a lag of several years. All in all, it seems reasonable to assume that, unless Tinbergen's sample included several Far Eastern countries with heavy graduate unemployment, the number of graduates may be presumed to be optimal with respect to current levels of GNP.

Even if we assumed that the ratio of graduates to output found by Tinbergen approximately to an optimum relationship<sup>13</sup> in each of the countries included in the sample, a further problem would still have to be faced. This is the legitimacy of using a multi-country stock - equation for single country flow-projections (i.e. by differentiation). Such procedures would imply either constant technology at each stage of the development process (i.e. if in 10 years' time Uganda had the same GDP and population as Ghana has today, she would produce that output with the same aggregate production function as Ghana does today). Alternatively, it would imply that, even if techniques changed, technical change is neutral with respect to demand for graduates.

11. This difficulty is also present in aggregate measures of physical capital: there must be a considerable amount of investment in non-profitmaking lines of activity mainly within the public sector which is only tenuously connected to the requirements of the economy (in the sense that people would be willing to pay an economic price for the resultant service).

12. Cf. The movement of Indian doctors to Britain, and of educated Greeks to West Germany, or the British "brain-drain" to the USA.

13. It may be legitimately objected that, insofar as "high level manpower" is the main source of innovation (and hence of growth), its optimum numbers should be defined as a function not only of present levels of output achieved but also of future levels of output sought. This view is undoubtedly correct, though it is difficult to make quantitative allowance for it. It applies principally, but not exclusively, to teachers and research workers, whose current output has a present value that is meaningful only in terms of its estimated future benefits. The Tinbergen equation, by lumping "graduates" of all kinds together, may be said to take this point indirectly into account, though it says nothing about the relative proportions of "innovators" and "operators". Eckaus (op.cit.) suggests that this proportion has been rapidly changing in the U.S.A. in favour of the former. In any manpower projection it would clearly be preferable (if it were possible) to estimate first the manpower implications of bringing about and maintaining a desired future level of output by time "t", and then, independently estimating the number of "innovators" required at time "t", in order to make possible a further desired growth by time "t+n". The famous Tinbergen-Correa model of educational planning ("Kyklos", 1963) does separate out teachers - though not other "innovators" - from the rest of the labour force, but its implication is that the number of teachers required at time "t" (the end of the planning period) is indeterminate, for this relates to the (as yet unspecified) growth-target of the next planning period.

The first assumption would clearly be wrong. Techniques do change: there is a closer resemblance between the technology of textile manufacture in Japan and in Uganda today, than there is between textile technology in Uganda today and that in Japan at the time when Japanese income per capita was what it is in Uganda today. The second assumption is easier to accept. Whereas historically the capital-labour ratio has a tendency to rise in virtually all activities, the capital-labour substitution involved is most often that of capital for "routine" labour. (Cf. pp.8-9 above). It can be persuasively argued (and has been by H. Correa among others<sup>14</sup> that capital and graduate labour are complementary factors of production, tending to grow at the same rate. As the capital-output ratio shows a historical tendency either to decline slightly or to remain stable, (this is suggested for instance by Kuznets' study of the U.S. economy over the past century or so), the implication is that over long periods G, growing at the same rate as K, will also grow at the same rate as Y, or possibly slightly slower.

Thus, the objections which can be raised against the use we propose to make of the Tinbergen equation, while real, are not conclusive. An empirical test would have been clearly preferable, and one hopes that when Prof. Tinbergen publishes his results in full, such tests will, in fact, be included. Meanwhile, it seems to us that cautious use of Tinbergen's equation was justified, both as a check on the appropriateness of present manpower stocks in East Africa, and even more as a broad guide to their "proper" rate of growth, given assumptions about the rates of growth of population and GDP.

b) Let us now explore the precise logical implications of the regression equation. The preceding discussion only defended the plausibility of the method of approach rather than the precise content of the equation. Before accepting it as a working hypothesis, it also has to be shown that the propositions made or implied are themselves persuasive (In the present discussion we shall confine ourselves to the first equation).

The equation will be easier to manipulate if we restate it in the form:

$$G = aY^{b-c} P^{-c} = 52Y^{1.038} P^{0.164} \quad 1/a$$

Differentiating 1/a with respect to time, and dividing by G, we get:

$$\frac{dG/dt}{G} = 1.038 \frac{dY/dt}{Y} + 0.164 \frac{dP/dt}{P} \quad 1/b$$

- i.e. the required rate of growth of the number of graduates is a positive function both of the rate of growth of national income, Y, and of population, P; depending far more on the former than on the latter. (Henceforth we shall use  $\frac{G}{G}$  for  $\frac{dG/dt}{G}$ , etc.)

- (i) If population is constant ( $\frac{P}{P} = 0$ ), the required rate of growth of G is slightly higher than that of Y (and, by implication, of  $\frac{Y}{P}$ ).  $\frac{G}{P}$ , graduates as a proportion of population, is rising at the same rate as G.
- (ii) If income is constant, but population is rising, the rate of required increase in G is about one sixth of that of population growth;  $\frac{G}{P}$  is falling.
- (iii) If both Y and P are growing at the same rate ( $\frac{Y}{Y} = \frac{P}{P}$ ) G grows at about one and a fifth times the rate of growth of Y (or P). G/P grows at a fifth of the rate of Y.

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14. H. Correa: "The Economics of Human Resources," (North Hollan Publishing Co., 1963.

It may appear surprising that G should be growing faster in relation to Y when per capita incomes are constant (case iii) than when they are rising (case i). This, of course, is the result of G being a positive function of P. The most plausible explanation appears to be that part of the demand for graduates depends not on income but on population (e.g. the demand for teachers depends on the number of school-children; the demand for doctors on the number of patients etc.) The exponent of Y (1.038) seems on the large side: expecting 'constant returns to scale', there seems to be no intuitive reason why, with  $\frac{Y}{P}$  constant, G should not be growing at the same rate as P (or Y). The implication of falling productivity per graduate is rather odd. It should be noted, however, that  $\frac{G}{P}$  grows over four times as fast in case(i) with  $\frac{Y}{P}$  rising, as  $\frac{G}{P}$  in case (iii) with  $\frac{Y}{P}$  constant.

The implications of the model will be further clarified if we substitute East African figures for the parameters  $\frac{Y}{P}$  and  $\frac{P}{Y}$  into the equation.

One technical problem needs to be solved before we can proceed to test the model. This is the interpretation to be given to Y, P, and  $\frac{Y}{P}$ . In so far as graduates are 'needed' to produce Y, it would seem reasonable to assume that they are needed to produce monetary - but not subsistence G.D.P., as graduates are, by definition, not subsistence producers. Yet, if Y is taken to mean monetary G.D.P. only, should P be correspondingly reduced to include only those involved in its production (and their dependents?) But should  $\frac{Y}{P}$  (a proxy for the standard of living in so far as it affects techniques of production) exclude subsistence income? In so far as G depends on P, it depends on it irrespective of the income of those counted: the child of the (largely) subsistence farmer also needs to go to school; plagues have to be avoided and the sick treated irrespective of the type of income of those involved. Our definitions, (admittedly somewhat arbitrary) therefore are:

Y = total GDP, P = total population  $\frac{Y}{P}$  = GDP per head.

Table 2. Fitting the Tinbergen Equation to East Africa 1961.

Territory	(1)	(2)	(3)	(4)	(5)	100 $\frac{(4)}{(5)}$
	Y	P	Y/P	G	G	
	\$/ mill. USA	(000s)	\$/ USA	Tinb.	Actual	
Uganda	440	6,845	64.1	4,412	4,132	106.8
Kenya	627	8,352	75.3	7,423	9,413	78.8
Tanganyika	498	9,339	52.9	4,735	4,477	105.8
East Africa <sup>15</sup>	1,569	24,536	63.9	18,240	18,022	101.2

All figures refer to 1961.

Source: Y and P: Statistical Abstracts of Uganda (1963). Kenya (1963), Tanganyika (1962)

G (Tinb.): solution of equation  $G = 5.2 Y^{1.202} (Y/P)^{-0.164}$

G (Actual): Guy Hunter: 'Education for a Developing Region', P.58 (George Allen & Unwin, 1963).

15. The figure of 18,240 for East Africa is not the sum of the individual Kenya, Uganda and Tanganyika totals, but the solution of the Tinbergen equation using East African figures for Y, P and  $\frac{Y}{P}$ .

The first thing to notice is how closely the equation fits the East African data. Given the G.D.P. and the population of Uganda in 1961, the equation overestimates the required number of Category I manpower by less than 7 percent. In Tanganyika, the equation overestimates the number by less than 6 per cent. For East Africa as a whole (where the nature of the regression equation means a different estimate for the three territories taken together than for the total of the three estimates made separately), the equation fits within a margin of 1.2 per cent. Only for Kenya does the equation suggest the income level was attainable with a smaller stock of Category I manpower. Even in Kenya, the difference between the estimated and actual requirements is only 21 per cent. (of the actual numbers) and we do know that in 1961 the Kenya economy was operating at significant excess capacity.

It may in fact be useful to mention the different interpretations of a bad fit. If the equation suggests a surplus (a smaller number of Category I men than exists) the reason may be that some Category I men are unemployed, or doing work for which they are "over-qualified". If the equation "predicts" a shortage (greater number of Category I men than are, in fact, available), the reason may be that some men are working at above-average intensity, or that many Category I jobs are filled by less qualified personnel, leading to some decline in standards. Further explanations of this sort could be elaborated, even without raising methodological questions about the definitions of "graduate manpower" or the applicability of the equation to East African conditions.<sup>16</sup>

What does the Tinbergen equation suggest about the required rate of growth of graduates, given assumptions about the growth of G.D.P. and population?

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16. A point needs to be made here about the meaning of the concept 'the right number of graduates', and by implication about the interpretation of a 'shortage', (or a 'surplus'). It can be plausibly argued that if a given level of GDP was actually produced by a given number of graduates, the G/Y relationship is ipso facto appropriate (or at any rate there is no 'shortage'). A higher number of graduates may well be desirable to attain a higher level of output, but not to maintain the level already reached, for that would imply zero marginal product for the additional graduates. The argument is certainly persuasive. Assuming a positive marginal product per extra graduate (and why else should a poor country invest in their education?), it is hard to conceive of increasing their number, without simultaneously increasing G.D.P.

Thus, while an apparent "surplus" of graduates can be relatively easily explained in terms of unemployment and underemployment, a "shortage" needs to be given a much more careful explanation, to avoid the implicit assumption that the additional graduates would have a zero marginal product. A possible assumption would be that they are needed not to increase G.D.P., but to prevent it from falling. If there had previously been a higher level of graduates and this had suddenly been reduced (e.g. through emigration of expatriates), the economic machine they operated might still, for a time, run on without apparent loss of output. To do this, however, it would be necessary to neglect the maintenance of capital assets and to postpone major replacements or necessary changes of direction. Under these circumstances there is a danger of an eventual fall in production, and it is to prevent this that additional "high-level manpower" is needed.

For East Africa, the reasonable range of population growth may be presumed to be between 2 per cent. and 3 per cent. per annum, while a reasonable range of planned (and achievable) rates of growth of G.D.P. may be taken to be 4 to 9 per cent per annum. Substituting these values into the Tinbergen equation, we find that the corresponding range of variation in  $\frac{\dot{G}}{\dot{Y}}$  (the relative rate of growth of the number of graduates in relation to G.D.P.) is between 1.16 (low growth of Y/P) and 1.07 (high growth dY/P). There is thus a near proportionality between the rates of growth of G and Y, irrespective of the assumptions one makes about the specific growth-rate of Y and P. This is in accordance with our a priori argument on preceding pages ( though of course at variance with Harbison type arguments).<sup>17</sup>

As the testing of the Tinbergen equation against East African income and population levels has given us a close enough degree of correspondence with actuality to suggest that it produces right orders of magnitude; while the growth-rates derivable from it correspond to our analysis, we have decided to assume in the ensuing projection for Uganda:

- (a) That the figures of the stock in 1961 are "adequate" overall, there being no empirical reasons to assume either a surplus or a shortage;
- (b) that the substitution into the Tinbergen equation of the appropriate Uganda parameters for the planned or projected rates of growth of GDP and population will give us a reasonable figure for the required rate of growth in the number of graduates.

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17. Strictly speaking the question of the proportionality of the growth rates of G and Y needs to be discussed not only for the economy as a whole, but also on a sector-by-sector basis. In other words, while it is admitted that aggregate G/Y may increase in the course of economic growth simply because those sectors where G/Y is higher than the average also grow faster than the average, this need not mean that within each sector G/Y needs to rise as output grows. This, possibility however, barely affects the proportionality issue, surprising though it may seem. Given, for instance the radical structural transformation of the Uganda economy envisaged by P.G. Clark and B. Van Arkadie ("Development Goals for the Uganda Economy in 1981", Economic Development Research Project, paper 42, East African Institute of Social Research, 1964) which foresees that the sector where G/Y is above the average, should also grow faster than the average, G grows at 8.9% per annum compared to Y's growth of 7.5% (i.e.  $\frac{\dot{G}}{\dot{Y}} = 1.18$  if we assume that within each sector G grows at the same rate as Y. (For detailed calculations, see Appendix Table 1. As the Clark - Van Arkadie projection envisages structural change of a most ambitious kind and still only yields a  $\frac{\dot{G}}{\dot{Y}}$  of 1.18, it may be confidently stated that the explanation for Harbison-type (as opposed to Tinbergen-type) of  $\frac{\dot{G}}{\dot{Y}}$  rates must be sought not in the structural transformation of the economy, but in the tendency of G/Y to rise within each sector as the output of that sector increases. This we have shown to be improbable.

VI.

Application of the Projection Model to Uganda

The preceding discussion has, in a sense, been a necessary preliminary to our practical purpose, which was a projection of Uganda's high-level manpower requirements up to 1981, with some exploration of their educational implications. The projection which follows is partial (i.e. it deals only with University graduates and their equivalents, but not with "second level" manpower: i.e. people with a School Certificate and one to three years of further vocational training). It is also highly aggregative, in the sense that we do not make estimates for graduates of different types, by subject of qualifications. For the initial long run estimation of the number of University places that will have to be created - and the corresponding number of secondary school places which will have to be created in advance of them - an aggregate projection such as this is adequate. The break down of future levels of demand (and its educational implications) by type of skill is a lengthy and complex procedure, and can only be undertaken once a detailed projection of economic activity has been made and has received political sanction.

Our detailed assumptions and projection procedure are outlined in the Appendix.

The conclusions are little short of staggering. The implications of an  $8\frac{1}{2}\%$  rate of growth of GDP (i.e. doubling 1962 per capita incomes by 1981 - the target actually adopted by the Uganda Planning Commission) are:-

- (i) that the number of graduates must increase  $5\frac{1}{2}$  times between 1962-81 (by about 9.3% p.a.), from 4,000 to over 22,000.
- (ii) If full Ugandanisation throughout the economy were sought by 1981, the number of local graduates must increase over 20 times in this period.
- (iii) The intake-capacity of the University (and of secondary schools) could not immediately handle expansion of this magnitude. There will be an inevitable shortfall of "output" in the earlier years, which will have to be compensated for by very large increases in later years. As a result of this, to achieve a 9.3% p.a. average increase in the stock of graduates for the period 1962-81, university intake would have to increase at a rate of 27% per annum from 1965 onwards. If this were undertaken by 1978, the proportion of national income devoted to higher education would have risen 7.7. times above its 1965 level\* (counting recurrent cost only, and assuming constant costs per student) or nearly 3% of 1978 GDP. Expenditure of this order of magnitude would only be possible with a massive injection of foreign aid (for recurrent as well as capital expenditure). Meanwhile, the

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\* If  $\frac{X_0}{Y_0}$  is the proportion of GDP (=Y) devoted to higher education (=X) in 1965, and X grows at 27% p.a. while Y grows at 8.5%, after 13 years

$$\frac{X_t}{Y_t} = \frac{X_0 \cdot 1.27^{13}}{Y_0 \cdot 1.085^{13}} = 7.7 \frac{X_0}{Y_0}$$

principal task of Ugandan educational planners is to produce substantially the per capita costs of University education.

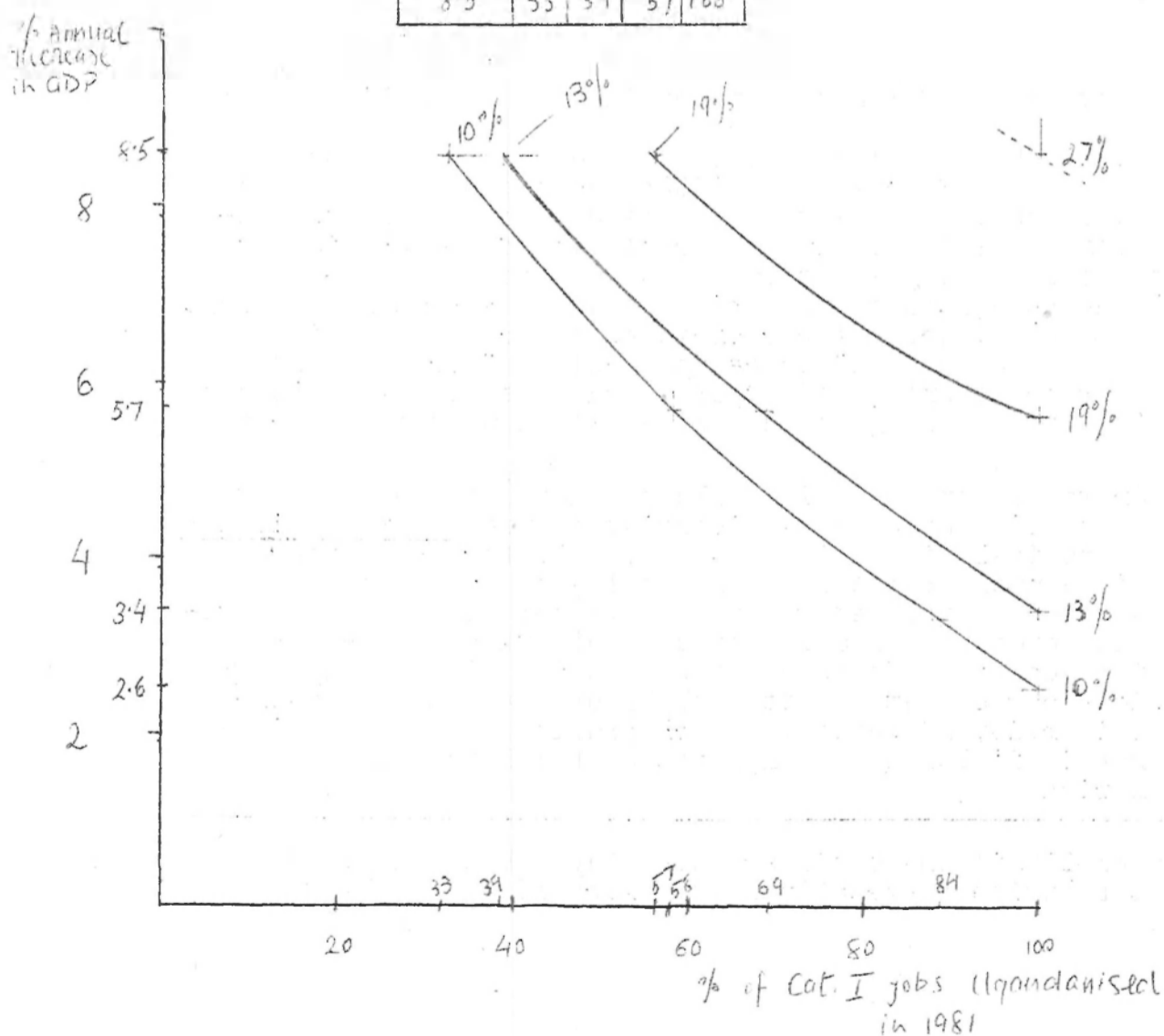
Even if it were possible to sustain such high rates of growth until 1981, it is clear that most of the period until then would be one of acute manpower shortage, which may reach critical proportions over the next six or eight years. During this first phase, the annual additions to stock will represent much less than the required 9.3%, while most of the "wastage" of non-Africans will be concentrated in this period. In order to make rapid growth possible in this transitional phase, Uganda will need to attract (or retain) large numbers of non-Africans to permit the total stock of graduate manpower to grow at the required rate. How successful this will be, depends to no small extent on whether the Government is able and willing to give its Asian community a place in the sun. (Indeed, this holds not only for professional manpower. Asians today are also the principal source of private saving and investment, as well as of entrepreneurial talent.)

Diagram I.

Average rates of increase of annual intake into University level training required for various rates of economic growth and Ugandanisation in 1981.

Degree of Ugandanisation 1981  
if annual intake grows at a rate of:

Annual % Δ GDP	10%	13%	19%	27%
2.6	100			
3.4	84	100		
5.7	58	69	100	
8.5	33	39	57	100





As Diagram I illustrates, the 3 key choices concern (a) the desired rate of growth of GDP; (b) the desired degree of "localisation" of high-level posts by 1981; and (c) the required rate of expansion of university intake, which follows once (a) and (b) are given. For an 8.5% growth-rate and 100% Ugandanisation, the required rate of expansion of university intake is 27% p.a. If this is not feasible, the growth-rate may still be realised if intake rises at a rate of 19%, but Ugandanisation only reaches 57% by 1981; or if the intake rises at a rate of 13%, but Ugandanisation is 39%. Alternatively, the 19% (or 13%) rate of increase in intakes is compatible with full Ugandanisation, if GDP grows at a rate of 5.7% (or 3.4%) per annum. Thus, given a financial constraint on the level of expenditure on higher education, the problem resolves itself to one of a political choice of priorities between economic growth and Ugandanisation.

We end by drawing attention to the implications of some of our important (but uncertain) assumptions.

We implicitly assumed that there will be no major difference between the labour-force participation rates of men and women. (Today women form a negligible fraction of Uganda's graduate manpower; by 1981 they may account for a third of it or more.) If this assumption is wrong, the rates of increase in university intake will have to be raised accordingly. We believe, however, that with proper advance planning, it will be possible to ensure a high degree of labour-force participation by women graduates.

We assumed that there will be no discrimination against Asians graduating from 1965 onwards. As they form about 10% of University enrolments, if this assumption proves false, it will be necessary to raise the rate of increase of African enrolments still further: discrimination has a high economic cost.

Although not all of expatriate "category I" manpower were University graduates in 1962\*, we assumed that all of their Ugandan replacements would need to be. The assumption seems reasonable, for a formal qualification will be these people's only substitute for the years of experience which the non-graduate expatriates had. Furthermore, there is only limited scope for recruiting experienced Africans from the "second level" to be upgraded to "first level" jobs, for the shortage of experienced persons at the "second level" is, if anything, even more acute than at the "first level".

On the other hand, it would be unwise to assume that all the people who need a University degree or its equivalent need to be full-time University students for three years. There is a whole range of high-level jobs (accountants, company secretaries, surveyors, etc.) for which it is possible (and normal) to qualify by a combination of on-the-job training, correspondence courses, evening classes and short sandwich-courses, at a cost much lower than that of full-time University education. Such provision neither exists now, nor is it being contemplated by the University of East Africa.

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\* Especially in the business community: bank managers, senior business executives, managers of large plantations, etc.

It would be idle to pretend that either our methodology of projection, or the specific assumptions we have made, are free from considerable margins of error. Indeed, we have been at some pains to emphasise our speculative assumptions and the crudity of our procedure. Nevertheless, we believe that the absence of perfect data is no excuse for not attempting quantitative answers to urgent quantitative questions; and that, given the limitations of imperfect methodology and data, the procedure we have chosen should yield answers of the right order of magnitude.

APPENDIX

GRADUATE REQUIREMENTS OF UGANDA IN 1981,

ON ALTERNATIVE GROWTH ASSUMPTIONS

1. Given the present stock of graduates (and "graduate equivalents"), their racial composition, and assumptions about wastage-rates among the various racial groups; given the numbers in the educational pipeline now, and the projected rate of population growth, the required rate of growth of the number of graduates will be a function of:-
  - (i) the desired (or planned) rate of growth of real GDP to a chosen target-date;
  - (ii) the desired degree of Africanisation (or "Ugandanisation") at the target date.
2. Given all the above assumptions, and the highest feasible university intake in 1965, one can calculate the required rate of growth of University intake 1965-78 (=output 1968-81), by making further assumptions about the drop-out and failure-rate among University students, and about the mortality-rate among them.  
The three key variables thus are :
  - (i) the planned rate of growth of GDP
  - (ii) the desired degree of Africanisation (or "Ugandanisation")
  - (iii) the required rate of growth of University intake.
3. Given (i) and (ii), (iii) will follow: i.e. there is a growth-rate of University intake corresponding to any given combination of assumptions about the growth of GDP and the degree of Africanisation. If the implied growth-rate of University intake is found not to be feasible either for financial or for "real" reasons (e.g. insufficient supply of qualified entrants), there are two choices open:-
  - (i) to give priority to the growth-rate and reduce (i.e. postpone) the Africanisation target;
  - (ii) to give priority to Africanisation, and reduce the growth-rate. - or, of course, any combination of (i) and (ii) which is compatible with a "feasible" rate of growth of intake.
4. Insofar as the feasibility of the growth-rate of University intake (2(iii) above) depends on a financial constraint, it may not be independent of the planned rate of growth of GDP. For the higher the rate of growth of GDP, the higher the feasible rate of growth of intake.
5. The above key relationships are illustrated in the diagram I (p.15). It will be seen, for instance, that the annual rate of increase in University intake which corresponds to an 8.5% growth-rate of GDP and 100% "Ugandanisation" by 1981 is 27% per annum. Should a 19% rate of increase in intake be considered the maximum feasible, the 8.5% growth-rate could still be attained if the Ugandanisation target were dropped to 57%. (it would also appear from the diagram that 100% Africanisation could be achieved by a 19% annual rate of increase in intake, if the growth-target were dropped to 5.7% p.a. This, however, is doubtful. If the 19% target is the maximum feasible at an 8.5% rate of growth of GDP, it is likely that the maximum compatible

with a 5.7% rate of growth of GDP will be less than 19%. By adding a further equation stipulating the rates of increase in intake which would be feasible at various rates of growth of GDP, the whole system may converge to a unique solution for all three variables.)

6. Below we give our detailed calculations of the educational implications of an 8.5% average rate of growth in real GDP, combined with a 100% Ugandanisation target by 1981. We chose this growth rate partly as a test of the Clark - Van Arkadie projection (op.cit), but mainly because, subsequent to its publication, the Uganda Planning Commission adopted substantially similar growth-targets for the relevant period. This figure, together with the official population-growth projection of 2.6% p.a., enables us to calculate the required rate of growth of the stock of graduates, by substituting these values into the Tinbergen equation (1/b; see page 10 above). The result is  $G = 9.26\%$  p.a. ( $= 1.09 \frac{Y}{Y}$ , which is assumed to be 8.5%).

7. As the estimated 1962 stock of graduates ( $G_{62}$ ) was 4150,\* the required number of graduates at the end of the plan period ( $G_{81}$ ) will be:
- $$1.0926^{19} G_{62} = 22,300$$

This calculation carries the assumption that the 1961/62 stock of graduates was broadly appropriate with respect to the GDP of those years. The required net increase,  $G_{81} - G_{62}$ , is therefore 18,350.

8. We then had to estimate wastage- and survival-rates of the present stock of graduates up to 1981, by racial group. Hunter\*\* gives the racial composition of the 1961 stock of "Grade I manpower" as:-

Europeans	-	50%
Asians	-	35%
Africans	-	15%

The wastage-rates were derived from an unpublished survey covering about 1/3 of the 1962 stock of graduates. (E.R. Rado: "Survey of Uganda's Professional Manpower", 1963.) They were:-

Average Annual Percentage Wastage Rates 1962-81:

	1962-70	1971-81	%surviving '81	%wastage '62-'81
Europeans	9	2½	0	100
Asians	4	3	35	65
Africans	2	2	62	38

\* From Hunter, op.cit; p.58. Hunter's figures refer to mid-1961. In the absence of other information, we assumed that the figure for the beginning of 1962 was substantially the same.

\*\* Ibid.

In actual numbers, the figures are:

	1962 <u>stock</u>	1962-81 <u>wastage</u>	1981 <u>survivors</u>
Europeans	2060	2060	nil
Asians	1430	930	500
Africans	650	250	400
Total	4140	3240	900

9. 1962-67 graduations are broadly predetermined by 1959-64 University intake in East Africa and abroad, adjusted for drop-outs and failures (which are small). Our rough estimate of 1962-67 Ugandan graduations is 900\*. Of these, survivors in 1981 will be about 650.
10. Thus the required number of graduates in 1981 who will have joined the labour force between 1968-81 will be  $22,300 (=G_{07}) - 9000$  (survivors of  $G_{62}$ ) - 650 (survivors of 62-67 graduations) = 20,750. This is not the gross graduate production target, because of normal demographic wastage of University students and graduates between 1965 and 1981.\*\* Because of this, to produce 20,750 graduates who survive until 1981, it will be necessary to produce a total of about 23,000 graduates during the period 1968-81.
11. The cumulative (65-78) intake required to produce 23,000 graduates between 1968-81 will exceed this by the number of undergraduates who enter University but leave without gaining a degree. We have assumed that this wastage-rate will be 10%, i.e. the required cumulative intake = 25,500. (This assumes no drop-outs due to non-academic reasons and continuation of the 90% pass-rate of recent years. This may well prove over-optimistic.)

It also implies that (i) the labour force participation-rate among women graduates will approach 100%, as it does for men, and (ii) there will be no significant emigration or unemployment of Asian graduates due to the pursuance of discriminatory policies against them.

12. The 1965 University intake of Ugandans is largely predetermined by 1964 Sixth Form enrolment in Secondary Schools and by the presumed HSC pass-rate. Assuming this continues at the average of the past four years (i.e. at 60%), the 1965 University intake will be about 250 Ugandans. To achieve the cumulative 1965-78 intake requirement of 25,500 (see paragraph 11 above), intakes after 1965 should grow at a rate of 27% p.a.\*\*\*

\* 425 from Makerere College, Uganda, 50 from the rest of East Africa and 425 from abroad (75% of Uganda students on degree courses abroad).

\*\* The wastage rates assumed, after consulting the UN Model Life Tables for Underdeveloped Countries, were equivalent to an annual average of 1.85% per annum. This is much lower than average death-rates of the relevant age-groups for most

under-developed countries. As, however, the people involved will be in the £1,000 p.a. and over income group, we decided to use current Eire death-rates as our guide.

\*\*\* This is derived by solving the geometric progression,  $x = a \frac{r^{n+1} - 1}{r - 1}$  for r. (x=cumulative intake requirement; a=intake of first year; r = 1 + the required rate of growth of intake and n = the number of years covered.) Substituting the relevant figures, we get:  $25,500 = 250 \frac{r^{14} - 1}{r - 1}$  and r = 1.27, i.e. a 27% rate of growth.

+ were equivalent to an annual average of 1.85%.

13. The projected Six Form enrolments of the years 1965-70 in the Uganda Education Plan are compatible with our growth assumptions, if one can assume that 62% of those who sit for HSC will, in fact, qualify to enter University or its equivalent. This may just be possible, in the light of the 60% pass rate of recent years, though it involves making some heroic assumptions. It should be noted, however, that the Education Plan envisages a falling off in the rate of increase of Sixth Form enrolment to under 15% by the late '60-s, and would have to be raised by 1970 to make the intake target feasible.
14. The financial implications alone cast the gravest doubt on the practicability of a sustained growth-rate of 27% in University intake. It would involve the creation of about 12,000 additional University places for Ugandans by 1978. At present "standards" and at present prices, the capital cost of this expansion would be of the order of £36m., while the annual recurrent cost would be about £13m. by 1978 (compared to under £0.5m. today). These figures are respectively about a quarter and a tenth of Uganda's present monetary GDP, and would still represent 7.5% and 3% of the 1978 GDP, assuming an 8.5% growth-rate in the intervening period. Whether or not these growth targets are adopted, it seems to us vital that the present atrociously high per capita costs of University education should be substantially reduced, together with some fresh thinking about the financing of higher education.
15. While the method of approaching the 1981 target which we outlined in paras. 10 - 12 above has much to commend it, it can also introduce an "accelerator effect" for high rates of growth. According to these calculations, the 1978 intake would be 5,600 ( $=250 \times 1.27^{13}$ ). The 1979 intake, however, would contain no "catching up" element (the target having been reached) and, assuming continuation of the 8.5% rate of growth of GDP, would be 9.26% of the 1981 stock, adjusted for wastage, i.e. about 2,400. Thus this pattern, if followed literally, would involve a drop of almost 60% in University intake from one year to the next, which clearly cannot be contemplated. To shift the impact of the accelerator from the University, it will be necessary to re-phase the expansion programme\* and to send abroad a significant proportion of the intake of the later years. (The expansion plans for secondary schools will have to be similarly re-phased, in the same way and for the same reasons.)

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\* having growth-rates well in excess of 27% in the period 1965-75, in order to permit a tailing off of the rate of growth thereafter.

Appendix, Table I.

Implications of the Clark - Van Arkadie Model for the Required Rate of Growth of Category I Manpower, assuming Equal Growth Rates of Real Output and Cat.I Manpower within each Sector.

Sector	Sector Share in G.D.P. in:		Projected sector growth p.a. 1962-81, %	Estimated distribution of Cat.I men 1962 %	Implied annual growth-rate of Cat.I men %
	1962 %	1981 %			
Agric. (incl. subsistence activities)	63.7	49.0	6.0	7	6.0
(Subsis. sector)	(31.6)	(19.1)	(4.7)	-	-
(cash-Agric.)	(32.1)	(29.9)	(7.1)	-	-
Industry & Transport	13.0	22.8	10.8	21	10.8
Services & Government	23.3	28.2	8.6	72	8.6
Total GDP	100.0	100.0	7.5	100	8.9*

a = subsistence sector  
b = cash agriculture

\* This figure of 8.9% differs from the 7.5% in Col.3, even though both are weighted averages of the same sectoral growth rates. To establish the growth rate of total G.D.P., the sectoral growth rates were weighted by Col.1, while to establish the overall growth rate of the numbers of Cat.I manpower, the same sectoral growth rates were weighted by Col.4.

Source.

Cols. 1, 2 & 3: Clark & Van Arkadie, op.cit.

Col. 4: Authors' estimate, based on Hunter (op.cit.) and official statistics.

Comments.

1. The growth rate of the total stock of graduates is 1.18 times the projected rate of growth of G.D.P.
2. The solution of the Tinbergen equation for a 7.5% rate of growth of G.D.P. (given the semi-official population growth projection of 2.6% p.a.) is 8.25% p.a. for the annual rate of growth of the stock of graduates (or 1.10 for the rate of growth of graduates relative to the growth rate of GDP). These two sets of growth rates are remarkably close, and the introduction of assumptions about sectoral growth rates and the sectoral distribution of graduates does not seem to lend credence to growth formulas of the Harbisonian kind.
3. The corresponding recommendation of Hunter (op.cit.), with Harbison acting as consultant, was that the number of graduates should grow at twice the projected rate of growth of GDP. The solution of the Tinbergen equation for Hunter's growth assumptions would be  $\frac{G}{G} : \frac{Y}{Y} = 1.12$ .

NOTE:

Section IV of the paper unfortunately got out of hand, leaving behind a devastating trail of symbols and formulae. If anyone has the determination to work through this, I would be grateful for his comments. Otherwise I suggest that readers skip to the end of the section, where I have included a summary of what I hope has been proved!

A.R.J.