DEMOGRAPHIC AND TECHNOLOGICAL VARIABLES IN KENYA'S EMPLOYMENT SCENE

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ABSTRACT

One reason why employment growth rate in Kenya has been rather disappointing despite impressive growth of output and capital stock is because in the recent past Kenya has experienced technological progress which is biased against labour usage. Capital per worker is far in excess of capital per head of population. The mode of job creation has been very capital-expensive.

An attack on the problem from the point of view of reducing population growth could only be effective in the long run because most of the working population for fifteen or so years to come has already been born. In order to increase the supply of positions for these workers, ways and means have to be devised for reducing the capital cost per job. One major recommendation is that institutional and educational measures be undertaken to hasten the development and adoption of efficient labour intensive technologies.

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INTRODUCTION

"Any attempt to study employment trends /in Kenya/ runs up against the familiar problem of inadequate data." (5, p. 4) With these words, Professor Dharam P. Ghai underlined the frustration that confronts a quantitatively-inclined inquiry in the absence of adequate relevant data. Ghai's study involved at one juncture the estimation of Kenya's potential labour force in 1969. He postulated this to be 35% of the population. An implicit assumption in this approach is that the potential labour force grows over time at the same rate as the total population.[1] Since Kenya's population is growing at about 3.3% per annum (10, p. 28), it is safe to assume that the limiting rate of growth of the potential labour force is also 3.3% per annum. With an anticipated annual increment to the potential labour force of 3.3%, employment should expand at this

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1. This holds because if we have two entities, P_1 and P_2 where the subscript refers to time, then the growth rate can be approximated by the first difference, namely $\frac{P_2-P_1}{P_1}$. If we attach a participation rate α to the two entities, the growth rate becomes

$$\frac{\alpha P_2-\alpha P_1}{\alpha P_1} = \frac{\alpha(P_2-P_1)}{\alpha P_1} = \frac{P_2 - P_1}{P_1}, \quad 0<\alpha<1$$

This expedient, dictated by data constraint, bypasses consideration of individual participation rates of various age and sex classes. Even the ILO Employment Mission to Kenya discovered that "the usual methods of assessing labour force participation rates did not work". (18, p. 106) In any case, it is possible and useful to talk of an average participation rate at the aggregate level, and α would be such a rate.

rate in order not to exacerbate the level of unemployment.[2] To reduce the unemployment rate in the long run to some acceptable level and to guarantee the ultimate provision of jobs for everyone, employment should expand faster than the potential labour force.

Unemployment is part of Kenya's reality today, as in all late developing countries. The potential labour force has been growing faster than recorded employment, the latter expanding at about 1.9% per year on average between 1964 and 1970. (See Table 1.) This has occurred despite the fact that national income has skyrocketed at about 7.5% per annum.[3] (See Appendix.) Capital, a cooperating factor of production, has been expanding with leaps and bounds. (See Table 2.) The question is: with the permissive factors - output and capital - exercising virtually no constraints, why do we still have relatively disappointing rates of growth of employment? In an endeavour to answer this question, we shall use a basic production relationship as a tool of analysis.

A LABOUR ABSORPTION MODEL[4]

Let us assume a well-behaved production function - a technical relationship between output (Q) and the inputs of capital (K) and labour (N) associated with it:

$$Q = f(K,N) \text{ for } K \geq 0 \text{ and } N \geq 0 \qquad (1)$$

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2. Due to the problem of identifying who is and who is not gainfully engaged in some sectors (particularly in non-monetary agriculture, the so-called informal sector and many service occupations), it is very hard to determine unemployment rates. The 1972 ILO Employment Mission reckoned that about 15% of the urban population is unemployed. (18, p.106) This is a rough estimate. Though we may not know the level of the unemployment rate, its direction of change will depend on the relative changes of the growth in the potential labour force (supply) and employment (demand).

3. It is not true, as the Parliamentary Select Committee on Unemployment contends, that "population growth has surpassed the rate of industrial growth". (9, p. 8) Gross output in the manufacturing and repairing sector has averaged a growth of about 11.73% per annum, which is about four times as great as population growth.

4. The model used here follows closely the pioneering work on India and Japan by John C.H. Fei and Gustav Ranis. (3, pp. 283-313 and 4, pp. 69 ff.)

As a well-behaved production function, this one satisfies the following axioms:

1) Indispensability, namely, to produce any output $Q > 0$, both inputs are needed in positive amounts; i.e., $f(0,0) = f(0,N) = f(K,0) = 0$

2) Non-redundancy, i.e., $f_N > 0$ and $f_K > 0$, where f_N and f_K are partial derivatives of the function with respect to N and K respectively.

3) Law of Diminishing Returns for both factors: $f_{KK} < 0$ and $f_{NN} < 0$

4) Law of Complementarity: $f_{KN} = f_{NK} > 0$ where f_{NK} and f_{KN} are cross partials.

In this sort of regime, the production contour -- the locus of points of the various combinations of capital and labour that will produce the same output -- is convex. To show this, recall that

$$Q = \bar{Q} = f(K,N) \tag{2}$$

so that

$$d\bar{Q} = f_K dK + f_N dN = 0$$

and

$$\frac{dK}{dN} = -\frac{f_N}{f_K} \tag{3}$$

Convexity holds if $\frac{d^2K}{dN^2} > 0$

From (3)

$$\frac{d^2K}{dN^2} = -\frac{f_K f_{NN} - f_N f_{KN}}{f_K^2} = \frac{f_N f_{KN} - f_K f_{NN}}{f_K^2}$$

for

$$\frac{d^2K}{dN^2} > 0, \quad \frac{f_N f_{KN} - f_K f_{NN}}{f_K^2} > 0$$

so that $f_N f_{KN} - f_K f_{NN} > 0$, which holds by the axioms above.

Two production contours or isoquants (Q_1 and Q_2) are shown in Figure 1. Corresponding to output Q_1, there is a marginal product curve for labour (MPP_N) which we label M_1. Assuming profit maximising behaviour, equilibrium will occur at the point where MPP_N is equal to labour's remuneration -- labeled W for wage. At this point N_1 people will be employed.

The production relationship (1) uses variables that refer to a particular period of time so that it should be written

$$Q_t = f(K_t, N_t)$$

but we left out the time subscript for notational convenience. Inescapably, however, the production relationship is greatly influenced by factors which are highly correlated with time. In particular, there are such factors as disembodied technical change which are independent of the stock of capital or number of labourers engaged; there are also such things as "learning-by doing".

To take account of these dynamic relationships, the production function (1) is modified to take time (t) explicitly as a variable. Hence,

$$Q = f(k, N, t) \qquad (4)$$

From this relationship we can get a magnitude f_t/Q or in discreet terms with reference to Figure 1 $(Q_1' - Q_1)/Q_1 = (Q_2' - Q_2)/Q_2$. This we shall call the <u>Intensity of Innovation</u> (J). It measures the fractional increase of output due entirely to the passage of one unit of time. It is caused solely by changes in the state of the arts (innovations) occurring through time and is, therefore, an index of the strength of output-raising effects of technological change.

Curve M_0 is constructed to correspond to <u>neutral innovation</u> of the same intensity as M_1'. M_0 can be obtained by blowing up (i.e., multiplying) the pre-innovation MPP_N curve M_1 by the constant (1+J). That M_0 and M_1' have the same innovational intensity (by construction) is seen by the equality of the area of the two shaded triangles ABC and CGF thus keeping total output after innovation (Q_1') constant.

Thus far, the total magnitude of labour absorbed due to innovations only (with capital stock constant at K_1) is a function of the following three factors (4, p. 95):

1. The height of point F relative to point E_1, representing the intensity of the innovation, that is how much the initial production contour has been blown up;

2. The height of point G relative to point F representing the degree of labor-using bias of the innovation;

3. The steepness or flatness of the M_1' curve representing the relative strength or weakness of the law of diminishing returns to labour. (The flatter M_1' the further to the right equilibrium point E_1'.)

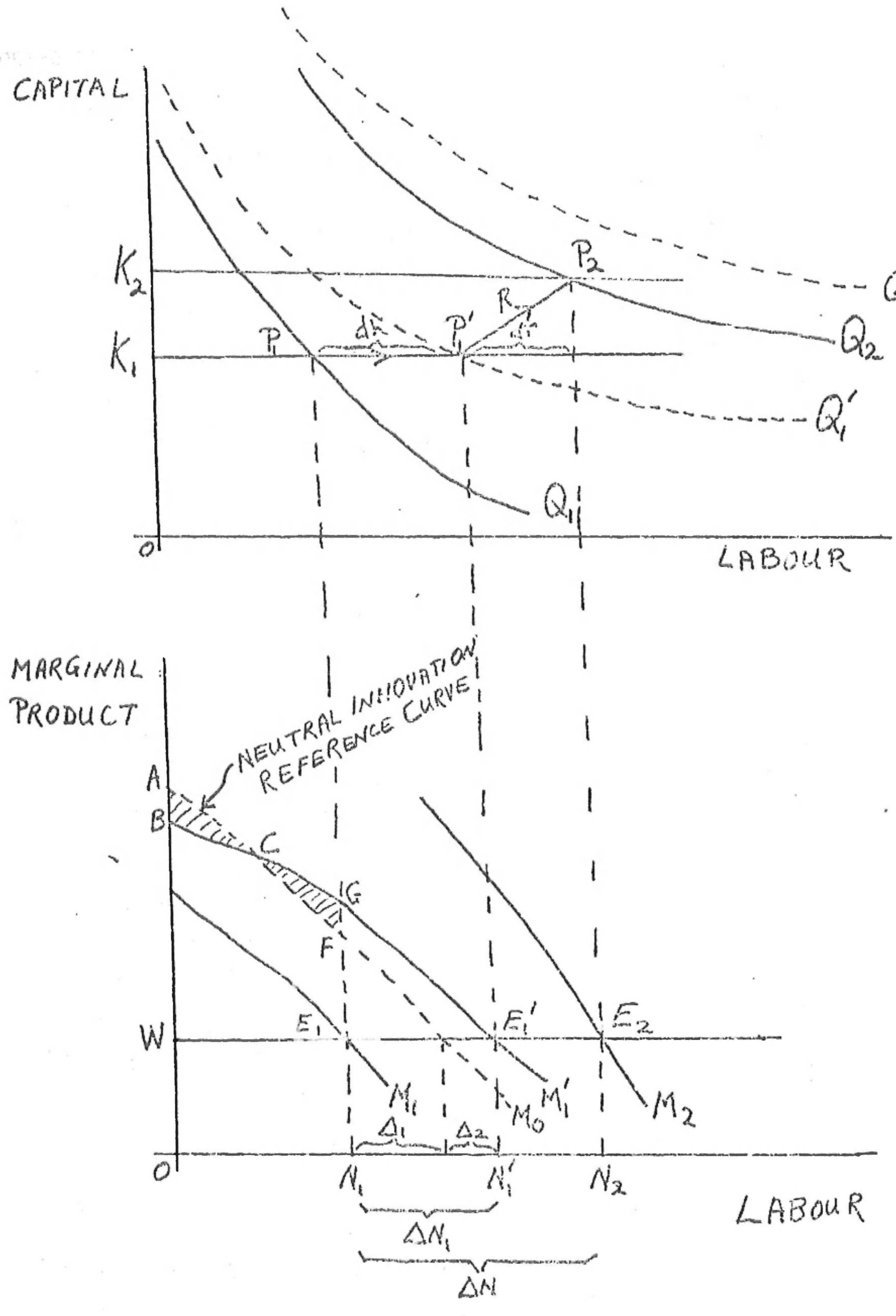

FIGURE 1
Production Map and Labour Demand Curves

Labour absorption due to technological change only is represented by a horizontal movement (arrow dh) which we call the Horizontal Effect.

Assume an increase in capital stock from K_1 to K_2. The new equilibrium point is now P_2. The labour absorption due to capital accumulation only is represented by a radical movement (arrow R) or more precisely by the horizontal projection of arror R, denoted by arrow dr which we call the Radical Effect.

An important growth equation can be derived from the production function (4), namely, the rate of growth of MPP_N ($=f_N$) which can be got by differentiating $W = f_N = f_N(K, N, t)$ with respect to t.

$$\frac{dw}{dt} = \frac{df_N}{dt} = f_{NN}\frac{dN}{dt} + f_{NK}\frac{dK}{dt} + f_{Nt} \qquad (5)$$

or

$$\eta_w = \eta f_N = \frac{(df_N/dt)}{f_N} = \frac{f_{NN}N}{f_N}\eta_N + \frac{f_{NK}K}{f_N}\eta_K + \frac{f_{Nt}}{f_N}$$

$$\eta_w = -\varepsilon_{NN}\eta_N + \varepsilon_{NN}\eta_K + H_N \qquad (6)$$

where $H_N \equiv \frac{f_{Nt}}{f_N}$ is time rate of increase of MPP_N.

The rate of growth of the variable subscripted is symbolised by η and ε_{NN} denotes the percentage decline of MPP_N per unit of percentage increase in the labour force, holding capital constant. It can be taken as an index measuring the strength of the law of diminishing returns to labour as more and more labour is added to a given capital stock. The more pronounced the law of diminishing returns the steeper the MPP_N curve and the larger the elasticity ε_{NN}.

From (6) we get

$$\eta_w = \varepsilon_{NN}(\eta_K - \eta_N) + B_N + J \qquad (7)$$

where $B_N = H_N - J$ and B_N is called the Degree of Factor Bias. An innovation is said to be in the labour-saving (or capital-using) direction if the MPP_N is raised, in percentage terms, less than the intensity J. Conversely, when the MPP_N is raised more than J, in percentage terms, innovation is said to be biased in the labour-using (or capital-saving) direction.

From (7) can be derived

$$\eta_N = \eta_N + \frac{B_N}{\varepsilon_{NN}} + \frac{J}{\varepsilon_{NN}} - \frac{\eta_w}{\varepsilon_{NN}} \qquad (8)$$

which is a labour absorption equation.

It will be noticed that the growth in wage rate, η_w, exerts a negative influence on the growth rate of employment, η_N. But in their framework Fei and Ranis assume a labour-surplus economy in which, as in the analysis of Arthur Lewis (11) the wage rate remains constant (or roughly so) so that $\eta_w = 0$. In our case, the main concern is how much labour will be demanded at <u>any given supply price of labour</u>. This amounts to examining the forces which determine the level as well as the position of the demand curve for labour over time. We shall, therefore, take the simplifying expedient[5] that $\eta_w = 0$.

Equation (8) is reduced to

$$\eta_N = \eta_K + \frac{B_N + J}{\varepsilon_{NN}} \qquad (9)$$

$\frac{J}{\varepsilon_{NN}}$ corresponds to Δ_1 in Figure 1 and is the <u>Intensity Effect</u>.

$\frac{B_N}{\varepsilon_{NN}}$ corresponds to Δ_2, the (labour-using) <u>Bias Effect</u>.

$\Delta_1 + \Delta_2 = \Delta N_1$ which is the <u>Horizontal Effect</u>.

We observe that more labour will be absorbed if

1) innovational intensity (J) is high;
2) innovations are more biased in the labour-using direction (B_N is high); and
3) the law of diminishing returns is operating less strongly (ε_{NN} is small).

Our analysis indicates that, besides accumulating as much capital as possible (either domestically or through foreign aid) the economy should seek innovations of as high intensity as possible and, given intensity, subject to as high a labour-using bias as possible. We shall see how well Kenya has done in this regard by:

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5. Appendix II - A in 15, pp. 163-165, suggests that $\eta_w = 0$ is a reasonable assumption.

a) Decomposition of the observed volume of labour absorption into:

(i) $\eta_r \doteq \eta_K$, i.e., the radial effect equals the rate of expansion of capital stock; and

(ii) $\eta_h = \eta_N - \eta_r$, i.e., the horizontal effect is the residual difference between total employment rate of growth η_N and the radial effect.

b) Capital spreading: this implies a declining capital-labour ratio (K/N) over time and would normally mean a labour-using biassed technological progress.

DATA SOURCES

Kenya's published sources of data on employment, capital formation and population are utilised.

Employment

We use the figures obtained in the annual Enumeration of Employees and summarised in the various issues of the Kenya Statistical Abstract. These figures cover "Numbers Engaged", that is all persons working in a particular industry or establishment. Included are full-time and part-time workers, working proprietors, active partners and directors, and family workers. The enumeration covers the so-called "modern"[6] sector, i.e., most urban establishments, large-scale firms, other large enterprises in the rural areas and the public sector. This is obviously an under-estimation.

Attempts to correct this shortcoming have been undertaken with surveys of urban small-scale and largely informal enterprises and by surveys of rural non-agricultural enterprises undertaken in 1967 and 1969. Table 1 presents employment in the modern sector and total wage employment in the economy. The latter comprises modern-sector employment and employment in small urban and rural enterprises.

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6. For conceptual and identification problems involved in such terms as modern, formal and informal, see John Weeks (20) and ILO (7, pp. 5-6). Should the informal sector be formalised, then such dichotomous classification would be rendered meaningless. See Mureithi (14).

Table 1. Employment in Kenya, 1958 - 1971.

Year	Employment in the Modern Sector ('000)	Annual Rate of Growth (%)	Total Wage Employment in Economy ('000)	Annua Rate of Growth (%)
1	2	3	4	5
1958	593.2	0.46		
1959	596.9	4.07		
1960	522.2	-3.93		
1961	596.8	-2.68		
1962	579.8	-6.83		
1963	539.2	6.53		
1964	575.4	1.16		
1965	582.1	0.57		
1966	585.4	2.60		
1967	600.6	1.00	1026.8	n.a.
1968	606.4	3.43	n.a.	n.a.
1969	627.2	2.76	1047.6	1.60
1970	644.5	5.46	1064.4	4.94
1971*	679.7	n.a.	1117.0	n.a.

n.a. means not available.
* provisional figures.

Sources: Statistical Abstract (1967, 1968, 1971) and Economic Survey (1970, 1972, 1973).

Unfortunately, these sources of extra data will not be utilised in this study for several reasons. First, there have been only two surveys and the time series emanating from them has been rather short. Second, there are gaps in the series; for the five years covered (1967-1971), only three years' figures can be counted on because no estimates are given for 1968 and because the 1971 figure is provisional. Third, due to what has been said already, we are unable to calculate annual growth rates for total wage employment in Kenya; even the figure for 1970, i.e. 4.97, is meaningless due to the provisional nature of the 1971 figure. Fourth, very little is known about the 1967 and 1969 surveys on which these estimates are based. Being merely surveys, they are by no means census enumerations.

Since we are ultimately concerned with growth rates, the absolute amounts are of second order of importance. We could still use a subset of the figures in Table 1 so long as they display rates of change similar to those characteristic of the whole set. Total wage employment expanded at a cumulative growth rate of 1.4% per year between 1967 and 1969, 1.5% between 1967 and 1970 and 2.1% between 1967 and 1971. These figure yield an average rate of 1.6% which is very close to the 1.9% rate mentioned in the introductory paragraphs. It is clear, then, that we would not go too far off the mark if we used the longer employment series (1958-1971) in the analysis that follows.

Capital Stock

In 1960, the Kenya Unit of the East African Statistical Department published A Survey of Capital Assets held in Kenya, 1958. We adjusted the figures in this survey for inadequate coverage. We then used it as a benchmark capital stock figure and linked it with published annual estimates of capital formation using the Perpetual Inventory Method to get a time series of capital stock in Kenya[7] (see Table 2).

Population

Though the first population census covering all communities in Kenya was taken in 1948, the earliest census that can be said to be reasonably accurate and comprehensive was taken in 1962. Another census was taken in 1969. We use these actual census figures. For the years between those in which censuses were taken, and for 1970 and 1971, we use official annual estimates of population.

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7. The method used is elaborated in 15, chapter 11, especially pp. 28-35.

Table 2. Capital Stock Estimates in Kenya, 1958-1971.

Year	Capital Stock (K£m)	Annual Rate (%)
1	2	3
1958	204.93	16.53
1959	238.81	13.96
1960	272.16	12.38
1961	305.86	7.72
1962	329.50	7.74
1963	354.03	6.26
1964	376.22	8.98
1965	410.02	8.37
1966	444.35	10.93
1967	492.93	13.75
1968	560.75	13.06
1969	634.01	11.90
1970	709.52	13.29
1971	803.84	

Source: 14, Table 2.2, pp. 33-34.

Table 3. Total Population in Kenya, 1962-1971.

Year	Population ('000)
1962	8,596
1963	8,847
1964	9,104
1965	9,365
1966	9,643
1967	9,928
1968	10,209
1969	10,942
1970	11,247
1971	11,694

Source: Statistical Abstract, 1971.

DECOMPOSITION ANALYSIS

The basic data used are summarised in Table 4, columns 2 through 4, and depicted in Figure 2. From these, it is clear that η_N was negative for the period 1960-1962. It is clear, too, that η_K has been positive for all the time since 1958, but η_h has been substantially negative except for 1963. This suggests that the Horizontal Effect has consistently exerted a negative influence on labour demand.

INPUT RATIO ANALYSIS

A glance at Table 4, column 5, reveals that the capital-labour ratio[8] has been consistently rising. This is an indication of capital deepening and strongly suggests a mode of production which is biassed against labour.

Recall expression (9):

$$\eta_N = \eta_K + \frac{B_N + J}{\varepsilon_{NN}} \qquad (9)$$

Re-arranging, we have

$$\eta_K - \eta_N = - \frac{B_N + J}{\varepsilon_{NN}}$$

or

$$\eta_{K/N} = -\frac{B_N + J}{\varepsilon_{NN}} \qquad (10)$$

where $\eta_{K/N}$ is positive. Since ε_{NN} is, by convention, a positive number for well-behaved labour demand functions, for the right-hand-side of expression (10) to be positive requires $B_N + J$ to be negative; i.e.

$$B_N + J < 0$$

$$\therefore \quad B_N < - J$$

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8. At this juncture, it is only the direction of change that is important. The absolute K/N ratio would alter if we consider total employment in the economy, but the series would display a rising tendency over time. For instance, if we divide column 2 of Table 2 by column 4 of Table 1, we get the following capital-labour ratios:

1967	480.06
1969	606.20
1970	666.60
1971	719.74

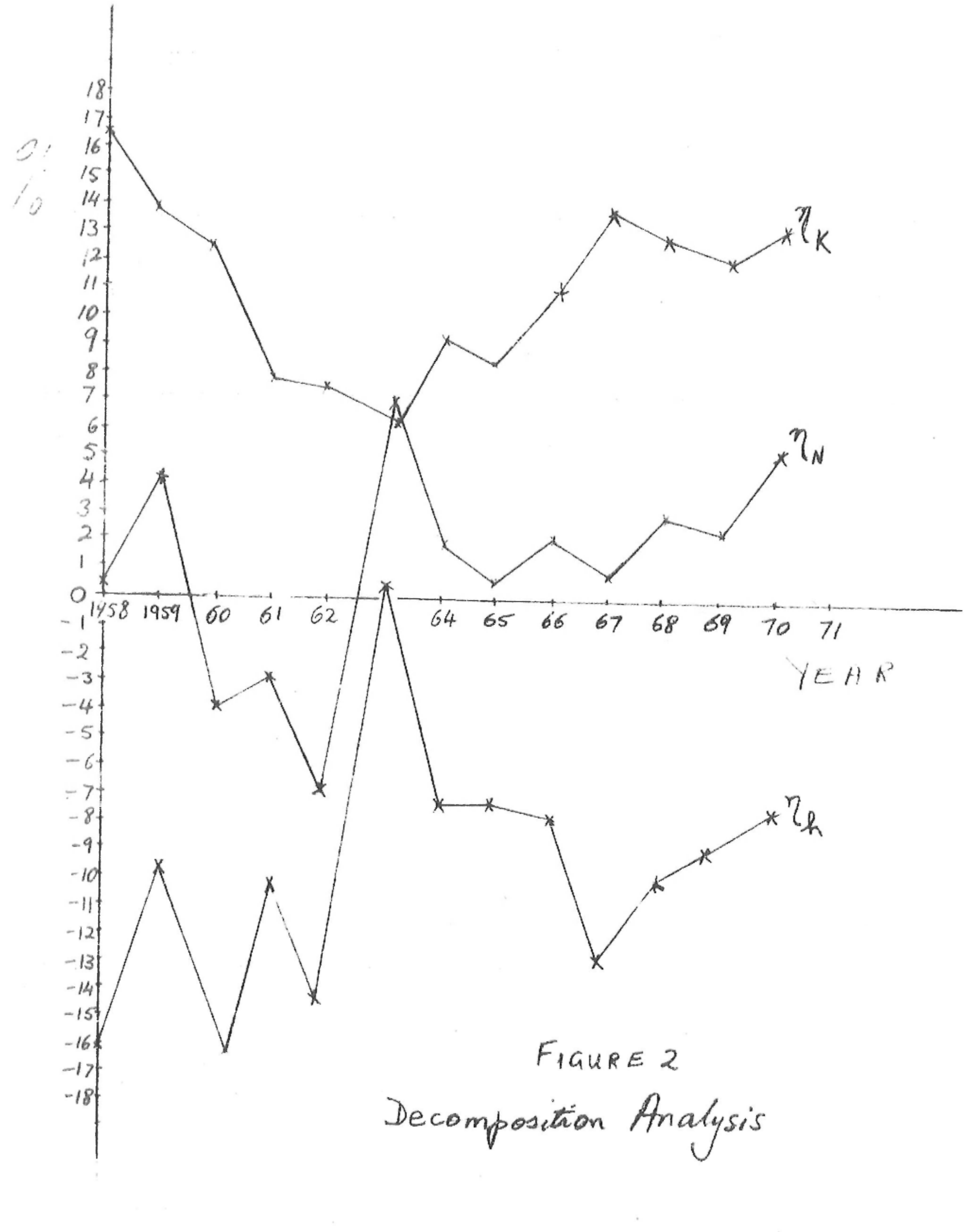

FIGURE 2
Decomposition Analysis

Table 4. Decomposition and Input Ratio Analysis.

Year	Employment Growth Rate η_N (%)	Radial Effect on η_N η_K (%)	Horizontal Effect on η_N η_h (%)	Capital-Labour Ratio K/N (K£)
1	2	3	4	5
1958	0.46	16.53	-16.07	345
1959	4.07	13.96	- 9.89	400
1960	-3.93	12.38	-16.31	437
1961	-2.68	7.72	-10.40	513
1962	-6.83	7.44	-14.27	568
1963	6.53	6.26	0.27	657
1964	1.16	8.98	- 7.82	654
1965	0.57	8.37	- 7.80	704
1966	2.60	10.93	- 8.33	759
1967	1.00	13.75	-12.78	821
1968	3.43	13.06	- 9.63	924
1969	2.76	11.90	- 9.14	1,010
1970	5.46	13.29	- 7.83	1,100
1971				1,183

Sources: Tables 1 and 2.

In terms of Figure 1, this means point G is below point F so that MPP_N is raised, in percentage terms, less than the innovational intensity J. This means that, in the recent past, Kenya has been experiencing labour-saving technological progress.

CONCLUSIONS AND IMPLICATIONS

With a capital-using technological change, it is not surprising that Kenya has not been able to create jobs fast enough to contain widespread unemployment. Demand for employment opportunities has consistently outrun supply.

A set of policy measures could be directed toward the demand side and another set toward the supply side. On the demand side, the main culprit is the number and the rate of increase of job seekers. This in turn is a function of population -- its magnitude, age and sex composition and rate of growth. But, even if population growth rate were to fall from the current 3.3 percent per annum, it is unlikely that working population would be reduced in the short run because most of the working population for the next fifteen years has already been born. Therefore, population policy can be effective in ameliorating the employment situation only in the long run.

In the short run, for example in the context of five-year development plans, effort should be concentrated on augmenting the supply of employment opportunities. The critical variable here is the capital-labour ratio; the higher that ratio is, the less the ability to create jobs out of any given capital stock level. Since that ratio is rising, it means that it is becoming increasingly more capital-expensive to create one job.

Of course it must not be supposed that rising capital intensity is bad per se. It is likely that a large part of the capital formation in Kenya in the recent past has been devoted to the building of infrastructure: roads, public works, communications, etc. The tourist boom has entailed heavy expenditures on buildings, transportation, etc. These forms of investment do not normally generate much employment. In some instances, a project has to be implemented as capital-intensive or dropped altogether. Some branches of production, such steel, tyres, cement, power generation, chemicals, fertilisers, petroleum refining, etc., are intrinsically capital dominated. The choice, e.g. between power generation by thermal energy or hydroelectricity, is at best between more or slightly less capital intensity. If it is necessary to develop such a project for balance of payments or other reasons, one must accept that it will not produce many employment opportunities, but the decision maker should try to make up this deficiency by implementing at the same time other projects which are labour intensive.

In addition, we should note that production actually takes place in stages:[9] 1) material handling, 2) material processing, 3) material handling among processes, 4) packaging, 5) storage of the finished products. Of the five stages, only the second, i.e., the central processing, need be capital intensive; this is especially true where fine precision

9. Such classification is utilised by Howard Pack (16).

of temperature, pressure, ingredients combination, etc. is of critical importance. But there are many other stages where factor substitutability is technically possible; for example, manual handling instead of automatic conveyer belt. These are processes that are auxiliary or peripheral to the central one. In some processes, it is occasionally possible to install semi-automatic movers rather than fully automatic equipment.

There is such a thing as an entrepreneur's technological preference in that from a whole set of available techniques[10] the entrepreneur's preferences lead him to choose a particular mode of production (a certain K/N ratio) at any given factor price ratio. During a study carried out for the ILO Employment Mission to Kenya (13), the author learned from the chief executive of a large firm that the equipment installed when the firm was established in 1970 was "the most sophisticated in the world". The executive emphasised that the firm would have used the same equipment regardless of in which country it was set up. The author also discovered that firms that were subsidiaries of foreign-based enterprises tended to utilise the same production techniques as the parent firms. For some other firms, historical ties with an organisation in an advanced country virtually dictate the production method. Foreign aid is usually tied to imports of equipment from the donor country. The general observation is a pervasive mood of "This is what we are used to", or "This is what we like".

Thus enterprises in Kenya tend to emulate enterprises in developed nations which face different factor endowments and which generally tend to economise on labour and utilise capital which they have in plenty. This form of "follower complex" should be eliminated.

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10. A strict technological preference would result in a very rigid production process. The elasticity of substitution between capital and labour would be approximately zero, not because of technological possibilities but because of entrepreneurial myopia or obstinacy. Some people (e.g. (2)) would argue that factor proportions are virtually unalterable; others would say those proportions are alterable if choice of techniques involves choice of products. (19) However, analyses within a production function framework suggests that factor proportions are alterable within reasonable limits (1 and 15, chapter 4) since the elasticity of substitution between K and N is significantly larger than zero. The implications of entrepreneurial technological preference will be examined in a forthcoming paper on "Optimisation with a Technological Constraint".

The theme is admirably and ably presented by F.A. Hayek, who is

> profoundly convinced that we should be doing more good to the underdeveloped countries if we ... could merely gain understanding of the simple and obvious fact that a country which cannot hope to reach within foreseeable time capital supply equal per head to that of the United States will not use its limited resources best by imitating American production techniques, but ought to develop techniques appropriate to a thinner and wider spreading of the available capital. (6, p. 89)

It would be interesting to see how capital per head of population (capital per capita) compares with capital per person employed (capital-labour ratio) in Kenya. See Table 5. Observed capital-labour ratio is between 15 and 17 times larger than capital per head of population.[11] It follows that to create one job one needs about seventeen times the per capita capital stock. Obviously not many jobs can be created with this kind of expense. Either capital stock has to grow at a very fast rate and/or the expense of creating jobs has to be reduced. The former is a long-term proposition; the latter should be a short-term policy action. A prime objective of policy is to make the provision of jobs cheap, on the average, so that they can be created in large numbers without imposing an undue strain on the economy's level of savings, imports and other scarce resources.

Several policy actions are recommended. First is the relaxation of institutional and historical ties which limit access to sources of capital goods or raw materials, because although an entrepreneur has bought from one source in the past it could be that another source is cheaper. Second, entrepreneurs should be made aware of the technological choices available. Educational measures should be undertaken to ensure widespread literacy, mathematical skills and technological know-how, because only with the full knowledge of the different technologies available can optimal choices be made. Third,

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11. When total employment in the economy is considered, capital per worker as a proportion of capital per head of population is:

1967	9.67
1969	10.45
1970	10.57
1971	10.47

That is between 10 and 11 times. This still reflects the imbalance between capital availability and mode of job creation. Reduction of capital-labour ratio, other things being equal, would make the proportion more in line with the available capital supply per head.

Table 5. Capital per Capita and Capital-Labour Ratio

Year	Capital-Labour Ratio (k) K£	Capital per Capita (k*) K£	Proportion k/k*
1962	568	38.33	14.82
1963	657	40.02	16.42
1964	654	42.53	15.38
1965	704	43.78	16.08
1966	759	46.08	16.47
1967	821	49.65	16.54
1968	924	54.93	16.82
1969	1,010	57.94	17.43
1970	1,100	63.09	17.44
1971	1,183	68.74	17.21

Sources: Tables 2, 3, and 4.

research and development must be initiated in the field of appropriate technology for developing countries. According to S. Schiavo-Campo and H.W. Singer:

> The developing countries would need a technology which is capital-saving rather than capital-using; which is labour using rather than labour-saving; which requires a low degree of skills to operate, control, repair and maintain; and particularly a technology on the basis of which plants can be efficiently operated on a small scale of operations, corresponding to the small markets, often purely local markets, of developing countries, and a technology providing plants which can, with a minimum of time and cost, be changed over from one output-mix to another, and be easily and cheaply installed. (17, p. 106)

Such technologies, according to Keith Marsden:

> Should stimulate economic progress by making optimum use of available resources. They should be conducive to social progress by enabling the mass of the population to share the benefits and not just a privileged few. They should represent technical progress, measured by improvements over existing methods and not by reference to external standards which may be irrelevant. And they should be progressive in a temporal sense, i.e. their characteristics will change over time in response to the society's ability to pay for them and capacity to employ them effectively. (12, p. 114)

All over the world those engaged in technological progress and research simply do not have the problems of the late developing countries put before them. If these problems were put before them with proper priority, we can have confidence that they would be solved. Schiavo-Campo and Singer observe that:

> The predominant characteristic of modern science is not that it yields large-scale productive units (that characteristic is contingent upon the requirements of the "users" of science), but rather that it is potentially capable of solving any problem put before it, including the evolving of labour-intensive, small-scale, flexible, and efficient techniques of production. (17, 107)

From this we conclude that the desirability of a technology is not to be judged merely by its scientific or technical sophistication, but rather by its appropriateness in the context of the society in which it will be used. It requires ingenuity to reduce the labour-saving elements of a technology while maintaining or improving quality and efficiency. The requirements are a dynamic machinery or capital goods sector and a large pool of technical manpower properly motivated. Kenya should accelerate the pace towards the realisation of these prerequisites.

APPENDIX

Gross Domestic Product, 1963-1970, at Current Prices.

Year	Gross Domestic Product (G.D.P.) (K£m.)	G.D.P. Rate of Growth (%)
1963	304.32	8.07
1964	328.87	4.01
1965	342.06	11.78
1966	382.36	5.49
1967	403.34	8.92
1968	439.32	9.26
1969	480.00	7.68
1970	516.81	

Source: Statistical Abstract (1967, 1968, 1971).

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