Employment-Output Conflicts, Factor-Price Distortions, and Choice of Technique: Empirical Results from Sierra Leone*

I. Introduction
The purpose of this paper is to bring empirical evidence from a comprehensive, microlevel survey of the major economic sectors of Sierra Leone to bear on the debate over the employment-output conflict. With the surge of interest in employment issues in developing countries, there has been considerable discussion of potential conflict between employment and output objectives in the design of development strategies.1 Much of this debate has centered on the question of choice of technique and on whether or not factor-price distortions have fa-

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1 See the review by Werner Baer and Michael Hervé, "Employment and Industrialization in Developing Countries," Quarterly Journal of Economics 80 (February 1966): 88–107; David Morawetz, "Employment Implications of Industrialization in Developing Countries: A Survey," Economic Journal 84, no. 3 (1974): 491–542; and Lawrence J. White, "The Evidence on Appropriate Factor Proportions for Manufacturing in Less Developed Countries: A Survey," Economic Development and Cultural Change 27, no. 1 (1978): 27–59. See also the discussions by Howard Pack, "The Employment Output Trade-Off in LDCs: A Microeconomic Approach," Oxford Economic Papers 26, no. 1 (1974): 388–404; William Steel, Small-Scale Employment and Production in Developing Countries: Evidence from Ghana (New York: Praeger Publishers, 1977); and Francis Stewart and Paul Streeten, "Conflicts between Output and Employment Objectives in Developing Countries," Oxford Economic Papers 23 (July 1971): 145–68.

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vored the choice of more capital-intensive techniques and reduced employment.2

There are several issues that are central to the debate on the employment and output trade-off. One of these issues is whether or not there is an array of alternative techniques or processes in use or potentially available within each sector or subsector of the economy. Factor-price distortions may influence employment and output if alternative techniques of production of varying labor intensity are found to exist within a sector. There have been two main approaches used to examine this issue empirically. One of these approaches has been to measure, by means of econometric estimations of aggregate production functions, the elasticity of substitution between capital and labor. Although most studies have concluded that considerable substitution possibilities do exist,3 there are serious methodological difficulties with most of these studies due to the aggregate nature of the variables used and the use of functional forms that assume a constant elasticity of substitution.4 Moreover, only techniques currently in use can be examined by this approach.

A second approach has been to delineate the main production techniques and processes in a given industry by using microlevel data to estimate the labor intensity of both existing and potential production techniques.5 These studies have generally shown a potential array of techniques of varying labor intensity, although the most labor-intensive techniques are not always the most efficient users of capital.6 But almost all of these studies have been confined to the industrial or processing sectors, with little attention given to other sectors of the economy, particularly agriculture. Moreover, within the industrial sector, the role of the more labor-intensive small-scale industries, particularly those in rural areas, has largely been overlooked.7

Another issue bearing on the employment-output trade-off relates to the choice of product mix. Even if there were no alternative production techniques in each sector, employment-output trade-offs could

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2 See, e.g., the reports of the ILO employment missions to Colombia and Kenya (International Labour Organisation, 1970, 1972); and Dennis Anderson and Mark Leiserson, “Rural Nonfarm Employment in Developing Countries,” Economic Development and Cultural Change 28 (January 1980): 227–48.

3 J. Gaude, “Capital-Labour Substitution Possibilities: A Review of the Empirical Evidence,” in Technology and Employment in Industry, ed. A. S. Bhalla (Geneva: International Labour Organisation, 1975).

4 See esp. Morawetz: see also C. St. J. O’Herlihy, “Capital/Labour Substitution and the Developing Countries: A Problem of Measurement,” Bulletin of the Oxford University Institute of Economics and Statistics 34 (August 1972): 269–80.

5 White.

6 See A. S. Bhalla, “Choosing Techniques: Hand Pounding vs. Machine Milling of Rice: An Indian Case,” Oxford Economic Papers 17, no. 1 (1965): 147–57; and C. G. Baron, “Sugar Processing Techniques in India,” in Technology and Employment in Industry, ed. A. S. Bhalla (Geneva: International Labour Organisation, 1975).

7 Morawetz.
arise because of the effect of demand on the product mix. Two questions are important in this regard. First, there is the extent to which an adequate consumer demand exists for products of labor-intensive industries. Some theoretical analyses argue that, in fact, the demand elasticities for small-scale industrial products are low, if not negative. Second, a hypothesis underlying much recent literature on development strategies is that lower-income groups consume more labor-intensive commodities—that is, a development strategy that promotes a more equitable income distribution increases the demand for labor-intensive commodities and hence promotes employment. To date, the empirical evidence on both of these questions is limited and inconclusive. Most studies have used aggregate commodity groups that do not delineate products produced by small-scale labor-intensive methods from similar products produced in large-scale sectors or abroad.

Finally, in a dynamic framework there are other issues bearing on the employment-output conflict. For example, the choice of technique and product mix must consider indirect as well as direct employment effects, because interindustry linkages vary with the type of product and production technique. Furthermore, if increased employment helps improve the income distribution of the poor, there may be a reduction in savings rates and hence future output. But there is very little evidence on savings rates among different income groups in developing countries.

An understanding of all these issues is fundamental to the relative emphasis that should be given to the labor-intensive small-scale sectors versus more capital-intensive, large-scale sectors in designing development strategies to promote both output and employment. Consequently, in this paper, the microlevel data are analyzed within a sectoral disaggregation that preserves the small-scale and large-scale classification in the economy. A small-scale activity or enterprise is defined as one employing less than 50 persons.

The analysis of these issues using Sierra Leonean data is developed in the following sequence. First, we examine factor-price distortions prevailing in the economy with particular reference to the variation in interest rates, wages, and tariffs between the small-scale and large-scale sectors. This leads to an examination of existing produc-

8 Stephen Hymer and Stephen Resnick, "A Model of an Agrarian Economy with Nonagricultural Activities," *American Economic Review* 59, no. 4 (1969): 493–506.
9 Ronald Soligo, "Factor Intensity of Consumption Patterns, Income Distribution and Employment Growth in Pakistan" (Program of Development Studies Paper no. 44, Rice University, 1973).
10 Morawetz.
11 For information on savings rates, see Dale Adams, "Mobilizing Household Savings through Rural Financial Markets," *Economic Development and Cultural Change* 26 (April 1978): 547–60; and Marvin P. Miracle, Diane S. Miracle, and Laurie Cohen, "Informal Savings Mobilization in Africa," ibid. 28 (July 1980): 701–24.
tion techniques in farming, agricultural processing, fishing, and manufacturing sectors to analyze variations in labor intensity and efficiency of capital and foreign exchange use. The sensitivity of the choice among these techniques to changes in factor prices is analyzed by budget and linear programming methods. We then turn to an analysis of rural demand patterns to determine the demand outlook for products from labor-intensive sectors and the variation of these demand patterns by income group. This analysis is based on a commodity classification using as a criterion the labor intensity of production. Finally, the dynamic questions of indirect employment linkages and savings rates are briefly discussed.

II. Overview of the Sierra Leone Economy and Data Sources

Sierra Leone is a small West African country of about 3 million people with an agriculturally based economy employing more than 70% of the population and generating 32% of the GNP. Rice is the principal crop produced, largely by traditional land-extensive technologies either as upland rice in a system of shifting cultivation or as swamp rice. Oil palm products, coffee, and cocoa are also produced by smallholders, largely for export. Mining is the second most important sector, accounting for 17% of GNP; this sector was not examined in this study because of the difficulties of obtaining reliable information on diamond mining, where illegal mining operators are common. The manufacturing sector, consisting of a few large-scale firms usually producing for import substitution and a wide range of small-scale firms, accounts for only about 5% of GNP, an extraordinarily low percentage even for developing countries.

Historically, government policy has implicitly emphasized expansion of the large-scale sectors with little attention to small-scale sectors. Recently stated government policy objectives have emphasized the importance of increasing employment opportunities. At the time of the study, the urban unemployment rate was about 14%. Little open unemployment exists in rural areas, but substantial seasonal unemployment occurs. Adults in rural areas worked an average of only 70 hours per month in the dry season. Small-scale manufacturing was an important source of dry-season employment.

Data employed in this analysis were collected through a nationwide survey in Sierra Leone during 1974–75. In this survey, members...
of 500 rural households were interviewed twice weekly over a 12-month period to obtain daily information on farm and nonfarm production and household consumption. In addition, some 60 firms in rice milling, the major agricultural processing sector, and 120 small-scale and large-scale firms in the fishing sector, another important rural sector, were interviewed twice weekly over the year. Finally, 250 small industrial firms in both rural and urban areas were surveyed and, together with secondary data on large-scale industries, provided an overview of production techniques in the industrial sector.

III. Factor-Market Distortions
Researchers studying employment issues have frequently cited "factor-market distortions" as a major cause of unemployment. The price of capital is assumed to be lower than its opportunity cost because of subsidized interest rates and overvalued foreign exchange, while the price of labor is assumed to be higher than its opportunity cost because of institutionally fixed wages. Rarely do economists disaggregate the economy to examine variations in factor prices within the economy. In this section, we examine factor prices prevailing in different economic sectors in Sierra Leone with emphasis on the small-scale/large-scale differentiation of the economy. The focus is on differences in prevailing factor prices rather than comparisons of actual and opportunity costs of a factor.

The Capital Market
At the time of our survey, we observed two distinct capital markets—the formal and informal markets. Formal lending institutions included commercial banks and the government-operated National Development Bank. The private banks charged an interest rate of 12% on all loans, the maximum allowed by government regulation. Since the rate of inflation for the period was over 15%, the banks were actually charging a negative real interest rate. Not surprisingly, given these low returns, private banks lent largely to large-scale commercial firms on a short-term basis, although some loans were outstanding in the large-scale industrial sector. The National Development Bank also provided loans at low interest rates of 9% per annum, but at the time of the

“The Economics of Rural and Urban Small-Scale Industry in Sierra Leone” (paper no. 14, 1976); Dunstan S. C. Spencer, Ibi I. May-Parker, and Frank S. Rose, “Employment, Efficiency and Income in the Rice Processing Industry of Sierra Leone” (paper no. 15, 1976); and Derek Byerlee, Carl Eicher, Carl Liedholm, and Dunstan Spencer, “Rural Employment in Tropical Africa: Summary of Findings” (paper no. 20, 1977). Also see Robert P. King and Derek Byerlee, “Factor Intensities and Locational Linkages of Rural Consumption Patterns in Sierra Leone,” American Journal of Agricultural Economics 60, no. 2 (1978): 197–206.
survey the minimum loan offered by this bank was $7,000.\textsuperscript{14} Again, the main recipients of these loans were firms in the large-scale sector. In addition, large-scale firms, particularly foreign owned, often had access to international sources of funding with interest rates of about 10%. A few small-scale firms received loans at 9%–12% interest rates through special credit agencies and agricultural development projects, but in our random sample of almost 1,000 small-scale farmers, fishermen, rice processors, and small-scale industries, less than 1% had ever received a loan from a formal financial institution.

Small-scale firms depend largely on their own savings and loans from the informal sector—that is, relatives, friends, and traders. But the interest rates on these informal loans are frequently quite high. From the survey of Sierra Leonean small-scale fishermen, for example, a detailed computation was made of the interest rate charged by private traders for the sale of outboard motors to fishermen.\textsuperscript{15} The actual effective interest rate to the fishermen implicit in the terms of the sale was approximately 168% per annum. But when adjustments were made for delayed and defaulted repayments, the actual yield to the traders was reduced to 43% per annum.\textsuperscript{16} Clearly, even with their detailed knowledge of the local community, the informal sector lenders faced high risks, and these risks were apparently a major element in the costs of capital in rural Sierra Leone.\textsuperscript{17} The 43% rate, which reflects the scarcity of capital, was not an unreasonable figure in a capital-short economy with a 15% inflation rate. Nevertheless, it was still substantially higher than the interest rate paid by large-scale firms. In summary, small-scale firms paid substantially higher interest rates than did large-scale firms.

\textit{Import and Export Tariff Structure}

Sectors that import equipment or intermediate inputs, or export their output, are affected by both the price of foreign exchange and tariffs

\textsuperscript{14} This limit has since been reduced in order to encourage more applications from small-scale firms.

\textsuperscript{15} Linsenmeyer.

\textsuperscript{16} The formula Linsenmeyer employed was to solve for the rate of interest, \( r \), in the equation:

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P = (1 - d) \left[ \frac{A_1}{1 + \frac{r}{12}} + \frac{A_2}{\left(1 + \frac{r}{12}\right)^2} + \ldots + \frac{A_n}{\left(1 + \frac{r}{12}\right)^n} \right] + dgE,
\]

where \( P \) is the principal of the loan extended, \( A \) is the monthly repayment, \( d \) is the default rate, \( g \) is the probability of repossession if there is a default, \( E \) is the value of the motor at the time of the default, and \( n \) is the number of months to repay.

\textsuperscript{17} One implication of this result is that potentially “solid” loan customers may be driven out by the high interest rates needed to recoup the losses due to the “lemons” or bad customers that the lender was not able to sort out. See G. Akerloff, “The Market for Lemons: Quality, Uncertainty and the Market Mechanism,” \textit{Quarterly Journal of Economics} 84 (August 1970): 488–500.
TABLE 1

| Industry                        | Duties on Raw Materials and Equipment | Duties on Competitive Imports |
|---------------------------------|--------------------------------------|-----------------------------|
| Small-scale agriculture ..........| Hand tools, 3%                        | Rice, free; palm oil, free; fish, 10% |
| Small-scale fishing .............| Nets, 36%; outboard motors, 36%      |                             |
| Small-scale manufacturing:      | Cotton fabric, 22%;* needles, buttons, thread, 36%; sewing machines, 16%; dye-stuff, 36% | Dyed cloth, 20% |
| Cloth and clothing .............| Plywood, 36%; nails, formica, polish, 35% | ... |
| Woodwork                        | ...                                  | Hand tools, 3%               |
| Metalwork                       | ...                                  |                             |
| Brewing                         | Beer-stout, 127%*                    |                             |
| Biscuits                        | Biscuits, 60%                        |                             |
| Sandals (plastic)               | ...†                                | Sandals, 35%                |
| Soap                            | Toilet soap, 36%                     |                             |
| Suitcases                       | Suitcases, 45%                       |                             |
| Flour milling                   | Flour, 167%                         |                             |

Source.—Published tariff schedules of Sierra Leone government.

* Specific tariff converted to ad valorem rate based on current f.o.b. prices.
† Most firms covered by Development Ordinance Act, which allows duty-free imports of raw materials and equipment.

and subsidies on imports and exports. In Sierra Leone, an open economy with a small industrial base, almost all sectors are affected by these trade policies. The import tariffs in table 1 show that small-scale firms pay substantially higher tariffs on imported inputs than large-scale firms. For example, tariff rates for sewing machine parts and outboard motors were on the order of 35%, which is similar to the rate for most noncompetitive imported consumer goods. On the other hand, large-scale firms enjoy low or zero tariffs on imported inputs through a Development Ordinance that allows duty-free imports of equipment and raw materials. Moreover, large-scale firms receive a high degree of protection with effective tariffs on competitive imports sometimes in excess of 100%. Finally, the government itself has duty-free privileges that encourage the use of imported equipment and inputs for its own activities.

Although small-scale firms account for the bulk of production of agricultural exports such as coffee, palm oil, and cocoa, these firms pay a high tariff on exports. In 1974, the price paid by the Sierra Leone Produce Marketing Board to farmers was only 45%, 48%, and 75%,
respectively, of the f.o.b. world market price for coffee, cocoa, and palm kernels. Some of this difference is due to transportation and marketing costs of delivering produce to the port, but a large part represents an implicit tariff on exports produced by small farmers.

At the time of the 1974 survey, foreign exchange was not rationed and there was no black market for foreign exchange. But the tariff structure does represent an implicit foreign exchange overvaluation. Using the Harberger-Schydlowsky method to compute this implicit overvaluation, we estimated that the leone was overvalued by approximately 15%.\(^\text{18}\) Although all sectors pay the same price for foreign exchange, this overvaluation provides a greater benefit to large-scale producers, who import a larger proportion of their equipment and inputs. Large-scale industry, for example, requires Le 25 of imported inputs to produce Le 100 of output, whereas agriculture and small-scale industry require only Le 4.5 of imported inputs per Le 100 of output.

The Labor Market\(^\text{19}\)

The wage rate for unskilled labor follows the same dichotomy between small-scale and large-scale sectors that we observed in the capital and foreign exchange markets. The structure of wage rates shown in table 2 indicates that, in urban areas, the wage rate for uneducated labor in large private firms is about double the wage in small-scale sectors. The actual differential, however, may be somewhat smaller because of the ability of the large firms to screen workers and obtain labor of a higher quality.\(^\text{20}\) The government maintains a minimum-wage policy, but this wage is only about 20% higher than the unskilled wage rate in small-scale sectors. Large private firms are apparently paying a higher wage rate than dictated by either a competitive market or by government minimum-wage legislation. Large private firms, however, employed less than 10% of urban unskilled labor.

The wage rate in rural sectors is on average 55% of the wage in urban small-scale sectors. When considered in the light of the higher

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\(^\text{18}\) A. C. Harberger, "Survey of Literature on Cost-Benefit Analysis for Industrial Project Evaluation," in Project Evaluation: Collected Papers (Chicago: University of Chicago Press, 1976), pp. 23–69; and D. M. Schydlowsky, "On the Choice of a Shadow Price for Foreign Exchange" (Economic Development Report no. 108, Development Advisory Service, Harvard University, 1968). The Harberger-Schydlowsky method estimates the implicit foreign exchange overvaluation as the weighted average tariff rate on imports and exports (subsidies are treated as negative tariffs) where the c.i.f. and f.o.b. value of imports and exports are the weighting factors. The resulting estimate approximates the extent to which the exchange rate differs from the exchange rate that would prevail in a free-trade situation.

\(^\text{19}\) Derek Byerlee, Joseph L. Tommy, and Habib Fatoo, "Rural-Urban Migration in Sierra Leone: Determinants and Policy Implications" (African Rural Economy Paper no. 13, Department of Agricultural Economics, Michigan State University, 1976).

\(^\text{20}\) For a discussion of labor quality in a firm, see J. M. Page, Jr., "Small Enterprises in African Development: A Survey," World Bank Staff Working Paper no. 363 (Washington, D.C.: World Bank, 1979).
TABLE 2
COMPARISON OF RURAL AND URBAN WAGE RATES FOR PERSONS WITH NO FORMAL EDUCATION, SIERRA LEONE, 1974

| Category and Area                        | Wage (Le/Hour) |
|------------------------------------------|----------------|
| Rural:                                   |                |
| Lowest-wage region, northern plains      | .07            |
| Highest-wage region, Scarcies            | .13            |
| Average wage                             | .08            |
| Urban:                                   |                |
| Employed in government                   | .19            |
| Employed in private large-scale sector   | .38            |
| Employed in small-scale sector           | .15            |
| Average wage (persons without education) | .25            |

SOURCE.—Derek Byerlee, Joseph L. Tommy, and Habib Fatoo, "Rural-Urban Migration in Sierra Leone: Determinants and Policy Implications" (African Rural Economy Paper no. 13, Department of Agricultural Economics, Michigan State University, 1976).

cost of living in urban areas, this difference does not seem to be unduly high.21 The largest wage differentials appear in urban areas between the large-scale private sector and the small-scale industrial services sector rather than between rural and urban areas.

IV. Variation in Production Techniques
The variation in factor prices noted above has potential implications for choice of production technique only if a range of production techniques of varying factor intensities exists. This issue was analyzed by computing for each production technique in each sector the relevant economic ratios: labor-capital, output-capital, and output-labor.

The labor-capital ratio is used as a measure of the labor intensity of production, where both labor and capital are expressed in annual flows.22 Labor is measured as actual flows of labor inputs, whereas capital is converted to annual flows through the capital recovery factor.23 This method avoids problems with the standard stock measures of labor and capital although it is still limited by the assumption of full-capacity utilization. Moreover, according to Morawetz, capital is valued at a shadow interest rate estimated at 35% in order to make comparisons across firms operating with different factor prices.24

21 Byerlee et al., "Rural-Urban Migration in Sierra Leone."
22 For a discussion of the limitations in using this ratio as a measure of labor intensity, see Bhalla (n. 6 above).
23 That is, \( R = rV/[1 - (1 + r)^{-n}] \), where \( R \) is the annual capital service flow, \( V \) is the original value of the asset, \( r \) is the discount rate, and \( n \) is the life expectancy of the equipment.
24 Morawetz (n. 1 above).
The output-capital ratio is used as one measure of the "efficiency" of the production technique with respect to the scarce factor, assumed to be capital. Capital was measured again in terms of annual flows using a shadow interest rate of 35%. Output was measured as value added. Consequently, to minimize output-employment conflicts, techniques or processes are required that are both labor intensive (i.e., high labor-capital ratio) and efficient users of capital (i.e., high output-capital ratio). The use of the output-capital ratio to measure "efficiency" implicitly assumes a labor surplus situation. This is somewhat true in Sierra Leone, where there is considerable seasonal unemployment of labor in rural areas and a substantial pool of urban unemployed. Nonetheless, a switch to more labor-intensive sectors and production techniques is likely to result in both an increase in employment and a redistribution of the share of income accruing to labor.

Table 3 lists the computed ratios for production techniques in agricultural, agricultural processing, fishing, and manufacturing sectors. In the agricultural sector, the greatest difference in production techniques with respect to capital-labor substitution is the use of tractors to replace hand labor for land preparation in rice production in two regions where the government operates a tractor hire scheme. Tractors are substantially more capital intensive (i.e., lower labor-capital ratio), particularly when the value of capital services is computed using the unsubsidized tractor rental rate, as in table 3. In rice milling there are very sharp variations in capital intensity, ranging from hand pounding up to large disk sheller mills capable of processing 2 tons of rice per hour. Both hand-pounding and small mills are privately owned and operated, whereas large mills are government owned and operated. For both agriculture and rice milling, the small-scale more labor-intensive processes (i.e., hand cultivation and hand pounding) also generated higher output-capital ratios than their larger, more capital-intensive counterparts.

In the fishing subsector, a wide range of techniques was identified depending on the type of boat, net, and propulsion equipment. Since outboard motors have been adopted by many small-scale fishermen, the total investment of small-scale firms is sometimes as high as Le 10,000. Other fishermen employ dugout canoes and paddles valued at less than Le 100. Despite this variation in total investment, there is strikingly little variation in the output-capital and output-labor ratio. In large part this arises because the mechanized boats are able to travel further to sea, operate in rougher weather, and hold a larger catch so that total output and employment is also substantially increased. But

25 Spencer and Byerlee (n. 13 above) estimate that the subsidy on the cost of tractor cultivation is about 85%.
TABLE 3
OUTPUT-CAPITAL, OUTPUT-LABOR, AND LABOR-CAPITAL RATIOS FOR SELECTED PRODUCTION TECHNIQUES AND INDUSTRIES IN SIERRA LEONE, 1974

| Industry and Production Technique | Output-Capital | Output-Labor | Labor-Capital | Economic Rate of Return to Capital (%) |
|----------------------------------|----------------|--------------|---------------|--------------------------------------|
| Rice Production:                 |                |              |               |                                       |
| Hand cultivation                 | 112.2          | .18          | 634.00        | 586                                  |
| Tractor cultivation              | 1.08           | .35          | 3.12          | -13                                  |
| Rice Milling:                    |                |              |               |                                       |
| Hand pounding                    | 57.1           | .06          | 889           | na                                   |
| Small steel cylinder mills       | 2.98           | 1.46         | 3.54          | na                                   |
| Small rubber roller mills        | 1.32           | 1.34         | 1.71          | na                                   |
| Large rubber roller mills*       | 1.40           | 9.61         | .34           | na                                   |
| Fisheries:                       |                |              |               |                                       |
| Boat < 20 ft, cast net           | 20.9           | .43          | 48.12         | 837                                  |
| Boat 20 ft, ring net             | 8.1            | .37          | 21.71         | 204                                  |
| Boat 30 ft, beach seine net      | 6.1            | .31          | 19.73         | 154                                  |
| Boat 40 ft, ring net, motor 26 hp| 6.7            | .29          | 22.94         | 100                                  |
| Trawler                          | 1.85           | .45          | 5.10          | -3.7                                 |
| Manufacturing:‡                  |                |              |               |                                       |
| Baking                           |                |              |               |                                       |
| Rural, small mud oven traditional| 12.4           | .50          | 24.7          | 11.5                                 |
| Urban, small peel oven           | 9.8            | 1.00         | 10.0          | 109.7                                |
| Urban, small multiple-deck oven  | 2.1            | .60          | 3.4           | 3.8                                  |
| Urban, large tunnel oven         | 1.7            | 1.00         | 1.7           | -10.5                                |

SOURCES.—For rice production and rice milling: Dunstan S. C. Spencer and Derek Byerlee, “Small Farmers in West Africa: A Descriptive Analysis of Employment, Incomes and Productivity in Sierra Leone” (African Rural Economy Working Paper no. 19, Michigan State University, 1977); and Dunstan S. C. Spencer, Ibi I. May-Parker, and Frank S. Rose, “Employment, Efficiency and Income in the Rice Processing Industry of Sierra Leone” (African Rural Economy Working Paper no. 15, Michigan State University, 1976). For fisheries: Dean A. Linsenmeyer, “Economic Analysis of Alternative Strategies for the Development of Sierra Leone Marine Fisheries” (African Rural Economy Working Paper no. 18, Michigan State University, 1976). For baking: Enyinna Chuta, “The Bread Industry of Sierra Leone,” mimeographed (East Lansing: African Rural Economy Program, Department of Agriculture, Michigan State University, 1979).

NOTE.—Output is measured in leones of value added, capital in annual costs at 35% opportunity cost, and labor in man-hours.

‡ Small-scale manufacturing refers to enterprises with fewer than 50 persons.

large-scale fishing firms (which operate trawlers) are considerably less labor intensive than small-scale firms and also have a lower output-capital ratio.

Finally, a range of production techniques for processes was also found within each of the major lines of manufacturing activity in Sierra Leone. There were, for example, four clothing, five bread, five gara (tie-dye), three metalworking, and three carpentry processes being
used, each of which possessed different factor proportions. In carpentry and blacksmithing, substantial variations exist in the labor-capital ratios, largely because of the use of powered machines in the larger, urban enterprises compared with the smaller, rurally based enterprises. In baking, production techniques vary from the traditional mud oven to modern electrically operated bakeries with investment exceeding Le 10,000, and there is a corresponding variation in the labor intensity across these techniques. Within the clothing industry, the techniques vary from rural tailors using manual sewing machines to large urban clothing factories with modern equipment exceeding Le 100,000. It should be further noted that the small-scale, more labor-intensive process in these industries generated higher output-capital ratios than did their larger, more capital-intensive counterparts (see table 3).

These results reveal that there are usually both small- and large-scale firms operating side by side within the same sector, but they are subject to different factor prices. Moreover, even within each of the small-scale sectors, a range of production technologies was found to exist. One explanation for why small-scale enterprises with differing technologies can exist simultaneously in the same sector is that they do not face uniform factor prices. Even within the small-scale sector, for example, wage rates vary by natural resource regions and by rural and urban classification (see table 2). Moreover, since management has not been explicitly incorporated into our analysis, some portion of the observed variation in factor proportions may reflect differences in the quantity and quality of the managerial effort supplied to the enterprise.

Most important, however, the results from each of the subsectors reveal that the smaller-scale, more labor-intensive techniques (i.e., higher labor-capital ratios) were associated with higher output-capital ratios. Consequently, if capital is assumed to be the scarce factor, there is no conflict between output and employment since labor-intensive production, which promotes employment, will also maximize output by efficient use of the scarce factor, capital.

26 See table 3; Liedholm and Chuta (n. 13 above).
27 Enyinna Chuta, "The Bread Industry of Sierra Leone," mimeographed (East Lansing: African Rural Economy Program, Department of Agricultural Economics, Michigan State University, 1979).
28 This failure of managers to employ known techniques with maximum efficiency is sometimes referred to as X-inefficiency (H. Leibenstein, "Allocative Efficiency vs. X-Efficiency," American Economic Review 56, no. 2 [1966]: 382–456) or a technical inefficiency (J. Page, "Technical Efficiency and Economic Performance: Some Evidence from Ghana," Oxford Economic Papers 32 [July 1980]: 319–39).
29 This conclusion will have to be tempered if there are important differences in product quality. See Francis Stewart, Technology and Underdevelopment (Boulder, Colo.: Westview Press, 1977).
Rather than relying entirely on the output-capital ratio as a measure of efficiency (which assumes a shadow price of labor of zero), we have also calculated the economic rate of return to capital for each of the different production techniques. The results of these calculations are displayed in table 3, and they are consistent with previous findings based on the output-capital ratio. In all cases the smaller-scale, more labor-intensive techniques generated the highest economic rates of return to capital.

V. The Effect of Factor Prices on the Choice of Technique

The availability of varying production techniques in each sector is only relevant to the question of employment-output conflicts insofar as the choice among these techniques is responsive to changes in factor prices. This sensitivity was investigated in each sector by a combination of budgeting and linear programming analysis. In all cases, the emphasis was placed on the effect of variation in the price of capital through changes in subsidies and tariffs and foreign exchange and interest rates—factors that are directly influenced by government policy.

In view of some important policy questions about the choice of techniques in the rice-processing sector, in-depth research was carried out to determine the effect of factor prices on five existing and potential techniques ranging from hand pounding to large government-operated mills.31

Surveys were carried out throughout the country in order to generate accurate data on the technical efficiency (milling percentage) of the five processing techniques. For example, a time-and-motion study of 70 hand-pounding (mortar and pestle) operations and 50 small rice mills throughout the country revealed the following: (a) 80% of the hand pounding was done by women; and (b) the milling percentages were hand pounding—68.4%, small steel mills—67.5%, small rubber mills—70.0%, and large steel mills—64.0%.

The surprising finding was the relatively high milling percentages for hand pounding—68.4%—a figure that was higher than small and large steel mills and lower than the 72.0% claimed by the manufacturer of the large rubber mills, which were not yet in operation in the field. Moreover, the hand-pounding milling percentage of 68.4% was substantially higher than the 55%–60% that is often used by agents selling rice-processing mills.

30 In making these calculations we have subtracted the following from value added: (a) capital services valued at a shadow interest rate of 35%; and (b) labor costs, including the inputs of family workers and proprietors valued at the competitive wage rate, which we assumed was equal to the opportunity cost of labor. A marginal firm would possess a zero rate of economic profit.

31 For more details, see Spencer et al. (n. 13 above).
### TABLE 4
PREDICTED NUMBER AND TYPE OF PROCESSING FACILITIES, EMPLOYMENT, AND INCOME IN RICE PROCESSING UNDER ALTERNATIVE POLICIES IN SIERRA LEONE, 1974

|                         | Actual Situation (1974) | Current Policies Continued* | Policy Reflecting Opportunity Costs of Resources† |
|-------------------------|-------------------------|-----------------------------|-----------------------------------------------|
| **Number of firms:**    |                         |                             |                                               |
| Hand pounding           | 40,807                  | 0                           | 35,757                                        |
| Small steel mills       | 110                     | 0                           | 0                                             |
| Large disk mills        | 0                       | 0                           | 0                                             |
| Small rubber mills      | 30                      | 498                         | 236                                           |
| Large rubber mills      | 0                       | 36                          | 0                                             |
| **Employment (thousands of man-days):** |                 |                             |                                               |
| Rural unskilled         | 12,242                  | 0                           | 10,727                                        |
| Urban unskilled         | 1                       | 34                          | 2                                             |
| Urban skilled           | 35                      | 163                         | 59                                            |
| Total employment        | 12,278                  | 197                         | 10,788                                        |
| **Income (thousands Le):** |                         |                             |                                               |
| Rural unskilled         | 4,774                   | 0                           | 4,185                                         |
| Urban unskilled         | 1                       | 35                          | 1                                             |
| Urban skilled           | 35                      | 182                         | 57                                            |
| Total income            | 4,810                   | 217                         | 4,243                                         |
| **Net foreign exchange costs (millions Le):** | 2.49                    | 3.64                        | 1.90                                          |

Source.—Dunstan S. C. Spencer, Ibi I. May-Parker, and Frank S. Rose, "Employment, Efficiency and Income in the Rice Processing Industry of Sierra Leone" (African Rural Economy Working Paper no. 15, Michigan State University, 1976).

* 10% interest rate, high rice prices.
† 35% interest rate; 20% premium on foreign exchange; rice prices at world prices.

The choice among the five processing techniques was analyzed using a linear programming approach developed from the methodology of Timmer. That is, a unit isoquant in value added was constructed for each of five techniques, taking into account the varying technical efficiency among the techniques and allowing the effect of changes in the price of capital to be easily analyzed. Labor costs were calculated at the competitive wage rate operating in the area (rural or urban). Moreover, in an important refinement of the Timmer approach, the costs of assembling raw materials from farmers prior to processing and costs of distribution of the processed product to consumers were explicitly incorporated. These costs are, of course, substantially greater for the large-scale mills than for hand pounding.

Table 4 compares the 1974 actual level with the results under two alternative assumptions: (1) continuation of low cost of capital (10%) to large mills, current foreign exchange rates, and high rice prices; and (2)

32 C. Peter Timmer, "Choice of Technique in Rice Milling in Java," Bulletin of Indonesian Economic Studies 9, no. 2 (1973): 57–76.
pricing capital at its opportunity cost (assumed to be 35%), adding a premium on foreign exchange (20%) and lower rice prices reflecting world prices. The model revealed that, if present policies are continued, all hand pounding would be eliminated by small and large mills, resulting in a loss of 40,000 person-years of employment. On the other hand, with prices reflecting opportunity costs, the amount of hand pounding is only slightly reduced from the 1974 level and large mills are eliminated from the solution. The model also showed that the choice of technique is more sensitive to rice prices than to factor prices (labor and capital) because of the variation in technical efficiency among the techniques. Moreover, under most assumptions, one processing technique was not completely dominant, but rather a combination of techniques are in the solution depending upon the local wage rate, available marketable surplus, and local transportation costs in the particular region.

Analyses of choice of technique in other sectors again show similar effects of changing factor prices on output and employment. In the agricultural sector, the profitability of tractor cultivation was highly sensitive to the rate of subsidy implicit in the tractor-hire scheme. Under subsidized prices for tractor hire, the cost of production with mechanical cultivation was 10% less than with hand cultivation. If subsidies on tractor hire were completely removed, however, the cost of production with hand cultivation was less than half the cost with mechanical cultivation. That is, once factor prices are changed to reflect the opportunity cost of capital, the optimal production technique switches from mechanical to hand cultivation. Moreover, demand for labor is almost doubled when hand cultivation techniques are used.

The choice of technique was also analyzed in the fisheries sector through a linear programming model. As expected, in view of the rather uniform labor-capital ratio among small-scale fishing technologies, there was little change in production techniques as a result of changing the cost of capital and reducing tariffs on materials and equipment to small-scale firms. But if large trawlers were charged the same factor prices as small-scale firms, there was a decline in output of these firms and an increase in production in small-scale sectors.

A linear programming model was used to investigate the choice of technique in the small-scale manufacturing sector, but no effort was made to analyze trade-offs between small-scale and large-scale sec-

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33 More technically efficient processes are favored by higher rice prices since more clean rice is produced per unit of husked rice.

34 The higher marketing and transportation costs associated with the large mills slightly offset their higher technical efficiency.

35 But it should be noted that the cost of mechanical cultivation in Sierra Leone is extremely high compared to similar schemes in other West African countries. See Spencer and Byerlee (n. 13 above).

36 See Linsenmeyer (n. 13 above).
The results indicated that variation in the interest rate and tariffs have their largest effects in the baking and carpentry industries, where there are the widest variations in factor intensities among techniques.

VI. Factor Intensities of Rural Consumer Demand Patterns

Demand patterns have potentially important implications for both employment and output. On the one hand, if the demand for labor-intensive commodities is low, there may be a serious constraint on an employment-oriented strategy that stresses the development of labor-intensive sectors. On the other hand, the demand for labor commodities may be affected by the pattern of income distribution. A widely accepted hypothesis is that high-income households tend to consume more capital-intensive goods and imports, whereas low-income households favor consumption of domestically produced labor-intensive commodities.

Expenditure elasticities for rural households in Sierra Leone were estimated for commodity groups disaggregated by labor intensity using a ratio semilog inverse model that allows the income elasticity to vary by income level and also preserves additivity of the marginal propensity to consume at each income level. Estimates of expenditure elasticities together with labor-capital ratios for specific commodities are shown in table 5. At the mean income level, there is a tendency for the more labor-intensive food and small-scale industry products to have a lower elasticity of demand than the more capital-intensive items such as transport and large-scale manufacturing. But these differences are not large and, in fact, most important labor-intensive commodities such as the staple food items have an expenditure elasticity approaching unity. Furthermore, for many of these labor-intensive commodity groups, particularly rice, fish, and small-scale industry products, there are substantial quantities of competing imports, which further raises the potential for increased demand through import substitution.

To determine to what extent higher-income households favor more capital-intensive and imported items, consumers were stratified into six income groups and expenditure elasticities computed by income group. Commonly consumed foods such as rice, root crops, palm oil, and fish do show declining expenditure elasticities as incomes rise, while

37 See Liedholm and Chuta (n. 13 above).
38 International Labour Organisation (ILO), Toward Full Employment (Geneva: ILO, 1970).
39 Mathematically, the ratio semilog inverse is expressed as

$$\frac{C}{Y} = a + b_1 \ln Y + b_2 \frac{Y}{Y},$$

where $C$ is consumption and $Y$ is income. In the final equation, variables for household size and subsistence ratio were included (see King and Byerlee [n. 13 above]).
TABLE 5
AVERAGE PROPENSITIES TO CONSUME AND EXPENDITURE ELASTICITIES BY INCOME CLASS FOR COMMODITY GROUPS OF DIFFERENT LABOR INTENSITIES

| Commodity                        | Labor-Capital Ratio* | Average Propensity to Consume† | Mean Income Level | Lowest Income Decile | Second and Third Decile | Fourth and Fifth Decile | Sixth and Seventh Decile | Eighth and Ninth Decile | Highest Income Decile |
|----------------------------------|----------------------|--------------------------------|-------------------|----------------------|-------------------------|-------------------------|--------------------------|------------------------|-----------------------|
| Rice                             | 750.0                | .394                           | .95               | 1.23                 | 1.07                    | .98                     | .94                      | .91                    | .88                   |
| Other cereal and root crops      | 974.0                | .082                           | .82               | 2.89                 | 1.41                    | .98                     | .79                      | .61                    | .34                   |
| Fruits and vegetables            | 582.0                | .029                           | .83               | 1.11                 | .94                     | .86                     | .80                      | .75                    | .68                   |
| Palm oil                         | 306.0                | .075                           | 1.08              | 1.71                 | 1.31                    | 1.14                    | 1.08                     | 1.04                   | .99                   |
| Meat and livestock products      | 282.0                | .016                           | 1.84              | .74                  | .30                     | 1.28                    | 1.92                     | 2.03                   | 1.87                  |
| Fish                             | 23.0                 | .084                           | .81               | 1.43                 | 1.07                    | .89                     | .80                      | .71                    | .60                   |
| Rural beverages and tobacco      | 635.0                | .019                           | .58               | .20                  | .22                     | .18                     | .67                      | 1.15                   | 1.51                  |
| Small-scale industry products    | 33.0                 | .023                           | .88               | .79                  | .83                     | .89                     | .88                      | .92                    | .90                   |
| Large-scale industry products    | 1.1                  | .134                           | 1.02              | 1.56                 | 1.22                    | 1.07                    | 1.01                     | .96                    | .92                   |
| Transport                        | 3.7                  | .022                           | 1.42              | .57                  | 1.09                    | 1.38                    | 1.44                     | 1.46                   | 1.43                  |
| Education                        | 66.0                 | .014                           | .67               | .06                  | .10                     | .44                     | .68                      | .98                    | 1.26                  |
| Services and ceremonial          | 435.0                | .043                           | 2.38              | 1.05                 | .37                     | 2.32                    | 2.37                     | 2.15                   | 1.90                  |

SOURCE.—Robert P. King and Derek Byerlee, “Factor Intensities and Locational Linkages of Rural Consumption Patterns in Sierra Leone,” *American Journal of Agricultural Economics* 60, no. 2 (1978): 197-206.

* Actual man-hours labor input/leone annual cost of capital.

† Average propensities to consume do not add to 1.00 because of the omission of minor and miscellaneous items.
“luxury” goods such as meat, transport, services, and ceremonies and education, all of which are generally more capital intensive, have increasing expenditure elasticities (see table 5).

Marginal propensities to consume for each commodity were combined with estimates of labor and capital requirements of the production process in each sector to calculate the direct marginal labor and capital requirements per unit of consumption—the factor intensity of consumption—at a given income level. That is,

\[ F_j = \sum_i \text{MPC}_i \cdot f_{ij}, \]

where \( F_j \) is the marginal factor intensity for factor \( j \), \( \text{MPC}_i \) the marginal propensity to consume the \( i \)th good, and \( f_{ij} \) the units of factor \( j \) required to produce one unit of output \( i \). In addition, marginal foreign exchange requirements were derived directly by estimating the marginal propensity to consume all imported goods.

As shown in table 6, marginal labor requirements decline and foreign exchange requirements increase as incomes increase in conformance with the hypothesized relationship between income and factor intensities. Capital requirements, however, fall slightly as incomes increase, a result that is the opposite of what is expected. To some extent, the drop in capital requirements can be explained by the fact that high-income groups with a higher marginal propensity to consume imports substitute imported goods for capital-intensive domestic goods. Moreover, since capital requirements are quite small relative to foreign exchange, the total requirements for the scarce factors—capital and foreign exchange—increase over the income range in the order of 10%–20%, which is much less than observed in studies in Pakistan.40

Our analysis of rural consumption patterns weakly supports the hypothesis that employment and output are complementary within the structure of rural consumption demands—that is, that redistribution of income toward lower-income groups could slightly increase the demand for labor-intensive goods and reduce the demand for capital-intensive and imported goods. This weak relationship between income and factor intensity of consumption patterns may reflect the low level of incomes ($200 per capita in 1974-75) and the relatively equal distribution of this income in rural areas of Sierra Leone where the overall Gini coefficient of income distribution was only 0.32.41 The addition of urban households, where average incomes are higher but much more

40 Ronald Soligo, “Factor Intensity of Consumption Patterns, Income Distribution and Employment Growth in Pakistan” (Program of Development Studies Paper no. 44, Rice University, 1973).

41 Capital and foreign exchange intensive consumer durables are not common in rural areas even among higher-income households.
| Marginal labor requirements (person hours/leone expended) | 9.200 | 9.020 | 8.740 | 8.520 | 8.120 | 7.590 | 8.520 |
| Marginal capital requirements (leone annual cost/leone expended) | .051 | .050 | .049 | .048 | .047 | .044 | .048 |
| Marginal foreign exchange requirements (leone/leone expended) | .133 | .137 | .140 | .142 | .144 | .147 | .141 |

Source.—See table 5.
unequally distributed, would likely increase the strength of the relationship between incomes and factor intensity.42

VII. Dynamic Considerations in the Employment-Output Conflict
The analysis of the empirical evidence in this paper has been presented in a static framework. There is some limited evidence that even in a dynamic framework employment and output will not necessarily be in conflict. The indirect employment effects of expanding output of the small-scale sectors, for example, are larger than for the large-scale sectors. In an input-output table developed for Sierra Leone from the microlevel surveys, Fatoo estimates that the small-scale nonagricultural sectors have the strongest backward linkages mostly to the other small-scale nonagricultural sectors and agriculture.43 The production of one unit of output in the small-scale nonagricultural sector requires .35 and .06 units of inputs from the small-scale and large-scale nonagricultural sectors, respectively, while one unit of output from the large-scale sector requires .06 and .15 units of inputs from the same sources. Corresponding requirements for imported inputs and for capital equipment are much higher for the large-scale sectors. For example, small-scale sectors import only about 20% of capital goods requirements, while large-scale sectors import over 50% of their capital goods.

If savings and reinvestment rates are lower among low-income groups, and particularly among small-scale sectors, however, there may be a longer-run trade-off between output and employment. In this study, no effort was made to measure savings and reinvestment rates, an almost impossible task in a rural subsistence economy.44 There was some indirect evidence, however, that there is considerable savings and reinvestment potential of small rural enterprises. The profit rate, an indication of potential savings, of the smaller manufacturing enterprises in Sierra Leone, for example, ranged from 20% for tailoring to 200% for gara dyeing. These profit rates were substantially above those generated by the larger manufacturing enterprises. In addition, the economic profit rate of the small fishing and agricultural enterprises was higher than that of the larger enterprises (see table 3). Moreover, there was evidence that a large part of the initial and rein-

42 The overall Gini coefficient of income distribution in Sierra Leone is estimated at 0.62 (S. Jain, Size Distribution of Income: A Compilation of Data [Washington, D.C.: World Bank, 1975]). A Gini coefficient of 0.56 was estimated for urban income distribution in Sierra Leone (see Thomas Eponou, "The Size Distribution of Income in Sierra Leone" [M.S. thesis, Michigan State University, 1978]).

43 Habid Fatoo, "Macro Economic Analysis of Output, Employment, and Migration in Sierra Leone" (Ph.D. diss., Michigan State University, 1977).

44 Donald Huddle found in a recent study of Colombian artisans, however, that the average savings rate of the rural artisan household was 16%, double that of the general population ("An Analysis of the Savings Behavior of a Group of Colombian Artisan Entrepreneurs" [Program of Development Studies Paper no. 81, Rice University, 1977]).
vested capital from small manufacturing enterprises was derived from savings. For manufacturing enterprises in Sierra Leone, for example, 60% of the initial capital came from agriculture or business and more than 90% of the expansion capital came from reinvested profits. These results provide some indication that small-scale enterprises may have a savings and reinvestment potential that is not markedly below that of their larger counterparts; thus there may be no output-employment conflict even in the long run.

VIII. Conclusions
In this paper, we have brought evidence to bear on the debate on employment-output conflicts using a unique set of data from a detailed nationwide survey of major economic sectors in Sierra Leone. The evidence was examined from both the demand and supply side. On the demand side, an important finding was the evidence of a favorable demand outlook for products of labor-intensive small-scale sectors both through increasing consumer incomes and import substitution. Moreover, demand for labor-intensive commodities would be marginally favored by more equitable consumer incomes. On the supply side, we first examined factor prices and showed that distortions in wage rates and interest rates are largely confined to the large-scale sector. An important result is the incidence of import and export taxes for large-scale and small-scale sectors. Small-scale sectors pay higher duties on imported inputs and equipment and at the same time lack the tariff protection of competitive products enjoyed by large-scale sectors.

There is also evidence that a wide range of production techniques with varying capital and labor intensities are being used in many subsectors of the economy. In most cases, the differences were accentuated between small-scale and large-scale firms within each sector. But within small-scale agriculture, rice processing, and small-scale manufacturing, there was also a range of factor intensities among production techniques. A particularly important finding was evidence that more labor-intensive techniques were also more efficient users of capital in all subsectors; consequently, the employment-output conflict, at least in a static sense, vanishes.

Finally, the evidence on factor prices and variation in production technique was combined to determine if changes in factor prices, particularly interest rates and tariffs, would affect the choice of technique. In most cases, these changes did produce a different mix of optimal technologies, particularly in the agricultural and rice-processing sectors, and they resulted in both lower costs of production and increased labor use.

Our nationwide research program in Sierra Leone provides solid empirical support for a rural mobilization strategy emphasizing small-
scale sectors and labor-intensive technologies to promote both output and employment. Such a strategy requires government action to correct the factor-price distortions, which favor the large-scale sectors, and fundamental improvements in institutions to support the small-scale sectors. A rural mobilization strategy requires strong and consistent government support in favor of small-scale sectors over a period of years. Clearly the present ad hoc approach to rural mobilization is unsatisfactory because it benefits those in power with access to subsidized credit and government services.