URBAN UNEMPLOYMENT AND ECONOMIC GROWTH IN AFRICA

By C. R. FRANK, JR.

One of the characteristics of the less-developed economies of the world is a rapidly growing urban population and urban work force combined with with a much slower increase in employment opportunities in the larger-scale urban establishments. The result has been either unemployment or under-employment in small-scale, often individual or family-run, establishments. This phenomenon has been noted in economies such as Puerto Rico and India with high population densities as well as in the relatively under-populated countries of Africa. Others, including politicians in power, fear it as a source of political instability. The presence of large numbers of poverty-stricken and jobless people in the cities puts a great deal of pressure on governments, national and local, to increase current expenditures rapidly to provide civil service jobs for the unemployed. At the same time governments are faced with demands on their capital budgets to spend more for development purposes. In addition, increasing urban population creates demands for urban services: housing, sewerage, lighting, roads, police, and fire protection and the like. A large mass of unemployed or under-employed do not generate the output or tax revenues which are needed to provide these services. For these and other reasons, the political consensus in most developing countries is that the pressures of urban unemployment and under-employment have to be relieved.

How best can this be accomplished? One might say the solution is through high rates of investment and rapid growth. The history of fast-growing countries and their continued inability to cope with the problem

1 This paper has benefited from comments by and conversations with numerous individuals including Jules Backman of New York University, Peter Clark of U.C.L.A., Peter Kilby of Wesleyan, Donald Huddle, Stephen Hymer and Howard Pack of Yale University, Alan Strout of U.S.A.I.D., and Brian Van Arkadie of Yale. Michael Duberstein and John Todd assisted capably as research assistants.

2 See Reynolds [25], Friedlander [12], Pearson [24], Calloway [6], and Doctor and Gallis [8].

3 See Baer and Herve [1].

4 For example, Calloway [7], (p. 60) asserts that '... no social and economic problem in Nigeria is so urgent as that of finding employment for the ever increasing number of school leavers. Nor is there any major policy issue of which the meanings and implications are so little understood'.
of unemployment indicate that something else besides rapid growth is required for a solution. Many writers suggest that growth must occur by investing in relatively labour-intensive activities rather than those which are capital-intensive. The argument runs that not only will this result in more rapid growth because of the low opportunity cost of labour relative to capital, but will increase the rate of growth of employment for any given level of investment. Even in cases, however, when the labour-intensive investment is less than optimal from the point of view of growth, it may be justified if a high enough priority is given to growth in employment and/or reduction in unemployment.

In this paper, we will attempt to show that for the typical African country\(^1\) neither high rates of growth in the modern urban sector nor an attempt to resort to labour-intensive techniques in that sector is likely to have much effect on the magnitude of the urban unemployment problem. The answer, if one exists, to the problem of urban unemployment must be sought through examination of urban-rural income differentials and the distribution of public goods and services to urban and rural areas.

A. Composition of the urban labour force

The urban labour force constitutes only a small fraction of the total working force of most African countries. In Nigeria, for example, one of the most urbanized of the African countries south of the Sahara, the urban population (in cities having a population greater than 20,000) is only about 13 per cent of the total population. In Uganda, one of the least urbanized African countries, only about 2.5 per cent of the total population lives in cities and towns of 2,000 or more people, although many of those who work in the towns of Uganda live outside the urban areas and commute by foot or bicycle.

The working force in the urban areas may be divided into two groups, those in the modern sector and those in the traditional sector. Since the line between the modern sector and the traditional sector is often hard to draw, this distinction is somewhat arbitrary. (We include government establishments in the modern sector.) Basically, the difference is one of scale of operations. Throughout urban Africa there are numerous very small-scale establishments often individually or family run. These include petty trading, individual craft activities (e.g. shoemaking, wood carving, furniture making) and very small-scale manufacturing and construction establishments (employing, say, less than ten people). Workers in the traditional sector typically use little capital, do not employ modern accounting and book-keeping methods, and receive little remuneration in

\(^1\) In referring to Africa in this paper, we generally mean Africa south of the Sahara exclusive of South Africa.
the way of profits or wages. A great many of the employees in the traditional sector are unpaid apprentices or family labour. Many traditional sector workers are employed on a part-time or casual basis. Those employed part time or seasonally often maintain very close connections with the rural areas, either spending a good part of each year in the countryside or returning to the rural areas periodically every few years.

Those employed in the modern or large-scale sector are better paid and more productive because of a higher capital to labour ratio. Many of the modern establishments are run and/or owned by Europeans. They employ modern methods of accounting and generally keep better records than the traditional establishments.

Of that part of the total work force living in the cities, only a fraction is engaged in the modern sector. In Nigeria, for example, workers in the modern sector account for about one-half of the urban work force or a little over 5 per cent of the total labour force. The rest of the urban labour force is either engaged in the traditional, low-productivity sector or is completely unemployed.

**B. Growth in the urban labour force in Africa**

Few data are available on urban labour participation rates in Africa. Growth in the urban labour force must be inferred from urban population data. Table I gives the rates of growth for some major cities of Africa. These vary considerably from 1.7 per cent per annum (Addis-Ababa) to more than 15 per cent (Fort Lamy). While the data on which these figures are based are very inadequate, the mean annual growth (weighted by initial size) of 6.8 per cent can be regarded as fairly typical. These differ considerably from the estimated growth of total population in the African countries which usually range between 2 and 3 per cent per annum. This means, of course, that the urban labour force is a growing percentage of the total labour force.

**C. Growth in demand for a modern urban labour force**

These very high rates of growth of the urban labour force have not been matched by correspondingly high rates of growth of the quantity of urban labour demanded by the modern larger scale establishments. Table II gives some representative rates of growth of total non-agricultural employment. Note that many of these rates of growth are negative. Furthermore, the growth in the Kenya, non-agricultural labour force would be considerably more negative were it not for the extraordinary jump in employment between 1963 and 1964. This discontinuity was most likely the result of a mild export boom in 1964 and, more importantly, the signing of the so-called Tripartite Agreement by government, private
### Table I

Sub-Saharan Africa: urban population growth

<table>
<thead>
<tr>
<th>City</th>
<th>Year (000)</th>
<th>Year (000)</th>
<th>Population growth (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salisbury</td>
<td>1946 69</td>
<td>1961 300</td>
<td>10.3</td>
</tr>
<tr>
<td>Dar-es-Salaam</td>
<td>1948 69</td>
<td>1957 129</td>
<td>7.2</td>
</tr>
<tr>
<td>Brazzaville</td>
<td>1955 76</td>
<td>1961 134</td>
<td>9.9</td>
</tr>
<tr>
<td>Dakar</td>
<td>1945 132</td>
<td>1960 383</td>
<td>7.4</td>
</tr>
<tr>
<td>Accra</td>
<td>1948 136</td>
<td>1960 491</td>
<td>11.3</td>
</tr>
<tr>
<td>Nairobi</td>
<td>1948 119</td>
<td>1962 315</td>
<td>7.2</td>
</tr>
<tr>
<td>Abidjan</td>
<td>1955 127</td>
<td>1960 180</td>
<td>7.2</td>
</tr>
<tr>
<td>Monrovia</td>
<td>1956 41</td>
<td>1962 81</td>
<td>12.0</td>
</tr>
<tr>
<td>Fort Lamy</td>
<td>1955 29</td>
<td>1963 92</td>
<td>15.5</td>
</tr>
<tr>
<td>Cotonou</td>
<td>1945 26</td>
<td>1960 113</td>
<td>10.3</td>
</tr>
<tr>
<td>Mombasa</td>
<td>1948 85</td>
<td>1962 180</td>
<td>5.5</td>
</tr>
<tr>
<td>Bamako</td>
<td>1945 37</td>
<td>1960 127</td>
<td>8.6</td>
</tr>
<tr>
<td>Bulawayo</td>
<td>1946 53</td>
<td>1964 214</td>
<td>8.1</td>
</tr>
<tr>
<td>Lusaka</td>
<td>1950 26</td>
<td>1964 122</td>
<td>11.7</td>
</tr>
<tr>
<td>Yaounde</td>
<td>1955 38</td>
<td>1962 93</td>
<td>13.3</td>
</tr>
<tr>
<td>Douala</td>
<td>1954 118</td>
<td>1964 187</td>
<td>4.7</td>
</tr>
<tr>
<td>Addis-Ababa</td>
<td>1951 400</td>
<td>1964 505</td>
<td>1.7</td>
</tr>
<tr>
<td>Khartoum-Omdurman</td>
<td>1948 210</td>
<td>1960 315</td>
<td>3.4</td>
</tr>
<tr>
<td>Luanda</td>
<td>1950 150</td>
<td>1960 220</td>
<td>3.9</td>
</tr>
<tr>
<td>Leopoldville</td>
<td>1946 110</td>
<td>1961 420</td>
<td>9.3</td>
</tr>
<tr>
<td>Elisabethville</td>
<td>1950 103</td>
<td>1961 190</td>
<td>5.7</td>
</tr>
<tr>
<td>Kumasi</td>
<td>1955 75</td>
<td>1960 190</td>
<td>20.4</td>
</tr>
<tr>
<td>Lourenco-Marques</td>
<td>1950 94</td>
<td>1961 184</td>
<td>6.3</td>
</tr>
</tbody>
</table>


Employers, and the labour unions which called for employers to increase their employment by ten per cent and the unions to hold back on wage demands.

The low rates of growth in Table II cannot be attributed to a low growth in output. Some representative annual rates of increase of non-agricultural output between 1954 and 1964 are:

- Kenya: 6.5
- Southern Rhodesia: 6.7
- Uganda: 7.7

Non-agricultural output in Tanzania increased at a rate of 6.0 per cent between 1954 and 1958 and 9.1 per cent between 1960 and 1964.

The very high rate of growth of employment in Ghana is very atypical. The reason for it has, however, been a very high growth in government employment brought about by very rapid growth in government expenditures. Given the current limitations on Ghana's ability to finance further increases in government expenditure and their move away from government make-work projects, there should be little further growth in employment from this source.¹

**TABLE II**

*Non-agricultural employment indices in selected African countries (1958 = 100)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Cameroons</th>
<th>Ghana</th>
<th>Kenya</th>
<th>Malawi</th>
<th>Nigeria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>102</td>
<td>82</td>
<td>107</td>
<td>88</td>
<td>n.a.</td>
</tr>
<tr>
<td>1956</td>
<td>104</td>
<td>91</td>
<td>105</td>
<td>95</td>
<td>95</td>
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<tr>
<td>1957</td>
<td>100</td>
<td>95</td>
<td>105</td>
<td>98</td>
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<tr>
<td>1958</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td>1959</td>
<td>95</td>
<td>106</td>
<td>100</td>
<td>99</td>
<td>99</td>
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<tr>
<td>1960</td>
<td>91</td>
<td>111</td>
<td>102</td>
<td>96</td>
<td>106</td>
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<tr>
<td>1961</td>
<td>94</td>
<td>122</td>
<td>98</td>
<td>93</td>
<td>89</td>
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<tr>
<td>1962</td>
<td>72</td>
<td>128</td>
<td>97</td>
<td>87</td>
<td>113</td>
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<tr>
<td>1963</td>
<td>91</td>
<td>132</td>
<td>91</td>
<td>87</td>
<td>94</td>
</tr>
<tr>
<td>1964</td>
<td>92</td>
<td>n.a.</td>
<td>111</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Rate of growth*  
(per cent)  
-1.0  6.3  -0.5  -0.7  0.1

<table>
<thead>
<tr>
<th>Year</th>
<th>Southern Rhodesia</th>
<th>Sierra Leone</th>
<th>Tanzania</th>
<th>Uganda</th>
<th>Zambia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>86</td>
<td>87</td>
<td>97</td>
<td>94</td>
<td>92</td>
</tr>
<tr>
<td>1956</td>
<td>92</td>
<td>87</td>
<td>104</td>
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<td>100</td>
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<td>1957</td>
<td>98</td>
<td>92</td>
<td>101</td>
<td>99</td>
<td>100</td>
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<tr>
<td>1958</td>
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<td>100</td>
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<td>1960</td>
<td>101</td>
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<td>1961</td>
<td>98</td>
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<td>104</td>
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<td>1962</td>
<td>95</td>
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<td>88</td>
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<tr>
<td>1963</td>
<td>91</td>
<td>119</td>
<td>91</td>
<td>89</td>
<td>86</td>
</tr>
<tr>
<td>1964</td>
<td>90</td>
<td>125</td>
<td>95</td>
<td>89</td>
<td>91</td>
</tr>
</tbody>
</table>

Rate of growth*  
(per cent)  
0.2  3.0  -0.4  -0.1  -0.9


* Rates of growth calculated by fitting a logarithmic time trend.

**Note:** n.a. means not available.

¹ Between 1961 and 1964, private enterprise employment in Ghana fell from 138 thousand to 115 thousand while public sector employment increased from 212 thousand to 262 thousand, a net increase of 27 thousand. Employment in the services sector increased by 30 thousand, thus accounting for all of the increase in employment and then some. See Ghana, *Quarterly Digest of Statistics*, December, 1962, p. 2 and Ghana Economic Survey, 1964, p. 105.
The low rates of growth of employment in Table II are, on the whole, considerably below the rates of growth of urban population in Table I. Thus, only a small portion of the annual increment in the urban labour force is being absorbed by the modern urban sector. The residual (those either unemployed or engaged in the traditional sector) are an increasing proportion of the urban work force. It is difficult to say how many of those in the residual are either under-employed or unemployed, but it is unlikely that the demand for the goods and services from the traditional urban sector has been growing at anywhere near the rate needed fully to absorb the growth of the residual labour force. In Nigeria, the large supply of workers to the traditional sector has kept the real wage-rate in the sector either constant or falling while real wages in the modern sector have risen considerably. (See Kilby [19].) The highly paid workers of the modern sector are becoming an increasingly smaller percentage of the urban work force while the wage differential seems to be widening.

D. Composition of labour demand

There are several striking aspects of the composition of labour demand in Africa. First, the role played by government is very large. Government non-agricultural employment as a percentage of total non-agricultural employment for selected countries is given in Table III. It ranges from 37·6 to 52·1 per cent. Second, employment in trade, commerce, and miscellaneous services is the most important component of non-agricultural employment in most African countries, ranging from 45 to 65 per cent for those countries in Table IV. Finally, manufacturing and public utilities accounts for a relatively small portion of non-agricultural employment, roughly between 15 and 20 per cent (see Table IV). These

<table>
<thead>
<tr>
<th>Year</th>
<th>Government (per cent)</th>
<th>Non-Government* (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda 1964</td>
<td>52·1</td>
<td>47·9</td>
</tr>
<tr>
<td>Kenya 1964</td>
<td>41·4</td>
<td>58·6</td>
</tr>
<tr>
<td>Tanzania 1963</td>
<td>48·9</td>
<td>51·1</td>
</tr>
<tr>
<td>Nigeria 1962</td>
<td>37·6</td>
<td>62·4</td>
</tr>
<tr>
<td>Ghana 1961</td>
<td>45·6</td>
<td>54·4</td>
</tr>
</tbody>
</table>


* Includes Government Corporations except for Uganda.
characteristics of the composition of labour demand have very important implications for the growth in demand for labour.

**Table IV**

*Distribution of non-agricultural employment by sector*

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing and public utilities</th>
<th>Commerce and services</th>
<th>Construction</th>
<th>Mining</th>
<th>Transport and communications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda (1964)</td>
<td>20.2</td>
<td>56.2</td>
<td>15.0</td>
<td>3.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Kenya (1965)</td>
<td>19.2</td>
<td>65.0</td>
<td>5.6</td>
<td>0.6</td>
<td>9.4</td>
</tr>
<tr>
<td>Tanzania (1963)</td>
<td>15.2</td>
<td>50.5</td>
<td>16.2</td>
<td>4.2</td>
<td>13.9</td>
</tr>
<tr>
<td>Nigeria (1962)</td>
<td>14.4</td>
<td>45.0</td>
<td>20.7</td>
<td>9.8</td>
<td>10.2</td>
</tr>
<tr>
<td>Ghana (1964)</td>
<td>13.9</td>
<td>47.6</td>
<td>19.3</td>
<td>8.6</td>
<td>10.2</td>
</tr>
</tbody>
</table>

**Sources:** Same as Table III except for Kenya and Ghana data which were obtained from International Labour Office, *Yearbook of Statistics, 1966*, Geneva, p. 268; and *Ghana Economic Survey, 1964*, Accra, 1965, p. 105.

Government employment grows roughly at about the same rate as recurrent government expenditure less the rate of growth of the average wage or salary paid by government. Wages and salaries comprise a large proportion of this expenditure (typically 60 to 80 per cent) which tends to change very little through time for any given country. Government investment expenditure is a small fraction of the total government expenditure, and wages and salaries are a much smaller proportion than is the case with recurrent expenditure. In any case, much of the investment expenditure by African governments is in payments to private contractors and this does not affect government employment. Thus the growth in government employment opportunities is largely a function of the taxing and borrowing capabilities of African governments and their willingness to expand recurrent expenditures. It makes little sense to talk about greatly altering these relationships by the use of more labour-intensive techniques when government recurrent services are largely the services of labour anyway.

Value added in commerce, trade, and miscellaneous services, while including some profits and depreciation, is largely composed of wages and salaries (explicitly or implicitly). Thus, as is the case with government, employment tends to grow roughly the same as value added (in money terms) with an adjustment for increased average employee remuneration, i.e. employment tends to grow about the same as real value added. Furthermore, the commerce, trade, and miscellaneous services industries may be viewed basically as intermediate goods industries whose output tends to grow in fixed proportion to the general level of economic activity. To conclude, with regard to trade, commerce, and other service
industries, there is little scope for increasing labour intensity and the growth of employment in this industry above that dictated by the overall growth of the economy.

The scope for increased employment growth through more labour intensity therefore lies in other urban-based industries such as mining, manufacturing, transport, construction, and public utilities which, however, generally account for less than 50 per cent of the total modern urban labour force.

E. The role of labour productivity

The growth of employment in these other urban-based industries is considerably reduced by growth in labour productivity which occurs independently of the choice of technique with regard to output expansion. This growth in productivity occurs for several reasons:

1. Increasing quality of the labour force, particularly through on-the-job training and increased experience in a factory environment;
2. Disembodied labour-saving technical change resulting from better management, organization, and work procedures;
3. An increase in the share of the market for those firms which have achieved higher labour productivity because of better management or better labour quality;
4. Economies of scale;
5. Increasing capacity utilization resulting in increased productivity of maintenance and administration personnel.

Of course, productivity may decrease through time if the labour force is deteriorating, or management control of operations becomes lax, but the main direction of change in Africa has been toward substantial increases in labour productivity.

The first three of these factors tend to operate independently of increases in output or value added. Thus, there is a tendency for some gain in productivity even though output is falling, stagnant, or growing slowly. Productivity increases resulting from economies of large-scale

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1 Reasons (2), (3) and (4) cited here are similar to Leibenstein's notion of an increase in X-efficiency. See Leibenstein [20].

2 This cause of increased labour productivity is somewhat peculiar to the smaller size, less developed economies. In most African countries, there is usually only one railway company, for example. Maintenance of the right of way and administrative and clerical operations require some minimum of workers. The need for these kinds of workers does not expand nearly as rapidly as output expands. In most African countries, the railway accounts for a considerable portion of the labour force, and as the railways are used to fuller capacity, workers per unit of output falls rapidly. There is also a tendency to build certain manufacturing plants substantially ahead of demand or to build a large enough size to handle demands during export booms (e.g. cement). As the average capacity utilization increases, maintenance and administrative personnel increase their productivity.
operation and/or increased capacity utilization come into play as output growth increases. Increases in output which begin to put a strain on the existing capital stock capacity may, however, cause the growth in productivity to fall off for very high rates of growth of output.

The curve $ABEH$ in Fig. 1 shows the relationships between output growth, productivity growth, and growth in employment.\(^1\) The vertical axis is the rate of growth of employment, and the horizontal axis is the rate of growth of output (value added). At zero rates of growth of output the growth in employment is negative and equal to minus the distance of $OA$. The rate of growth of output must be greater than $OB$ in order for there to be any positive increase in employment at all.

The growth in productivity is approximately given by the distance between the 45 degree line $OCG$ which emanates from the origin. For example, when the rate of growth of employment is zero, the rate of growth of productivity is equal to $OA$ (the rate of decrease of employment). When the rate of growth of output is $OB$, the growth in productivity is approximately given by $BC$. If the growth in output is $OF$, the

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\(^1\) A derivation of the relationship between growth in employment and growth in output assuming that there are three factors, labour, skilled labour, and capital; and labour-augmenting and capital-augmenting technological change is contained in the appendix.
growth of productivity equals zero. Whenever the slope of the curve $ABEH$ is equal to unity (at the point $E$ in Fig. 1), there is no change in the rate of growth of productivity. Below the point $E$, the rate of growth of productivity is increasing and above the point $E$, productivity growth decreases.

We place no great faith in the particular form of the curve $ABEH$ shown in Fig. 1 other than the fact that (a) for most relevant rates of growth of output, it probably lies below the 45 degree line (on the average, at any relevant rate of growth of output there is a net increase in productivity) and (b) only for very high rates of growth of output would there be a tendency for productivity to decline, i.e. for a wide range in the growth of output, there is a tendency for the curve to have less than unitary slope.

In order to test the appropriateness of such a relationship among growth rates of output, employment, and productivity, we have analysed data from mining activities in three countries and for two railway systems in Africa.

**a. Mining in Nigeria**

In Nigeria, the bulk of employment in mining relates to tin and coal. The gains in labour productivity in both these industries has been remarkable. Between 1950 and 1957, despite an increase in tin output from 949 tons to 1096 tons per month or 15·6 per cent, employment dropped from 58·2 to 55·2 thousand or 4·6 per cent, implying an increase in productivity of 20·9 per cent or an average increase of 2·8 per cent per annum. Between 1950 and 1964, tin output hardly increased, but tin employment fell by 24·2 per cent, an increase of productivity of 36·8 per cent or 2·3 per cent per annum. Between 1950 and 1957 there was virtually no increase in labour productivity in coal, but between 1959 and 1964 coal output fell by 15·5 per cent, and employment fell by 60·5 per cent, an increase in productivity of 113 per cent or 11·4 per cent per annum.1

**b. Mining in Ghana**

In Ghana, most employment in the mining industry relates to gold. Between 1948 and 1964 output increased from 672,000 fine oz. to 865,000 fine oz. while employment dropped from 32·2 thousand to 20·6 thousand. Productivity increased by about 100 per cent over 16 years, an increase of about 4·4 per cent per annum.2

1 Date from Nigeria, Quarterly Digest of Statistics, various issues.
2 Data from Ghana, Quarterly Digest of Statistics, various issues.
c. Mining in Zambia

Copper output (electrolytic and blister combined) in Zambia more than doubled (from 309 thousand to 635 thousand tons) between 1950 and 1963. Employment increased by only 4.5 per cent from 37.4 thousand to 39.1 thousand. The increase in productivity was 98 per cent or 5.0 per cent per annum over the 14-year period.¹

d. The East African Railways

The East African Railways is the largest non-government employer in East Africa. Employment in 1949 was 47.1 thousand, but by 1963 this had dropped to 44.7 thousand. In the meantime, ton-miles carried increased from 1.2 million to 2.1 million or 75 per cent. The implied increase in ton-mile productivity was 60 per cent or 3.4 per cent per annum.²

e. Railways in Nigeria

Between 1948 and 1963, ton-miles carried by the Nigerian Railways increased from 554 thousand to 1,410 thousand or nearly threefold in 15 years. Employment meanwhile increased from 22,100 to 27,400, a gain of only 24 per cent. Productivity increased at about 5 per cent per annum over the 15 years. The gain in productivity has been particularly noticeable between 1952 and 1963; ton-miles per worker more than doubled, a gain of 7 per cent per annum.³

We regressed annual percentage change in employment on annual percentage increase in output for each of the above industries. In the case of East African Railways, we added a third variable, the ratio of the increase in capital expenditure to employment.⁴ The results are summarized in Table V. The constant term in each of these equations is the rate at which employment decreases in these industries when output is stagnant. We converted these to percentage increases in output required to prevent a drop in employment by setting \( Y = 0 \) and solving for \( X_1 \). The results are presented in the last column of Table V.

Studies of various manufacturing industries as well indicate very large increases in productivity. For example, a study by Azarias Baryaruha of three firms in Uganda, Nyanza Textiles, Uganda Breweries, and British-American Tobacco Company, revealed average annual increases in physical labour productivity of 12.2, 6.6, and 3.4 per cent respectively.

¹ Employment data from Northern Rhodesia Chamber of Mines, Year Book 1964.
³ Data are from East African Economic and Statistical Review, various issues.
⁴ Data from Nigeria, op. cit., various issues.
⁵ This variable was added as an explanatory variable since employment figures covered workers employed on capital projects.
TABLE V

Employment growth—productivity growth regressions

<table>
<thead>
<tr>
<th>Industry</th>
<th>Regression</th>
<th>Data</th>
<th>Required growth in output to prevent employment from falling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria Coal</td>
<td>$Y = -7.1 + 1.704X_1$ (R² = 0.28)</td>
<td>1950–64</td>
<td>4.2%</td>
</tr>
<tr>
<td>Nigeria Tin</td>
<td>$Y = -1.5 + 0.875X_1$ (R² = 0.90)</td>
<td>1950–64</td>
<td>1.7</td>
</tr>
<tr>
<td>Ghana Gold</td>
<td>$Y = -3.8 + 0.720X_1$ (R² = 0.46)</td>
<td>1948–64</td>
<td>5.3</td>
</tr>
<tr>
<td>Zambia Copper</td>
<td>$Y = -3.7 + 0.669X_1$ (R² = 0.995)</td>
<td>1950–63</td>
<td>5.5</td>
</tr>
<tr>
<td>East African</td>
<td>$Y = -2.0 + 0.318X_1$ + 1.432X_2 (R² = 0.48)</td>
<td>1949–63</td>
<td>6.7</td>
</tr>
<tr>
<td>Railways</td>
<td>Output in ton miles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nigeria Railways</td>
<td>$Y = -1.2 + 0.216X_1$ (R² = 0.70)</td>
<td>1948–63 annual percentage changes in three-year moving averages of employment and output (ton miles)</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Note: $Y$ is percentage change in employment; $X_1$ is percentage change in output and $X_2$ is ratio of increase in capital expenditure to employment.

over the 1960–4 period. Using employment figures from the annual enumeration of employees and Gross Domestic Product data, Baryaruha also revealed the following increases in labour productivity in Uganda over the period 1960–4:¹

- Cotton, Coffee, and Sugar Processing 6.9%
- Manufacture of Food Products 2.7%
- Miscellaneous Manufacturing 6.2%

In a study of the sugar industry in East Africa, the present author concluded that productivity in sugar processing in Kenya increased 52 per cent between 1958 and 1962 or an average of more than 10 per cent per annum.²

These studies also indicate that the increases in productivity could not be attributed to the adoption of more capital intensive techniques of production but rather to some of the factors mentioned above. For example, the increase in the productivity of the tobacco firm studied by Baryaruha occurred despite no new investment during the period and with

¹ See Baryaruha [2].
² See Frank [11], p. 92.
a 10 per cent decline in production over the period. The productivity increases most likely were the result of more efficient operation and increases in worker skills. The increase in the productivity of sugar-processing in Kenya was basically the result of higher rates of utilization and efficiency of the existing processing equipment.

F. The role of wage rates

One possible way of stimulating a growth in employment opportunities is a reduction of wage rates or perhaps, more appropriately, a reduction in the growth of wage rates. In particular, wage-rate reductions can have a very significant influence on the growth of employment opportunities generated by government activity. For example, suppose government recurrent expenditures are expected to increase 5 per cent from one year to the next. If the average government wage also increases by 5 per cent, the increase in employment will be nil. If government wage increases are held to only 2 per cent and there is no change in the revenue and expenditure picture, the increase in employment will be about 2.9 per cent. Alternatively, the funds freed by holding the wage increase down to 2 per cent may be used, not for increased employment out of the recurrent budget, but for additional government investment activity which will have both direct and indirect stimulative effects on employment opportunities.

Several remarks are appropriate here, however, with regard to the use of wage restraint as an employment-stimulating device.

First, many industrial enterprises in Africa are foreign-owned, large-scale enterprises which use very capital intensive methods of production. Wage costs are small relative to value added and wage changes have very little effect on output decisions and the technology used.

Secondly, wage changes tend to have less effect on the labour-intensity of the already existing capacity than on the labour intensity of new investment. When new investment plans are made, the current wage structure can be taken into account by choosing the appropriate technology. Past investments may involve a given commitment to particular products and particular technologies, embodied, for example, in the type of equipment and plant layout used.

Thirdly, for those industries which are highly labour-intensive, such as trade and commerce, the effectiveness of wage restraint in stimulating employment depends on the price elasticity of demand for the services of these industries. If demand is inelastic, there will be little change in the employment opportunities.

Fourth, a reduction in wages at the lower scales may have an insignificant impact on employment opportunities if trained supervisors are relatively scarce. The hiring of additional unskilled workers even at very
low wages may not be profitable if it is not possible to hire additional trained supervisors.

Fifth, a reduction in wages at the lower scales only may have an insignificant effect on government employment if there are large wage and salary differentials between skill levels. For example, in the 1959 Nigeria Report on Earnings and Employment Enquiry, 11.7 per cent of those employed by the Federal and Regional governments together were classified as either professional, technical, administrative, executive, or managerial. The cash earnings of these senior employees comprised 41.5 per cent of the total wage and salary bill. At the other end of the scale, general unskilled labour accounted for 36.6 per cent of employment but received only 13.9 per cent of total earnings. A 10 per cent reduction in the lower wage scales could result in approximately a 10 per cent increase in unskilled employment at the same level of expenditure. A 10 per cent reduction of salaries of skilled personnel, which would adversely affect considerably fewer individuals could result in an increase in unskilled employment of approximately 30 per cent.

Finally, and most important, an advocacy of wage restraint as an employment-stimulating device must take into account the social and institutional factors which accompany the wage determination process in Africa. In the modern urban sector, the central government usually sets the pace in one way or another. Unlike in the developed western countries, in some areas such as in East Africa, British Central Africa, and Ghana, minimum wage legislation essentially determines the whole wage scale. Minimum wages are periodically adjusted upwards usually as the result of recommendations of minimum wages advisory boards which are appointed every few years. The increase in the minimum wage is very effective in raising the whole wage scale since the wages of most unskilled workers are at or near the current minimum wage. Recent increments in the minimum wage in many African countries have been very substantial. In Uganda, for example, minimum wages in the urban areas were adjusted in 1959, in 1962, and 1964. The minimum wage was set at Shs. 75.4, Shs. 120.0 and Shs. 152.0, respectively, implying more than a doubling of the money wage in five years.1 The real minimum wage increased almost as much since there was little price inflation during those years.2 In Ghana, minimum wage legislation was introduced in 1960. The result was a sharp shift upwards in wage rates.3

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1 See Uganda [27], pp. 9 and 18.
2 The index of retail prices in African markets in Kampala was 102 in June of 1959 and 102 in June of 1964. The cost-of-living index (based on expenditure patterns of middle-income civil servants) in Kampala was 138 in June of 1959 and 157 in June of 1964, an increase of about 14 per cent over five years.
3 See Birmingham, Neustadt, and Omaboe [4], p. 137.
In those countries where minimum wage legislation is not the major factor in setting wage rates, the government wage scales have a substantial impact on wage scales throughout the modern sector of the economy. Such is the case in Nigeria today and Ghana before 1960. There are two reasons why government scales set the pace for the rest of the modern sector. First, the preponderance of government as the largest single employer means that other employers set their scales at or near those of the government in order to hold their own labour force and to be in a competitive position to attract better quality workers at all levels. Secondly, the larger private employers, for political reasons, want to achieve and maintain a reputation as 'progressive employers'. In some instances, the private employers pay substantially above government rates for these reasons.

The central government often raises its wage scales in large and discrete jumps. In Nigeria, for example, the traditional mechanism for raising government wage scales is the appointment of a commission of inquiry into wages and conditions of employment every few years. The commission's recommendations are usually adopted without substantial change, resulting in a discrete jump in wage scales which is changed only slightly until the next commission of inquiry is appointed. Government wage scales in Nigeria were adjusted upwards in 1954–5, 1959, and 1964 upon recommendations of the Gorsuch Commission in 1954, the Mbanefo and Morgan Commissions in 1959, and a second Morgan Commission in 1964. The minimum wage for general labour increased from 4s. 8d. in 1955 to 5s. 10d., in 1959, to 7s. 8d. in 1964. The increase of 67 per cent in the money wage of general labour was accompanied by only small changes in the price level.

The sharp increases in real wage rates brought about by changes in minimum wage legislation or changes in government wage scales, accompanied by increasing urban unemployment, indicate that the wage in the modern sector tends to be set institutionally and politically without great regard for achieving balance between the demand and supply of labour. An examination of available recent government documents which deal with the policy issue of wages confirms this fact. There are two main arguments used to justify the usual recommendation of a substantial

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1 See Kilby [19], pp. 13–20 and Birmingham et al., op. cit.
2 See Kilby [19], p. 20.
3 Changes in the Consumer Price Index for various Nigerian cities are as follows:
   Lagos: 1953 = 100; 1964 = 112
   Ibadan: 1953 = 100; 1964 = 127
   Enugu: 1963 = 100; 1964 = 147
   Kaduna: 1957 = 100; 1964 = 118
   Port Harcourt: 1957 = 100; 1964 = 117
   These indices are based on expenditure patterns of employees earning £350–400 per annum. See Nigeria, Quarterly Digest of Statistics.
increase in the wages paid to general unskilled labourers. The first is that a stable, modern, urban labour force requires that the lowest paid workers be able to maintain themselves and their families at a 'living wage' or what is necessary to provide a man and his family 'a minimum standard of health and decency'.¹ A good statement of this philosophy is contained in the Uganda Government's Report of the Minimum Wages Advisory Board, p. 5.

The wages of unskilled workers in Uganda, in common with many other developing countries, are so low in many cases that they live in a state of permanent poverty and are generally 'underfed, underhoused and underclothed'. We feel, therefore, that until such time as they achieve a minimum wage which will enable them to live as decent human beings equipped, at least, with the basic necessities of life we cannot allow our consideration for any increase to be determined solely by the so-called 'economic laws', even though this may be contrary to the economist's usual ideas of how wage levels should be determined. It is of paramount importance to the country's future stability and prosperity that we achieve, as rapidly as possible, a wage structure based on the needs of the family unit. The realisation of this objective should receive top priority and the full co-operation of both the Government and of the business community.

In practical terms, a minimum monthly wage of 240 shillings was deemed a living wage by the 1964 Uganda Minimum Wages Advisory Board which it felt ought to be achieved in a few years, implying a 58 per cent increase over and above their current recommendations.² Since the concept of a living wage is ephemeral, to say the least, once a wage of 240 shillings a month is achieved, this will no doubt be regarded as inadequate.

The second argument most often used relates to the very substantial differences in pay scales between the various labour categories. In Nigeria, for example, a young university graduate entering the civil service typically has a starting salary of £600 or £700 per annum with more or less guaranteed raises up to a maximum level of £1,400 or £1,500 a year. If he is lucky enough to be promoted to the so-called super-scales, he can earn close to £4,000 a year. A typical unskilled labourer will start at about £100 per annum and, unless he is able to qualify as an artisan by further training, cannot hope to rise much above £150 a year.

These large income disparities result in significant pressures and sentiment in favour of forcing a more equitable income distribution by raising the lower wage scales. The alternative policy of lowering the higher wage and salary scales has been attempted by Nkrumah and Nyerere with significant political repercussions. Few other African political leaders would probably attempt such a solution.

Granted that the African governments cannot set wage scales which are completely devoid of any considerations of demand and supply; nevertheless, within a very large range, they have the power and the

¹ See Nigeria [22], pp. 11–12.
² See Uganda [27], p. 15.
apparent determination not to let 'economic forces' determine employee remuneration.

G. Policy measure to stimulate growth in modern sector employment

In general, attempts to solve the urban unemployment problem by stimulating the growth in the demand for employment are likely to meet with difficulties. Efforts by government to increase its employment opportunities are limited by government budgetary considerations and the need to strike a balance between recurrent and investment expenditures. Attempts to impose a more labour-intensive regime in the private sector would have limited impact because of the relatively small proportion of the labour force employed in those industries with a significant scope for choice of technique. In any case, a policy of more labour-intensive production in the modern private sector is difficult to implement. It requires either (a) direct government controls, (b) a system of taxes and subsidies to encourage the use of labour, or (c) a policy of wage restraint. The first two alternatives carry with them the danger that private investment may be discouraged and reduced in the process. The third alternative, wage restraint, involves some formidable social and political obstacles.

Perhaps the most discouraging argument against attempting to solve the urban unemployment problem by increasing employment opportunities is the tendency for supply and demand to interact in such a way that an increase in employment is accompanied by an increase in unemployment. At any given wage rate and at any given point in time, the number of entrants into the urban labour force is not only a function of the

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1 The author [11] conducted a study of the projected growth in modern sector employment in Nigeria from 1963 to 1972. He used various assumptions, both optimistic and pessimistic, regarding the growth of government recurrent expenditure, growth of leading sectors, and the labour intensity of manufacturing investment. The annual growth in employment ranged from 2.4 per cent under the most pessimistic assumptions to 5.4 per cent under the most optimistic assumptions. The major conclusions derived from this study were the following:

(a) Assumptions concerning growth of government recurrent expenditure were the most important determinants of the growth of employment because of the importance of government in the total;

(b) The ratio of investment to total expenditure was an important determinant of the rate of growth of employment because of the indirect, effect on the growth of construction, a relatively labour-intensive industry; and

(c) A doubling of the labour intensity of investment in manufacturing had a very small impact on the growth rate of employment, resulting in an increase in the growth rate of from 0.4 to 0.6 percentage points.

2 The relationship between quantity supplied of labour (labour force participation) and the numbers employed and unemployed has long been recognized with regard to the U.S. economy and recently has been the subject of intense empirical research. See Mooney [21] which contains a bibliography on studies of this nature. This kind of analysis has particular relevance for urban labour force participation rates in African countries because of the large stock of potential entrants into the urban labour force, i.e. those residing in the rural areas.
prevailing wage rate, rural-urban real income differentials, etc., but probably also a function of the assessment of individuals of the subjective probability of getting a job. Prior to entering the urban labour force, a prospective entrant’s assessment of this probability is likely to be very crude but nevertheless proportionately related to the ratio of the current stock of unemployed to the current number of persons gainfully employed.

Once a person has entered the labour force, any decisions to withdraw later from the labour force depends on whether he is gainfully employed or not. If he is not employed, his decision to withdraw, like his decision to enter, depends both on the wage rate and on his subjective assessment of the probability of getting a job which will change through time as the amount of his information increases through experience. Furthermore, the average length of time a labour force participant goes without a job is dependent on the ratio of those unemployed to those employed. The longer the labour force participant remains without a job, the more likely he is to leave the labour force both because his assessed probability of getting a job decreases the longer he remains unsuccessful in becoming employed and because his financial and intangible assets decrease. By intangible assets, we refer to his ability to live off relatives, friends, and tribesmen during his period of seeking work.

Once a person becomes employed, the likelihood of his leaving the labour force is reduced.

If the quantity of labour demanded increases autonomously, in the first instance, the ratio of unemployed to those employed increases as the number of employed increases. The fall in this ratio induces: (a) a greater flow of entrants into the labour force because of the increase in the subjective probability of obtaining a job and (b) reduces the flow of withdrawals from the labour force because of the increase in subjective probabilities, because of the reduction in the length of time a participant goes without a job, and because those who become gainfully employed are less likely to leave the labour force.

Thus, the quantity of labour demanded and quantity supplied to the labour force are not independent. An increase in quantity demanded brings forth an increase in the quantity supplied through a reduction in the flow out of the labour force and an increase in the number of new entrants. If the increase in the quantity supplied is greater than the increase in the quantity demanded, the net result will be an increase in the number unemployed.¹

¹ In terms of a mathematical model, let \( w \) be the wage rate, \( Q_d \) be the quantity of labour demanded and \( Q_s \) be the quantity of labour supplied.

\[
Q_d = f_d(w; a), \quad Q_s = f_s\left(w, \frac{Q_s - Q_d}{Q_d}\right)
\]
This analysis of interactions between supply and demand also indicates that the current rates of rural-urban migration may not be maintained for very long in the future. As the ratio of those not employed in the modern sector to those employed becomes very large, the subjective probability of obtaining a job will decrease. People are unlikely to continue to flock to the cities at current rates if there are so few jobs available. In the meantime, the stock of unemployed and under-employed is building up very rapidly and may be quite large before some sort of equilibrium is reached.¹

Up to this point we have been concerned only with the possibility of increasing labour demand in the modern urban sector to alleviate urban unemployment. Other, perhaps more encouraging, alternatives exist. The first is a policy of encouraging the growth of the small-scale, mainly indigenous, urban entrepreneur. The second approach is to focus on policies which operate on the supply of labour rather than solely the demand for labour.

H. Encouraging the small-scale producer

Perhaps the most successful way of raising the labour intensity of investment is to give every encouragement, or probably more important, avoid every discouragement to the growth of the traditional small-scale sector. The employment effect of investment in the small-scale sector is much greater than in the modern sector. Estimates by Peter Kilby² and the National Manpower Board in Nigeria indicate that investment per worker in small-scale industry is about £100 to £200. In large-scale establishments, the average ratio is from £2,000 to £3,000 per worker.³ With regard to where a is an autonomous shift parameter. Equilibrium occurs when \( Q_d = Q_s \) but the existence of equilibrium is not assured unless, among other things, there is some upper bound on \( Q_s \), the total labour supply. For African countries, there is almost no effective upper bound on the numbers which can be supplied to the urban work force since it is such a small fraction of the total work force. A shift in demand (a change in \( a \)) results in the following change in quantity supplied if the wage rate is held constant:

\[
\frac{\partial Q_s}{\partial a} = -\frac{Q_s}{Q_d^2} \cdot \frac{\partial f_s}{\partial e} \cdot \frac{\partial Q_d}{\partial a}
\]

where \( e = (Q_s - Q_d)/Q_d \) is the unemployment ratio. The sign of \( \partial f_s/\partial e \) is negative for reasons discussed above. Thus the increase in demand at a given wage results in an even larger increase in supply if

\[
-\frac{Q_s}{Q_d^2} \cdot \frac{\partial f_s}{\partial e} > 1.
\]

With this kind of model, an increase in demand can actually lower the equilibrium wage even if the slopes of the demand and supply curve \( (\partial f_d/\partial w \text{ and } \partial f_s/\partial w) \) are negative and positive, respectively.

¹ For an analysis of the long-run unemployment equilibrium using a model similar to the one outlined here see Todaro [25].
² See Kilby [17], p. 5.
encouragement of the small-scale sector, several points are worth making:

1. Aid to small-scale producers in the form of loan schemes or training schemes may not have much impact on increasing the labour absorptive capacity of small-scale establishments. The thrust of many schemes is to increase the efficiency of existing producers rather than to encourage expansion of total output and the entry of new firms. Increased efficiency often means less employment rather than more for a given level of output.

2. Investment in large-scale modern establishments sometimes competes directly with certain types of small-scale producers. The productivity of shoes and sandals and enamel hollow-ware in modern establishments may be examples where large-scale production has significantly replaced small-scale production and has led to a net decrease in employment in those industries. In other African countries, the establishment of large-scale government-owned wholesale and retail operations may have had a depressing effect on small-scale trading by private individuals. A few African governments have established large-scale, government trading corporations. If others should plan to do so in the future, the impact on small-scale trading should be considered.

3. Government regulation, licensing and controls may discriminate against the small-scale producers. While African countries, particularly those formerly controlled by the British, have had fairly liberal regimes, there have been many instances in other less developed countries where the unintended effect of government regulation and control has depressed small-scale production. Foreign exchange control, in particular, discriminates in favour of the large-scale, established producers. Exchange allocations are often based on past needs for imports and are difficult to obtain for small-scale, newer, and potentially growing establishments. The fixed costs involved in obtaining foreign exchange licenses, cutting through the red tape, bribery of officials, etc., can be absorbed more easily by the larger firms. Road transport licensing seems to have had an inhibiting effect on the growth of small-scale African run transport firms in East Africa.¹

Development, 1962), p. 329, cites ten industrial undertakings in the western region having a total capital of £5.5 million and employing only 1,573 workers or an investment per worker of about £3,400. A forthcoming study by T. M. Yesufu reveals that the investment per worker in selected current and prospective development projects in Nigeria ranges from £1,700 to £34,000.

A survey conducted by the East African Manufacturers Association with 38 responses indicated a total paid-up capital of £44 million and 19,626 workers. The range of variation in the capital/labour ratio was £1,000 to £50,000. ¹ See Hawkins [14], Chapter VI.
I. Reducing the supply of urban workers

Perhaps the most crucial variable which operates on both demand and supply is the rural-urban real income differential. Urban wage restraint must not be viewed so much as a stimulus to demand as a retardant operating on the supply of workers to the urban areas, especially if accompanied by policies which might raise rural real incomes.

It would be foolish to suppose that the real wage in the modern urban sector could be lowered by reducing money wages. If money wages are held constant or restrained, however, inevitably inflation would take its toll and real wages would deteriorate or rise only very slowly. As we pointed out above, the growth in money wages in Africa has come about mainly as the result of recommendations of commissions of inquiry into civil service wages and minimum wage legislation.

Rural real incomes might be raised in several ways. The pattern of development in many African countries has been one in which rural incomes have provided much of the surplus which has been used to finance expansion of social overhead facilities and modern sector development in the urban areas. The mechanism for providing this transfer has been agricultural marketing board policies (see Helleiner [15]), export taxes, and import duties on consumption goods. Direct income taxes on rural incomes and the channelling of savings through financial intermediaries has not been used to such a large extent. Two questions arise with regard to this policy. First, has the resulting reduction of peasant incomes been wise, given the rapid increase in real incomes of those employed in the modern sector? The transferring of the agricultural surplus probably has reduced peasant investment and contributed to the excessive draining off of workers to the city. Secondly, what has been the net impact on the rural sector of the investment financed through agricultural surpluses? Investment in urban construction, manufacturing, public utilities, and urban social overheads has often had little positive impact on the rural sector, especially when manufacturing of import substitutes involves higher prices to the rural consumers because of increased tariffs and monopoly protection. Investment in roads, rail, air travel, and port facilities has to some extent facilitated the movement of goods and services to and from and within the rural sector. All too often, however, a large proportion of the investment in roads is for widening, improving, and paving the connections between main urban centres, and very little has been spent on agricultural and feeder roads. Most of the investment in air travel has been for improving the main international airports and purchasing aircraft for international service rather than for improving connections between rural centres.
More important, perhaps, than the bias of investment activity toward provision of services for the urban areas has been the bias of administrative and political effort towards satisfying the needs of urban areas. Improvement in the quality of rural life, say through increased activities of the departments and ministries concerned with rural community development, may not require so much increased investment in the rural areas as a redirection of thought, effort, and research towards that end and a political reform which gives rural interests a stronger voice in formulating government policy.

Finally, an approach based on limiting the growth of population might be possible. Such a policy combined with attempts to reduce the urban-rural income differential could significantly reduce the population pressures on the cities. A report prepared for the Government of Kenya by several eminent experts on population control was fairly optimistic on the possibilities for population control in that African country. The government's response to the report was quite favourable. Perhaps some preliminary investigations of large-scale attempts at population control elsewhere in Africa are in order. Population control, however, is a very controversial subject and the deleterious effects of rapid population growth on development goals would have to be amply demonstrated before government acceptance could be obtained.

To sum up, the key to the solution of the unemployment, part-time and under-employment problem in the cities is a reduction of urban-rural real income differentials. This can be accomplished not only by urban real wage restraint and an increasing agricultural real incomes from cash crops, but by a redistribution of the benefits of social welfare schemes and public consumption goods toward the rural areas.

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1 Rapid rates of overall population growth tend to aggravate the urban unemployment problem for a number of reasons. First, the rapid growth of population means an increasing supply of potential entrants into the labour force. Secondly, while Africa is generally considered to be a land surplus area, there are certain regions of Africa where overpopulation is becoming an increasing problem. In other areas, a continued rapid growth in population will begin to result in pressures on the land in a few years (see Etherington [9]). The increasing scarcity of land means that everything else being equal, the rate of rural-urban migration will increase.
APPENDIX: THE RELATION BETWEEN GROWTH IN EMPLOYMENT AND GROWTH IN OUTPUT

In this appendix let us derive the relationship between growth in output and growth in employment using a general neo-classical type production function:

\[ Y = f(Le^{at}, Ke^{bt}, S) \]

where

\[ L: \text{Labour} \]
\[ K: \text{Capital} \]
\[ S: \text{Skilled Labour} \]
\[ Y: \text{Output} \]
\[ \alpha: \text{Rate of labour-augmenting technical change} \]
\[ \beta: \text{Rate of capital-augmenting technical change} \]
\[ L^* = Le^{at}: \text{‘effective’ labour force} \]
\[ K^* = Ke^{bt}: \text{‘effective’ capital stock} \]

The equilibrium labour force at any time is determined by equating the marginal product of labour \( f_L \) with its price \( p_L \):

\[ f_L = p_L = f_L e^{at} \]

The change in (1) through time is determined by taking the total derivatives of both sides of these equations:

\[ \dot{Y} = f_L \dot{L}^* + f_K \dot{K}^* + f_S \dot{S} \]

\[ \dot{\alpha} f_L + \dot{f}_L \dot{L}^* + f_L \dot{K}^* + f_S \dot{S} = \dot{p}_L \]

where the dot over a variable represents change per unit of time, \( f_x \) represents the first partial of \( f \) with respect to the variable \( x \) and \( f_{xy} \) represents the partial of \( f_x \) with respect to the variable \( y \).

From (1*) and (2*) we may eliminate \( K^* \) and solve for \( L^* \).

\[ \dot{L}^* = \left[ -f_K \dot{p}_L + (f_{LS} f_K - f_S f_{LK}) \dot{S} + f_L \dot{K}^* + \alpha f_L f_K \right] \cdot \left( f_K f_L - f_{LL} f_K \right)^{-1} \]

Using the chain rule and product rule for differentiation we have the following relationships:

\[ \dot{f}_L = e^{-at} f_L; \quad \dot{f}_K = e^{bt} f_K \]
\[ \dot{f}_{LL} = e^{-at} f_{LL}; \quad \dot{f}_{LK} = e^{bt} f_{LK} \]
\[ \dot{L} = e^{at} \dot{L} + \alpha L \cdot e^{at} \]

Substitute (4), (5), and (6) into (3).

\[ \dot{L} = \frac{1}{D} \left[ -f_K \dot{p}_L + (f_{LS} f_K - f_S f_{LK}) \dot{S} + f_L \dot{K}^* + \alpha f_L f_K \right] \]

where under the usual assumptions about production functions

\[ D = (f_{LK} f_L - f_{LL} f_K) > 0 \]

We may rearrange (7) as follows:

\[ r_L = \alpha \left( \frac{f_{JK} f_L - D f_{LK}}{D f_L} \right) \frac{f_K \dot{p}_L + (f_{LS} f_K - f_S f_{LK}) S}{D L \dot{S} + f_{LK} Y} \]

\[ \frac{f_L}{D L} \dot{y} \]
where

\[ r_L = \frac{1}{L} \dot{L}: \text{rate of growth of labour (employment)} \]

\[ r_S = \frac{1}{S} \dot{S}: \text{rate of growth of skilled labour} \]

\[ r_Y = \frac{1}{Y} \dot{Y}: \text{rate of growth of output} \]

Equation (9) is represented in Fig. 1 assuming \( \dot{p}_L \), \( r_S \), and \( \alpha \) are held constant at some fixed level. The effects of these variables will be to cause the intercept \( A \) in Fig. 1 to be negative if (a) wage rates rise (\( \dot{p}_L > 0 \)); (b) if skilled labour grows (\( r_S \) positive) and skilled labour growth is on balance substitutable for growth in unskilled employment (\( (f_{LS} - f_{SfLK}) \) is negative); and/or (c) labour-augmenting technical change \( \alpha \) is positive and \( f_{KfL} < D.L. \). The slope of the curve in Fig. 1 is the coefficient of \( r_Y \) in equation (9) and depends on the particular type of production function postulated.

**BIBLIOGRAPHY**


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