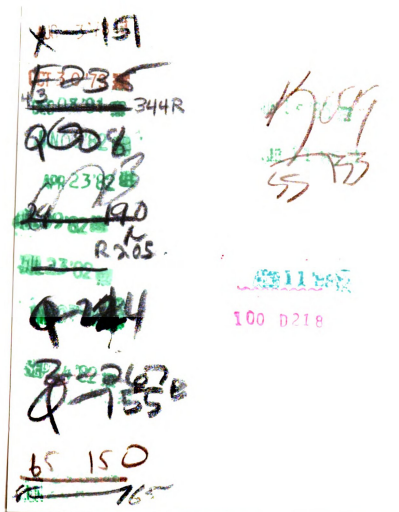

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ABSTRACT

A LINEAR PROGRAMMING ANALYSIS OF SMALL SCALE INDUSTRIES IN SIERRA LEONE

By

Enyinna Chuta

Most African governments are becoming aware of the importance of rural and urban small scale industries. Recently, Sierra Leone government emphasized the need to assemble data on small scale industries in order to evolve a detailed development program. This study is a direct response to the request of the Sierra Leone government.

From March 1974 to August 1975, a two-phased survey of small industries was undertaken in Sierra Leone. The first phase of the survey enabled the statistical estimation of the underlying population of Sierra Leone small scale industries. In phase II, a twelve months survey was undertaken to assemble daily input-output data from 366 small scale industrial firms.

The results of the phase I survey revealed that the small scale industrial subsector of Sierra Leone consists of about 50,000 establishments, employing about 89,000 people and dominating the industrial sector of Sierra Leone. The dominant small scale industry is tailoring, followed by blacksmithing, carpentry, bakery, gara dyeing, etc. The bulk of the small scale industrial establishments (95 percent) are located in the rural areas. On the basis of the phase II survey data, a linear programming model was built, first, for evaluating the efficiency of resource use among the five major small scale industries, and second, to test the effects of alternative policies on the small

scale industrial subsector.

Two significant results emerged from the base run of the linear programming model. First, the results indicated inefficiencies in the existing patterns of resource allocation and highlighted inadequate knowledge about foreign markets. Second, due to the high cost of electricity, workshop rentals and wages, urban small scale industrial firms have absolute cost disadvantages when compared to firms in rural towns or villages.

The results of the sensitivity analyses of the open model revealed that on the aggregate, increasing the rate of interest on capital resulted in a decline in output, employment and profits of the small scale industry subsector. Also, higher level of capacity utilization altered the comparative advantage of small scale industries. While customs duty rebates increased the profits and output of the subsector, raising the tariffs on competing imports distorted the patterns of comparative advantage, resulting in a decline of aggregate output and gara exports. Increasing the supply of labor to the subsector resulted in doubling the value of output, employment and profits.

With respect to specific industries, increasing the rates of interest and granting customs duty rebates resulted in increased output, employment and profits of the gara industry. Although higher rates of interest resulted in increased labor utilization, output also declined in the bakery industry. Finally, the analysis revealed that the blacksmithing industry will eventually become exclusively rural industry.

The policy implications of the results of the base run are that

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first, an export market should be promoted for gara cloth; second, means should be found to transfer surplus iron scrap and bars in urban areas to blacksmiths in rural areas; and third, steps should be taken to reduce the high cost of electricity, housing and wage bills of the widely dispersed urban small scale entrepreneurs.

The results of the sensitivity analyses indicate that increasing the demand for small scale industry products and supply of trained manpower, and granting customs duty rebates on intermediate inputs are effective ways of increasing output, employment and profits of small scale industries in Sierra Leone. Raising interest rates and tariffs on capital and competing imports respectively cannot by themselves accomplish the desired results.

Further research efforts needed for improving the findings of this study include computations of demand elasticities for competing imports and labor, tracing the employment and growth implications of reinvested profits and examining the interaction of farm-nonfarm activities within the small scale industrial subsector.

# A LINEAR PROGRAMMING ANALYSIS OF SMALL SCALE INDUSTRIES IN SIERRA LEONE

By

Enyinna Chuta

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1977

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Enyinna Chuta

1977

DEDICATION

To my beloved father, late J.W. Chuta, who laid the foundation for my education but did not live to see the results of his efforts.

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## ACKNOWLEDGMENTS

I wish to express my thanks to the Department of Agricultural Economics, the chairman and Graduate Committee, for financing my graduate program at Michigan State University.

I also gratefully acknowledge the assistance given to me by members of my Guidance and Thesis Committees: Derek Byerlee, Carl Eicher, Stephen Harsh, Glenn Johnson, Carl Liedholm, Vernon Sorenson and Robert Stevens. Particularly, I am grateful to my major professor, Carl Eicher, for stimulating my interest in graduate work and empirical research. His critical comments on my draft thesis, resulted in fundamental revisions and improvment of this dissertation. I also appreciate the role of my thesis supervisor, Carl Liedholm, in reading my manuscripts and making useful suggestions. Finally, I am indebted to Stephen Harsh whose expertise was always available for building my linear programming model.

I extend my gratitude to the following: the African Rural Employment Research Project, which, through its AID Research contract, financed my field research; the University of Sierra Leone for providing a base for my research; the staff of the Department of Agricultural Economics and the Rural Employment Research Project members at Njala University College for support and encouragement; Dr. Dunstan Spencer, the project director, for guidance in the field and invaluable contributions toward the building of my linear programming model;

and very important, the enumerators, coders, supervisors, research assistants, respondents and vehicle drivers who participated in the field work.

The excellent cooperation of Mr. M.A. Tunis, the Head of the Small Scale Industry Division, Ministry of Trade and Industry, Sierra Leone and the assistance of his office staff contributed immensely to the success of our field research in Sierra Leone. I am also grateful to all the traditional rulers and other government officials through whom we gained access to our respondents.

I am indebted to Pamela Marvel, Linder Buttel, and Jacqueline Grossman, whose skills in computer programming, patience and availability, facilitated data processing and analysis.

The study was completed mainly because of the support, patience, sacrifice and understanding of my family. Therefore, I am grateful to my wife, Chijindu and our children, Ihuoma, Ijeoma and Kelechi.

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# CHAPTER I

## INTRODUCTION

The focus of this thesis is on the use of a linear programming model to analyse the small scale[1] industrial subsector[2] in Sierra Leone. This study concentrates on the analysis of five major small scale manufacturing industries in Sierra Leone: tailoring, gara dyeing or tie-dyeing, carpentry, blacksmithing and bakery, which engage in the production and repair of manufactured goods.[3] According to the results of phase I survey of small scale industries in Sierra Leone,[4] these industries constitute 80 percent of the employment and 67 percent of the value-added by the small scale industrial subsector of Sierra Leone [Chuta and Liedholm, 1975, p. 29; Liedholm and Chuta, 1976, p. 12]. Specifically, the linear

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[1] In this thesis, small scale is defined to include those establishments employing less than 50 persons. Staley and Morse [1965, p. 14] have various definitions for "small scale." Georgia Institute of Technology has found at least fifty different definitions of "small scale" in seventy-five countries.

[2] The manufacturing industrial sector constitutes about 7% of Sierre Leone gross domestic product and the small scale industry subsector contributes about 42% of total industry value-added (Liedholm and Chuta, 1976, p. 13).

[3] The scope of manufacturing industries adopted in this study exclude mining, construction, trading, transportation, financial, social and personal services and agricultural processing. For further details, see Liedholm [1973, pp. 6-8].

[4] See Chapter 2 on research methodology.

programming model will trace the short-run and long-run effects of changing some policy variables on output, employment, profits and trade patterns within the small scale industrial subsector of Sierra Leone.

## 1.1 The Problem Setting

Four major considerations serve as background for this study. First, most development models have not been based on solid micro foundations [Hayami and Ruttan, 1971, p. 25]. For example, the usual dichotomy of the economy into two sectors--agriculture and industry or traditional and modern--has ignored the intersectoral and intrasectoral dynamics that constitute the key to understanding the problems of migration, employment, and income distribution. In addition, the closed[1] economy models in the development literature have underplayed the potentials of the small scale industrial subsector as a source of output and employment. This research will depart from the conventional theoretical framework and focus on the nonfarm, urban and rural small scale industries. Moreover, the analytical framework for this thesis incorporates a trade sector. Such an approach will allow small scale industrial firms to reap the benefits from foreign demand for their products, while "import industries," which introduce the imports of products of small scale industries, enhance the competitive performance of domestic small industries.

Second, development economists have asserted that rates of

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[1] Closed economy models would normally exclude the Foreign Trade Sector. See, for example, Harris and Todaro [1970].

economic growth could be maximized by pursuing strategies to promote large-scale, urban-based, capital intensive industrial projects [Ewing, 1968, p. 43]. Recently however, most developing countries have discovered that these policies over the past ten to twenty years have not yielded the desired results. In addition, manufacturing employment not only failed to keep pace with manufacturing output growth, it also lagged behind the rate of growth of population and the rate of rural to urban migration. For example, while the rates of urban population growth in Africa are typically about six to eight percent, nonagricultural employment grew at the rates of -1.0, -0.5, -0.7, 0.1, 3.0, -0.4, -0.1 and -0.9 percent for Cameroon, Kenya, Malawi, Nigeria, Sierra Leone, Tanzania, Uganda and Zambia respectively between 1955-1964 [Frank, 1967].

In view of the disappointing results of the industrialization policies pursued in the previous past decades, some African governments and scholars have started to assess the role of small scale industries in both urban and rural development. Particular attention has been focussed on rural manufacturing as an important component in rural development strategies [Norman, 1973; Government of Tanzania, 1974; Abban 1975; Ntim and Powell, 1975]. International donor agencies [United Nations, 1974] have also started reassessing their lending strategies for industrial development.

Third, since about 1970, there has been intense debate over the effects of alternative development strategies on output, employment and income distribution objectives [Stewart and Streeten, 1971; Morawetz, 1974]. Resolving this controversy requires systematic empirical studies of both small scale and large scale industries.

However, little research has been carried out on these problems in Africa [Steele, 1974]. Of special interest to this research is the case of Sierra Leone. While pursuing an import substitution strategy, in which policies were designed to encourage large-scale, urban-based, capital-intensive industries, Sierra Leone achieved a manufacturing growth rate of only 2.8 percent per year from 1966/67 to 1971/72. During the same period, large-scale manufacturing employment declined at a rate of 3.5 percent [Chuta and Liedholm, 1975]. Moreover, by 1971, unemployment in the urban areas had grown to about 14 percent [Byerlee, Tommy, Fatoo, 1976]. After much disenchantment with its previous industrialization policies, Sierra Leone recently set out a new industrialization strategy in which priority is given to small scale, agro-based, labor-intensive industries [Government of Sierra Leone, 1974].

Fourth, although there is growing interest in assessing the role of rural small scale industries in economic growth and development, steps have not been taken to generate adequate data for a rigorous analysis of small scale industries in most African nations. For example, in Africa, there is no systematic study of factor proportions, output-factor ratios, production processes, scale economics, elasticities of factor substitution, locational advantage and profitability of rural small scale industries. Recently, the need to generate reliable data was recognized by the Sierra Leone government when it stressed that "an immediate task relating to the [small scale industry] subsector, is to conduct an economic survey to assemble data on its size, composition, structure of inputs and outputs, development problems and potential. The survey is essential for

evolving a detailed development programme...." [Government of Sierra Leone, 1974, p. 185]. This study is a direct response to the needs of the Sierra Leone government. It will provide detailed information on the composition and characteristics of small scale industries in Sierra Leone.[1]

## 1.2 Objectives of the Study

In order to make policy suggestions for the development of small scale industries, it is necessary first, to evaluate the existing pattern of resource allocation among small scale industires. Second, it is important to examine the effects of alternative policy strategies on the small scale industrial subsector. On the basis of the results of these analyses, some implications for small scale industries in Sierra Leone can be discussed. The objectives are as follows:

1. To construct representative firm types, by industry and location in order to aggregate the linear programming results;

2. To evaluate the efficiency of resource use among small scale industries in Sierra Leone;

3. To examine the short-run and long-run effects of changing some policy variables on techniques of production, output, empolyment and trade among small scale industries in Sierra Leone and

4. To discuss the implications of the policy analysis for small scale industries in Sierra Leone.

---

[1] See Chapter 3 of this thesis. Also see Chuta and Liedholm, 1975; Liedholm and Chuta, 1976 for more details of the composition and economic characteristics of small scale industries in Sierra Leone.

## 1.3 Literature Review

The purpose of this section is to review studies of small scale industries in developing countries. The theoretical and analytical developments relating to such research and their empirical findings will be reviewed in some detail.

### 1.3.1 Theoretical and Analytical Developments

Most of the theoretical work on small scale industries can be classified at least into three categories: sectoral analysis, supply and demand analyses.

### 1.3.2 Sectoral Analysis

Dual sector models as presented by scholars such as Lewis [1954], Fei and Ranis [1964], Harris and Todaro [1970] and Mellor and Lele [1972], focused on the traditional (agricultural) and modern (industrial) sectors. The modern sector is assumed to be the source of dynamism within the economy while the traditional sector slowly declines. These models did not explicitly incorporate the small scale industries in either the rural or urban areas, and they failed to deal effectively with rural-urban migration and employment generation in the economy as a whole. Due to such serious limitations of dual sector models, economists began to produce more comprehensive models for sectoral analysis.

The first theoretical model to include nonagricultural activities in an agrarian economy was produced by Stephen Hymer and Stephen Resnick [1969]. In their model, rural households not only engaged in agricultural production but also are involved in nonfarm productive activities called "z-good" activities. Also, an I.L.O. mission to

Kenya [1972] recognized the need to go beyond the two sector models. While still maintaining the agricultural and industrial (nonagricultural) sectors' framework, the I.L.O. study in Kenya introduced formal, government-related and informal nongovernment-related subsectors. Oshima [1971] developed a trisector model in which the nonagricultural sector was split into labor-intensive and captial-intensive subsectors with agriculture remaining as a labor intensive sector. Also, he recognized a fourth sector, the government sector, even though he did not include this last sector in his theoretical analysis. Finally, Byerlee and Eicher [1972] developed a four sector model of the economy, made up of urban large-scale, urban small scale, rural nonfarm and agricultural production sectors.

### 1.3.3 Demand

One of the key theoretical issues on the demand side centers on the nature of demand facing the products of small scale industries. Hymer and Resnick [1969] have argued that the only source of demand for the products of small scale industries is farm income. Moreover, they contend that the products of small scale industries are "inferior" goods so that as farm income increases, the demand for the production of small scale industry products will decline. Bautista [1971] has developed a theoretical model in which "Z-goods" could be consumed or used as intermediate capital input for agricultural production.

Liedholm [1973, pp. 23-26], has suggested that the Z-good concept is too general and needs disaggregation into three categories--nontraded home production for own use, traded production undertaken

as a secondary occupation and traded production undertaken as a primary occupation. Second, he suggested that the model should be modified to take account of the potential urban or foreign based demand for rurally produced goods. Third, Liedholm emphasized that the "Z-good" concept cannot be restricted only to consumer goods, but should be expanded to include intermediate goods. Finally, Liedholm pointed out that the Hymer-Resnick model could be modified to explicitly take account of the backward and forward linkages between the rural nonfarm activities and the agricultural sector. Apart from such linkages, Staley and Morse [1965, p. 46] point out a different kind of linkage that exists between rural artisal production and urban industries, especially where both perform complementary functions. They cited wholesale and retail shops, shoe production and shoe repairing as examples of such complementarity. In addition, Huddle and Ho [1972] have argued that international demand for traditional goods produced by small scale industries is quite substantial.

Little work has been carried out to assess the effects of the level of effective demand on the activities of small scale industries. A number of scholars recognize that a low level of aggregate demand could affect the growth of employment demand in these industries [Steel, 1973; Stewart and Weeks, 1975, p. 93]. But the magnitude of such effects have not been empirically ascertained. This study will yield elasticities of output and employment which would focus attention on specific fiscal policies that could favor the growth of relatively labor-intensive industries; policies that specifically affect the domestic and foreign demand for the products

of particular small scale industries; and policies that affect sectoral incomes and thus the level of aggregate demand [Furtado, 1975; Schydlowsky, 1970, p. 82].

1.3.4 Supply

One obvious consequence of lack of "Effective demand" is the low level of captial utilization on the supply side.[1] Most theoretical work on the supply side emphasize the creation of more jobs without considering that the existing labor force needs to be more fully employed.[2] Lack of full capacity utilization in industrial production makes it difficult to use the concept of factor proportions [Winston, 1976, p. 1314], and difficult to determine the choice of efficient production processes, given relative factor prices. Thus, in order to isolate the effects of factor prices on choice of technique of production, different levels of capacity utilization ought to be incorporated in any meaningful economic analysis [Steel, 1976, p. 14].

The analysis of scale effects and factor substitution possibilities is of considerable theoretical significance. The neoclassical production function maintains that all firms, irrespective of their size, are on the same production function, given constant returns to scale. Therefore, theoretically, a proportionate change in capital and labor (which leaves the capital-labor ratio constant) will not alter the magnitudes of average product of both capital and labor.

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[1] See Winston, 1971, p. 38 for other causes of excess capacity. Excess capacity in our context, means the difference between expected and actual levels of utilization.

[2] See Chapter 4 for the various levels of excess capacity.

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But a case of economies of scale will exist if a proportionate increase in capital and labor (for example) leads to increasing values of capital and labor productivities and possibly a decline in the captial-labor ratio. In other words, if scale economies exist in the small scale industries, it would mean that relatively larger firms make more economic use of resources than relatively smaller firms. Since the linear programming analysis will be utilized in this study, constant returns to scale is assumed. The validity of this assumption rests on the fact that both the Cobb-Douglas and the Constant Elasticity of Substitution production functions, when fitted to the Sierra Leone data, revealed constant returns to scale [Liedholm and Chuta, 1976].

The degree of labor intensity depends partly on the elasticity of substitution between labor and capital ($\alpha$). The larger the $\alpha$, the greater the substitutability between labor and capital, and the greater the income distribution effect from labor intensive production so that labor's share of value added is maintained or increased. The analytical approaches for estimating the elasticity of factor substitution varies from the Cobb-Douglas function where $\alpha$ is equal to 1; the Leontief fixed inputs coefficient function where $\alpha$ is equal to zero; the more general version, the Constant Elasticity of Substitution (C.E.S.) function [Arrow et al., 1961; Drhymes and Kurz, 1964] which varies from zero to infinity and of which the Cobb-Douglas and Leontief functions are special cases.

Under conditions of the smooth neoclassical production function and flexible factor prices, continuous process and factor substitution is possible since in fact, an infinite number of production

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processes is assumed. But, with the Leontief fixed inputs coefficient function, neither process nor factor substitution is possible because only one process is assumed to exist. A representative firm linear programming model will be utilized to examine factor substitution possibilities among Sierra Leone major small scale industries. Although input ratios are assumed fixed, the delineation of a finite number of production processes induces factor substitution through process substitution in analysis of choice of technique problem. The linear programming and even the nonlinear programming approaches for anlaysing labor-capital substitution possibilities have gained attention quite recently [Chenery and Raduchel, 1971; Duloy and Norton, 1973; Goreur, 1973], though not in the analysis of small scale industries. But all these efforts have focused on highly aggregated macro economic data. This study will focus more on the individual firm as a decision-making unit.

The potential advantage of small scale industry is not limited to employment. Output gains might also result from such technological shifts. However, serious questions have arisen recently as to whether policies designed to increase employment would decrease output. Recently, Stewart and Streeten [1971] have distinguished between static and dynamic tradeoffs between output and employment and have clarified much ambiguities that surround the concepts of "output" and "employment." In a purely static sense, the presence or absence of tradeoffs have been shown to depend on the relevant point, given any positive real wage, on the neoclassical production function [Stewart and Streeten, 1971, pp. 147-148; Pack 1973, Morawetz, 1974]. For example, given one fixed factor, capital, and a

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variable resource, labor, and one product, provided the marginal product of labor is positive, every increase in employment will raise the productivity of capital and therefore increase output. In this sense there cannot be a conflict. But if employment is increased to the point where the extra labor input leads to a decline in output, then a tradeoff can exist. Moreover, Peacock and Shaw [1971] have shown that the employment output conflict boils down to a fiscal problem of transferring income from the output-maximizing sector to engage surplus labor in a static framework.

In a dynamic sense, Stewart and Streeten [1971] distinguish between a situation where less production and more employment now leads to future increased output and secondly, a situation where current low level of employment and high level of output leads to increased future employment. Focusing on aggregate savings ratio, they[1] pointed out that if the savings ratio is determined by the distribution of income between wages and profits and if such distribution is in turn determined by the level of employment, a conflict might arise between maximizing the growth of employmnent and income, and such conflicts worsen with increases in wage level. They also pointed out that if a given savings ratio can be invested in either a capital goods industry or consumer goods industry, a higher proportion allocated to the capital goods industry will not lead to a trade off between employment and growth, provided labor requirement is the same in both sectors.[2] But if labor requirement

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[1]Stewart and Streeten [1971, p. 161] recognize the weaknesses of the assumptions of this model.

[2]Here, an invalid closed economy model is assumed.

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is higher in the consumer goods industry, then a conflict between employment and growth arises. Such a conflict arises because an optimal investment allocation to maximize income growth may be inconsistent with the optimal investment allocation required to maximize employment growth.

Stewart and Streeten also distinguish between increase in labor productivity that results from technological developments (improved managerial performance) and increased labor productivity that results from other kinds of technical developments such as the installation of new machines. Whereas, in the former where output increases faster than employment, the technique or techniques which maximize output growth also maximize employment growth; in the latter, the trade-off might exist since the choice of more capital intensive techniques over labor intensive ones might lead to a fall in employment. This study is designed to verify under what circumstances an output-employment tradeoff might or might not exist among small scale industries in Sierra Leone.

## 1.4 Review of Empirical Findings on Small Scale Industires

An attempt will be made to examine first, the kinds and content of actual field surveys that have taken place with respect to small scale industries. Second, an attempt will be made to summarize the results of such field surveys in so far as they affect the supply of and demand for output and employment in small scale industries.

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1.4.1 Field Surveys

Most of the previous data on small scale industries are quite rudimentary. Nevertheless, those studies do indicate the magnitude of employment that is involved in the small scale industrial sub-sector. For example an I.L.O. study indicates that in rural Western Nigeria, 27 percent of employed males had their primary occupation in the rural nonfarm sector and 14 percent of the employed males were secondarily engaged in nonfarm activities.[1] Thus, 41 percent of employed males were engaged in rural nonfarm activities. Similarly, the data presented by H.A. Lunning [1967, p. 77] reveal that 48 percent of employed males had either primary or secondary occupation in rural small industries.[2] In addition, David Norman's data, generated from a survey of three villages in Northern Nigeria, show that approximately 47 percent of the average male working time in the major village of Dan Mahawayi was spent on off-farm activities.[3] Also, available fragmentary data reveal large seasonal variations in labor allocation between agricultural production and nonfarm activities. For example, Lunning's study [1967, p. 77] reveals that while 65 percent of males in rural Sokoto Province were primarily engaged in nonfarm occupations during the dry season, only 6 percent were primarily engaged in this sector during the wet season.

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[1] Liedholm [1973, pp. 3-4] computed these figures from a recent I.L.O. report [1972, p. 117].

[2] See Liedholm [1973, p. 3].

[3] See Norman [1973, p. 29]. Each family adult spent 122.6 days per annum on off-farm activities out of a total of 262.7 days worked per family adult.

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However, since these studies were essentially rural or farm-management surveys, the small scale industries were not given adequate attention with respect to the composition, content and the economic characteristics of these small industries. Kilby's Study of Small Industry in Eastern Nigeria [1962] and the survey of Small Scale industries in the Western Nigerian Urban centers of Ibadan, Oyo and Iwo [1970] were attempts to assemble data relating to the economic characteristics of small industries. Recently, Child [1973] studied 120 rural firms in the four regions of Kenya, including 36 different market centers. Industries surveyed included cloth workers, carpenters, bakers, tinsmiths, and blacksmiths. Although the firms surveyed were biased in favor of the clients of the Rural Industral Development Centres it was discovered that small industries were more profitable than the modern sector; that credit was not a major bottleneck and that there was need for improving managerial skills. Also, a recent study in Ghana by Steel [1977], carried out a detailed analysis of small scale industires in urban areas. The study conducted a complete enumeration of Aburi and Nsawam, localities that represent the smallest and medium sized localities in Ghana, and 10 percent sample survey of Acra, which is one of the two largest cities. In the first phase of the study, a frame was assembled which enabled the selection of firms for detailed study in a subsequent phase. This study, apart from revealing that small industries constituted between 60-75 percent of industrial firms in urban Ghana, has enabled a detailed analysis of the economic characteristics of these firms.

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contributions to the study of small scale industries, they have serious limitations. The most serious limitation is that both the Kenya and Ghana studies were one contact surveys. Thus, they could not reveal the patterns of seasonal variations that existed among small scale industries with respect to industrial types and location.[1] Another limitation of the Ghanaian and Nigerian studies is that they focused too much attention in the urban areas to the neglect of the rural areas. Empirical evidence from Sierra Leone reveals that the small scale industries in the localities of less than 2,000 contributed about 90 percent of total small scale industrial establishment, 78 percent of employment [Chuta and Liedholm, 1975, p. 14] and 57 percent of value added [Liedholm and Chuta, 1976, p. 12] of the entire subsector in Sierra Leone.

### 1.4.2 Demand

Until now, very little data were available on the demand for the products of small scale industries in developing nations. Yet, the question of the growth of small scale industries depends to a great extent on the nature of demand that faces those industries. Liedholm [1973] had shown that evidence with respect to the growth of rural small industries was inconclusive and conflicting. For example, whereas the studies of Stephen Resnick [1970] and Montoya and Villalba [1969] indicate that these industries decline over time, those of Arthur Gibb [1972] in the Philippines, and E. Gerken [1973] in Paktia, Afganistan, revealed an increased rate of labor absorption

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[1] See Chapter 3 for some details on pattern of seasonal variation existing among small scale industries in Sierra Leone.

in these industries over time. Evidence exists for the linkages and employment potential for urban registered and unregistered small industries in India. Jan Herre van der Veen [1972], in his case study of Gujarat State, found that "unregistered" industries have a higher employment-output ratio than "registered" ones. His study, however, was limited to urban firms employing six or more persons. Thus, the rural and very small urban firms were not examined.

One major contribution of the Sierra Leone project [Byerlee and King, 1976], is that evidence now exists to dispell the notion that the products of rural small scale industries are "inferior" goods as portrayed in the Hymer and Resnick model [1969]. The consumption survey of the Sierra Leone Project was designed to obtain a detailed breakdown of household expenditures on individual nonfood items by origin of production. The data generated from a sample of 220 rural households revealed that the expenditure elasticity coefficient for all small scale industries was 1.60. For the major small scale industries, the elasticity ranged from 1.22 for tailoring to 1.90 for carpentry.[1] These coefficients indicate that these industries will not decline as per capita incomes are increased in the rural economy. The small scale industry survey in Sierra Leone has also revealed some important sectoral linkages.[2] In addition, foreign markets do exist for the products of gara industry in Sierra Leone. The important linkages, together with the income elasticity coefficients,

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[1]The standard errors for the aggregate coefficient, tailoring and carpentry are .17, .22, and .31 respectively.

[2]The details of these linkages have been spelled out in Chapter 3 of this thesis.

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### 1.4.3 Supply

Due to the paucity of systematic field surveys of African small scale industries, empirical evidence with respect to the supply of output and employment is scanty [Pack, 1976, p. 45]. Recent studies by Child in Kenya [1973], and Steel in Ghana [1977], while focusing on the economic characteristics of small-scale industrial firms, failed to examine the production functions of those firms and did not derive the relevant supply parameters. Pack's recent survey of 42 plants in Kenya [1976] which employ over 50 workers, is not very relevant for the study of small scale industries. Moreover, that study did not also estimate production function parameters. It is only the recent work of Liedholm and Chuta [1976] that did come out with detailed analysis of the production relations of small scale industries in Sierra Leone. According to their study, both the Cobb-Douglas and the C.E.S. production functions revealed that Sierra Leone small scale industries exhibit constant returns to scale. Thus, large firms are not more efficient than the small firms in resource utilization. In addition, their analysis revealed that the elasticity of substitution was not significantly different from one .99 for tailoring, .93 for gara dyeing, .98 for carpentry, .80 for blacksmith and .70 for bakery industries.[1] According to these parameters, any proportionate change in factor price ratio

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[1]Computed from the Estimated substitution parameters [Liedholm and Chuta, 1976, p. 78].

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will tend to lead to the same proportionate change in factor ratio, thus indicating the possibility of factor substitution. Recently, Roemer [1975] carried out a time-series analysis of Ghanaian manufacturing. Using the C.E.S. production function, he also found that the elasticities of substitution for five manufacturing industries in Ghana were close to one. Those industries included bakeries, and clothing.

Although evidence is beginning to emerge about scale and substitution parameters, the relevance of these estimates for practical policy purposes is often questioned. First, it is usually pointed out that the use of value added in the estimating formula excludes material inputs as a productive resource. Thus, the estimating model is incompletely specified. Also the constant omission of working capital is another case of model misspecification [Bhalla, 1970]. Second, the econometric models do not differentiate between levels of managerial skill. This omission tends to mask an upward bias in the measurements of elasticity. Third, the econometric procedure does not differentiate between capital of different levels of vintage and technology. Such distinction may be very important from a point of view of near-future investment decisions [Roemer, 1975, p. 80]. Fourth, the econometric technique fails to take account of existing situation such as market imperfections, and capacity under utilization. Because of these limitations of econometric models, it is necessary to exercise caution while interpreting parameters that have been estimated from highly aggregated econometric models.

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## 1.5 Outline of Small Scale Industry Research in Sierra Leone

As a result of the field survey[1] of small scale industries in Sierra Leone, two joint papers have been published.[2] Chapter 3 of this thesis will attempt to present some aspects of those publications that describe the extent, composition and economic characteristics of small scale industries in Sierra Leone. Recently, a report has been written for the World Bank, highlighting the economic characteristics of rural and urban small scale industries in Sierra Leone deserving the World Bank's attention.

This thesis will attempt to accomplish three major objectives. First, a representative firm linear programming model of the small scale industrial subsector of Sierra Leone will be built. The model will serve as a major tool of analysis in this thesis. Second, some sensitivity analysis will be undertaken to examine the consequences of changes in some policy variables among the small scale industries in Sierra Leone. Third, the implications of the policy analyses for the development of small scale industries in Sierra Leone will be discussed.

Currently, further research[4] is being undertaken for the World

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[1]The details of the field survey of small scale industries in Sierra Leone are presented in Chapter 2.

[2]See Chuta and Liedholm, 1975; Liedholm and Chuta, 1976.

[3]The Liedholm and Chuta [1976] World Bank report on small scale industries is confidential.

[4]This research is an extension of MSU Agricultural economics and World Bank Research contract whereby Carl Liedholm and Enyinna Chuta consult for the World Bank on rural and urban small scale industries.

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Bank on: (1) a generalizable research methodology for carrying out base-line surveys of small scale industries, monitoring and evaluating small scale industry bank projects and programs; and (2) brief guidelines on analytical procedures for appraising the Bank's project work.

It is anticipated that over the next one year, further analytical work will be undertaken on case studies of the individual small scale industries. Also, an attempt will be made to analyze the employment and income distribution effects of farm-nonfarm interaction in the rural labor markets. Finally, the growth patterns of the different small scale industries will be traced, using a recurcive linear programming framework.

## 1.6 Plan of the Thesis

In order to undertake a linear programming analysis of small scale industries in Sierra Leone, Chapter 2 of this thesis will be devoted to a discussion of the research procedure utilized for obtaining primary data. Thus, a description of the objectives and scope of the survey, the sample design, and how the various inputs and outputs have been measured will be presented.

In Chapter 3 an overview of small scale industries in Sierra Leone will be discussed. Some details on the extent, composition, the relative magnitude and the economic characteristics of small scale industries will be outlined.

Chapters 4, 5 and 6 contain detailed descriptions of the delineation of the representative firm types, the specification of the linear programming model and an analysis of the results of the

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In Chapters 7 and 8, both the short-run and long-run policy analyses of small scale industries will be presented. On the basis of such policy analysis, suggestions will be outlined for developing small scale industries. These suggestions, together with the summary of the research findings will constitute the topics of Chapter 9.

## 1.7 Summary

The objective of this thesis is to develop a linear programming model of the small scale industrial subsector in order to examine the impact of alternative policies on small scale industries in Sierra Leone.

Although primary data concerning small scale industries in Africa are still inadequate, this thesis will be based on daily input-output data that were, for the first time, generated over a one year period, on both rural and urban small scale industries in Sierra Leone.

The policy analyses that will be undertaken in this thesis are of both theoretical and practical relevance. First, changes in the rate of interest will highlight the possibilities of labor absorption and employment-output tradeoffs among small scale industries. Second, changes in the levels of effective demand and capacity utilizations will reveal the directions and magnitudes of changes in output, resource productivities and employment among small scale industries. Third, the policy analyses will verify the impacts of foreign trade and different rates of labor supply on the activities of small scale industries.

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# CHAPTER 2

# RESEARCH METHODOLOGY

## 2.1 Introduction

The purpose of this chapter is to describe 1) the objectives and scope of the survey, 2) the survey design, 3) the methods of data collection, handling, storage and processing, 4) the procedures for data analysis and 5) how the various inputs and output have been measured for analysis.

## 2.2 Purpose and Scope of the Survey

Specifically, the purpose of the survey was to generate the primary input-output data required for the detailed economic analysis of small scale industrial activities in Sierra Leone. In order to achieve this objective, it was necessary to organize the survey in two phases. In Phase I of the survey, an attempt was made to collect data that would enable a statistical estimation of the population of small scale industrial establishments in Sierra Leone and obtain additional information concerning the characteristics of the underlying population of these industries. The Phase II survey involved the collection of detailed input-output data from a selected sample of small scale industrial firms, over a one year period, in order to undertake some rigorous economic analysis relating to those industries. Each of the surveys will now be discussed in further detail.

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2.2.1 Phase I Survey

Phase I survey of small scale industries in Sierra Leone took place between March and June 1974. In order to accomplish the purpose of Phase I survey, a one-page questionnaire was constructed (See Appendix 2.1) and a simple manual was written to guide the administration of the questionnaire. The questionnaire was designed to obtain the following information:

1. Type of enterprise,
2. Identification or address of firm,
3. Workshop description (whether temporary; built of mud or cement walls; operates in the open; thatch or zinc roof, etc.),
4. Types of labor (proprietor, hired, apprentices),
5. Number of each type of laborer,
6. Kinds of machines being used (power driven or manually operated), and
7. Number of machines being used.

Due to budgetary and time constraints, it was not possible to carry out a complete census of industrial establishments in Sierra Leone. Also, since previous studies have revealed that both the magnitude and composition of industrial activity varies with size of settlements,[1] a stratified sampling procedure based on locality size was adopted. First, a total establishment enumeration was undertaken in the 18 localities, including Freetown, with a population in excess of 20,000. Secondly, one-half of the 42 localities with 2,000-20,000 inhabitants were randomly selected for total

[1] Liedholm, 1973, p. 4.

establishment enumeration. Finally, 24 "enumeration areas,"[1] each with less then 2,000 inhabitants and constituting the smallest sampling unit were randomly selected and enumerated.

With a team of 12 enumerators, a Volkswagon bus, and well-planned logistical support field trips were made to the different localities or groups of localities to carry out the survey. A dawn-to-dusk, street-by-street enumeration was undertaken throughout the period. Fortunately, excellent cooperation was obtained from the traditional rulers and government officials, who, in most cases, provided the enumerators, not only with food and lodging, but also local personnel who assisted in locating the various establishments. Indeed since most of the industrial establishments did not have signs and were often hidden behind other buildings, these local informants were vital in ensuring that an accurate enumeration of firms was obtained. In Freetown, the capital city, a comprehensive up-to-date street map, obtained from the Ministry of Land and Survey, ensured a complete coverage of that city. The farm level[2] enumerators, who already were stationed in the enumeration areas before our Phase I study was launched, also assisted in identifying various establishments.

The Phase I survey was used to assemble a sample frame for the selection of firms for the Phase II study. The research findings of Phase I survey were published in 1975 [Chuta and Liedholm, 1975].

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[1] "Enumeration areas" are groups of villages that were artificially grouped together by the central office of statistics for the 1963 Sierra Leone population census. Each such enumeration area contains an estimated 200 families [Spencer,1972, p. 8].

[2] For the component parts of the Rural Employment Research Project in Sierra Leone, see p. 29 below.

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### 2.2.2 Phase II Survey

The Phase II survey of small scale industries in Sierra Leone started on August 1, 1974, and ended on July 31, 1975. In order to achieve the purpose of Phase II survey, three kinds of primary data were collected. First, stock data on buildings, tools, equipment and furniture; inventories of material input and output stock were collected both at the beginning and end of the survey period. Secondly, detailed input-output flow data were gathered over a one year period. Such input-output data included labor input by hours and categories of proprietor, family, hired and appretice labor; daily output data including the disposition of such output and destination of daily output sales; daily material input purchases and monthly financial expenditures relating to production. Finally, a one contact interviewing was undertaken to carry out in-depth studies of the entrepreneurs and apprentices.[1] All the questionnaires have been included in Appendix 2.1.

## 2.3 Sample Design

In this section the procedures adopted for choosing the units of study for the Phase II survey will be described. In general, a two stage (cluster) sampling procedure was used in selecting the firms that were enumerated in detail. In the first stage, a sample of localities/enumeration areas (primary units) were selected while in the second stage, a sample of industrial firms (elementary units) were chosen from within the primary units.

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[1] Results of Phase I study revealed that both proprietor and apprentice labor constituted 90 percent of employment in the small scale industries.

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2.3.1 Sample Size

Usually in any sampling procedure, the choice of sample size is a critical issue. Ideally for a two stage cluster sampling procedure, the sample sizes for both the primary units and elementary units have to be statistically predetermined. Two important kinds of information are required to determine sample size. First, one has to specify the desired limit of error in the measurement of important variables. Such limits of error or degrees of precision are usually stated in the form of standard errors or coefficients of variation. Secondly, the equation that connects the sample sizes with the degrees of precision has to contain advance variance estimates of the items to be measured.

In order to estimate the optimal number of elementary units to be selected per primary unit in our survey, we would have needed variance estimates among primary units and within primary units. Also, it would have required detailed budgeting procedures to determine the cost of access to the primary unit relative to the cost of obtaining data from any element within the primary unit. The following equation sheds light on these issues [Cockran, 1963, p. 280]:

$$M_{opt} = \frac{s_2}{\sqrt{s_1^2 - s_2^1/M}} \left(\sqrt{c_1/c_2}\right)$$

Where:

$M_{opt}$ = optimum number of elementary units

$s_1^2$ = variance between primary units

$s_2^2$ = variance within primary units

$M$ = total number of elements within primary units

$c_1$ = cost of gaining access to primary units

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$c_2$ = cost of obtaining information from each element within the primary unit

Due to insufficient leadtime, it was not possible to obtain information on $c_1$ and $c_2$. Also, since no detailed study of small scale industries had been undertaken anywhere in Africa, no advance variance estimates were available at the time of study. Because of time and budget constraints, it was not possible to organize a pilot study in order to obtain the variance estimates of the important items. Some authors [Deming, 1960; Cockran, 1963] do recommend the use of variance estimates obtained by guesswork about the structure of the population and assisted by already existing mathematical results. Thus,

$s^2 = pqh^2$ (in the case of binomial distribution),

$s^2 = 0.083h^2$ (with a rectangular distribution), and

$s^2 = 0.042h^2$ (with a distribution like isoscles triangle),

where

$s^2$ = variance estimates

$p$ = the probability of a success = 0.5

$q$ = $(1-p)$ = 0.5

$h$ = range of the distribution.

Unfortunately little or nothing was known about the structure of the population of the key variables to be measured in the survey. Any guess as to the distribution and range of values for such variables such as daily hours of labor input by labor types and daily output by enterprise and locality size would have been misleading. What follows therefore are the procedures that enabled the determination of sample sizes at the levels of both primary and elementary

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### 2.3.1 Choice of Primary Units

In order to take advantage of the integrated nature of the Sierra Leone project[1] it was decided to choose localities that serviced the 24 randomly selected enumeration areas that were already being used for the farm level study.[2] As a working defintion, a locality was defined to "service" an "enumeration area" if the inhabitants of the enumeration area purchased any of their goods and services in that particular locality. On the basis of the preliminary returns from the rural consumption portion of the overall project, it was subsequently determined that the following thirteen localitites serviced at least one enumeration area: Freetown (with excess of 100,000 people; Bo; Kenema, Makeni (each falling within the population range of 20,000-100,000) and Port Loko, Segbwema, Rotifunk, Pendembu, Pujehun, Mattru, Kabala, Kamakwie, and Rokupr (localities with 2,000-20,000 inhabitants). Koidu was also added to the sample because it ranked next to Freetown in terms of industrial concentration. Figure 2 shows the location of the sample localities and the enumeration areas which they serviced.

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[1]The Integrated Rural Employment Research Project at Njala University College, University of Sierra Leone, consisted of the following studies: a) Farm Level Study; b) Agricultural Processing and Marketing Study; c) Migration Study; d) Consumption Study and; e) Non-farm Small Scale Industry Study.

[2]See the map on next page.

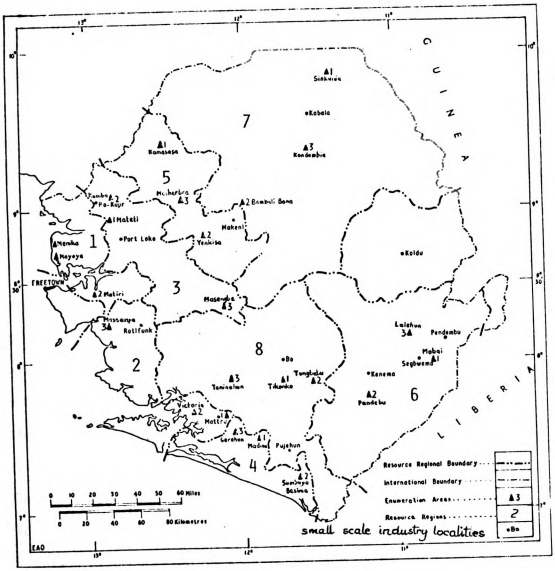



Figure 2. Small Scale Industry Sample Localities and the Enumeration Areas Which They Service.

2.3.3

2.3.3 Choice of Elementary Units

Having chosen 14 localities and being constrained by the budget to hiring only nine full-time enumerators, it was possible to determine how many firms to study in each of the 14 localities. On the basis of the results obtained when the questionnaire was pretested, it was discovered that one full-time enumerator could interview a total of thirty establishments per week. Thus, a total of 270 firms could be interviewed in these localities by the nine full-time enumerators assigned to the small scale industries. In actual fact, the small scale industry study had 18 enumerators on a half time basis, because the same enumerators also worked half time on the marketing and rice processing studies.

Two sampling procedures were adopted in choosing the actual firms to be studied in each of the fourteen localities. Based on the sample frame that was assembled during the Phase I survey, two-thirds of the establishments chosen for each locality were selected on a completely random basis. This random sample ensured a reasonable representation of the underlying population of small scale industries in Sierra Leone. Secondly, one-third of the establishments selected in each locality were chosen purposively. The purposive selection enabled the collection of information on the various techniques of production being utilized and different kinds of industrial activities that were skipped during random selection.[1] Table 2.1 shows that 180 establishments were chosen randomly out of

[1] A superior alternative to the combination of 2/3 random and 1/3 purposive sample would have been a simple random selection of firms from the frame stratified by location, industry and techniques of production.

Table 2.1 Initial Distribution of Establishments in the Random Sample of Small Scale Industries in Sierra Leone, 1974/75 Survey

| ENTERPRISE: | Tailoring | Carpentry & Furniture Making | Baking | Blacksmithing | Goldsmithing | Shoemaking | Tinsmithing | Vehicle Welding & Metal Work | Watch Repairing | Radio Repairing | Mattress Making | tie-dyeing | Photographers | Cloth Weaving | Tile Making | Barbing | Pot Making | Printing | Wood Carving | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Locality | | | | | | | | | | | | | | | | | | | | |
| Freetown | 12 | 1 | | 1 | 1 | 1 | | | 2 | | 1 | | 1 | | | | | | | 20 |
| Bo | 12 | 3 | | 1 | | | | 1 | 1 | | | 2 | | | | | | | | 20 |
| Kenem | 13 | 2 | | | | | | 1 | 1 | | | | 2 | | | | | 1 | | 20 |
| Makeni | 10 | 3 | 1 | 1 | | 1 | | | 1 | | | 3 | | | | | | | | 20 |
| Koidu | 6 | 1 | | | | | | | 2 | | | | | | | 1 | | | | 10 |
| Kamakwie | 6 | 4 | | | | | | | | | | | | | | | | | | 10 |
| Mattru | 4 | 3 | | 1 | | 1 | | | | | | 1 | | | | | | | | 10 |
| Pendembu | 7 | 1 | 1 | | | | | | | | | 1 | | | | | | | | 10 |
| Port Loko | 6 | 1 | | | 1 | 1 | | | | | | 1 | | | | | | | | 10 |
| Pujehuu | 4 | 2 | 4 | | | | | | | | | | | | | | | | | 10 |
| Rokupr | 5 | 1 | | 1 | 1 | | | | | | | 1 | | 1 | | | | | | 10 |
| Rotifunk | 5 | 2 | 2 | | | | | | | | | | | 1 | | | | | | 10 |
| Segbwema | 3 | 1 | 1 | 2 | | | | | | | | | | 2 | | | 1 | | | 10 |
| Kabala | 8 | 1 | | | | | | | | 1 | | | | | | | | | | 10 |
| Total | 101 | 26 | 9 | 7 | 3 | 4 | | 2 | 7 | 1 | 1 | 9 | 3 | 4 | | 1 | 1 | 1 | | 180 |
| % of Total | 56 | 14 | 5 | 4 | 2 | 2 | | .5 | 4 | .5 | .5 | 5 | 2 | 2 | | .5 | .5 | .5 | | 100 |

Initial Distribution of Establishments in Both Random and Purposeful Samples

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Locality | | | | | | | | | | | | | | | | | | | | |
| Freetown | 12 | 4 | 5 | 1 | 1 | 1 | | | 2 | | 1 | 1 | 1 | | 1 | | | | | 30 |
| Bo | 14 | 5 | 3 | 1 | | | 1 | 1 | 1 | | 1 | 3 | | | | | | | | 30 |
| Kenems | 16 | 4 | 3 | 1 | | | | 1 | 1 | | 1 | | 2 | | | | | 1 | | 30 |
| Makeni | 10 | 3 | 3 | 1 | | | 1 | 1 | 1 | 1 | | 8 | | 1 | | | | | | 30 |
| Koidu | 7 | 2 | 2 | | | | | 1 | 2 | | | | | | | 1 | | | | 15 |
| Kamakwie | 6 | 4 | 1 | 1 | | 1 | | | 1 | | | | | | | | | | 1 | 15 |
| Mattru | 4 | 3 | 1 | 2 | | | 1 | | 1 | | 1 | 2 | | | | | | | | 15 |
| Pendembu | 7 | 3 | 2 | 2 | | | | | | | | 1 | | | | | | | | 15 |
| Port Loko | 6 | 2 | 1 | 1 | 1 | 1 | | 1 | | | | 2 | | | | | | | | 15 |
| Pujehuu | 4 | 2 | 4 | | 1 | | | | | | | 1 | | 3 | | | | | | 15 |
| Rokupr | 7 | 1 | 1 | 2 | 1 | 1 | | | | | | 1 | | 1 | | | | | | 15 |
| Rotifunk | 5 | 2 | 2 | 2 | | | | | | 1 | | 1 | | 2 | | | | | | 15 |
| Segbwema | 3 | 2 | 1 | 2 | | 1 | | | | 2 | | 1 | | 2 | | | 1 | | | 15 |
| Kabala | 8 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 1 | | | | | | | | 15 |
| Total | 109 | 38 | 30 | 17 | 5 | 6 | 3 | 5 | 9 | 5 | 4 | 22 | 3 | 9 | 1 | 1 | 1 | 1 | 1 | 270 |
| % of Total | 40 | 14 | 11 | 6 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 8 | 1 | 3 | .3 | .3 | .3 | .3 | .3 | 100 |

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a sample size of 270. Out of the 180, 70 firms, representing 3 percent of industrial establishments in the "urban" localities and 110 firms, representing 4 percent of industrial establishments in "rural" localities of Sierra Leone, were selected.[1] In addition, a replacement sample of 33 percent of the original sample size was randomly selected for each locality.[2] However, the enumerators were advised not to replace firms unless they were permitted to do so by the senior officials of the research project.

### 2.3.4 Selection of Firms in the"Enumeration Areas"

In order to take advantage of the integrated nature of the Sierra Leone project, it was necessary to select establishments for detailed study from the 24 "enumeration areas" that had previously been randomly selected for the farm level study. Thus, it was possible to utilize the services of the farm level enumerators in collecting input-output data on small scale industries. The decision as to how many firms to be studied in each enumeration area was based on the information contained in the enumeration area sample frame (household listings). Such village household listings indicated that approximately one-sixth of the combined farm and nonfarm households were primarily engaged in industrial activities. Since twenty

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[1] Our cut-off line for "rural" localities is consistent with the United Nations definition of "rural" as towns with less than 20,000 inhabitants. However, the definitions of rural and urban areas vary from country to country.

[2] If the rate of nonresponse or attrition among respondents is high, the use of a replacement sample can lead to a severe reduction in sample size. Warwick and Linninger [1975, p. 112] suggest an upward adjustment in sample size to take care of the rate of attrition or nonresponse.

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farm households were already chosen randomly for the farm level study, it was decided that four households primarily engaged in industrial activities would be randomly selected for detailed study in the Phase II survey. Ninety-six households primarily engaged in industrial activities were selected in the enumeration areas and both their farming and industrial activities were studied in detail throughout the one year period. All the relevant information concerning the methods of data collection is in Appendix 2.2.

## 2.4 Principal Features of the Sample

Since the linear programming model using representative firms will be used to estimate output and employment, a combination of both the random and purposive samples will be used to delineate the representative firm types. As was shown on Table 2.1 a total of 270 firms were initially chosen in the combined sample for those localities with above 2,000 people. At the end of the survey period, the sample size dropped to 225 due to the following unavoidable circumstances. First, in one locality, Kabala, due to the multiethnic composition of that locality, we needed an enumerator who could speak the relevent three native languages, and also be familiar with that environment. Our inability to find such an enumerator, led to dropping this locality. Secondly, in Pendembu, we had worked for only four months when our enumerator stole valuable properties from a closeby tenant. Thus, we considered it inappropriate to continue to work in that locality. Thirdly, after a period of six months of data collection in Rotifunk, we had fired two enumerators due to general incompetence. A total of 45 sample firms were already lost

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in these three localities, thus reducing the overall sample size to 225, or 177 for the five major small scale industries, namely, tailoring, tie-dyeing, carpentry, blacksmithing and bakery,[1] industries in eleven localities (see Talbe 2.1).

Out of the 177 firms, 12 months data were obtained from 105 firms. Twenty-four out of the 177 firms closed down or changed their line of activity, 30 changed residence, and 14 refused to give out information. For the first two categories of dropouts, it was not possible to obtain complete 12 months data since they dropped out at some point during the survey period.

In the enumeration areas, out of the 96 firms initially randomly selected, 37 in the category of tailors, carpenters and blacksmiths provided information. Out of the 37, only 23 had 12 months data that could be used for constructing the representative firms. The reduction in the sample size from the original 96 was due to problems relating to assembling the sample frame at the initial stage of the survey. When households were being listed, heads of households were asked about their primary occupation. Their responses tended to coincide with the on-going seasonal activity. Since the household listing was undertaken during the period of low farming activity, rural households gave a biased report of their primary occupation. Thus, our input-output data revealed that household heads who were assumed to be nonfarm households, turned out to be

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[1] According to Phase I survey, tailoring, carpentry, gara dyeing, baking and blacksmighing industries accounted for 80 percent of the employment and 67 percent of the value-added in the small scale industry subsector of rural Sierra Leone. (See Chuta and Liedholm, 1975, p. 29; Liedholm and Chuta, 1976, p. 12.)

farming households. Table 2.2 provides a summary of the sample sizes of industrial firms, by industry and by location, used in the actual construction of representative firm types. Firms that did not have complete twelve months data have been excluded from this table. Altogether, 128 firms were used for constructing representative firm types in the four regions and for the five major small scale industries in Sierra Leone.

Table 2.2 The Distribution of Sample Firms Used for Analysis

| Localities / Industries | Less than 2,000 | 2,000-20,000 | 20,000 - 100,000 | Over 100,000 | Total |
|---|---|---|---|---|---|
| Tailoring | 7 | 25 | 29 | 6 | 67 |
| Gara Dyeing | - | 2 | 4 | 4 | 10 |
| Carpenters | 6 | 4 | 6 | 3 | 19 |
| Blacksmiths | 10 | 5 | 3 | 1 | 19 |
| Bakers | - | 4 | 6 | 3 | 13 |
| Total | 23 | 40 | 48 | 17 | 128 |

Source: 1974/75 Small Scale Industry Survey in Sierra Leone

## 2.5 Input-Output Measurements

In this section, it will be necessary to define the units in which our various inputs and outputs have been measured. In doing this, some issues relating to such measurements will be discussed. The first variable that will be described is labor.

## 2.5.1 Labor Input

During the survey, labor input data were gathered on a daily basis throughout the period of one year. Such labor input data were measured in hours actually worked in production process [Morawetz, 1974, p. 497] as distinct from hours that firms planned or expected to work. This procedure of measuring labor input was chosen because it not only produces the more accurate factor services input for production function analysis but also provides an indication of an establishment's excessive capacity.[1] In addition, labor hours of services were collected in all possible categories of labor--proprietor, male family, female family, child[2] family, apprentices and hired workers. In this study, the first four labor categories were lumped together as proprietor and family labor.

Also, no attempt has been made to convert labor hours of the female and child labor into adult male equivalents. This is because child labor constitutes only .09 percent of total labor input in the five major small scale industries, and female family labor constitutes about 3 percent in the four locality sizes. Proprietor labor, male family labor, apprentice and hired labor types are of the magnitudes of 26 percent, 6 percent, 41 percent and 24 percent, respectively.[3] Limited amounts of child labor were observed in the gara industry where "stick ironing" of dyed fabric[4] is sometimes

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[1] See page 91 for our definition of excess capacity.

[2] The cut-off point for a child is ten years.

[3] Computed from survey data.

[4] See Chuta and Steacy, 1975.

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done by children and in the balcksmithing industry where children occasionally operated the bellows for their fathers. Although 3 percent of labor hours utilized for the five major small industries in Sierra Leone is attributed to female family labor, it is important to remember that in the gara industry alone, female labor input accounts for a magnitude of over 70 percent of total hours input in that industry. This is because approximately 80 percent of all gara proprietors are women.[1]

### 2.5.2 Capital Input

Whereas labor input data were collected on a flow basis, i.e., annual service flows in hours for the different labor types, data on capital were collected on a stock basis. Thus, information was collected on the original cost of buildings, tools, equipment and furniture, and working capital, i.e., inventories of material inputs and finished output held by the enterprise.[2] For purposes of more adequate valuation and accounting procedure [Livingstone and Burns, 1971, p. 33], all capital stock values were converted into annual capital service flows. The advantage of such a conversion is that the untenable assumption of the proportional relationship between capital service flow and capital stock data was avoided. As Yotopoulos [1967] and Winston [1974] pointed out, such a proportionality exists, only if capital stocks are of the same durability and vintage. The variations in durability and vintage, prevailing

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[1] Computed from survey data.

[2] Because information with respect to cash on hand and bank savings were difficult to obtain from respondents, our working capital definition is very restrictive.

within the Sierra Leone capital stock data, will now be discussed.

In order to identify the range of durability existing for the stocks of tools, equipment and furniture, capital stock items were grouped into seven categories--machines, iron tools, non-iron tools, metal tools, wooden tools, furniture and others. For these categories of equipment, durability[1] ranged as follows: 12-25 years, 9-35 years, 3-11 years, 5-10 years, 20-25 years, 10 years and 8-15 years, respectively. With respect to vintage, the capital stock data also revealed a wide variation. For example, in the bakery industry, there are the traditional ovens, built of mud, the modern French and German "peel oven," the outmoded British dough brake, and the Italian automatic oven. In the carpentry industry, equipments ranged from the earliest saws and hammers to the recent Italian electrical "combining" machines. Thus, in view of the wide variations in durability and vintage among our inventories of capital equipments, and the presence of a wide range of excess capacity,[2] all capital stocks data were converted into annual service flows. The procedure for such conversions will be described next.

Since the flow of current services from capital is approximated in a perfect market by the rental price of the capital assets per unit of time, times the units worked in the year [Yotopoulos, 1967; Crouch, 1972, p. 69], annual capital services flows were calculated

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[1] During the field interviewing, respondents were asked first how long each equipment had lasted in use. Then secondly, they were asked to estimate how much longer they expected each equipment to last in useful employment. From both responses, it was possible to compute the average expected life of each group of equipment items.

[2] See page 91.

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as follows. For working capital, an appropriate discount rate[1] was applied to obtain the opportunity cost of working capital for each firm. For buildings, the annual rental values, which were calculated from monthly rental values observed during the field survey, were used as rental price on buildings. Where rentals were not reported, a rental value was inputed on the basis of what was observed for a similar kind of industrial firm in the same region. With respect to tools, equipment and furniture, the following formula was applied:[2]

$$R = \frac{rV}{1 - (1 + r)^{-n}}$$

Where

R = Constant annual capital service flow

V = Original acquisition cost of the asset

r = Discount rate

n = Expected life of capital[3]

Thus, the annual capital service input for each firm is the sum of the opportunity cost on working capital, annual rental on buildings and the constant annual capital service flow (R).

The yet unclarified issue is what the appropriate discount rate should be. Ideally, the appropriate discount rate required for any economic analysis should be that rate that truly reflects the opportunity cost of capital. Such opportunity cost of capital

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[1] See page 43.

[2] It is important to remember that R is the discounted value of the asset's expected future services [Hayek, 1934; Hawtrey, 1937; Domar, 1953; Boulding, 1955; Livingstone and Burns, 1971; Crouch, 1972].

[3] See footnote on page 39.

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has to be considered from the nature of capital market existing in Sierra Leone during the survey period.

The capital market in Sierra Leone is highly fragmented. According to a pilot survey of farmers' credit in Sierra Leone [Sierra Leone, 1969], 80 percent of farmers in Sierra Leone obtained credit from institutional (commercial banks) and noninstitutional sources (friends, relatives, traders, fellow farmers). Out of the 80 percent that obtained credit, 91 percent had access to noninstitutional sources. In a recent fisheries study in Sierra Leone [Linsenmeyer, 1976], 52 percent of traditional fishermen obtained credit from noninstitutional sources, while 2 percent obtained credit from commercial banks. Table 2.3 shows the various sources from which the Sierra Leone small scale industry entrepreneurs obtained their initial captial. The data reveal that our small scale entrepreneurs also obtained capital from both institutional and noninstitutional sources. Although about 62 percent of the 185 proprietors got their initial capital from past savings, about 1 percent obtained initial capital from commercial banks, 7 percent from friends and relatives, 13 percent whose initial capital were outright gifts from parents, 1 percent from money lenders and 17 percent from other sources. Thus, while 1 percent of the proprietors got their initial capital from institutional sources, 38 percent obtained from noninstitutional sources.

Whereas, the maximum discount rate charged by commercial banks in Sierra Leone is 12 percent [Sierra Leone, 1975], noninstitutional interest rates vary from zero to 100 percent [Sierra Leone, 1969, p. 22]. Also, although the maximum interest

Table 2.3

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Table 2.3 Source of Initial Capital by Size of Location for Small Scale Industrialists in Sierra Leone, 1974/75

| Sources of Initial Capital | Localities | | | | |
|---|---|---|---|---|---|
| | less than 2,000 | 2,000-20,000 | 20,000-100,000 | over 100,000 | All Localities[a] |
| | % | % | % | % | % |
| Savings from Agriculture | 38 | 21 | 8 | - | 18 |
| Savings from Trade and Industry | 26 | 43 | 48 | 64 | 44 |
| Loans from Commercial Banks | - | - | 2 | - | .7 |
| Loans from Government Banks | - | - | - | - | |
| Friends and Family | 3 | 9 | 5 | 12 | 7 |
| Gifts | 6 | 10 | 20 | 12 | 13 |
| Money Lenders | 3 | - | 2 | - | 1 |
| Others | 24 | 17 | 15 | 12 | 17 |
| Total | 100 | 100 | 100 | 100 | 100.7 |
| Number of Observations | 34 | 69 | 65 | 17 | 185 |

Source: Computed from the random sample observations obtained during the 1974/75 survey of small scale industries in Sierra Leone.

[a]These percentages have been weighted by the number of observations for each locality size group.

rate charged by the commercial banks in Sierra Leone is about 12 percent, the actual rate paid by two of our respondents (a gara dyer and a carpenter) during the survey is about 17 percent.[1] Thus, it is

[1]The respondents gave information with respect to how much they borrowed, the duration of loan and how much they were going to pay back to the banks.

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likely that commercial banks do allow for risk premium over and above the official rate of interest. With respect to rural interest rates, Bottomley [1963a, 1963b, 1975], has pointed out that any determination of the opportunity cost of capital from rural sources has to consider administration premium, risk (default) premium and monopoly profits.[1] The major way of reducing the administrative cost of lending to a large number of widely dispersed rural entrepreneurs is through rural cooperatives. But evidence exists to show that banks, while lending to rural cooperatives, also charge a commission to cover administrative costs [Von Pischke, 1973; Ingle, 1973]. In addition, default rates[2] on commercial and rural lendings in most less developing countries, is in excess of 50 percent [Bottomley, 1975, p. 285]. With respect to monopoly profits, traders in Gambia, Sudan and Sierra Leone charge rates that range from 50 percent to 300 percent [Bottomley, 1975, p. 287; United Nations, 1963, pp. 30-31].

The implication of the foregoing is that the 12 percent rate of interest currently charged by the commercial banks in Sierra Leone may not reflect the true social cost of capital. But, it is equally likely that the interest rates prevailing in the noninstitutional credit sources are above the true social cost of capital. Due to these two extreme circumstances, a 20 percent rate of interest was subjectively chosen for the purpose of discounting the capital stock values. It is hoped that a differential of 8 percent

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[1]See Bottomley, [1975] for excellent discussions of these topics.

[2]Linsenmeyer [1976] observed about 17 percent default rate from fishermen that use outboat engine.

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above the commercial rate of interest in Sierra Leone will reasonably cover the necessary administrative and risk premiums.

### 2.5.3 Material Input and Output

All material inputs have been valued at their purchase price. On the other hand, gross output which includes all daily sales, gifts to outsiders, consumption within the establishment, and storage have been valued at the sales price at the firm.

## 2.6 Summary

The survey of small scale industries in Sierra Leone was carried out in two phases. In Phase I, an attempt was made to generate data for the estimation of the population of small scale industrial establishments. On the basis of the sample frame that was assembled in the Phase I survey, the second phase of the survey was undertaken to gather input-output data from a selected number of firms in order to analyse the economics of small scale industries.

Since previous studies have revealed that both magnitude and composition of industrial activity vary with size of settlement, the whole country was stratified into localities of different population sizes and about 40 localities were randomly selected for the Phase I survey. In the Phase II survey, a two-staged stratified (cluster) sampling procedure was adopted. First, 13 localities which primarily services the 24 enumeration areas were selected. Secondly, 270 firms were both randomly and purposively selected from the 13 localities and 96 firms were randomly selected from the enumeration areas, for the purpose of collecting input-output data.

Two major kinds of data were collected during the Phase II

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survey. Firstly, stock data included information on buildings, tools, equipments, furniture, inventories of material input and output. Secondly, flow data were collected in the form of daily hours input by labor types, material input purchases and daily output. In order to ensure adequate accounting and valuation procedures for the anticipated economic analysis of small scale industries, all stock data were converted into flow data.

All the input-output data were collected over a one-year period. The one-year coverage was important to test the hypothesis that extensive seasonality existed among small scale industries. A one-shot survey would fail to capture any seasonality that might exist, both within industries and location. Also, since most respondents did not keep records of their transactions, a method of twice weekly visits was adopted for interviewing respondents.

Finally, the data that were used for the construction of representative firm types were those obtained from 128 industrial firms. Such data were considered reliable and extended over a 12-month period.

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# CHAPTER 3

# AN OVERVIEW OF SMALL SCALE INDUSTRIES IN SIERRA LEONE

## 3.1 Introduction

The purpose of this chapter is to outline some general background information on the small scale industries of Sierra Leone.[1] The extent of the small scale industrial subsector will be examined first, followed by discussion on the relative magnitude and composition of the small scale industrial subsector in Sierra Leone. Finally, seasonality, resource use, profitability, and problems among the small scale industries in Sierra Leone will be disucssed.

## 3.2 The Extent of the Small-Scale Industry Subsector

One of the important findings of the research is the discovery that the industrial sector in Sierra Leone is much more extensive than had been previously recognized. This result is apparent from Table 3.1, which presents distribution of industrial establishments and industrial employment by location and size. These figures reveal that in 1974 approximately 50,000 industrial establishments employed almost 93,000 individuals.[2] The Government of Sierra Leone, on the other

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[1] For more details see Chuta and Liedholm [1975] and Liedholm and Chuta [1976].

[2] The revised figures are somewhat higher than the initial results presented in African Rural Employment Paper No. 11 [Chuta and Liedholm, 1975] where 47,000 establishments and 87,000 individuals were estimated for small-scale industry.

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Table 3.1 Distribution of Industrial Establishments in Sierra Leone by Location and Size, 1974

| Location and Firm Size | Number of Establishments | Percent | Employment | Percent |
|---|---|---|---|---|
| A. Small-scale industry | | | | |
| 1. Localities with population less than 2,000[a] | 45,000 | 89.7 | 73,000 | 78.8 |
| 2. Localities with population from 2,000-4,999[b] | 1,704 | 3.4 | 4,164 | 4.5 |
| 3. Localities with population from 5,000-20,000 | 834 | 1.7 | 1,995 | 2.2 |
| 4. Localities with population from 20,000-100,000 (Bo, Kenema, Koidu, Makeni) | 1,189 | 2.3 | 4,368 | 4.7 |
| 5. Localities with population over 100,000 (Freetown) | 1,408 | 2.8 | 5,039 | 5.4 |
| Total small-scale | 50,135 | 99.9 | 88,566 | 95.6 |
| B. Large-scale industry | | | | |
| Total large-scale | 28 | .1 | 4,111 | 4.4 |
| Total large- and small-scale industry | 50,163 | 100.0 | 92,677 | 100.0 |

SOURCE: Small-scale industry data collected during Phase I of small-scale industry component of African Rural Employment Project, Njala University College. Data for large-scale industry were obtained from employment lists of the Ministry of Labor for December 1973, supplemented by data collected by the authors.

[a]Estimate based on projection from preliminary data received from twenty-four sample enumeration areas. These data include those individuals who engaged in industrial activities on a part-time basis.

[b]The actual establishments and employment figures obtained were doubled since only half the localities in this size range were examined.

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hand, had assumed that only 52,000 individuals would be employed in this sector in 1974.[1] Thus, the Phase I survey results indicated that their industrial employment estimate should have been increased by three-fourths.

## 3.3 The Relative Magnitude of the Small Scale Industry Subsector

The surveys also reveal that the small-scale industrial establishments dominated the industrial sector in terms of both the number of firms and total employment. "Small scale" was defined in this study to include those establishments employing less than fifty persons.[2] Using this definition, there were only 28 large-scale establishments in Sierra Leone and those firms employed only 4,111 individuals.[3] In those localities with populations in excess of 2,000, on the other hand, there were approximately 5,000 small-scale industries employing approximately 15,000 individuals (see Table 3.1). Moreover, it was projected that there were approximately 45,000 small-scale establishments employing 73,000 persons in those localities with populations less than 2,000.[4] Thus, these results indicate

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[1] Government of Sierra Leone [1974, p. 27].

[2] For a more complete discussion of the small-scale industry definition used in this study, see Chuta and Liedholm [1975, p. 9].

[3] Data obtained from employment list of the Ministry of Labor for December 1973 and supplemented by data on eight large-scale firms not included on this list.

[4] These estimates were obtained by multiplying the actual number of industrial establishments and industrial employment in each of the 24 sample village "enumeration areas" by a figure reflecting the representation of that "enumeration area" in that particular agricultural region. It should be further noted that individuals engaged in industrial activities on a part-time basis are included in these data.

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that small-scale establishments account for over 95 percent of the employment in Sierra Leone's entire industrial sector.

The average size of the industrial establishment in Sierra Leone was very small. The "average" industrial firm, for example, employed only 1.8 workers.[1] Indeed, 98.9 percent of the firms employed less than 5 individuals, 0.7 percent employed from 5 to 9 individuals, 0.3 percent employed from 10 to 49 individuals and only 0.1 percent employed over 50 individuals.[2] Thus, in terms of employment the vast majority of firms in Sierra Leone were concentrated at the lowest end of the small-scale industry size continuum.

Another useful indicator of the relative importance of small-scale industry is "value added." In the Sierra Leone study, the annual value added of the small-scale industrial establishments has been estimated from the output and cost data collected from firms on a twice-weekly enumeration. The mean value added for each of those firms in the small-scale industrial category in each locality group was calculated and then blown up according to the number of establishments in each area.[3] The resulting estimates for small-scale industry as well as the various estimates for small- and large-scale industry prepared by the Government of Sierra Leone are summarized in Table 3.2.

Table 3.2 reveals that small industry in 1974-75 accounted for

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[1] Computed from Table 3.1.

[2] The average size of firm, in terms of the number employed, is larger in Freetown (3.5 workers) than in the enumeration areas (1.6 workers).

[3] The breakdown of the individual mean value added is described in detail below.

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approximately Le 13 million[1] or 2.9 percent of Sierra Leone's Gross Domestic Product. This estimate is surprisingly close to the value added estimate prepared by the Central Statistics Office for the National Accounts, an estimate which was not based on an extensive survey and which was admittedly "very rough" [Government of Sierra Leone, 1973, p. 31].

Table 3.2 Estimates of Value Added by Large and Small Scale Industries in Sierra Leone

| | Government Estimate | | Authors' Estimate | |
|---|---|---|---|---|
| | 1970/1971 | Percent GDP | 1974/1975 | Percent GDP |
| | (Leones Million) | | | |
| Small-scale industry | 11.1 | 2.9 | 13.2 | 2.9 |
| Large-scale industry | 8.5 | 2.3 | 17.4[a] | 3.9 |
| Total industry | 19.6 | 5.2 | 30.6 | 6.8 |
| Gross domestic product | 375.3 | | 450.4 | |

SOURCE: 1970/1971 data from Government of Sierra Leone [1973].

[a]The large-scale industry value added figure for 1974/1975 was obtained by subtracting all indirect taxes from the large-scale industry value added estimate presented in the Second Annual Plan [Government of Sierra Leone, 1975, Chapter X].

When the value added for small-scale industry is compared with the latest estimate of the value added of large-scale industry (Le 17.4 million or 3.9 percent of Sierra Leone's Gross Domestic Product

[1]Le (Leone) = $1.10 U.S. during the survey period.

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in 1974-75), the small-scale establishments are revealed to contribute approximately 43 percent of the entire industrial sector's value added. Although the value added percentage of small-scale (43 percent) is much lower than the percentage employed in small-scale (i.e., 95 percent) relative to large-scale industry the study shows that small-scale establishments are a significant component of Sierra Leone's industrial sector.

Moreover, the small-scale component of Sierra Leone's industrial sector appears to be relatively large when compared with other developing countries. Data on the very small industrial firms in most countries are not generally collected and thus, of necessity, only a limited number of comparisons are possible. Small-scale industry employing less than 50 workers accounted for 95 percent of the manufacturing employment in Sierra Leone, but only 70 percent in Nigeria [Aluko, 1973], 71 percent in Tunisia [IBRD, 1974], 79 percent in the Philippines [ILO, 1974] and 69 percent in Colombia [Berry, 1972].[1] The corresponding contribution of small-scale industries to value added in manufacturing, on the other hand, was 43 percent in Sierra Leone, 32 percent in Colombia, and only 14 percent in the Philippines. In these countries the percentage contribution of small-scale industries to value added was thus substantially less than employment; indeed, the value added contribution was less than one-half that of employment.[2]

In terms of both employment and value added, however, the

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[1] In the more industrialized countries, the share is lower and ranges from 12 to 34 percent [Morawetz, 1974].

[2] For the explanation for these results, see above.

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relative importance of small-scale industry in Sierra Leone appears to be somewhat greater than elsewhere. This result is perhaps traceable, in part, to the extensive effort made in our Sierra Leone survey to include the small rural establishments, which are often overlooked and thus are underestimated in surveys. In addition, there may also be economic reasons, such as the small size of the Sierra Leone domestic market, that account for the relatively large numbers of very small-scale industrial enterprises in Sierra Leone.

## 3.4 The Composition of the Small Scale Industry Subsector

An examination of the composition of the industrial activities undertaken in Sierra Leone can provide additional insights into the nature of the industrial sector. The number of establishments, the number of employed, and value added are used in this chapter to portray the distribution of industries by industrial category as well as by size of locality. Although the preliminary results of this distribution by employment and enterprises were presented in African Rural Employment Paper No. 11 [Chuta and Liedholm, 1975], the final results have now been obtained and consequently are presented in Table 3.3. The industrial composition by value added is presented in Table 3.4.

One of the most salient findings is the dominant position of tailoring activity in Sierra Leone's industrial sector. Tailoring accounted for 31 percent of the employment, 33 percent of the establishments and 37 percent of the value added within the small-scale industrial sector. This finding is consistent with studies of small-scale industry in other African countries and elsewhere, which have

Table 1.4 Distribution of Small Scale Establishments and Employment by Industrial Categories and Size of Location, 1974

Table 3.3 Distribution of Small Scale Establishments and Employment by Industrial Categories and Size of Location, 1974

| I.S.I.C.[a] | Type of Activity | Localities Less Than 2,000 Inhabitants | | Localities 2,000–5,000 | | Localities 5,000–20,000 | | Localities 20,000–100,000 (Bo, Kenema, Koidu, Makeni) | | Localities Over 100,000 (Freetown) | | Total | | Percent of Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estab. | Empl. | Estab. | Empl. | Estab. | Empl. | Estab. | Empl. | Estab. | Empl. | Estab. | Empl. | Estab. | Empl. |
| 31 | Food | | | | | | | | | | | | | | |
| 3117 | Baking | 1,500 | 3,500 | 104 | 206 | 40 | 119 | 17 | 120 | 11 | 164 | 1,672 | 4,109 | 3.3 | 4.6 |
| 32 | Textiles and wearing apparel | | | | | | | | | | | | | | |
| 3211A | Spinning and weaving | 4,000 | 6,000 | 86 | 126 | 15 | 26 | 2 | 2 | 0 | 0 | 4,103 | 6,154 | 8.2 | 6.9 |
| 3211B | Gara dyeing | c | c | 180 | 760 | 50 | 114 | 110 | 610 | 20 | 160 | 360 | 1,644 | 0.7 | 1.9 |
| 3214 | Mat making | 9,000 | 10,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,000 | 10,000 | 17.9 | 11.2 |
| 3220 | Tailoring | 14,000 | 21,000 | 782 | 1,508 | 457 | 973 | 656 | 1,839 | 816 | 2,380 | 16,711 | 27,700 | 33.4 | 31.3 |
| 3240 | Shoe making and repair | 1,000 | 1,000 | 16 | 18 | 21 | 34 | 24 | 37 | 81 | 131 | 1,142 | 1,220 | 2.3 | 1.4 |
| 33 | Wood | | | | | | | | | | | | | | |
| 3319 | Carving | 500 | 1,500 | 24 | 76 | 4 | 14 | 4 | 23 | 3 | 4 | 535 | 1,617 | 1.1 | 1.8 |
| 3320 | Carpentry | 5,500 | 12,500 | 226 | 666 | 117 | 391 | 135 | 628 | 75 | 345 | 6,053 | 14,530 | 12.1 | 16.4 |
| 37-38 | Metal | | | | | | | | | | | | | | |
| 3720 | Goldsmithing | 1,500 | 2,500 | 22 | 32 | 14 | 43 | 17 | 47 | 20 | 54 | 1,573 | 2,676 | 3.1 | 3.0 |
| 3811 | Blacksmithing | 6,000 | 13,000 | 74 | 180 | 28 | 63 | 14 | 46 | 12 | 37 | 6,128 | 13,326 | 12.2 | 15.1 |
| 3819 | Welding and fitting | 0 | 0 | 6 | 20 | 3 | 7 | 9 | 50 | 19 | 86 | 37 | 163 | 0.1 | 0.2 |
| 951 | Repair services | | | | | | | | | | | | | | |
| 9512 | Radio | c | c | 10 | 12 | 7 | 14 | 19 | 44 | 20 | 61 | 56 | 131 | 0.1 | 0.2 |
| 9513 | Vehicle | c | c | 20 | 98 | 26 | 102 | 54 | 609 | 66 | 578 | 166 | 1,387 | 0.3 | 1.6 |
| 9514 | Watch | c | c | 10 | 16 | 15 | 22 | 28 | 40 | 56 | 76 | 109 | 154 | 0.2 | 0.2 |
| 3909 | Others | 2,000 | 2,000 | 144 | 446 | 37 | 73 | 100 | 273 | 209 | 963 | 2,490 | 3,755 | 5.0 | 4.2 |
| | Total | 45,000 | 73,000 | 1,704 | 4,164 | 834 | 1,995 | 1,189 | 4,368 | 1,408 | 5,039 | 50,135 | 88,566 | 100.0 | 100.0 |

SOURCE: Data collected during Phase 1 of small-scale industry component of African Rural Employment Project, Njala University College.

[a] International Standard Industrial Classification.

[b] Final estimate based on projection from data obtained from the twenty-four sample "enumeration areas". The estimates were obtained by multiplying the actual number of industrial establishments and industrial employment in each "enumeration area" by figures reflecting the representation of that "enumeration area" in that particular agricultural region.

[c] Included in "others".

*Table 3.4 Value Added by Small-Scale Industrial Categories and Location, 1974/1975*

Table 3.4 Value Added by Small-Scale Industrial Categories and Location, 1974/1975

| Industrial | Villages Less Than 2,000 Inhabitants | Localities 2,000-20,000 | Localities 20,000-100,000 (Bo, Koidu Kenema, Makeni) | Locality Over 100,000 (Freetown) | Total | Percent |
|---|---|---|---|---|---|---|
| | (Leones) | | | | | |
| Tailoring | 2,836,000 | 534,000 | 571,000 | 982,000 | 4,923,000 | 37 |
| Blacksmithing | 1,427,000 | 77,000 | 11,000 | 9,000 | 1,524,000 | 12 |
| Carpentry | 385,000 | 558,000 | 219,000 | 122,000 | 1,284,000 | 10 |
| Baking | a | 259,000 | 175,000 | 264,000 | 698,000 | 5 |
| Gara dyeing | a | 345,000 | 165,000 | 30,000 | 540,000 | 4 |
| Other | 3,062,000 | 480,000 | 257,000 | 477,000 | 4,276,000 | 32 |
| Total | 7,710,000 (58%) | 2,253,000 (17%) | 1,398,000 (11%) | 1,884,000 (14%) | 13,245,000 | 100 |

SOURCE: Data collected during Phase 2 of the small-scale industry component of the African Rural Employment Project, Njala University College.

[a]Included with "other" industries.

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also revealed that tailoring is the single most important small-scale industry.[1] Blacksmithing, which accounted for 12 percent of the sector's value added, and carpentry, which accounted for 10 percent, were the next most important industrial activities, but both followed tailoring by a large margin.

The composition of industries, however, varied importantly with the size and location of settlements in Sierra Leone. Although tailoring is ubiquitous in Sierra Leone, it is relatively more important in Freetown than in the smallest villages. Indeed, the more "traditional" crafts such as blacksmithing, weaving, and mat making are relatively more important in the smallest villages, while the more "modern" activities such as tailoring, vehicle repair, and metal welding are more important in Freetown.[2]

These results reflect the importance not only of including location in the analysis of industry, but also provide support for distinguishing between "rural" and "urban" small-scale industries. Although any division between rural and urban is arbitrary, 20,000 inhabitants has been adopted as the dividing line in this study. Thus, Freetown, Koidu, Kenema, Bo, and Makeni, localities with more than 20,000 inhabitants (see Spencer, May-Parker and Rose [1976]), have been classified as urban, while all other localities have been classified as rural. Using this classification scheme, 95 percent of the industrial establishments in Sierra Leone are located in rural localities, and account for 86 percent of the employment in

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[1] See Liedholm [1973] for a review of these studies.

[2] Chuta and Liedholm [1975] and Tables 3.3 and 3.4.

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the industrial sector.[1] Finally, 75 percent of the value added by the small-scale industries in Sierra Leone is generated in the rural rather than the urban areas.[2] These results thus reflect the importance of rural industries and the need to include these enterprises in studies of the industrial sector of Sierra Leone. Moreover, these results also point to the need to ensure that rural industries are incorporated into industrial studies in developing countries.[3]

## 3.5 Seasonal Variations in Output

The annual value added and output data, however, mask important variations in the level of activity over the year. Indeed, one of the key reasons that data were gathered for one year in the present study was to permit these seasonal variations to be more precisely quantified.

The mean monthly variation in output of the major small-scale industry groups located outside the villages are portrayed in Figure 3.1. The graph reveals that all the major industrial groups were subject to large monthly fluctuations in the level of activity. Indeed for all the major industries, the mean output in the peak

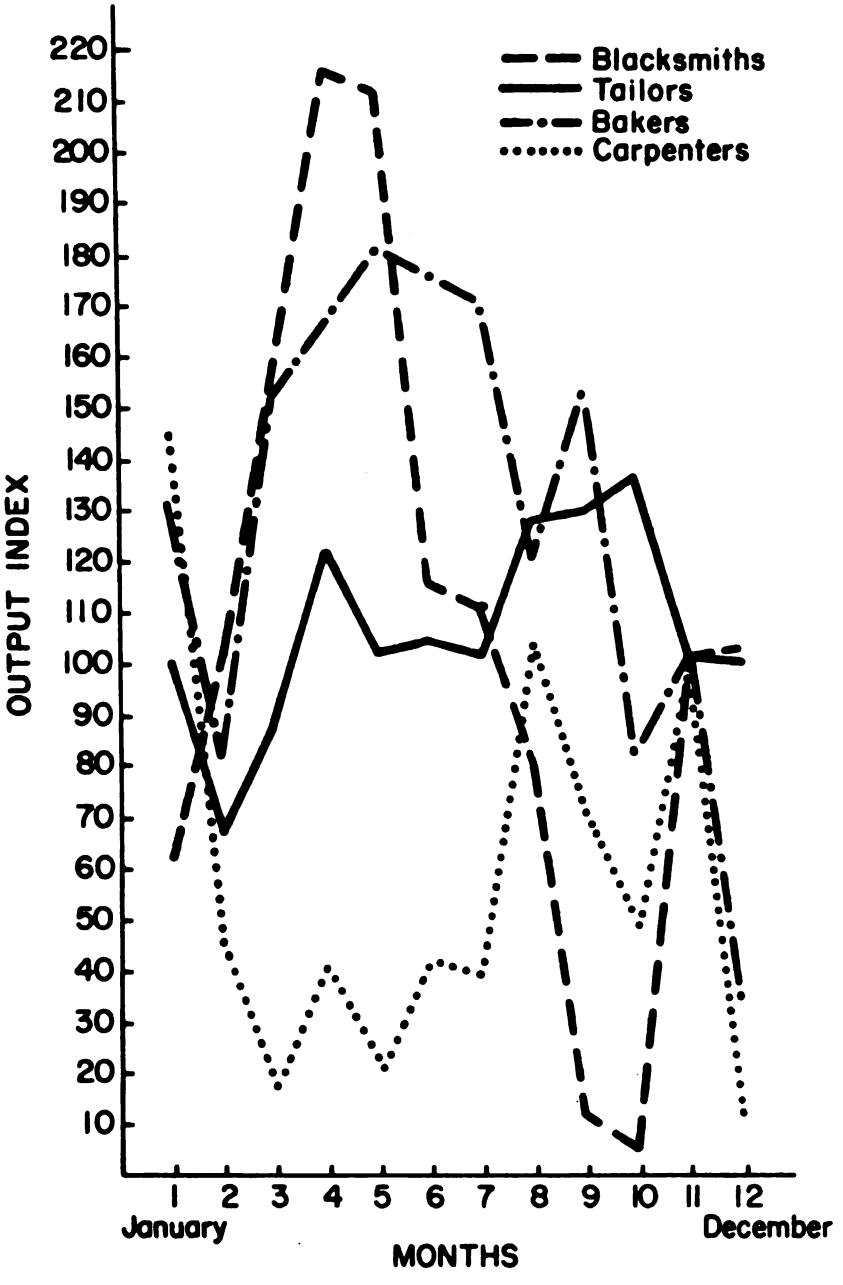
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[1] Computed from Table 3.1.

[2] Computed from Table 4. Rural small-scale industries account for approximately 33 percent of the total industry value added.

[3] Due to the lack of comparable data in other countries, it is difficult to assert that the Sierra Leone results about the relative importance of rural industry will be found in other developing countries. A similar unpublished survey undertaken by the authors in Eastern Nigeria, however, yielded results similar to those found in Sierra Leone. Moreover, the indirect evidence relating to rural non-farm activity reported in Liedholm [1973, p. 2] points to the relative importance of these rural industrial activities. Clearly, however, more comparative research on rural industries is needed.

Figure




*Source: Survey data*

*Note: [a] The indexes for tailors and carpenters reflect the mean output value for all localities while the indexes for blacksmiths and bakers are limited to those localities with 20,000 - 100,000 inhabitants.*

Figure 3 Index of Monthly Output of Major Small-Scale Industries, 1974-75 (November = 100[a])

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month was at least twice the mean output in the lowest month. The blacksmithing industry exhibited the largest variation in output over the year, while tailoring exhibited the least.

The seasonal pattern of output, however, is not the same for all the major industrial groups. Tailoring, the most important of the small-scale industries, for example, is most active during the last quarter of the year, the period when the major harvesting activities are occurring. The seasonal peak for tailoring may be traceable not only to the several important religious festivals and holidays that occurred during this period, but also to the fact that the farmers, who are the major customers for tailoring products in the more rural localities, earn much of their cash income at this time. The blacksmithing and baking industries, on the other hand, attain their peak levels of activity in the second quarter of the year. The seasonal peak for bread may be due to the fact that rice, which is a partial substitute for bread, may be less available and relatively more costly during this period. The main explanation for the seasonal peak for blacksmithing activity is that the farmers, who are the major demanders of blacksmithing services, engage in land clearing during the second quarter and thus require large quantities of blacksmiths' products and services at that time. In summary these results thus reflect the importance of incorporating seasonal variation into any analysis of small-scale industry and point to the potential dangers of surveys limited to one month.

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## 3.6 Relative Magnitudes of Types of Labor and Capital

The labor used by the small scale entrepreneur consists of his own or family labor, paid employees and apprentices. In the small scale industrial establishments in Sierra Leone, the apprentices represent the largest component of the labor used by the firms in those localities with 2,000 or more inhabitants. Indeed, apprentices accounted for 42 percent of the labor used, while paid employees and proprietors accounted for 17 and 41 percent respectively. The use of apprentices in Sierra Leone appears to be somewhat less widespread, however, than in other African countries. In rural Western Nigeria, for example, over 56 percent of the small scale industrial labor (including proprietors) consisted of apprentices (I.L.O. [1972, p. 87]). The reasons for the relatively smaller use of apprentices in Sierra Leone, particularly in view of the nonformal educational services it provides, must be further studied.

The relative importance of the use of apprentices, however, does vary markedly from industry to industry. The highest percentage of apprentices is found in such industries as vehicle repair (53 percent) and carpentry (58 percent), while correspondingly smaller percentages are found in such industries as tailoring (42 percent), blacksmithing (37 percent), gara dyeing (31 percent) and baking (17 percent). Finally, it should be noted that the use of apprentices varies by size of locality. In urban Freetown, for example, 45 percent of the labor used were apprentices while in rural localities with 2,000 to 5,000 inhabitants, the percentage declined to 36 percent. The rural-urban distinction once again thus proved to be important.

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The amount of physical captial used by the small scale industrial establishments in Sierra Leone provided to be quite small. Data collected during Phase I of the study reveal that 63 percent of the small scale establishments possessed at least one machine. The use of machinery was concentrated, however, in the tailoring industry, because virtually every establishment in that particular industry possessed at least one sewing machine. Since 55 percent of the industrial establishments were engaged in tailoring, it is clear that the use of machines elsewhere was indeed minimal. Moreover, the majority of machines used by this sector was manually powered. In those establishments in localities with 2,000 or more inhabitants, 16 percent were power driven and 84 percent were manually powered.

Finally, it should be noted that the use of machines was less widespread in the rural than in the urban areas. In urban Freetown, for example, 57 percent of the establishments used machines while in those rural localities with 2,000 to 5,000 inhabitants only 48 percent of the establishments used machines. Indeed, it should be further noted that none of the establishments in these smaller rural localities used any power-driven machines. In these rural areas, it will thus be important to ascertain whether the lack of power is an effective constraint on an expansion of small scale industries.

## 3.7 Returns to Proprietor and "Economic" Profit Rate

The return to the small-scale industrial proprietors and the economic profit rate within the various small scale industries will

be examined in this section. The return to the proprietor parameter is important because it provides not only a measure of the real income earned by the proprietor, but also, to the extent that the proprietor is a scarce factor of production, an indication of the relative economic viability of the various industries and processes. The economic profit rate provides an additional measure of the relative economic viability of the various small-scale industries in Sierra Leone.

Before proceeding to examine the returns to the proprietor and the economic profit rate, it will first be necessary to specify more precisely how these measures were obtained. Since one of the primary objectives of the study was to examine the economic viability of small-scale industries, measures of the economic rather than the financial returns were required. Consequently, it was important that all inputs be valued at their opportunity rather than the actual costs. Thus, the returns to the proprietor measure for each firm was obtained by subtracting from the firm's value added figure the opportunity cost of its annual capital services and its annual non-family labor services. The capital services figure are the annual user or rental cost of capital estimated at a discount rate of 20 percent, the assumed opportunity cost of capital in Sierra Leone.[1] The estimate of the opportunity cost of the proprietor and family labor was obtained by combining the assumed opportunity costs of hired and apprentice labor. The opportunity cost of the hired labor was assumed to be equal to the actual money wage paid, since the earlier

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[1] See pages 38-44 for a discussion of the opportunity cost of capital.

production function analysis had indicated that the marginal product and the wage rate of hired labor were quite similar. The production function analysis, on the other hand, indicated that the marginal product of apprentices was higher than the nominal remuneration they received; thus, in this study, the apprentices' labor was valued in terms of the estimated value of their marginal product in each industry.[1]

The "economic" profit rate measure, on the other hand, was designed to provide an indication of the return generated by the industrial firm when all inputs, including the proprietor's input, had been valued at their opportunity cost. On this basis, the "marginal," yet viable, firm would thus generate zero returns or a zero economic profit, while a firm generating a positive return would be earning a pure surplus or positive "economic" profit.[2] The "economic" profit figure for each firm was obtained by subtracting from the returns to the proprietor, the opportunity cost of the proprietor's labor. For lack of a better indicator of this parameter, the opportunity cost of the proprietor's labor was measured in terms of the approximate value of the proprietor's marginal product in

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[1]Thus, based on the previous marginal productivity analysis, tailoring apprentices were valued at Le .08 per hour worked, blacksmithing apprentices at Le .05 per hour worked, and gara, carpentry and baking apprentices at Le .05 per hour (assumed to be the same as tailors in the absence of a good estimate).

[2]The economic profit must be kept distinct from the accountant's concept of profit which usually includes the opportunity cost of the return on capital and proprietor's labor.

each industry.[1] Finally, for comparative purposes, the "economic" profits figures have been expressed in rate terms as a percentage of the total value of firm's capital stock.

The ruturns to the proprietor are summarized in Table 3.5. The table reveals the wide variation in the returns to the proprietor both by process and by industry. The returns, for example, vary from a high of Le 10,601 per year for "modern" bakers to a low of -Le 850 per year for "modern" blacksmiths. At the major industry level, bakers generate the highest proprietor's return, while tailors and blacksmiths generate the lowest return.

One of the most striking results presented in the table, however, is the indication that often the proprietor's return varies markedly between processes in the same industry. Indeed, analysis of variance procedures applied to these data revealed that except for gara dyeing and carpentry, these variations were statistically significant.[2] The more "modern" technique in each industry, it should be noted, did not necessarily yield the highest return to the proprietor. Although in tailoring and baking the more "modern" techniques produced the highest returns, in carpentry and blacksmiths the highest returns did not accrue to those proprietors using the more "modern" technique.

The returns to the proprietor, however, also varied by location.

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[1] Thus, based on previous marginal productivity analysis, tailoring proprietors were valued at Le .35 per hour, gara proprietors at Le .84 per hour, carpenters at Le .35 per hour (assumed to be the same as tailors in the absence of a good estimate), blacksmiths at Le .30 per hour and bakers at Le .54 per hour.

[2] At the 10 percent significance level.

Table 3.5 Annual Mean Return to Proprietor and Economic Profit Rate by Major Process and by Major Small-Scale Industry Category

| Industrial Categories[a] | Annual Returns to Proprietors | Economic Profit as a Percent of Total Capital Stock |
|---|---|---|
| | (Leones) | (Percent) |
| Tailoring | | |
| "Traditional" | 377 | 23 |
| "Modern" | 982 | 46 |
| Gara | | |
| "Traditional" | 1,572 | 190 |
| "Modern" | 1,463 | 170 |
| Carpenters | | |
| "Traditional" | 2,062 | 169 |
| "Modern" | 2,060 | 21 |
| Blacksmiths | | |
| "Traditional" | 745 | 75 |
| "Modern" | -850 | -25 |
| Baking | | |
| "Traditional" | 1,476 | 106 |
| "Modern" | 10,601 | 35 |

SOURCE: Survey data.

[a]Includes both randomly and purposively sampled firms in these localities with 2,000 or more inhabitants.

This fact is demonstrated in Table 3.6 where the returns to those proprietors using the more "traditional" processes are arranged by locality size. The mean proprietor returns are generally highest in the intermediate size localities and lowest in the villages. For example, the tailoring proprietors engaging in ordinary sewing in those localities with from 20,000 to 100,000 inhabitants generate

Table 3.6 Annual Returns to Proprietor by Major Industry and Location for "Traditional" Processes Only

(Leones per Year)

| Industrial Category[a] | Locality | | | |
|---|---|---|---|---|
| | Villages Less Than 2,000 | 2,000-20,000 | 20,000-100,000 | More Than 100,000 |
| Tailoring | 164 | 316 | 465 | 365 |
| Gara dyeing | -- | -- | 1,572 | -- |
| Carpentry | 33 | 1,365 | 2,680 | 1,514 |
| Blacksmithing | 199 | 779 | 645 | -- |
| Baking | -- | 1,443 | 1,564 | -- |

SOURCE: Survey data.

[a]Includes all randomly and purposively selected "traditional" firms; for definition of term "traditional", see text.

an annual return of Le 465, while those tailoring proprietors in the villages generate only Le 164 per year. The relatively low return to the proprietor in the villages is undoubtedly due to the fact that they also engage in farming activity. Unfortunately, it has not yet been possible to determine the income generated by the proprietor's farming activity; this interaction, however, will be the subject of a subsequent study.

The returns to the proprietor for firms in localities with 2,000 or more inhabitants, however, do shed some light on the relative income position of the proprietors. The mean annual return to the proprietor from the randomly selected firms, for example, was

Le 672. The unskilled urban worker receiving the minimum wage earned approximately Le 250 per year, while the farm proprietor received a mean annual income in 1974/75 of approximately Le 475 [Spencer and Byerlee, 1976]. The mean return of small scale industry proprietors was thus higher than that earned by individuals in these two groups. The determination of the exact relative income position of the small scale industry proprietors must await more complete supporting data.[1]

An examination of "economic profit" rates of the small scale industries can provide additional insights into the economic viability of these activities. The estimated "economic" profit for these firms, expressed as a percentage of their capital stock, has consequently been estimated and summarized in Table 3.5, where the data have been presented by major process and major industry. The most striking result is that, with the exception of "modern" blacksmithing, all the processes and industries generated a positive "economic" profit; thus, if the assumptions underlying the analysis have been correctly specified, all the major types of small industrial activities, except "modern" blacksmithing, must be considered economically viable.

The "economic" profit rate varied widely, however, both by process and industry. Baking, gara dyeing and carpentry, for example, generated the highest rates of economic profit, exceeding 100 percent in several instances, while tailoring and blacksmithing generated

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[1]Byerlee, Tommy and Fatoo [1976] report that those migrants who are self-employed earn an income almost one-third higher than that of the average employed migrant.

economic profit rates that were significantly lower.[1] Moreover, the "ecomomic" profit rates differed significantly by major processes within each industry.[2] It was the more "traditional" rather than the more "modern" processes that generally produced significantly higher "economic" profit rates in these major industries. Indeed, only in the tailoring industry, did the more "modern" processes, embroidery, generate an economic profit rate exceeding that generated by the more "traditional" process. Even the traditional tailors, however, earned a positive "economic" rate of profit. The analysis thus indicates that the "traditional" processes used by small scale industries in Sierra Leone are economically viable at the present time.

## 3.8 The Problems of Small Scale Industry Entrepreneurs

As Table 3.7 shows, 60 percent of the 213 entrepreneurs[3] who provided information said that the lack of capital was a major problem facing their enterprise; 23 percent of the respondents felt that high cost of material inputs and/or scarcity of materials were major problems hindering the progress of their business; 9 percent of those respondents believed that the lack of effective demand was a major bottleneck facing them, while 6 percent of the proprietors thought that troubles with repairing equipment and obtaining the necessary spare parts were major problems they had to face occasionally. In

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[1] Annalyses of variance indicated these were different statistically at the 1 percent level.

[2] 5 percent level.

[3] This figure includes the respondents in both the random and purposive sample.

order to place these problems in proper perspective for a later analysis, each of these problems will be duscussed in greater detail.

Table 3.7 Problems of Small Entrepreneurs in Sierra Leone, 1974/75

| Kinds of Problems | Tailoring | Gara dyeing | Carpentry | Blacksmithing | Bakery | Others | All Industries[a] |
|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % |
| 1. Lack of demand | 15 | 28 | 6 | - | - | 6 | 9 |
| 2. Lack of Technical advice | - | - | - | - | 5 | - | 0.5 |
| 3. Troubles with equipment | 4 | - | 3 | 5 | 5 | - | 3 |
| 4. Lack of skilled labor | - | - | 3 | 5 | - | - | 0.9 |
| 5. Poor transportation | - | - | 3 | - | - | - | 0.5 |
| 6. Lack of capital | 64 | 43 | 66 | 52 | 40 | 66 | 60 |
| 7. Scarcity of materials | - | - | 3 | 14 | 5 | 10 | 5 |
| 8. Scarcity of spare parts | 4 | - | - | 5 | - | 4 | 3 |
| 9. High cost of materials | 13 | 29 | 16 | 19 | 45 | 14 | 18 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Number of observations | 80 | 7 | 32 | 21 | 22 | 51 | 213 |

Source: Computed from the entrepreneurship survey

[a] These percentages are weighted averages.

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[1] The survey data revealed also that out of the 270 respondents that were selected for study in regions I-III, 9 percent dropped out

### 3.8.1 Lack of Capital

Although most of Sierra Leone small scale entrepreneurs feel that lack of capital was their major problem, a recent analysis of the Sierra Leone data reveals that profitability in business is negatively correlated with the level of initial capital [Liedholm and Chuta, 1976]. However, the survey data also reveal that 80 percent of the funds used to establish small scale industries come from personal and family savings, and that 90 percent of funds used for expansion were reinvested profits [Liedholm and Chuta, 1976].

### 3.8.2 Scarcity and High Cost of Materials

Table 3.7 further reveals that the industries affected most by the high cost of materials are the gara dyers and bakers. How can we explain such a rise in the costs of material inputs? With respect to the gara dyers, the prices per cwt. of synthetic organic dyestuffs and caustic soda (sodium hydroxide)[1] rose at annual rates of 42 percent and 4.4 percent (Freetown C.I.F.) between the period, 1969 and 1973 (Quarterly Trade Statistics). Also, during the period of the survey, 1974/1975, our material input purchases data revealed a price increase of about 20 percent for each of these inputs. Such price increases could be explained partly by the scarcity of the materials from which the inputs are traditionally synthesized. A case in point is the scarcity of petroleum in recent years.

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of the sample due to such problems as lack of capital, lack of effective demand and scarcity of material inputs.

[1]The three ingredients necessary for forming the dye solution are the synthetic organic dyestuff, the caustic soda (sodium hydroxide) and soda ash (sodium dydrosulphite). These ingredients constitute about 14 percent of the total material input purchases in gara dyeing.

In addition to the rapidly increasing import prices, the import duty on dyestuffs and other dyeing ingredients, which is in the magnitude of 36 1/2 percent ad valorem adds to the cost burden. However, another possible reason for the high cost of these ingredients to small producers is the small amounts in which they were purchased. Although, the Major and Company in Freetown, that deals on the Iandanthren vat dye-stuffs, allowed a rebate of one leone for each pound weight of dyestuff purchased, such economies of large scale purchasing did not accrue to small individual producers, some of whom bought dyeing ingredients in spoonfulls rather than in large volumes.

In Gara dyeing, expenditures on imported textile fabrics are one major item of material input purchases, accounting for about 80 percent of total material input purchases needed for gara dyeing.[1] Although textile fabrics, available to gara dyers in Sierra Leone, range from shirting and poplin, costing about 45 cents and 65 cents a yard respectively, to the very expensive cotton fabrics, costing Le 1.2 per yard for the "Omega," "Santos" and "Satin" brands and Le 3.6 per yard for the "Super" brand, most gara dyers prefer to purchase the medium price of fabric.[2] The prices of these fabrics have increased due, not only to increases in the world prices of Egyptian cotton and overseas production costs, but also due to a customs duty

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[1] Computed from Survey data.

[2] "Santos," "Omega" and "Super" brands were sold in widths of 50" to 52", "Satin" in 36" widths, poplin in 31" to 32" width and shirting in 27" to 28" widths. The quoted prices are relevant for the 1974/75 survey period.

of about 22 percent ad valorem.[1] The scarcity of the medium brand fabric always forced dyers to purchase the costliest brand, where it was available, and this sitution inflated the domestic production costs.

The bulk of the purchased intermediate inputs in the bakery industry is flour which constitutes about 50 percent of total value of output and between 90 percent to 95 percent of total value of material input purchases needed for baking. The high cost of flour is associated with the high cost of domestic production that results from the Sierra Leone government's import - substitution policy of the 1960s. Since the flour mill was installed in 1967, flour imports have been officially banned and bakers have to purchase the locally milled flour at a high cost. In fact, based on the price of wheat flour quota imports, the implicit tariff on wheat flour in Sierra Leone is about 167 percent.[2]

Another industry affected by the scarcity and high cost of material input is the blacksmithing industry. Local blacksmiths depend on car springs, iron rails or scraps, and railway sleepers for manufacturing cutlasses, axes and hoes respectively, items that are important for agricultural production. Our survey reveals that the price of car springs has increased by about 100 percent in recent years. Since rural blacksmiths do not have access to iron scrap or car springs that are found in large cities, most of the time, these

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[1]The 22 percent ad valorem equivalent was computed from the specific duty.

[2]The price of imported flour was about Le 6 (Freetown, C.I.F.) while locally produced flour cost Le 15 per cwt. in Freetown during the survey period.

material inputs are not available.

The industries least affected by the rising cost of material inputs are tailoring and carpentry. Nevertheless, these industries are also affected by import duties, but only to the extent of the import content of the material inputs. In the tailoring industry, the purchases of textile fabric varies from 21 percent in region I, 82 percent in region II to 33 percent in region III.[1] Whereas the import duty on textile fabric is about 22 percent ad valorem, the import duty on the other inputs such as needles and buttons is 36 1/2 percent.

In the carpentry industry, the bulk of the material input purchases is timber, constituting on the average about 32 percent of total material input purchases. According to our survey, all the timber utilized by the sample firms is locally produced. Another category of material input purchase in the carpentry industry is plywood. All plywood utilized by our sample firms was imported and at a cost of an import duty of 36 1/2 percent ad valorem. However, plywood purchases of one respondent constituted 67 percent[2] of the total cost of this material input purchases. For the others, plywood purchases constituted only 4 percent to 9 percent[3] of total material input purchases. The third category of material input purchases subject to about 35 percent import duty includes nails, formica, polish and sandpaper. Since nails are manufactured in

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[1]Computed from Survey data.

[2]Computed from Survey data.

[3]Computed from Survey data.

Sierra Leone, some firms purchased only imported nails while others combined the use of imported and locally produced nails. Most carpenters in region I used imported nails only.

### 3.8.3 Lack of Demand

The problem of lack of demand is most severe among the gara and tailoring industries. The presence of excess capacity among these firms[1] is one indication of the low level of demand for the products of these industries. With the exception of the gara industry, the small scale industries depend on the domestic market for the purchasing of their goods. Sierra Leone has good export prospects for gara cloth, not only among African countries, but also in America and Europe. Our survey reveals that about 18 percent of total value of gara cloth production was exported in 1974/75.

## 3.9 Summary

The survey results reveal that the small scale industrial establishments in Sierra Leone dominate the industrial sector in terms of both the number of firms and total employment. Tailoring occupies the dominant position in the Sierra Leone's small scale industrial subsector, accounting for 31 percent of the employment, 33 percent of the establishments and 37 percent of the value added. The Sierra Leone survey reveals seasonal variations in industrial activity among the small scale industries. Although small scale industry entrepreneurs utilize the services of family labor, hired workers and apprentices, apprentices accounted for 42 percent of

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[1] See pages 92-94.

the labor used. All the major types of small scale industrial activities, except "modern" blacksmithing can be considered economically viable.

The data reveal that the bulk of the small scale entrepreneurs (60 percent) feel that the lack of capital was a major problem facing their business. Other perceived problems include, the lack of effective demand for the products of small scale industries, scarcity and high cost of material inputs, troubles with equipment and the lack of spare parts. Available time series and secondary data reveal that much of the high cost of the material inputs used by small scale intrepreneurs is due to both price increases in recent years and high import duties on imported intermediate inputs.

# CHAPTER 4

# DELINEATION OF REPRESENTATIVE FIRM TYPES

## 4.1 Introduction

In order to focus on the small scale industrial firm, as a decision making unit, representative firm types or production process types [Dorfman, 1953-a] will be delineated. Since the procedures for delineating and weighting the representative firms for the purpose of aggregating the linear programming results involve errors of aggregation bias, the criteria will be spelled out for grouping firms into representative firm types.[1] It will now be necessary to present, first, a broad descriptive categorization of representative firm types, and second, a detailed breakdown of representative firm types, which will be used for our linear programming analyses.

## 4.2 Broad Categories of Representative Firm Types

Most analytical procedures tend to delineate production process types as "traditional," "modern," or "intermediate." Sometimes, "labor-intensive" and "capital-intensive" processes are used synonymously with the "traditional" and "modern" techniques of production

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[1] For the purpose of this thesis, the definition of the representative firm as the average or modal firm is inadequate [Day, 1963]. For a classical definition of a representative firm, see Marshall [1920, p. 317].

respectively.[1] In defining the broad production methods used in the Sierra Leone small scale industry, these concepts, though inadequate, will be utilized to differentiate the production processes.

In the tailoring industry, treadle sewing machines are widespread. But most treadle machines can be operated by electricity in localities where electricity is available. Since electricity is not available in most rural towns and villages, sewing machines are operated manually. In addition, there are sewing machines which do simple sewing, whereas other more complicated types are capable of putting embroidery designs on sewn fabrics. These differences in the type of tasks performed are also reflected in cost differences--Le 100 to Le 110 for simple sewing machines of the Chinese "butterfly" brand or Japanese "Hedjazi" and Le 230 to Le 300 for the embroidery machines of the Italian "Necchi" brand or the Japanese "Zenith" or "Hijaz." But more important is the fact that within the embroidery process type, there exists a wide range in the cost structures of machines - ranging from Le 230 or Le 300 (as already pointed out) to Le 1000 for the British "Cornely" brand of embroidery machines.[2]

Within the gara[3] industry, there is a clear distinction between "traditional" firms which dye fabric with the native indigo dye and the "modern" firms which use synthetic vat dyes such as the

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[1]Bhalla [1975] points out that the dichotomy of labor-intensive and capital-intensive techniques is "confusing" and "inappropriate."

[2]These prices were observed for the survey period, 1974/75.

[3]"Gara" refers to the leaves of a Leguminonous plant (Loncho-carpus Cyanescens) that grows in the Northern Province of Sierra Leone. The native indigo dye solution is made out of those gara leaves in combination with other local leaves, nuts, roots, and tree bark. (See Chuta and Steacy, 1975).

Indanthren and Caledon vat dyes that are imported form the German Federal Republic and United Kingdom respectively. Whereas the native indigo dye takes seven to fourteen days to vat[1] in 44-gallon-size drums, the synthetic dyestuff takes only 10 to 15 minutes to vat in small dye basins. In addition, whereas the native indigo dye yields only the dark blue or dark green color when combined with Kola nut ("Kola acuminata"), the synthetic dye has a large number of color variations [Chuta and Steacy, 1975]. There are, of course, firms which combine both the native indigo dye and the synthetic dyestuffs, even on one fabric, in their dyeing operations.

In the carpentry industry, traditional firms employ simple hand tools like saws, planes, hammers, and operate in thatch-roofed workshops. On the other hand, the "modern" carpenters, in addition to using simple tools, employ sophisticated equipment such as the Italian electrical combining machines, which contain wood planer, wood mortiser, vertical router, retractile circular saw, square, knife, and sharpener and costing about Le 4000 (Freetown C.I.F.). In addition, modern carpenters incur higher workshop rental costs since they operate in cement buildings with zinc roofs.

Within the blacksmithing industry, the "traditional" firms use simple tools like hammers, bellows, anvils while their "modern" counterparts use electric forges, drilling machines, and welding equipment. Whereas the majority of "traditional" blacksmiths operate in thatch-roofed sheds and mud houses, the "modern" ones invest in cement

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[1]The vatting process involves reducing the dye particles into their "Leuco" compounds whereby they become soluble in caustic alkalies.

houses with zinc roofs that command much higher rental values than the traditional type of workshops.

Finally, the bakery industry in Sierra Leone contains at least three distinct firm types. The "traditional" firms mix, knead, and cut their dough manually and bake their bread in mud ovens costing about Le 50. On the other hand, the modern firms use electrical mixers, kneaders, cutters, rollers, and ovens. The electrical ovens vary from the French and German "peel" oven, to the British "reel" or "rotary" oven and the Italian "automatic" oven. These modern equipments cost between Le 30,000 to Le 60,000 (Freetown C.I.F.). Due to the differences in the types of workshops being used, the "traditional firms" incur a rental cost of about Le 24 per year, while the "modern" firms incur an average annual rental of about Le 2400. One bakery firm of the intermediate technology type uses a wood-firing iron oven imported from Britain some years ago.

## 4.3 Detailed Delineation of Representative Firm Types

There are at least three considerations--definitional, empirical, and analytical--that necessitate a more detailed breakdown of our firm types. First, for definitional reasons, processes are said to be different so long as resources are consumed in different proportions, even while using the same resources and producing the same output [Dorfman, 1953-b, p. 14]. Secondly, the Sierra Leone small scale industry data have revealed that, given one technique of production, there exist several ranges of resource combinations involved in producing an industrial output category. The wide variations in resource combinations may be due to such factors as cost differentials, excess capacity levels which also vary with locations,

industry, and managerial ability. Thirdly, for purely analytical reasons, representative firm models present serious problems that could render the solutions they yield meaningless. Some of these problems relate to the manner in which the typical firms are selected; others arise because of the type of constraints that are imposed on the representative firm types; finally some of the problems are purely errors due to aggregation bias. The details of these problems and the empirical handling of those problems in the Sierra Leone small scale industry study will now be duscussed.

The first kind of problem that is associated with the representative firm model is connected with the selection of the representative firm types [Sharples, 1969]. The purpose to be served by the representative firms determines the procedure for selecting the typical firms. If the objective is supply response, then a procedure of obtaining representative firms by simple averaging of data will yield unrealistic results [Lee Day, 1963]. It has been pointed out that responsive firms are located not at the middle but at the tails of distributions [Barker and Stanton, 1965]. Thus the procedure that seeks to estimate supply response by focusing on the mean values misses the responsive managers. Barker and Stanton [1965] also point out that another source of bias for the representative firm approach stems from the fact that, in sampling, units are grouped into relatively homogenous strata and equal number of elements are selected from each stratum. If indeed supply response is the primary objective of using the representative firm approach, then the relative concentration and flexibility of firms and resources have to be taken into account. Thus more elements should be selected

for study from those areas where firms and resources are most responsive to price changes and the selection of representative firms based on those elementary units.

In the Sierra Leone small scale industry study, the ultimate selection of representative firm types was fully considered at the stage when respondents were being selected for the field survey.[1] First, by adopting both a random and purposive procedure for selecting respondents, we ensured that not only average firms but the more "progressive" ones were selected [Chuta and Liedholm, 1975]. Secondly, by selecting a larger number of firms for study from towns of larger population concentration and income levels, we allowed more firms in these areas a greater chance of being included in our representative firm types [Chuta and Liedholm, 1975]. These procedures ensure that firms with different levels of economic incentive and risk-bearing capabilities are represented in the study.

Another serious problem of the linear programming representative firm approach is externalities [Sharples, 1969, p. 355]. This approach obtains aggregate supply by summing the weighted representative firm supply functions while assuming that input costs and physical transformation rates of individual firms remain constant at all levels of aggregate production. In reality, aggregate production could have a major impact on input prices which in turn affect supply functions. It all depends on the elasticities of supply of various kinds of input categories. In order to overcome the problem of externalities, some studies have limited the major inputs on a

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[1] See pages 31-34.

regional or subregional level for the different representative firm situations rather than limit those inputs to the level of the representative firm's statistical averages [Sharples, 1969; Buller, 1965]. The use of regional or subregional restraints allows the representative firms enough capacity to compete for input supply. Under this circumstance, it is valid to assume that input supply is perfectly elastic while demand is fixed. On the other hand, if inputs are constrained at the level of statistical averages, competition among the representative firm types might exhaust the prescribed level of those inputs. In such a circumstance, the assumption of perfectly elastic input supply function is not tenable [Lard, 1963; University of Minnesota, 1965]. The small scale industry study will specify resource constraints at four regional levels for the different kinds of resources.

Finally, one fundamental problem that is involved in selecting representative firms for linear programming models is the aggregation error. Richard Day [1963] points out that the question to be answered is "to what extent the component firms be alike in order for a single model to represent the aggregate of the individual decision problems without distortion." Day further specified what is usually referred to as the sufficient conditions for exact aggregation of linear programming models. Using the duality theorem of dual linear programs, Day specified that for exact aggregations to obtain, the following conditions must be satisfied. They are that:

$$B_i = B_j = B \tag{1}$$

$$C_i = \lambda_i C \quad : \quad \lambda_i > 0; \quad \lambda_i < 1; \quad \Sigma\lambda_i = 1 \tag{2}$$

$$Z_i = \gamma_i Z \quad : \quad \gamma_i > 0;\ \gamma_i < 1;\ \Sigma\gamma_i = 1 \tag{3}$$

$$Z = \Sigma\alpha_i Z_i \quad : \quad \alpha_i \geq 0;\ \Sigma\alpha_i = 1 \tag{4}$$

$$\Sigma\alpha_i\gamma_i = 1 \tag{5}$$

Where:

$B_i$ = Technical coefficient matrix of the $i^{th}$ firm.

B = Technical coefficeint matrix of the aggregate firm and the equality of $B_i$'s with B ensures the condition of technical homogeniety.

$C_i$ = Constraint vector of the $i^{th}$ firm.

C = Constraint vector of the aggregate firm.

$Z_i$ = The expected net return vector of the $i^{th}$ firm.

Z = The expected net return vector of the aggregate firm.

$\alpha_i$ = Weighted average of the individual firm's objective function.

$\lambda_i$ = Vector of proportionality, i.e., the proportion of each region's resources which the $i^{th}$ firm possesses.

$\gamma_i$ = The proportion of the value of the aggregate objective function, possessed by the $i^{th}$ firm.

Homogeneity[1] of the technical coefficients implies that all the individual firms that constitute a representative firm or production process type require the same amount of resources in producing an additional unit of output. Thus, if the sum of the vectors of proportionality are greater than one, i.e., $\Sigma\ \lambda_i > 1$, it suggests

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[1] Day admits that the homogeneity of technical coefficients includes cases of proportional variation in the input-output structures of firms that make up a representative firm type.

that some firms within a representative firm group are more productive than the average firm, and hence, would be more optimistic in responding to changes in some exogenous incentive parameters. Likewise, if $\Sigma \lambda_i > 1$, some firms within the representative firm group are earning net returns that are greater than the average and thus would possess different investment and growth patterns. In these cases, where $\Sigma \lambda_i > 1$ and $\Sigma \gamma_i > 1$, the linear programming models will tend to predict output, profit, and investment patterns that are less optimistic than the actual, the difference between tha actual and predicted values being errors due to aggregation bias. The redundancy of equation (5), which states the condition that $\Sigma \alpha_i \gamma_i = 1$, i.e., that the sum of the product of weights of the firm objective functions and of the proportionality vectors for the net revenue vectors be equal to one, has been proven by Marenco [1969]. The redundancy is based on the fact that when once the $\alpha_i$ is known, the $\gamma_i$ is automatically determined [Marenco, 1969, p. 686].

Many scholars have considered Richard Day's specifications (that is, homogeneity/proportional heterogeneity for coefficient matrices and proportionality for constraint and net return vectors) too restrictive for empirical work [Lee Day 1963, Miller, 1966]. Recently, Paris and Rausser [1973] have pleaded for conditions of aggregation less binding than those specified by Day. They have therefore suggested and proven mathematically that an assumption of "equal dimensionality of all the firms' problems," is enough to ensure exact aggregation. In other words, provided that all the firms that are to be aggregated into a representative firm type have equal number of activity columns and rows, exact aggregation

can be carried out. For example, "equal dimensionality" condition will invalidate an attempt to aggregate bakery firms that produce only bread with those that produce both bread and cakes and/or biscuits.

In order to aviod serious errors of aggregation,[1] both the restrictive and relaxed aggregation conditions have served a useful guide in delineating the representative firm types. Allowing for some narrow variations in resource ratios, the Sierra Leone small scale industrial firms have been grouped into relatively homogenous firm types. The major criterion for grouping those firms into specific firm types is the individual firm's labor-capital ratio (which incorporates output - labor and output - capital ratios). But, since labor-capital ratios vary widely from industry to industry, and from location to location, firms have been stratified by location and industry, before aggregating individual micro firms into homogenous firm types on the basis of labor-capital ratios. Analysis of variance procedure confirms that the variations of labor-capital ratios by industry and location are statistically significant at the 1 percent level and 10 percent level, respectively [Liedholm and Chuta, 1976, pp. 52-53.].

On the whole, 43 representative firm types have been identified, as shown in Tables 4.1 through 4.4. As the third columns of Tables 4.1 - 4.4 reveal, the range of variation of labor-capital ratios within groups of firms that have been aggregated is very narrow. This

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[1] H. Theil [1957, p. 122] pointed out that "the aggregation bias of small industries, i.e., industries with relatively small total outputs, tend to be small in an absolute (not relative) sense...."

ensures the near-homogeneity of output and resource vectors of individual firms that constitute a representative firm type. The last two columns of Tables 4.1 - 4.4 yield additional information that explains the variations in labor-captial ratios between representative firm types. For example, whereas the individual firms that constitute representative tailoring firm type, P111 on Table 4.1, have a labor-capital ratio of 8-9, those of P112 have a labor-capital ratio of 4-5. This variation in labor-capital ratio is due to the fact that the firms constituting P111 and possessing only one or two sewing machines, are less capital-intensive than the individual firms constituting P112, and having between two and five sewing machines, including one expensive embroidery sewing machine. Finally, Table 4.5 is an attempt to assign weights to the different representative firm types as they are considered to exist in the population. Those weights will be used for aggregation purposes in the linear programming model, after they have been adjusted for their upper and lower bonds.[1]

## 4.4 Annual Resource and Output Requirements for the Representative Firm Types

Tables 4.6, 4.7, 4.8 and 4.9 show the annual resource and output requirements for each industrial representative firm type in the respective regions. The resource and output coefficients have been computed with the objective of carrying out the analysis of the base run of the model and also some sensitivity analysis.

As column one of Tables 4.6 - 4.9 shows, variables with an

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[1] See page 113.

*Table 4.1 General Characteristics of the Representative Firm Types for Region I*

| Industry | Representative Firm Code Name | Range of Labor-Capital Ratio | No. of Sample Firms in the Category | Type and/or Size of Major Tools and Equipment | Other Description of Firms in the Representative Firm Grouping |
|---|---|---|---|---|---|
| Tailoring | P111 | 8-9 | 2 | 1-2 sewing machines | Do only straight sewing |
| | P112 | 4-5 | 2 | 2-5 sewing machines | Sewing machines include one expensive embroidery machine. Do straight sewing too. |
| | P113 | 24-31 | 2 | 2-5 sewing machines | Sewing machines include one relatively cheap embroidery machine. Do straight sewing. |
| Gara dyeing | P311 | 10 | 1 | 3 dye basins | Uses synthetic dyestuff and very expensive fabric. |
| | P312 | 20 | 1 | 3 dye basins | Uses synthetic dyestuff and less expensive fabric. |
| | P313 | 50 | 1 | 1 dye basin<br>1-6 44-gallon drums | Uses traditional dyestuff and less expensive fabric. |
| Carpentry | P411 | 54-55 | 2 | Small tools | Temporary workshop |
| | P412 | 5 | 1 | Large machines | Cement building and zinc roof |
| Black-smithing | P511 | 2 | 1 | Large machines<br>Electrical forge | Cement building and zinc roof |
| Bakery | P811 | 6-9 | 3 | Large modern electrical machines | Cement buildings and zinc roof |

Table 4.2 General Characteristics of Representative Firm Types for Region II

| Industry | Representative Firm Code Name | Range of Labor-Capital Ratio | No. of Sample Firms in the Category | Type and/or Size of Major Tools and Equipment | Other Description of Firms in the Representative Firm Grouping |
|---|---|---|---|---|---|
| Tailoring | P121 | 5-7 | 6 | 1-2 sewing machines | Do only straight sewing |
| | P122 | 14-30 | 14 | 1-2 sewing machines | Do only straight sewing |
| | P123 | 10-16 | 5 | 1-3 sewing machines | Sewing machines includes at least one embroidery machine. Do straight sewing too. |
| | P124 | 7-8 | 4 | 4-7 sewing machines | Sew machines include at least one embroidery machine. Do straight sewing too. |
| Gara dyeing | P321 | 10 | 1 | 3 dye basins | Uses synthetic dyestuff and most expensive fabric. |
| | P322 | 50 | 1 | 1 dye basin, 1-6 44-gallon drums | Uses traditional dyestuff and less expensive fabric. |
| | P323 | 92-176 | 2 | 2 dye basins, 1 44-gallon drum | Combine a greater use of synthetic dyestuff and less use of the traditional dyestuff. Use less expensive fabric. |
| Carpentry | P421 | 31-33 | 2 | Small tools | Temporary workshop |
| | P422 | 91 | 2 | Small tools | Temporary workshop |
| | P423 | 2-4 | 2 | Large machines | Cement building; zinc roof |
| Black-smithing | P521 | 15-30 | 2 | Small tools | Temporary workshop |
| | P522 | 2 | 1 | Large machines and electrical forge | Cement building, zinc roof |
| Bakery | P821 | 2-4 | 3 | Large modern electircal machines | Cement buildings, zinc roof |
| | P822 | 16 | 1 | Iron-wood, firing oven | Cement buildings, zinc roof |
| | P823 | 35-38 | 2 | Mud wood-firing oven | Mud building, thatch roof |

Table 4.3 General Characteristics of Representative Firm Types for Region III

| Industry | Representative Firm Code Name | Range of Labor-Capital Ratio | No. of Sample Firms in the Category | Type and/or Size of Major Tools and Equipment | Other Description of Firms in the Representative Firm Grouping |
|---|---|---|---|---|---|
| Tailoring | P131 | 7-9 | 2 | 1 sewing machine | Straight sewing only |
| | P132 | 11-21 | 13 | 1-2 sewing machines | Straight sewing only |
| | P133 | 25-28 | 6 | 1 sewing machine | Straight sewing only |
| | P134 | 11-24 | 4 | 2-3 sewing machines | Sewing machines include at least one embroidery machine. Do straight sewing too. |
| Gara dyeing | P331 | 64-92 | 2 | 2 dye basins | Use synthetic dye, use very cheap fabric |
| Carpentry | P431 | 30-35 | 2 | Small tools | Temporary workshop |
| | P432 | 123 | 1 | Small tools | Temporary workshop |
| | P433 | 114 | 1 | Large machines and small tools | Cement building, zinc roof, no wage labor, much use of apprentice labor. |
| Black-smithing | P531 | 20-33 | 3 | Small tools | Temporary workshop |
| | P532 | 99-111 | 2 | Small tools | Temporary workshop |
| Bakery | P831 | 24 | 1 | Mud Woodfiring Oven | Mud Walls, thatch roof |

Table 4.4 General Characteristics of Representative Firm Types for Region IV

| Industry | Representative Firm Code Name | Range of Labor-Capital Ratio | No. of Sample Firms in the Category | Type and/or Size of Major Tools and Equipment | Other Description of Firms in the Representative Firm Grouping |
|---|---|---|---|---|---|
| Tailoring | P141 | 34 | 1 | 1 sewing machine | Devotes 71 percent of time to tailoring |
| | P142 | 11-17 | 3 | 1 sewing machine | Devotes 30 percent of time to tailoring |
| | P143 | 6-10 | 3 | 2 sewing machines | Devotes 15 percent of time to tailoring |
| Carpentry | P441 | 13-18 | 2 | Small tools | Devotes less than 15 percent of time to carpentry |
| | P442 | 9 | 2 | Small tools | Devotes less than 15 percent of time to carpentry |
| | P443 | 2 | 2 | Small tools | Devotes less than 15 percent of time to carpentry |
| Black-smithing | P541 | 52-65 | 2 | Small tools | Devotes 62-81 percent of time to blacksmithing |
| | P542 | 10-30 | 6 | Small tools | Devotes 10-20 percent of time to blacksmithing |
| | P543 | 1-5 | 2 | Small tools | Devotes 2-5 percent of time to blacksmithing |

Table 4.5

| Region | Indust |
|---|---|
| I | |
| II | |
| III | |
| IV | |

Note: L/K

Source: The

Table 4.5 Population Weight Distribution of Industrial Firms by Representative Firm Type

| Region \ Industry | Tailors | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | L/K | No. | Type | L/K | No. | Type | L/K | No. | Type | L/K | No. | Type | L/K | No. |
| I | P111 | 8-9 | 514 | P311 | 10 | 3 | P411 | 54-55 | 56 | P511 | 2 | 12 | P811 | 6-9 | 11 |
| | P112 | 4-5 | 139 | P312 | 20 | 16 | P412 | 5 | 19 | | | | | | |
| | P113 | 24-31 | 163 | P313 | 50 | 1 | | | | | | | | | |
| | Total | | 816 | | | 20 | | | 75 | | | 12 | | | |
| II | P121 | 5-7 | 138 | P321 | 10 | 13 | P421 | 31-33 | 50 | P521 | 15-30 | 14 | P821 | 2-4 | 6 |
| | P122 | 14-30 | 315 | P322 | 50 | 13 | P422 | 91 | 51 | P522 | 2 | 1 | P822 | 16 | 1 |
| | P123 | 10-16 | 112 | P323 | 92-176 | 74 | P423 | 2-4 | 34 | | | | P823 | 35-38 | 10 |
| | P124 | 7-8 | 92 | | | | | | | | | | | | |
| | Total | | 657 | | | 100 | | | 135 | | | 15 | | | 17 |
| III | P131 | 7-9 | 99 | P331 | 64-92 | 120 | P431 | 30-35 | 163 | P531 | 20-23 | 80 | P831 | 24 | 144 |
| | P132 | 11-21 | 644 | | | | P432 | 123 | 179 | P532 | 99-111 | 26 | | | |
| | P133 | 25-28 | 297 | | | | P433 | 114 | 1 | | | | | | |
| | P134 | 11-24 | 198 | | | | | | | | | | | | |
| | Total | | 1,239 | | | 230 | | | 343 | | | 106 | | | 144 |
| IV | P141 | 34 | 1040 | | | | P441 | 13-13 | 1666 | P541 | 52-65 | 1375 | | | |
| | P142 | 11-17 | 10920 | | | | P442 | 9 | 1666 | P542 | 10-30 | 2750 | | | |
| | P143 | 6-10 | 1040 | | | | P443 | 2 | 1666 | P543 | 1-5 | 1375 | | | |
| | Total | | 13,000 | | | | | | 4,998 | | | 5,500 | | | |

Note: L/K means range of labor-capital ratio.

Source: The total figures were computed from Phase I survey data. (See Chuta and Liedholm, 1975, pp. 18-19.)

"a" footnote indicate resource and output coefficients computed at the capacity utilization level existing in the 1974/75 survey period. On the other hand, variables with a "b" footnote indicate resource and output coefficients computed at the 100 percent level of capacity utilization.[1] The adjustments of resource and output coefficients for 100 percent level of capacity utilization was based on the observed level of excess capacity as shown in the first rows of Tables 4.6 - 4.8. For example, in Table 4.6, in order to allow the representative firm type P111 to operate at 100 percent level of capacity, the annual output coefficients at existing level of capacity utilization were increased by 18 percent, i.e., from Le 1011 output value to Le 1193. Likewise, proprietor hired and apprentice hours of labor services were increased from 1417, 0, and 500 to 1672, 0 and 590 respectively. Also, material input costs were increased by 18 percent, from Le 382 to Le 451. Finally, variables with "c", "d" and "e" footnotes in Tables 4.6 - 4.9 refer to capital coefficients computed at 10 percent, 20 percent, and 35 percent rates of interest.

The coefficients that are relevant for the initial run of the linear programming model in Chapter 5 are those that relate to the 1974/75 survey period level of capacity utilization and with capital coefficients computed at 20 percent rate of interest. Those variable coefficients bear the footnote "a" and "d" on Tables 4.6 - 4.9. The rest of the coefficients will be utilized for the sensitivity analysis yet to be undertaken in Chapters 6 and 7.

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[1] Representative firms in Region IV have not been adjusted for 100 percent capacity utilization since those firms also actively engage in agricultural production.

Table 4.6 Annual Resource and Output Coefficients by Representative Firm Types for Region I

| Industrial Firm Types / Variables | Unit | Tailoring | | | Gara Dyeing | | | Carpentry | | Black-smithing | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P111 | P112 | P113 | P331 | P312 | P313 | P411 | P412 | P511 | P811 |
| Excess capacity | % | 18 | 56 | 30 | 17 | 0 | 17 | 0 | 27 | 0 | 38 |
| Output[a] | le | 1011 | 1073 | 3285 | 6591 | 8077 | 3316 | 4567 | 9492 | 1008 | 118569 |
| Output[b] | le | 1193 | 1674 | 4271 | 7711 | 8077 | 3880 | 4567 | 12055 | 1008 | 163925 |
| Proprietor labor[a] | hrs. | 1417 | 980 | 1945 | 1815 | 1380 | 1286 | 1711 | 1375 | 466 | 3672 |
| Proprietor labor[b] | hrs. | 1672 | 1529 | 2548 | 2124 | 1380 | 1505 | 1711 | 1746 | 466 | 5067 |
| Hired labor[a] | hrs. | 0 | 815 | 44 | 805 | 20 | 422 | 0 | 3918 | 0 | 48486 |
| Hired labor[b] | hrs. | 0 | 1271 | 57 | 942 | 20 | 494 | 0 | 4976 | 0 | 66911 |
| Apprentice labor[a] | hrs. | 500 | 9 | 5045 | 0 | 44 | 0 | 17124 | 0 | 775 | 0 |
| Apprentice labor[b] | hrs. | 590 | 14 | 6559 | 0 | 44 | 0 | 17124 | 0 | 775 | 0 |
| Material Input[a] | le | 382 | 536 | 469 | 3348 | 6320 | 2263 | 1365 | 7749 | 560 | 86148 |
| Material Input[b] | le | 451 | 836 | 610 | 3917 | 6320 | 2648 | 1365 | 9841 | 560 | 118884 |
| Capital[c] | le | 215 | 314 | 221 | 137 | 48 | 10 | 260 | 853 | 434 | 5207 |
| Capital[d] | le | 225 | 408 | 243 | 264 | 72 | 18 | 345 | 1088 | 552 | 7168 |
| Capital[e] | le | 250 | 563 | 283 | 453 | 106 | 27 | 494 | 1473 | 736 | 10476 |

Source: Computed from the survey data of small scale industries in Sierra Leone.

[a] coefficient at existing capacity utilization

[b] coefficient at 100 percent capacity utilization

[c] capital cost at 10 percent rate of interest

[d] capital cost at 20 percent rate of interest

[e] capital cost at 35 percent rate of interest

Table 4.7 Annual Resource and Output Coefficients by Representative Firm Types for Region II

| Industrial Firm Types / Variables | Unit | Tailoring | | | | Gara Dyeing | | | Carpentry | | | Black-smithing | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P121 | P122 | P123 | P124 | P321 | P322 | P323 | P421 | P422 | P423 | P521 | P522 | P821 | P822 | P823 |
| Excess capacity | % | 23 | 36 | 35 | 55 | 17 | 17 | 17 | 45 | 0 | 13 | 25 | 0 | 44 | 0 | 23 |
| Output[a] | le | 634 | 771 | 1870 | 2341 | 6591 | 2518 | 3316 | 6956 | 9614 | 9496 | 975 | 1042 | 32538 | 28419 | 5016 |
| Output[b] | le | 780 | 1049 | 2525 | 3629 | 7711 | 2945 | 3880 | 10086 | 9614 | 10730 | 1219 | 1042 | 46855 | 28419 | 6170 |
| Proprietor labor[a] | hrs. | 644 | 833 | 1148 | 927 | 1815 | 1780 | 1286 | 1238 | 1626 | 775 | 1124 | 190 | 1040 | 72 | 1032 |
| Proprietor labor[b] | hrs. | 792 | 1133 | 1550 | 1437 | 2124 | 2083 | 1505 | 1795 | 1626 | 876 | 1405 | 190 | 1498 | 72 | 1269 |
| Hired labor[a] | hrs. | 0 | 58 | 0 | 1 | 805 | 118 | 422 | 91 | 326 | 1127 | 70 | 1338 | 7223 | 14528 | 3140 |
| Hired labor[b] | hrs. | 0 | 79 | 0 | 2 | 942 | 138 | 494 | 132 | 326 | 1274 | 88 | 1338 | 10401 | 14528 | 3862 |
| Apprentice labor[a] | hrs. | 130 | 266 | 990 | 1122 | 0 | 0 | 0 | 3980 | 19956 | 3381 | 953 | 569 | 927 | 0 | 0 |
| Apprentice labor[b] | hrs. | 160 | 362 | 1337 | 1739 | 0 | 0 | 0 | 5771 | 19956 | 3821 | 1191 | 569 | 1335 | 0 | 0 |
| Material Input[a] | le | 99 | 111 | 615 | 306 | 3201 | 916 | 2200 | 807 | 6080 | 2647 | 130 | 868 | 18235 | 15733 | 2765 |
| Material Input[b] | le | 122 | 151 | 830 | 474 | 3745 | 1072 | 2574 | 1170 | 6080 | 2991 | 163 | 868 | 26258 | 15733 | 3401 |
| Captial[c] | le | 95 | 58 | 157 | 273 | 137 | 10 | 12 | 132 | 143 | 1379 | 119 | 885 | 4710 | 695 | 102 |
| Capital[d] | le | 101 | 59 | 180 | 343 | 264 | 24 | 18 | 162 | 240 | 1950 | 120 | 1020 | 6824 | 912 | 114 |
| Capital[e] | le | 121 | 75 | 214 | 482 | 453 | 27 | 37 | 220 | 391 | 2893 | 143 | 1239 | 10352 | 1270 | 136 |

Source: Computed from the survey data of small scale industries in Sierra Leone.

[a]Coefficient at existing capacity utilization

[b]Coefficient at 100 percent capacity utilization

[c]Capital costs at 10 percent interest rate

[d]Capital costs at 20 percent interest rate

[e]Capital costs at 35 percent interest rate

*Table 4.8 Annual Resource and Output Coefficients by Representative Firm Types for Region III*

Table 4.8 Annual Resource and Output Coefficients by Representative Firm Types for Region III

| Variables \ Industrial Firm Types | Unit | Tailoring | | | | Gara Dyeing | Carpentry | | | Black-smithing | | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P131 | P132 | P133 | P134 | P331 | P431 | P432 | P433 | P531 | P532 | P831 |
| Excess capacity | % | 86 | 55 | 40 | 50 | 15 | 14 | 14 | 17 | 30 | 30 | 41 |
| Output[a] | le | 246 | 596 | 520 | 678 | 2389 | 3203 | 2749 | 26904 | 1396 | 750 | 2181 |
| Output[b] | le | 458 | 924 | 728 | 1017 | 2747 | 3651 | 3134 | 31478 | 1815 | 975 | 3075 |
| Proprietor labor[a] | hrs. | 398 | 680 | 1162 | 1021 | 1193 | 1960 | 331 | 8226 | 1173 | 1893 | 1928 |
| Proprietor labor[b] | hrs. | 740 | 1054 | 1628 | 1532 | 1372 | 2234 | 377 | 9624 | 1525 | 2461 | 2718 |
| Apprentice labor[a] | hrs. | 100 | 245 | 40 | 763 | 62 | 8322 | 4071 | 45116 | 1817 | 1971 | 93 |
| Apprentice labor[b] | hrs. | 186 | 380 | 56 | 1145 | 71 | 9487 | 4641 | 52786 | 2362 | 2562 | 131 |
| Material Input[a] | le | 46 | 166 | 198 | 205 | 1679 | 1262 | 603 | 5976 | 228 | 71 | 1361 |
| Material Input[b] | le | 86 | 257 | 277 | 308 | 1931 | 1439 | 689 | 6981 | 296 | 92 | 1919 |
| Capital[c] | le | 50 | 48 | 35 | 90 | 10 | 145 | 22 | 329 | 88 | 28 | 62 |
| Capital[d] | le | 61 | 57 | 45 | 107 | 16 | 306 | 36 | 468 | 152 | 36 | 84 |
| Capital[e] | le | 80 | 77 | 53 | 138 | 30 | 488 | 45 | 698 | 166 | 60 | 96 |

Source: Computed from the survey data of small scale industries in Sierra Leone.

[a]Coefficient at existing capacity utilization

[b]Coefficient at 100 percent capacity utilization

[c]Capital cost at 10 percent interest rate

[d]Capital cost at 20 percent interest rate

[e]Capital cost at 35 percent interest rate

*Table 4.9 Annual Resource and Output Coefficients by Representative Firm Types for Region IV*

Table 4.9 Annual Resource and Output Coefficients by Representative Firm Types for Region IV

| Variables \ Industrial Firm Types | Unit | Tailoring | | | Carpentry | | | Blacksmithing | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | P411 | P412 | P413 | P441 | P442 | P443 | P451 | P452 | P453 |
| Output[a] | le | 636 | 194 | 143 | 149 | 40 | 46 | 338 | 264 | 98 |
| Family Labor[a] | hrs. | 912 | 437 | 441 | 438 | 401 | 87 | 1487 | 771 | 110 |
| Material Input Costs[a] | le | 17 | 10 | 13 | 21 | 0 | 1 | 19 | 4 | 1 |
| Capital Cost[b] | le | 21 | 27 | 37 | 24 | 39 | 32 | 21 | 30 | 32 |
| Capital Cost[c] | le | 27 | 30 | 54 | 28 | 43 | 42 | 26 | 41 | 44 |
| Capital Cost[d] | le | 37 | 53 | 83 | 46 | 89 | 68 | 36 | 63 | 67 |

Source: Computed from Survey Data of Small Scale Industries in Sierra Leone.

[a]Coefficient at existing capacity utilization

[b]Capital cost at 10 percent interest rate

[c]Capital cost at 20 percent interest rate

[d]Capital cost at 35 percent interest rate

## 4.5 Resource Efficiency Among Representative Firm Types

In order to examine the relative efficiency of resource use among the different representative firm types, attention will be focused on three key economic ratios--gross output--labor ratio, gross output--capital ratio and labor-capital ratios. The first two ratios yield the values of the average products of labor and capital respectively while the labor-capital ratio gives the quantities of labor hours that combine with a Leone worth of capital in the production process. Thus, while the ratios throw light on the average productivities of labor and capital, they also highlight the labor intensity or capital intensity of each production process. These three ratios need to be considered together since an isolated treatment might lead to inconsistent results.[1]

In examining the relative efficiency of the representative firm types, it will also be necessary to do so within the framework of our linear programming analysis. Thus, the first question that arises is, which of the representative firm types, within each industry and within each region, will likely be dropped out of the solution. With respect to the linear programming problem, each representative firm has an opportunity cost in terms of the amount of income sacrificed due to a marginal decrease in the number of such firms and a marginal increase in the number of alternative firm types. If such opportunity cost is less than the revenue generated by a marginal increase of an alternative activity, then profit will

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[1] Bhalla [1975, p. 28] points out that if capital-labor and capital-output ratios are considered in isolation, a technique could be identified as labor-intensive as well as capital-intensive.

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be increased [Heady and Candler, 1969, p. 64]. Thus, in a profit maximization problem, the solution will include a combination of activities which yields the greatest revenue from given resources or costs. Activities with the largest positive marginal costs will be dropped from the solution since their inclusion will reduce total profits by that large amount.

If one assumes that capital is the scarce resource in most less developed countries, the relevant economic ratios for examining efficiency become output-capital ratio (O/K) and labor-capital ratio (L/K). For each industry and in each region, the least efficient firms will be those firms having the smallest O/K and L/K ratios. Thus, in the tailoring industry, and as shown in Table 4.10 production processes such as P112, P131, P143 in Regions I, III and IV, respectively, could be dropped from the solution. In the gara industry, the least efficient firms are P311 and P321 in regions I and II respectively. Among the carpentry firms, the processes that might likely be dropped are P412, P423, P431 and P443, while in the blacksmithing industry, processes such as P521, P531 and P543 are the least efficient in terms of resource utilization. Finally in the bakery industry process P281 in region II is the least efficient.

On closer examination, it becomes clear that the dichotomy of labor-intensive and capital-intensive production processes, as a procedure for identifying efficient techniques of production can be misleading. For example in Table 4.10 and in region III, whereas types such as P431 (labor-intensive, traditional carpentry firms) is relatively inefficient, process type P433 (a modern carpentry

Table 4.10 Resource Efficiency of Representative Firm Types

Table 4.10 Resource Efficiency of Representative Firm Types

| Region | Efficency Variable \ Industrial Firm Type | Tailoring | | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P111 | P112 | P113 | | P311 | P312 | P313 | P411 | P412 | | P511 | | | P811 | | |
| I | Output-labor ratio | .53 | .59 | .47 | | 2.5 | 5.6 | 1.9 | .24 | 1.8 | | .83 | | | 2.3 | | |
| | Output-Capital ratio | 4.5 | 2.6 | 13.3 | | 25 | 115 | 184 | 13.2 | 914 | | 1.8 | | | 16.5 | | |
| | Labor-Capital ratio | 8.5 | 4.4 | 28.3 | | 10 | 20.5 | 102 | 55 | 5.2 | | 2.2 | | | 7.2 | | |
| | | P121 | P122 | P123 | P124 | P321 | P322 | P323 | P421 | P422 | P423 | P521 | P522 | | P821 | P822 | P823 |
| II | Output-labor ratio | .82 | .67 | .87 | 1.1 | 2.5 | 1.4 | 1.9 | 1.3 | .44 | 1.8 | .45 | .50 | | 3.5 | 1.9 | 1.2 |
| | Output-capital ratio | 6.3 | 13.1 | 10.4 | 6.8 | 25 | 105 | 184 | 42.9 | 40.1 | 4.9 | 8.1 | 1.02 | | 4.8 | 31.2 | 44 |
| | Labor-capital ratio | 7.7 | 19.6 | 12.0 | 6.2 | 10 | 80.8 | 102 | 33 | 91.1 | 2.7 | 18 | 2.04 | | 1.4 | 16.4 | 36.7 |
| | | P131 | P132 | P133 | P134 | P331 | | | P431 | P432 | P433 | P531 | P532 | | P831 | | |
| III | Output-labor ratio | .49 | .64 | .43 | .38 | 1.9 | | | .31 | .62 | .50 | .47 | 19 | | 1.1 | | |
| | Output-capital ratio | 4.0 | 10.5 | 11.6 | 6.3 | 149 | | | 10.5 | 76 | 57.5 | 9.2 | 20.9 | | 26.0 | | |
| | Labor-capital ratio | 8.2 | 16.4 | 27.0 | 16.6 | 78.4 | | | 33.9 | 122.6 | 115 | 19.6 | 110 | | 23.6 | | |
| | | P141 | P142 | P143 | | | | | P441 | P442 | P443 | P541 | P542 | P543 | | | |
| IV | Output-labor ratio | .70 | .44 | .32 | | | | | .34 | .10 | .53 | .23 | .34 | .89 | | | |
| | Output-capital ratio | 23.6 | 6.5 | 2.6 | | | | | 5.3 | .93 | 1.1 | 13 | 64 | 2.2 | | | |
| | Labor-capital ratio | 33.7 | 14.8 | 8.1 | | | | | 15.6 | 9.3 | 2.1 | 56.5 | 188 | 2.5 | | | |

firm) proves more efficient. It has to be remembered that the O/K and L/K ratios observed are a function of the existing capital utilization levels, the existing factor prices, and effective demand levels. It is possible that changes in our independent variables could lead to different patterns of resource efficiency and therefore different patterns of choice of production processes. Such an analysis will be undertaken in Chapters 6 and 7.

## 4.6 Summary

The purpose of Chapter 4 was to lay out the procedure for and delineate the representative firm types. In order to avoid serious errors of aggregation bias, firms were first stratified by industry and location. Further stratification was carried out by grouping firms with approximately the same labor-capital ratios, as shown in Tables 4.1 - 4.4. On the whole, 43 representative firm types were identified. As Table 4.5 shows, weights have been assigned to the representative firm types.

Tables 4.6 - 4.9 present annual resource and output coefficients for each representative firm type. As column one of those tables indicates, variables with "a" and "d" footnotes identify coefficients which will be used for the base run analysis of the model while those with "b," "c" and "e" footnotes indicate coefficients that will be used for the sensitivity analysis of the model.

On the basis of the base run coefficients, i.e., coefficients belonging to variables with "a" and "d" footnotes in Tables 4.6 - 4.9, some economic ratios such as output-capital ratios (O/K), output-labor ratios (O/L) and labor-capital ratios (L/K) have been

constructed for each representative firm type and presented in Table 4.10. Since the O/K and O/L ratios indicate the average productivities of capital and labor by representative firm type while the L/K ratios indicate labor intensities of representative firm types, these ratios might be useful in highlighting why some representative firm types enter the linear programming final solution, while others drop out.

# CHAPTER 5

# THE STRUCTURE OF THE LINEAR PROGRAMMING MODEL

## 5.1 Introduction

This study uses a linear programming (LP) model to evaluate the efficiency of production, resource utilization and trade patterns during the 1974/75 survey period, and to carry out sensitivity analysis of the effects of some policy variables on output, employment, capital services utilization and profits among small scale industries in Sierra Leone. Although the input-output coefficients, resource and demand constraints have been specified at regional[1] levels, the model is an interregional LP model. This interregional LP framework allows interregional feedbacks through the mechanism of trade flows within and between regions. The mechanism of trade flows, based on the prinicple of comparative advantage, affects regional production and distribution of final products and determines patterns of resource utilization.

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[1] In the literature of regional economics, the two basic principles of regionalization are uniformity and function [Hoover, 1971, pp. 122-124; Morrill, 1970, pp. 184-185]. In this study, regions will be demarcated by grouping localities, though not geographically contiguous, have a uniform range of population size. Thus, region I will be made up of localities with an excess of 100,000 inhabitants. This region is constituted by greater Freetown, the capital territory of Sierra Leone. Regions II, III and IV will be made up of all localities with population ranges of 20,000-100,000; 2,000-20,000; and less than 2,000 respectively.

The model is also a representative firm LP model because the process of aggregating the LP results will be achieved through the representative firm types which have been constructed by industry and region.[1]

The model is open because it incorporates the foreign trade section in the basic linear programming model. Finally, the model is used to carry out both short-run and long-run policy analyses. In the short-run model, flexibility restraints will be imposed on the number of firm types, so that adjustments within the flexibility limits will determine the approximate number of representative firm types, as they exist in the population. But, in the long-run model, such flexibility restraints will be removed.

The basic linear programming model is discussed in detail in the subsequent sections of this chapter. The three important aspects of the linear programming model are: 1) the objective function, 2) the constraint structure, and 3) the activity set. Each of these aspects will now be disucssed in fuller detail.

## 5.2 The Objective Function

The linear objective function of the model will be to maximize the profits of the small scale industry subsector. The decision to maximize the profits of the subsector is based on the finding that 58 percent of the 226 proprietors in the random and purposive sample said that they joined their business in order to make profits. One weakness of profit maximization as a rationale for decision-making

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[1]The details of delineating the representative firm types have been outlined in Chapter 4.

is that security goals,[1] which ranked second in importance (16 percent) to profit goals, is not taken into account in the objective function. Day [1963] and Norman [1973, pp. 38-44] have shown that farmers maximize net incomes subject to the satisfaction of household food consumption requirements. Such a "constrained" type of profit maximization [Day, 1963] will not be undertaken in this study due to lack of relevant data. Therefore, it is necessary to interpret the values of the objective function with caution.

In mathematical notation the linear objective function used in the study can be stated as follows:

$$\begin{aligned}\text{Maximize } \pi = & \sum_{j}\sum_{k}\sum_{\ell} P_{jk\ell}\, \alpha^{Y}_{jk\ell} - \sum_{i}\sum_{j}\sum_{k} (c_{\ell})\, L_{ijk} \\ & - \sum_{j}\sum_{k} (c_{m})\, M_{jk} - \sum_{j}\sum_{k} (c_{z})\, Z_{jk} \\ & - \sum_{Y}\sum_{r\neq K'} (c_{y})\, Y_{kk'} - \sum_{Y}\sum_{kg'} (c_{t})\, G_{kg'} \\ & + \sum (c_{g})\, G_{e} - \sum_{Y_m} (c_{r})\, Y_{m} \\ & - \sum_{Y_m}\sum_{gk'} (c_{t})\, Y_{m} \qquad (1)\end{aligned}$$

The objective function can be defined as maximizing the difference between the sum of the value of gross output[2] of all representative firms and incomes from gara dyeing exports on the one hand, and total expenditures from purchasing labor services, material inputs,

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[1] The survey data also revealed that 7 percent, 6 percent, 1 percent and 16 percent of the 226 respondents joined business because of family enterprise, father's occupation, prestige and security respectively. Eleven percent joined business for other reasons.

[2] Due to the heterogenous nature of the output categories of small scale industries, only values of output will be utilized in the model. Thus, physical quantities of industrial output and corresponding prices will not be explicitly shown in the model.

capital services, costs of competing imports and costs of transporting goods within Sierra Leone and between Sierra Leone and the outside world, on the other hand.

The symbols, subscripts and superscripts that have been used in defining the objective function equation (1) are defined as follows:

$\delta^{Y}_{jk\ell}$ = annual Leone value of the y-th output of the j-th production process in the k-th region and of the $\ell$-th representative firm,

$P_{jk\ell}$ = number of the j-th production process in the k-th region and of the $\ell$-th representative firm,

where j represents:

1 for tailoring production processes,

3 for gara production processes,

4 for carpentry production processes,

5 for blacksmith production processes,

8 for bakery production processes; and

k = 1, 2, 3, and 4 regions and $\ell$ = 1, ..., n; 1, ..., q; 1, ..., r; 1, ..., s; 1, ..., t categories of representative firm type.

$L_{ijk}$ = level of the i-th labor type utilized by the j-th production processes in the k-th region where i represents hours of the following categories of labor:

F - proprietor and family labor

H - hired labor

A - apprentice labor;

Mjk = level of the material input costs utilized by the j-th production processes in the k-th region;

Zjk = level of capital utilized by the j-th production processes in the k-th region;

Ykk' = level of the y-th output values transported from region k to k' where values of Y represent the following output categories:

T - tailoring output

G - gara output

C - carpentry output

B - blacksmith output

K - bakery output;

Gkg' = level of the G output values transported for exports from region k to g' (port of shipment);

Ge = level of the gara output values exported outside Sierra Leone;

Ym = level of Ym output values imported into Sierra Leone; and

Ygk' = level of the Y-th output imported into Sierra Leone and reshipped from g (the port of entry) into the k' region.

## 5.3 The Activity Set

The full activity set is denoted:

{P1k1, ..., P1kn, P3k1, ..., P3kq; P4k1, ..., P4kr, P5k1, ...,

P5ks, P8k1, ..., P8kt; LFjk, LHjk, LAjk, Mjk, Zjk, Tkk', Gkk',

Ckk', Bkk', Kkk', Gkg', Ge, TM, TMgk', BM, BMgk'}

where:

k = regions 1, 2, 3, and 4; $k \neq k'$;

g = g' = either port of shipment or port of entry for Sierra Leone;

j = 1 for tailoring production process,

3 for gara dyeing production process,

4 for carpentry production process,

5 for blacksmithing production process,

8 for bakery production process;

P1k1, ..., P1kn are activities involving tailoring production processes in the k-th region, with 1 to n representative firms;

P3k1, ..., P3kg are activities involving gara dyeing production processes in the k-th region with the 1 to q representative firms;

P4k1, ..., P4kr are activities involving carpentry production processes in k-th regions with 1 to r representative firms;

P5k1, ..., P5ks are activities involving blacksmithing production processes in the k-th regions, with 1 to s representative firms;

P8k1, ..., P8kt are activities involving bakery production processes in the k-th regions, with 1 to t representative firms;

LFjk are activities involving the purchases of proprietor labor services in the k-th region for producing each of j-th production process goods;

LHjk are activities involving the purchases of hired labor services in the k-th region for producing each of j-th production process goods;

LAjk are activities involving the purchases of apprentice labor services in the k-th region for producing each of j-th production process goods;

Mjk are activities involving the purchases of material inputs in the k-th region and for producing each of j-th production process goods; and

Zjk are activities involving the purchases of capital services in the k-th region and for producing each of j-th production process goods.

Tkk' are activities involving the transportation of tailoring output values from k-th region of production to k'-th region of demand;

Gkk' are activities involving the transportation of gara dyeing output values from k-th region of production to k'-th region of demand;

Ckk' are activities involving the transportation of carpentry output values from k-th region of production to k'-th region of demand;

Bkk' are activities involving the transportation of blacksmithing output values from k-th region of production to k'-th region of demand;

Kkk' are activities involving the transportation of bakery output values from k-th region of production to k'-th region of demand;

Gkg' are activities involving the transportation of gara dyeing output values from k-th region of production to g'-th port of shipment to the outside world;

Ge is the gara dyeing export activity;

TM is the tailoring products import activity;

TMgk' are activities involving the transportation of imported tailoring product values from g-th port of entry to the k'-th region of demand;

BM is the blacksmithing products import activity;

BMgk' are activities involving the transportation of imported blacksmithing product values from g-th port of entry to the k'-th regions of demand.

Now that the activity set has been outlined, further details concerning some specific activities need to be described. The relevant activities are therefore transportation, export, and import activities. Effort will be made to outline the rationale for including those activities in the model and explanations will be given concerning the derivation of all the coefficients that have to deal with those activities.

### 5.3.1 Transportation Activities

In order to integrate the regions, the overall model contains a transportation section. This section of the linear programming model will activate interregional shipments of output values. Such shipments will highlight comparative advantage and trade patterns within a general equilibrium framework [Moses, 1960; Hsiaso, 1971].

We assume that products of each industry, irrespective of region of origin, are homogenous. Therefore, a given commodity is a perfect technical substitute for the same commodity from another region and regional commodity trade flows will depend only on economic considerations.

In order to introduce some realism in the model, we have restricted the interregional transportation of regional output in two respects. First, since all the blacksmithing output in region 1 were observed during the survey to be in the nature of industrial services, we have not allowed region 1 to transport blacksmithing output into regions 2, 3 and 4 which demand essentially agricultural implements. Secondly, we have not allowed region 4 to export any of its products to other regions. Our survey data reveal that region 4 imports 2.5 percent of tailoring outputs of regions 1, 2 and 3, 1.3 percent of gara output and 10 percent of carpentry output from those regions and finally, 25 percent of blacksmith output of regions 2 and 3. Thus, given the limitations placed on the interregional flow of goods and services, the model will determine the trade patterns for the industries included in the model.

### 5.3.2 Transportation Costs

The objective function coefficients of the transportation matrix will be the imputed costs of transporting a unit value of the output of a particular industry from the region of production to other regions. Most of the task of distributing the output of the small scale industries is not borne by the proprietors of those industries. However, the bakery industry and to some extent, the tie-dye industry

are exceptions. Most of the modern bakeries distribute bread in delivery vans and thus incur transportation costs. But most of such deliveries are done within the locality. Producers of tie-dye cloth ship their products to other localities and regions where friends, relatives or fancy shops serve as retail outlets. Here, the cost of shipping out tie-dye cloths across regions will be borne by the proprietors. In the tailoring, blacksmiths and carpentry industries, customers traditionally travel across regions to place orders and pick up their final products and thus, the costs of transporting such products will be borne by the customers.

Nevertheless, for purely theoretical and analytical reasons, we shall assume that transportation costs are involved in the spatial distribution of the final products of each industry from one region to another. We shall also assume that transportation costs are proportionally related only to the distances over which commodities are conveyed. Thus, relative weights and volumes of different commodities will not be considered in imputing the transportaion costs.

Based on the Sierra Leone Road Transport Corporation (SLRTC) estimates, the average distance from $U^1$ to $U^2$, $U^1$ to $U^3$, $U^2$ to $U^3$, $U^2$ to R, $U^3$ to R, and $U^1$ to R are 180, 212, 195, 24, 15 and 227 miles respectively[1] (as shown in Table 5.1). Also, using the SLRTC freight rates for 1975, the average cost of transporting a ton of rice (costing about Le 452.0 in 1975) from $U^1$ to $U^2$, $U^1$ to $U^3$, $U^2$ to $U^3$, $U^2$ to R, $U^3$ to R and $U^1$ to R, given the above regional distances, are Le 9.0, Le 11.0, Le 9.75, Le 1.2, Le .75 and Le 12.0 respectively. Therefore, the costs of transporting a Leone value

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[1] $U^1$, $U^2$, $U^3$, and R refer to urban region 1, urban region 2, urban region 3 (small rural towns) and rural areas respectively. Also see footnote on page 101.

of rice from $U^1$ to $U^2$, $U^1$ to $U^3$, $U^2$ to $U^3$, $U^2$ to R, $U^3$ to R and $U^1$ to R become .02¢, .02¢, .02¢, .003¢, .002¢ and .03¢ respectively.

Table 5.1 Imputed Transportation Costs Between Regions

| Regions | Average Distance in Miles | Average Cost of Transporting a Ton of Rice | Average Cost of Transporting a Leone Value of Rice |
|---|---|---|---|
| $U^1$ ot $U^2$ | 180 | Le 9.0 | .02 ¢ |
| $U^1$ to $U^3$ | 212 | Le 11.0 | .02 ¢ |
| $U^2$ to $U^3$ | 195 | Le 9.75 | .02 ¢ |
| $U^2$ to R | 24 | Le 1.2 | .003¢ |
| $U^3$ to R | 15 | Le .75 | .002¢ |
| $U^1$ to R | 227 | Le 12.0 | .03 ¢ |

These imputed transportation costs will be used for transporting the output of the small scale industries. It has to be mentioned that these transport costs do not include the personal transport costs of a customer who travels to pick up his final product from the establishment. The justification for such an exclusion is that customers do not make single trips for the sole purpose of picking up items from the establishments. Rather, such trips are made with multiple purposes in mind, such as selling or purchasing other items as well, seeing friends or relatives, or even transacting other business. Therefore, there is no way of allocating personal transportation costs among various purposes.

### 5.3.3 Export Activities

Since our survey data revealed that 20 percent of gara cloth produced by our sample firms was exported from Sierra Leone, the overall model includes an export section. In this section, activities will be included to transport gara cloth from each region to the port of shipment and to the outside world, subject to regional demands for gara cloth. The objective function coefficient for the gara export activity is the difference between the foreign price of one Leone value of gara cloth in Chicago [Wahlman and Chuta, 1977] and the domestic price of a Leone value of gara cloth at the region, plus the costs of handling and transporting a Leone worth of gara cloth from the region of production to the point of shipment (Freetown), and from Freetown to Chicago.

### 5.3.4 Import Activities

Since Sierra Leone imports the products of small scale industries from other countries, we decided to allow imports to enter the model. This approach assumes that these foreign imports are perfect substitutes for their domestic counterparts and that their "production" and distribution patterns will be determined by the optimization scheme, subject to specified objective function coefficients and transportation costs.

The two major imports are products of tailors and blacksmiths. Using the five-digit S.I.T.C., the relevant categories of tailoring products would be men's and boys' outer garments, other men's and boys' outer garments, blouses for females and infants, female and infant outer garments, and shirts of textile fabric. The categories

of imported blacksmith products are matchetes and axes and hatchets. The average annual values (Freetown C.I.F.) of tailoring and blacksmithing products imports used as technical coefficients in the basic model are Le 1,028,386 and Le 42,728 respectively[1] (Quarterly Trade Statistics). The objective function coefficients for the import activities are the Freetown C.I.F. values plus tariff markups--40 percent and 2 3/4 percent ad valorem on tailoring and blacksmith products, respectively. Thus, it will cost Le 1,439,740 and Le 43,903 to import Le 1,028,386 and Le 42,728 worth of tailoring and blacksmithing products, respectively.

## 5.4 The Constraint Structure

Equation (1) is maximized subject to the following constraints:

$$P_{jk\ell} \geq 0 \qquad (2)$$

where $j = 1, 3, 4, 5$ and 8 industrial production process categories,

$k = 1, \ldots, 4$ regions,

$\ell = 1, \ldots, n; 1, \ldots, q; 1, \ldots, r; 1, \ldots, s; 1, \ldots, t$

industrial representative firm categories,

(the number of each representative firm type cannot be nagative);

$$\sum_{j=1}^{t} \alpha_{jk}^{i} P_{jk\ell} \leq L_{ik} \qquad (3)$$

(the sum of the i-th labor hours utilized in the j-th production process in the k-th region and using the $\ell$ representative firms should not exceed the maximum amount of the i-th labor type specified in the model for the k-th region);

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[1] Figures are averages over the five-year period 1969-1973.

$$\sum_{j=1}^{t} \beta^{m}_{jk} P_{jk\ell} \geq 0 \qquad (4)$$

(the sum of the total material input costs used in the j-th production processes in the k-th region and with $\ell$ representative firms has to be positive);

$$\sum_{j=1}^{t} \gamma^{z}_{jk} P_{jk\ell} \leq Z_{k} \qquad (5)$$

(the sum of all capital costs used in the j-th production processes in the k-th region utilizing the $\ell$ representative firms should not exceed the maximum amount of capital services specified in the model for the k-th region);

$$\sum_{j} \delta^{y}_{jk} P_{jk\ell} - \sum_{k \neq k'} Y_{kk'} + \sum_{k \neq k} Y_{k'k} - \sum G_{kg'} + \sum Y_{mgk'} = D_{ky} \qquad (6)$$

(total production of Y-th output values from j-th production processes in the k-th region minum domestic exports of the Y-th output values from the k-th region to k' plus domestic imports of the Y-th output values from k to the k'-th region, minus foreign exports of the gara output values plus foreign imports of the Y-th output values must equal the maximum demand level specified for the Y-th output values in the k-th region);

$$P_{jk\ell} \leq (1 + \bar{\beta}_{j})^{1} A_{jk\ell} \leq U_{jk\ell} \qquad (7)$$

and

$$P_{jk\ell} \geq (1 - \underline{\beta}_{j}) A_{jk\ell} \geq S_{jk\ell} \qquad (8)$$

---

[1] In regions 1, 2 and 3, $\bar{\beta}_{j} = \underline{\beta}_{j} = 10$ percent. Since 5 percent and 7 percent were observed as the maximum exit and growth rates respectively for small scale industries in the sample, 10 percent was chosen as the worst or the most optimistic annual rates of decay or growth that can be allowed in the model. In region 4, $\underline{\beta}_{j} = 20$ percent since rural firms have the alternative of switching their time to agricultural production. But $\bar{\beta}_{j}$ was maintained at 10 percent.

(number of each representative firm type should lie between the lower and upper limits specified for each representative firm type as shown in Table 5.2);

where:

$\alpha^{i}_{jk\ell}$ = annual amount of the i-th labor type required by the j-th process type with the $\ell$-th representative firm in order to produce $Y^{\delta}_{jk}$ in the k-th region;

$\beta^{m}_{jk\ell}$ = amount of material input costs required to produce $Y^{\delta}_{jk}$ by j-th production process in the k-th region;

$\gamma^{z}_{jk\ell}$ = amount of annual rental price of capital required to produce $Y^{\delta}_{jk}$ by the j-th production process in the k-th region;

Dky = maximum demand level for the y-th output in the k-th region;

Lik = maximum amount of hours of the i-th labor type specified in the k-th region;

Zk = maximum Leone amount of capital specified in the k-th region;

Ajk$\ell$ = actual number of j-th production process representative firm type in the population of the k-th region;

Sjk$\ell$ = minimum number of the j-th production process representative firm type in the k-th region, allowed in the model, and

Ujk$\ell$ = maximum number of the j-th production process representative firm type in the k-th region, allowed in the model.

## 5.4.1 Derivation of Constraint Levels

Having defined the constraint structure of the model, there is a need to describe how we specified the actual level of the constraints in the model. The procedure used in obtaining our flexibility coefficients that enabled the specification of lower and upper limits of the

Table 5.2 Minimum and Maximum Number of Each Representative Firm Type Allowed in the Model[1]

| Region I | | Tailors | | | Gara Dyers | | | Carpenters | | Blacksmiths | | Bakers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P111 | P112 | P113 | P311 | P312 | P313 | P411 | P412 | P511 | | P811 | |
| | Minimum | 463 | 125 | | 3 | 18 | 1 | 50 | 17 | 11 | | 10 | |
| | Maximum | 565 | 153 | | 3 | 22 | 1 | 62 | 21 | 13 | | 12 | |
| **Region II** | | **Tailors** | | | **Gara Dyers** | | | **Carpenters** | | **Blacksmiths** | | **Bakers** | |
| | | P121 | P122 | P123 | P321 | P322 | P323 | P421 | P422 | P423 | P521 | P522 | P821 | P822 | P823 |
| | Minimum | 124 | 284 | 101 | 83 | 11 | 11 | 67 | 45 | 46 | 31 | 13 | 1 | 5 | 1 | 9 |
| | Maximum | 152 | 347 | 123 | 101 | 14 | 14 | 81 | 55 | 56 | 37 | 15 | 1 | 7 | 1 | 11 |
| **Region III** | | **Tailors** | | | **Gara Dyers** | | | **Carpenters** | | | **Blacksmiths** | | **Bakers** | | |
| | | P131 | P132 | P133 | P134 | P331 | | | P431 | P432 | P433 | P531 | P532 | P831 | | |
| | Minimum | 89 | 580 | 267 | 178 | 207 | | | 147 | 161 | 1 | 72 | 23 | 130 | | |
| | Maximum | 109 | 708 | 327 | 218 | 253 | | | 179 | 197 | 1 | 88 | 29 | 158 | | |
| **Region IV** | | **Tailors** | | | **--** | | | **Carpenters** | | | **Blacksmiths** | | **--** | | |
| | | P141 | P142 | P143 | **--** | | | P441 | P442 | P443 | P541 | P542 | P543 | **--** | |
| | Minimum | 1144 | 12012 | 1144 | **--** | | | 1833 | 1833 | 1833 | 1513 | 3025 | 1513 | **--** | |
| | Maximum | 837 | 8736 | 837 | **--** | | | 1333 | 1333 | 1333 | 1100 | 2200 | 1100 | **--** | |

[1] See page 113 for the determination of the flexibility coefficients.

representative firm types has been presented.[1] We shall now describe how the levels of regional demands, labor and capital constraints were determined.

5.4.2 Demand Constraints

In order to specify the final demand constraints for the output of each region, the daily sales of each firm's output were utilized. Since the ultimate destination of each firm's daily output sales was recorded, it was possible to determine the regional allocation of the total output of each firm and therefore each industry. Daily output that was consumed by members of the establishment was allocated within the region where the firm was located. Output that was an outright gift was allocated to the region where the recipient was reported to be residing at the time.

Each of the region's final demand for each industrial output can be defined as follows:[2]

$$D_y^k = q_y^k - e_y^k + m_y^k$$

where:

$D_y^k$ = final demand of y-th output in region k

$q_y^k$ = output of the y-th industry in region k

$e_y^k$ = domestic exports of the y-th output in region k

$m_y^k$ = domestic imports of y-th output in region k

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[1] See footnote on page 113.

[2] An alternative procedure of estimating final demand levels would have been to use the per capital consumption coefficients. But these do not exist for Sierra Leone localities with population exceeding 2,000.

Thus, for our four regions, say, $U^1$, $U^2$, $U^3$, and R or even including an X region (outside Sierra Leone), the following demand matrix was specified and applied to our daily output sales data, in order to estimate our final demand constraints. Thus:

$$q_y^1 = U_y^1 R_y + U_y^1 U_y^2 + U_y^1 U_y^3 + U_y^1 X_y + \quad U_y^1 U_y^1$$

$$q_y^2 = U_y^2 R_y + \quad U_y^2 U_y^3 + U_y^2 X_y + U_y^2 U_y^1 + \quad U_y^2 U_y^2$$

$$q_y^3 = U_y^3 R_y + U_y^3 U_y^2 \quad + U_y^3 X_y + U_y^3 U_y^1 \quad + U_y^3 U_y^3$$

$$q_y^k = \quad R_y U_y^2 + R_y U_y^3 + R_y X_y + R_y U_y^1 \quad + R_y R_y$$

where superscripts represent regions, subscripts represent y-th output, $U^1$, $U^2$, $U^3$, and R and X represent urban regions 1, 2, and 3, rural region and outside Sierra Leone respectively.

Ignoring the regional output shipments to itself, i.e., $U_y^1 U_y^1$, $U_y^2 U_y^2$, $U_y^3 U_y^3$ and $R_y R_y$, it is easy to see that the sum of the row values is equal to each region's domestic exports to other regions. Thus:

$$e_y^1 = U_y^1 R_y + U_y^1 U_y^2 + U_y^1 U_y^3 + U_y^1 X_y = \text{sum of domestic exports}$$

from region $U^1$ and column values are interregional imports, thus,

$$m_y^1 = U_y^2 U_y^1 + U_y^3 U_y^1 + R_y U_y^1 = \text{sum of domestic imports from other}$$

regions into region $U^1$.

Table 5.3 shows the regional demand levels for each industrial output as determined with the formulation already presented.

Table 5.3 Constraint Levels of Product Final Demand by Industry and Location, 1974/75

| Industry | Region | Final Demand (le) |
|---|---|---|
| Tailoring | I | 1,817,814 |
| | II | 1,092,948 |
| | III | 623,948 |
| | IV | 2,856,016 |
| Gara | I | 46,180 |
| | II | 300,000 |
| | III | 222,000 |
| | IV | 25,000 |
| Carpentry | I | 415,440 |
| | II | 721,771 |
| | III | 1,693,836 |
| | IV | 347,892 |
| Blacksmith | I | 12,588 |
| | II | 14,667 |
| | III | 54,705 |
| | IV | 1,591,890 |
| Bakery | I | 1,173,833 |
| | II | 246,426 |
| | III | 283,658 |
| | IV | 244,474 |

Source: Sierra Leone Small Scale Industry Survey, 1974/75.

### 5.4.3 Labor Constraints

Each category of labor-proprietor, hired or apprentice, is constrained at the regional level. The actual level of each regional labor constraint is the sum of the products of the average quantity of labor services of each category utilized by each representative firm type and the number of such representative firm type existing

in the population, across all the industries. The industry and total hours of labor services by type are presented in Table 5.4. In addition, Table 5.5 presents the per hour costs of each category of labor prevailing in the various industries during the 1974/75 survey period.

Given the present levels of capacity utilization among Sierra Leone small industries, the total labor hour figures should be the accurate available numbers. The availability of entrepreneurs and hired workers is limited by the fact that it takes about two to five years to acquire the necessary skills, depending on the type of industrial skill required [Liedholm and Chuta, 1976, p. 35]. The supply of apprentices is limited by the fact that youths look to the modern sector for employment at the existing legal minimum wages. Also, during the field interview, some proprietors complained that their apprentices left before completing their training.

### 5.4.4 Capital Constraint

Capital services have also been constrained by region. The actual level of each regional capital services constraint is the sum, across all industries, of the product of the average value of capital services utilized by each representative firm type and the number of each representative firm type existing in the population during the 1974/75 survey period. Such aggregates have also been presented in Table 5.4.

The aggregate levels of capital services constraint are reasonable approximations of the amount of capital services available for the following reasons. Firstly, not only are commercial banks skeptical about lending to small entrepreneurs, small entrepreneurs are

Table 5.4 Resource Constraints by Industry, Labor Type and Location, 1974/75

| | Unit | Tailoring | Gara | Carpentry | Black-smithing | Bakery | Total |
|---|---|---|---|---|---|---|---|
| Region I | | | | | | | |
| Proprietor labor | hrs. | 1,587,120 | 28,811 | 121,941 | 5,352 | 40,392 | 1,783,616 |
| Hired labor | hrs. | 134,500 | 3,160 | 74,442 | 0 | 533,346 | 745,448 |
| Apprentice labor | hrs. | 1,080,586 | 704 | 958,944 | 9,300 | 0 | 2,049,534 |
| Capital | le | 211,971 | 1,962 | 39,992 | 6,624 | 78,848 | 339,397 |
| Region II | | | | | | | |
| Proprietor labor | hrs. | 565,127 | 72,747 | 171,176 | 15,926 | 16,632 | 841,608 |
| Hired labor | hrs. | 18,362 | 22,075 | 59,494 | 2,318 | 89,266 | 191,515 |
| Apprentice labor | hrs. | 315,834 | 0 | 1,331,710 | 13,911 | 5,562 | 1,667,017 |
| Capital | le | 84,239 | 2,682 | 86,640 | 2,700 | 42,996 | 219,257 |
| Region III | | | | | | | |
| Proprietor labor | hrs. | 1,024,594 | 143,160 | 386,955 | 143,058 | 277,632 | 1,975,399 |
| Apprentice labor | hrs. | 330,634 | 7,440 | 2,130,311 | 196,606 | 13,392 | 2,678,383 |
| Capital | le | 77,298 | 1,920 | 26,478 | 13,255 | 12,096 | 131,047 |
| Region IV | | | | | | | |
| Proprietor labor | hrs. | 6,179,160 | - | 1,542,716 | 4,316,125 | - | 12,038,001 |
| Capital | le | 411,840 | - | 188,258 | 209,000 | - | 809,098 |

Source: Sierra Leone Small Scale Industry Survey, 1974/75.

Table 5.5 Per Hour Costs (in Leones) for the Different Kinds of Labor by Industry and Region 1974/75

| Region | Labor type | Tailoring Industry | Gara Industry | Carpentry Industry | Blacksmith Industry | Bakery Industry |
|---|---|---|---|---|---|---|
| I | Proprietor and Family Labor | .35[a] | .84[a] | .51[c] | .30[a] | .54[a] |
| | Hired Labor | .10 | .15 | .20 | .15 | .15 |
| | Apprentice Labor | .02 | .01 | .12 | .08 | .08 |
| II | Proprietor and Family Labor | .35[a] | .84[a] | .51[c] | .30[a] | .54[a] |
| | Hired Labor | .10 | .15 | .08 | .13 | .15 |
| | Apprentice Labor | .02 | .01 | .02 | .08 | .08 |
| III | Proprietor and Family Labor | .35[a] | .84[a] | .51[c] | .30[a] | .54[a] |
| | Apprentice Labor | .02 | .01 | .02 | .02 | .02 |
| IV | Proprietor and Family Labor | .09[b] | -- | .09[b] | .09[b] | -- |

[a] Values of the marginal productivities of labor by industry (without regional breakdowns) as estimated from Cobb-Douglas production function (Liedholm and Chuta, 1976, p. 73).

[b] Per hour wage for male hired worker in the enumeration areas. (Spencer and Byerlee, 1976).

[c] Average of values of marginal productivities for family labor in tailoring, gara, blacksmithing and bakery industries. Carpentry labor coefficient was statistically insignificant when computed with the Cobb-Douglas function. All the other values were the observed wage payments per hour by industry and by location.

also reluctant to apply for loans from commercial banks. Reluctance on the part of commercial banks to grant loans to small entrepreneurs could be due to lack of adequate collateral, and unduly high administrative costs per unit of credit to be made available to a widely dispersed small entrepreneurs. According to the survey data, whereas accessibility to commercial bank credit was highest with the bakery industry, followed by gara dyeing and carpentry industries, failure to obtain credit, even among these industries, was high and in the magnitude of 67 to 100 percent.

## 5.5 The Linear Programming Tableau

Appendix 5 is a matrix presentation of the linear programming tableau of the entire model. The component parts of the tableau have already been described in most sections of this chapter.

The dimension of the entire matrix is 209 rows by 184 columns. Pages 247-249, 250-252, 253-255 and 256-257 of Appendix 5 refer to the regional submatrices. Pages 258-269 present the transportation section of the entire matrix, while part of page 260 and page 261 contain the foreign trade section of the matrix. The matrix notations are the same as those used in the model presentation. Income transfer activities, $cY_k$, and income transfer rows $R_k$, have been included in the regional submatrices to facilitate the aggregation of gross output values in the objective function.

## 5.6 Summary

This study uses an interregional representative firm, linear programming model to analyse output, employment and trade aspects of Sierra Leone small scale industries. The model is used first to

simulate the 1974/75 survey period, and second, to analyse the effects of changes in some policy variables.

The three important aspects of the model, i.e., the objective function, the activity set and the constraint structure, have been discussed. Since the model is open, both import and export activities have been incorporated in the model. The transportation section of the model serves the purpose of integrating the economic activities of small scale industries between regions.

The resource constraints in the model are specified at region levels. The actual level of each regional industry resource constraint is the sum of the products of the average quantity/value of the services of each resource utilized by the representative firm type, and the corresponding weights of the representative firm types. Each region's industry final demand constraint is expressed as a function of regional output, minus both domestic and foreign exports, plus domestic and foreign imports.

Finally, Appendix 5 is a matrix presentation of the entire model. The component parts of the tableau have already been described in this chapter.

# CHAPTER 6

# RESULTS OF THE LINEAR PROGRAMMING MODEL BASE RUN

## 6.1 Introduction

The purpose of this chapter is to establish some bases for evaluating the patterns of resource allocation, production and trade among small scale industries in Sierra Leone during the 1974/75 survey period. Since our linear programming model is an "optimising"[1] model, it reveals the "best" combination of production processes or the "largest" possible output or value-added obtainable for every input combination [Baumol, 1965, p. 271]. However, such optimum (best) solutions are obtained under the assumptions[2] of perfect knowledge concerning both resource and product market situations. Although these perfect situations do not exist in real life, the best results of the model, when compared with actually observed data, do highlight the existing level of efficiencies among small scale industries. On the basis of such comparisons, suggestions can be made to guide decision makers in formulating policies that would enable small

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[1] According to Richard Day [1974], "optimising" is finding a best choice among possible alternative choices.

[2] Since firms are assumed to be perfectly aware of and have access to the cheapest input and most profitable product markets, they continue to combine their inputs, say labor and capital, until the ratio of their marginal products is equal to the ratio of their prices. In the product market (domestic and foreign) the marginal cost of selling a unit value of output will be equated to its marginal revenue [Braff, 1969, pp. 269-272].

scale entrepreneurs to come closer to their objectives, i.e., maximum profit [Baumol, 1965, pp. 4-5].

## 6.2 Number of Firms

On the aggregate, our model predicts a total of 26,877 industrial firms that are in the Sierra Leone Small Scale Industrial subsector during 1974/75 (see Table 6.2). This predicted number is 2 percent less than the actually observed number. Thus, our model predicts that a total of 528 most inefficient industrial firms ought to be dropped form the subsector so that the profit of the subsector as a whole can be maximized.

Although the aggregate number of firms declined by 2 percent, there are variations in the changes of number of firms by region, industry and production process type. In region I, and with the exception of the blacksmithing firms, all firms increased above the actual numbers as shown in Table 6.2. The sole blacksmithing firm type in region I, entered the model solution at the level of 12 firms, as was observed in 1974/75.

Increases in the number of firms have been observed also in region II's tailoring, and carpentry industries, as shown in Table 6.2. But, the number of gara dyeing, blacksmithing and bakery firms, declined by 11 percent, 13 percent and 12 percent respectively. Such declines in firm numbers could be explained by a further examination of process types. Accordingly, as can be seen from Table 6.1, the blacksmithing firm, P522, did not enter the basic solution. Although this firm adopts modern production methods, it has very low output-capital and labor-capital ratios (as shown in Table 4.10), thus

Table 6.1 Predicted Number of Firms by Industrial Process Type and Location for the Base Run, 1974/75

Region I (Localities over 100,000)

| Industries | Tailoring | | | Gara Dyeing | | | Carpenters | | Blacksmithing | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|
| Firm type | P111 | P112 | P113 | P311 | P312 | P313 | P411 | P412 | P511 | P811 |
| | 565 | 153 | 179 | 3 | 18 | 1 | 62 | 21 | 12 | 12 |
| Industry Subtotal | | 897 | | | 22 | | | 83 | 12 | 12 |

Region II (Localities 20,000-100,000)

| Industries | Tailoring | | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Firm type | P121 | P122 | P123 | P124 | P321 | P322 | P323 | P421 | P422 | P423 | P521 | P522 | P821 | P822 | P823 |
| | 152 | 296 | 123 | 101 | 11 | 11 | 67 | 55 | 56 | 33 | 13 | 0 | 5 | 1 | 9 |
| Industry Subtotal | | | 672 | | | 89 | | | 144 | | | 13 | | 15 | |

Region III (Localities 2,000-20,000)

| Industries | Tailoring | | | | Gara Dyeing | Carpentry | | | Blacksmithing | | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Firm type | P131 | P132 | P133 | P134 | P331 | P431 | P432 | P433 | P531 | P532 | P831 |
| | 89 | 580 | 267 | 178 | 246 | 170 | 197 | 1 | 72 | 23 | 132 |
| Industry Subtotal | | | 1114 | | 246 | | 368 | | | 95 | 132 |

Region IV (Localities less than 2,000)

| Industries | Tailoring | | | Carpentry | | | Blacksmithing | | |
|---|---|---|---|---|---|---|---|---|---|
| Firm type | P141 | P142 | P143 | P441 | P442 | P443 | P541 | P542 | P543 |
| | 1144 | 10354 | 837 | 1411 | 1333 | 1833 | 1513 | 3025 | 1513 |
| Industry Subtotal | | 12,335 | | | 4577 | | | 6051 | |

Table 6.2 Comparison of Actual[1] and Predicted Number of Firms by Industry and Location, 1974/75

| Industry | Localities over 100,000 | | Localities 20,000-100,000 | | Localities 2,000-20,000 | | Localities less than 20,000 | | Total | | Industry Percentages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Actual | Predicted | Actual | Predicted | Actual | Predicted | Actual | Predicted | Actual | Predicted | Actual | Predicted |
| Tailoring | 816 | 897 | 657 | 672 | 1239 | 1114 | 13,000 | 12,335 | 15,712 | 15,018 | 57% | 56% |
| Gara dyeing | 20 | 22 | 100 | 89 | 230 | 246 | - | - | 350 | 357 | 1% | 1% |
| Carpentry | 75 | 83 | 120 | 144 | 343 | 368 | 5,000 | 4,577 | 5,538 | 5,172 | 20% | 19% |
| Blacksmithing | 12 | 12 | 15 | 13 | 106 | 95 | 5,500 | 6,051 | 5,633 | 6,171 | 21% | 23% |
| Bakery | 11 | 12 | 17 | 15 | 144 | 132 | - | - | 172 | 159 | .5% | .6% |
| Total | 934 | 1,026 | 909 | 933 | 2062 | 1955 | 23,500 | 22,963 | 27,405 | 26,877 | 100% | 100% |
| Locality Percentages | 3% | 4% | 3% | 3% | 8% | 7% | 86% | 85% | 100% | 100% | | |

[1]Actual figures have been computed from the data generated during 1974/75 field survey.

indicating a very low efficiency performance. In the bakery industry, while the decline in firm numbers could be due to the relative inefficiency of the "modern" process type firm P821, the decline in the number of the traditional bakery firm types, P823, and the three gara firm types could be due to other factors such as levels of effective demand, regional comparative advantage, capacity utilization, forces that will be more thoroughly analysed in the next chapter.

In region III, Table 6.2 also reveals that the number of firms in the gara dyeing and carpentry industries increased. But the firm numbers in the tailoring, blacksmithing and bakery industries declined by 10 percent, 10 percent, and 8 percent respectively. Also, in region IV, while firm numbers in the tailoring and carpentry industries declined by 5 percent and 8 percent respectively, the number of firms in the blacksmithing industry increased.

## 6.3 Employment Patterns

Table 6.3 reveals that on the aggregate, the predicted quantity of labor hours utilized by small scale industries exceeds the actually observed data by only one percent. In addition, both the model predictions and actually observed data indicate a wide variation in resource utilization by industry and location. Such variations exist for both the use of different kinds of labor and capital.

### 6.3.1 Labor Utilization

Table 6.3 reveals that out of a total labor service input of 24,255,222 hours predicted by our model for the year 1974/75, the

Table 6.3 Comparison of Actual[1] and Predicted Patterns of Labor Utilization by Industry and Location, 1974/75

| Industry | Localities over 100,000 | | Localities 20,000 - 100,000 | | Localities 2,000 - 20,000 | | Localities less than 2,000 | | Total | | Percentages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual | Predicted |
| Tailoring | 2,727,072 | 2,618,203 | 940,167 | 930,167 | 1,500,429 | 1,219,308 | 6,162,000 | 5,937,289 | 11,329,668 | 10,704,967 | 46 | 44 |
| Gara Dyeing | - | 35,560 | 200.500 | 164,134 | - | 309,019 | - | - | 200,500 | 508,713 | .8 | 2 |
| Carpentry | - | 1,278,923 | 408,360 | 1,693,827 | 6,404,831 | 2,668,799 | 1,540,000 | 1,312,066 | 8,353,191 | 6,953,615 | 34 | 29 |
| Blacksmithing | 14,652 | 15,248 | 26,955 | 27,911 | 315,590 | 304,152 | 4,097,500 | 4,748,536 | 4,458,697 | 5,095,847 | 18 | 21 |
| Bakery | - | 625,895 | 70,907 | 98,099 | - | 268,086 | - | - | 70,907 | 992,080 | .3 | 4 |
| Total | 2,741,724 | 4,573,829 | 1,646,889 | 2,914,138 | 8,224,850 | 4,769,364 | 11,799,500 | 11,997,891 | 24,412,963 | 24,255,222 | 100 | 100 |
| Percentage | 11 | 19 | 7 | 12 | 34 | 20 | 48 | 49 | 100 | 100 | | |

[1]Actual figures originate from the random sample of the Sierra Leone Small Scale Industry Survey, 1974/75.

tailoring industry contributed 44 percent, the highest hours input, followed by the carpentry, blacksmithing, bakery and gara dyeing industries which accounted for 29 percent, 21 percent, 4 percent and 2 percent respectively. The table also reveals that the bulk of the total labor input in the subsector is located in the rural areas. Thus, while 49 percent of labor services of the subsector is accounted for by localities with less than 2,000 people, regions I, II and III account for 19 percent, 12 percent and 49 percent respectively. These predicted patterns are close to the actually observed patterns.

### 6.3.2 Labor Types

A first glance at Table 6.4 will seem to indicate that the proprietor and family labor is the most important labor type utilized in the small scale industry subsector. This bias stems from the fact that in region IV, the proprietor and family labor is the dominant labor type and accounts for 100 percent of the labor services utilized by all industries located in this region. However, the data also reveal that if region IV is ignored, apprentice labor seems to be the most important labor type contributing, 50 percent, 61 percent and 58 percent of the total labor services in regions I, II and III respectively. Next to the apprentice labor type is the proprietor family labor type which accounts for 33 percent, 32 percent and 42 percent of the total labor services of regions I, II and III respectively. The least important labor category is the hired type which only accounts for 17 percent, and 7 percent labor input in regions I and II. Region III virtually does not use hired labor services.

Apart from the locational variation in labor type utilization,

Table 6.4 Predicted Percentage of Hours Input by Labor Types by Industry and Location, 1974/75

| Location | Localities with above 100,000 | | | | Localities, 20,000-100,000 | | | | Localities with 2,000-20,000 | | | | Localities with less than 2,000 | | | | All localities | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry | PL | HL | AL | Total | PL | HL | AL | Total | PL | HL | AL | Total | PL | HL | AL | Total | PL | HL | AL | Total |
| Tailoring | 50 | 5 | 45 | 100 | 62 | 2 | 36 | 100 | 76 | - | 24 | 100 | 100 | - | - | 100 | 77 | 1 | 22 | 100 |
| Gara dyeing | 89 | 9 | 2 | 100 | 77 | 23 | - | 100 | 95 | - | 5 | 100 | - | - | - | | 89 | 8 | 3 | 100 |
| Carpentry | 11 | 6 | 79 | 100 | 11 | 3 | 86 | 100 | 15 | - | 85 | 100 | 100 | | | 100 | 29 | 2 | 69 | 100 |
| Blacksmithing | 37 | - | 63 | 100 | 53 | 3 | 44 | 100 | 42 | - | 58 | 100 | 100 | - | - | 100 | 96 | 0 | 4 | 100 |
| Bakery | 7 | 93 | - | 100 | 15 | 80 | 5 | 100 | 95 | - | 5 | 100 | - | - | - | - | 32 | 67 | 1 | 100 |
| All Industries | 33 | 17 | 50 | 100 | 32 | 7 | 61 | 100 | 42 | - | 58 | 100 | 100 | - | - | 100 | | | | |

Note PL = hours of proprietor and family labor

HL = hours of hired labor

AL = hours of apprentice labor

Table 6.4 reveals a remarkable variation in labor type utilization by industry. Whereas the apprentice labor is crucial for the carpentry industry, accounting for 79 percent, 86 percent and 85 percent in regions I, II and III respectively, the hired labor is of critical importance in the bakery industry accounting for 93 percent and 80 percent of total industry hours input in regions I and II while proprietor and family labor clearly dominates labor input in gara dyeing, accounting for 89 percent, 77 percent and 95 percent of labor input in regions I, II and III respectively. These patterns of variation in labor utilization by industry and location as predicted by our model correspond with the actually observed data [Liedholm and Chuta, 1976, p. 35].

### 6.3.3 Capital

Table 6.5 reveals that the value of capital services utilized by the small scale industries exceeded the actually observed data by only 9 percent. However the patterns of industrial and locational variations in the utilization of capital services remain the same.

Out of a predicted total capital services of Le 1,547,155 utilized by the firms in the small scale industrial subsector for the year 1974/75, the tailoring industry accounted for 50 percent of total capital services as shown in Table 6.5. The gara industry, which used the least amount of the subsector capital services accounted for only .7 percent of the total capital services. These predicted patterns also synchronize with the actual situations that were observed in Sierra Leone during the survey period.

The pattern of capital services utilization varies both by

Table 6.5 Comparison of Actual[1] and Predicted Values of Capital Services Utilization by Industry and Location, 1975/75

| Industry | Localities over 100,000 | | Localities 20,000 - 100,000 | | Localities 2,000 - 20,000 | | Localities less than 2,000 | | Total | | Percentages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual | Predicted |
| Tailoring | 241,536 | 233,046 | 83,439 | 89,600 | 76,818 | 69,550 | 507,000 | 386,716 | 908,793 | 778,912 | 64 | 50 |
| Gara Dyeing | - | 2,070 | 1,800 | 4,374 | - | 3,939 | - | - | 1,800 | 10,383 | .1 | .7 |
| Carpentry | - | 44,238 | 15,840 | 86,938 | 57,624 | 59,590 | 185,000 | 183,435 | 258,464 | 374,201 | 18 | 24 |
| Blacksmithing | 6,588 | 6,893 | 8,025 | 1,560 | 22,896 | 11,772 | 209,000 | 229,935 | 246,509 | 250,160 | 17 | 16 |
| Bakery | - | 86,299 | 1,989 | 36,058 | - | 11,142 | - | - | 1,989 | 133,499 | .1 | 9 |
| Total | 248,124 | 372,546 | 111,093 | 218,530 | 157,338 | 155,993 | 901,000 | 800,086 | 1,407,555 | 1,547,155 | 99 | 99 |
| Percentage | 18 | 24 | 8 | 14 | 11 | 10 | 64 | 52 | 101 | 100 | | |

[1]Actual figures originate from the random smaple of the Sierra Leone Small Scale Industry Survey, 1974/75.

industry and location. Whereas the bulk of the annual capital services are utilized by the tailoring industry, carpentry, blacksmithing and bakery industries utilize 25 percent, 16 percent and 9 percent of the total subsector capital services respectively. Also, as Table 6.5 reveals, the bulk of the subsector annual capital services is consumed in the rural areas - localities with less than 2,000 people. Thus, while region IV utilizes 52 percent of total annual capital services, region I accounts for 24 percent while regions II and III account for 14 percent and 10 percent respectively.

### 6.3.4 Limiting and Unlimiting Resources

In a linear programming framework, a resource is limiting if it earns a positive value of marginal product (VMP). Such resource VMPs thus indicate possible gains/losses in income through the acquisition/salvage of scarce resources, given the level at which those resources were initially constrained. The results of our model reveal that all our labor categories earned postive VMPs, thus indicating that labor is a scarce resource.

In regions I and IV, the VMPs of the different categories of labor are equal to the per hour labor costs originally stipulated in the model.[1] But in regions II and III, the VMPs reflect different scarcity levels for the different labor categories as shown in Table 6.6. Whereas hired labor is most constraining in region II, both proprietor and family labor and apprentice labor types are very constraining in region III. Thus, the VMPs of hired labor in regions II and III exceed two Leones while the VMPs of apprentice labor in region II range between Le 7 and Le 2.1.

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[1] See page 121.

Table 6.6 Divergencies Between Per Hour Labor Costs and Predicted Values of Marginal Productivity of Labor by Industry and Location (in Leones), 1974/75

| Region | Labor Type | Tailoring | | Gara Dyeing | | Carpentry | | Blacksmithing | | Bakery | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Per hour Cost | VMP | Per hour Cost | VMP | Per hour Cost | VMP | Per hour Cost | VMP | Per hour Cost | VMP |
| II | PL | .35 | .35 | .84 | .84 | .51 | .50 | .30 | .30 | .54 | .54 |
| Localities 20,000 - 100,000 | HL | .10 | 2.7 | .15 | 2.7 | .20 | 2.7 | .15 | 2.7 | .15 | 2.7 |
| | AL | .02 | .02 | .01 | 0. | .12 | .02 | .08 | .08 | .08 | .08 |
| III | | | | | | | | | | | |
| Localities 2,000 - 20,000 | PL | .35 | 2.4 | .84 | 2.9 | .51 | 2.6 | .30 | 2.4 | .54 | 2.6 |
| | AL | .02 | 2.1 | .01 | .7 | .02 | .7 | .02 | .7 | .02 | .7 |

NOTE: PL = proprietor and family labor hour services.

HL = hired labor hour services

AL = apprentice labor hour services

One explanation for the relative scarcities of labor in regions II and III could be the relative low net migration rates in these regions as distinct from the high net migration rates in region I [Byerlee, Tommy, Fatoo, 1976, p. 38]. If region I receives a large proportion of net flow of migrants in Sierra Leone, then one would expect labor to be less constraining there, than in regions where the rate of out migration is high. In addition, labor is less constraining in region IV, the rural localities, because not only does a large proportion of the entire population live there, but only about .5 percent, an insignificant percent, of the rural population change residence in a year [Byerlee, Tommy and Fatoo, 1976, p. 42].

Our analysis reveals that capital is not a limiting resource both by region and industry. This is so because capital services always earned a zero VMP. This important finding lends support to our earlier finding that lack of capital is no barrier to the success of small entrepreneurs [Liedholm and Chuta, 1976, p. 97].

## 6.4 Gross Output

As Table 6.7 reveals, our model predicts an annual gross output of Le 13,401,447 for the five major industrial categories of the small scale industrial subsector. This figure is greater than the actually observed figure of Le 9,618,400 for the value of annual gross output of the subsector. Our model prediction is thus 39 percent higher than the actually observed data.

Out of the total gross output predicted, the tailoring industry contributes 42 percent while the carpentry, bakery, blacksmithing and gara dyeing industries account for 24 percent, 15 percent, 12 percent

Table 6.7 Comparison of Actual[1] and Predicted Values of Gross Output by Industry and Locaction, 1974/15

| Industry | Localities over 100,000 | | Localities 20,000 - 100,000 | | Localities 2,000 - 20,000 | | Localities less than 2,000 | | Total | | Percentages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual hrs. | Predicted hrs. | Actual | Predicted |
| Tailoring | 1,352,928 | 1,323,399 | 952,650 | 791,050 | 748,356 | 623,261 | 2,769,000 | 2,856,016 | 5,822,934 | 5,593,726 | 61 | 42 |
| Gara Dyeing | - | 168,475 | 348,500 | 322,371 | - | 588,245 | - | - | 348,500 | 1,079,091 | 4 | 8 |
| Carpentry | - | 482,486 | 262,440 | 1,235,493 | 1,204,273 | 1,113,068 | 390,000 | 347,898 | 1,856,713 | 3,178,945 | 19 | 24 |
| Blacksmighing | 12,096 | 12,588 | 10,590 | 12,765 | 129,295 | 117,763 | 1,353,000 | 1,458,268 | 1,504,981 | 1,601,294 | 16 | 12 |
| Bakery | - | 1,442,828 | 85,272 | 236,253 | - | 289,310 | - | - | 85,272 | 1,948,391 | .9 | 15 |
| Total | 1,365,024 | 3,409,776 | 1,659,452 | 2,597,842 | 2,081.924 | 3,731,647 | 4,512,000 | 4,662,182 | 9,618,400 | 13,401,447 | 100 | 100 |
| Percentage | 14 | 25 | 17 | 19 | 22 | 28 | 47 | 35 | 100 | 100 | | |

[1]Actual figures originate from the random sample of the Sierra Leone Small Scale Industry Survey, 1974/75.

and 18 percent of total output respectivley. Apart from the industrial variation in gross output, there is quite a variation by location. Whereas the rural localities, region IV, accounts for over one third of total gross output of the subsector, i.e., 35 percent, regions I, II and III contributed 25 percent, 19 percent and 28 percent of total gross output, respectively. The predominant share of the tailoring industry and the rural localities in the total value of gross output is predicted by our model and confirmed by the observed data.

## 6.5 Production and Trade Patterns

In this section of Chapter 6, an attempt will be made to describe the patterns of intraregional, interregional and foreign trade as revealed in our model. In addition, the predicted patterns of trade will be compared with the observed patterns.

### 6.5.1 Intraregional Trade Patterns

Table 6.8 shows the overwhelming importance of intraregional as opposed to interregional trade of the commodities of the five major small scale industries in Sierra Leone. Although on the aggregate, about 92 percent of total regional production is consumed within the region of origin, some regional and industrial variations exist in the patterns of intraregional trade. For example, whereas region IV trades all its produce internally to satisfy regional demand, regions I, II and III consume only 87 percent, 79 percent and 62 percent of their entire industry production respectively. With respect to industrial variation in intraregional trade patterns, it

Table 6.8 Predicted Production and Trade Patterns by Industry Products and Location (in Leones), 1974/75

| Region of Origin | Products of | Regions of Destination | | | | | | Percentage of intra-regional trade % |
|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | Foreign Exports | Total Exports** | |
| I*** | a | 1,323,399 | -- | -- | -- | -- | 1,323,399 | 100 |
| | b | 46,180 | -- | -- | -- | 122,295 | 168,475 | 27 |
| | c | 415,440 | -- | 67,046 | -- | -- | 482,486 | 86 |
| | d | 12,588 | -- | -- | -- | -- | 12,588 | 100 |
| | e | 1,173,833 | 10,173 | -- | 238,822 | -- | 1,422,828 | 82 |
| II | a | -- | 791,050 | | | | 791,050 | 100 |
| | b | -- | 300,000 | | 22,371 | | 322,371 | 93 |
| | c | -- | 721,771 | 513,722 | | | 1,235,493 | 58 |
| | d | -- | 12,675 | | | | 12,675 | 100 |
| | e | -- | 236,253 | | | | 236,253 | 100 |
| III | a | | -- | 623,261 | | | 623,261 | 100 |
| | b | | -- | 222,000 | -2,629 | 363,616 | 588,245 | 38 |
| | c | | -- | 1,113,068 | | | 1,113,068 | 100 |
| | d | | -- | 54,705 | 63,057 | | 117,763 | 46 |
| | e | | -- | 283,658 | 5,652 | | 289,310 | 98 |
| IV | a | | | | 2,856,016 | | 2,856,016 | 100 |
| | b | | | | -- | | -- | -- |
| | c | | | | 347,892 | | 347,898 | 100 |
| | d | | | | 1,458,268 | | 1,458,268 | 100 |
| | e | | | | -- | | -- | |
| Foreign Imports | a | 494,415 | 298,061 | | | | | |
| | b | | | | | | | |
| | c | | | | | | | |
| | d | 1,992 | | 70,565 | | | | |
| | e | | | | | | | |
| Total Imports | a | 1,817,814* | 1,092,948* | 623,261 | 2,856,016 | | | |
| | b | 46,180 | 300,000 | 222,000 | 25,000* | | | |
| | c | 415,440 | 721,771 | 1,693,836* | 347,892 | | | |
| | d | 12,588 | 14,667 | 54,705 | 1,591,890* | | | |
| | e | 1,173,833 | 246,426* | 283,658 | 244,474* | | | |

Note * Commodities where regional production falls short of regional requirement.

** Total export in our context equals total commodity production.

*** a, b, c, d, e correspond to tailoring, gara dyeing, carpentry, blacksmithing and bakery industries respectively.

is clear from Table 6.8 that all of tailoring output is consumed within the region of origin. With the exception of region III, all of the blacksmithing output is produced to satisfy regional demands.

### 6.5.2 Interregional Trade Patterns

Table 6.8 reveals that the bulk of the interregional trade is in carpentry, gara dyeing, bakery and blacksmithing outputs. Region I ships 14 percent and 17 percent of its carpentry and bakery output to regions III and IV respectively; region II ships 42 percent and 7 percent of its carpentry and gara output to regions III and IV respectively; and region III exports .4 percent and 2 percent of its gara and bakery products respectively to region IV. In addition, region III ships about 54 percent of its blacksmithing output to region IV.

### 6.5.3 Foreign Trade

The model predicts that 45 percent of total gara production is exported as shown in Table 6.8. But the bulk of this export, originates from region III. But, while region I ships 75 percent of its total gara produce as foreign exports, region III ships about 62 percent of its production as foreign exports. With respect to imports, our model predicted increased importation of blacksmithing output above the stipulated annual average. The bulk of such imports, i.e., 97 percent, were shipped to region IV for use in agricultural production. On the other hand, the model predicted that only 77 percent of the stipulated annual tailoring imports came into the solution. Out of this, 62 percent of the tailoring imports were shipped to region I while 48 percent of the tailoring imports went

to region II.

When all the predicted trade patterns are compared with the observed data, it becomes clear that the model has made very reliable predictions. First, whereas we actually observed that only 4 percent of all tailoring output is traded interregionally, our model predicted that regions consume 100 percent of their tailoring output. Secondly, whereas we observed about 10 percent interregional shipments of bakery output, our model predicted that 13 percent of the value of total bakery output was traded interregionally during the survey period. Thus our model predictions synchronize with actual field observations in confirming the fact that the consumption of both tailoring and bakery products is highly localized. Thirdly, our model prediction of 18 percent interregional shipment of total value of carpentry produce is comparable to the actually observed 15 percent.

While there exists such synchronizations between actually observed data and our model predictions, there are some differences too. Whereas our model predicted that 2 percent, and 4 percent of the total value of output of the gara, and blacksmith industries respectively entered interregional trade, we actually observed 37 percent and 32 percent respectively for those industries. The great divergence between actual and predicted values of gara cloth traded interregionally deserves some attention. Under conditions of perfect knowledge with respect to product prices in international markets and perfect mobility with respect to resources and products, our model predicted profitable increases in gara production for the export market. However, such perfect conditions do not exist

in real life. Thus, whereas we observed an actual export of 18 percent of total value of gara production, our model predicted 45 percent. In connection with blacksmith products, the model predicted that it is cheaper to import cutlasses and matchets from abroad than to produce them locally. For example, whereas one leone value of blacksmithing import[1] costs 1.076 cents, it costs 1.31 cents to produce one leone value of blacksmithing output using process type P151. Hence the model predicted the importation of Le 72,557 worth of matchets and cutlasses, about twice the import coefficient stipulated in the model, and not unusual for some previous years.

## 6.6 Regional Comparative Advantage

In order to explain the pattern of interregional trade observed and predicted by our model for the year 1974/75 in Sierra Leone, the principle of comparative cost advantage will be useful. For convenience, we shall concentrate on the composite financial costs[2] of producing one Leone value of output by industry and location as shown in Table 6.9. Accordingly, two commodities stand out clearly in terms of comparative cost advantages. Since region II is the least cost gara cloth producer (with a unit cost of .63 cents), it exports gara cloth to region IV. Although regions I and III produce gara for foreign exports, nothing can be said about

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[1] See page 261 in Appendix 5.

[2] Composite costs include annual labor costs, material input costs, working capital costs, building and equipment rentals and fixed capital costs. Kreinin [1971, p. 199] illustrated comparative opportunity cost principle using "composite factor cost."

the comparative advantage of Sierra Leone in foreign gara markets since we do not know the production-cost schemes of other competitors. Secondly, region III has a comparative advantage in producing blacksmithing output when compared with regions I and II. With a unit cost of production of .23 cents, as compared to Le 1.1 and .66 cents in regions I and II respectively, region III is able to ship over Le 63,000 worth of agricultural implements to region IV.

Table 6.9 Predicted Per Unit Costs[a] of Production by Industry and Location (in Leones), 1974/75

| Industry Region | Tailoring | Gara Dyeing | Carpentry | Black-smithing | Bakery |
|---|---|---|---|---|---|
| 1 | .45 | .77 | .59 | 1.1 | .77 |
| 2 | .31 | .63 | .45 | .66 | .66 |
| 3 | .42 | .71 | .36 | .26 | .66 |
| 4 | .18 | - | .63 | .19 | - |

[a]Costs include labor costs, material inputs and capital costs.

The situation is not quite as straight forward when it comes to carpentry and bakery industries. Although region I has absolute disadvantages in producing all the four interregionally traded products of the small scale industries, such absolute disadvantages are least in carpentry and bakery but greatest in blacksmithing industries. Thus region I produces carpentry and bakery products where it has the least disadvantage and ships these products out to regions III and IV respectively. Likewise, although region II has absolute disadvantages in producing carpentry and blacksmithing products,

having unit costs of .45 cents and .66 cents respectively when compared to region III, its costs disadvantage is greater in blacksmithing than in carpentry products. Hence reigon II produces enough carpentry output, and exports these to region III which has a comparative advantage in blacksmithing industry. Finally, region III is a least cost producer of bread output and is able to supplement the bread needs of region IV. It is important to realize that although the unit cost of bread production is the same in regions II and III, region III enjoys a lower cost of transportation advantage over region II. Whereas it costs .003 cents to ship a unit value of bread output from region II to IV, it costs .002 cents between regions III and IV.

### 6.6.1 Factors Determining Regional Comparative Advantage

Table 6.9 revealed that region I has absolute disadvantages in the production of all the five categories of small scale industry products. Such absolute disadvantages are further highlighted by Table 6.10. With the exception of carpentry industry, almost all the firms in region I tend to be capital intensive (at least on the aggregate). In our definition, capital incorporates not only service inputs from tools and equipments, but also from working capital and buildings. Thus, for example, whereas building rentals constitute about 31 percent of total capital services in region I, it is only 16 percent for region II and for similar kinds of modern bakery firms. In addition, and with the exception of tailoring, all the other industries in region I tend to utilize large amounts of material input, when compared with similar industries in the other

Table 6.10 Predicted Resource Requirements by Industry and Location as Bases for Explaining Comparative Advantage, 1974/75

| Locality / Industry | Labor-Capital Ratios (Hours per Leone Value of Capital) | | | | Material Input Requirement Per Unit Value of Output (Leones) | | | |
|---|---|---|---|---|---|---|---|---|
| | Localities over 100,000 | Localities 20,000-100,000 | Localities 2,000-20,000 | Localities Less Than 2,000 | Localities over 100,000 | Localities 20,000-100,000 | Localities 2,000-20,000 | Localities Less Than 2,000 |
| Tailoring | 11.2 | 10.4 | 17.3 | 15.4 | .29 | .20 | .30 | .05 |
| Gara dyeing | 17.2 | 37.5 | 78.5 | -- | .75 | .60 | .70 | -- |
| Carpentry | 28.9 | 19.5 | 44.8 | 7.2 | .51 | .38 | .30 | .03 |
| Blacksmithing | 2.2 | 17.9 | 25.8 | 20.7 | .56 | .13 | .15 | .03 |
| Bakery | 7.3 | 2.7 | 24.1 | -- | .73 | .51 | .62 | -- |

regions as shown in Table 6.10. One would expect the cost of material inputs to be lower in region I, being the port of entry for the entire country. But, if one recalls that most of the firms in region I purchase the services of electricity, water, and telephone, the high input coefficients of region I becomes understandable.

With the exception of gara production, region III has an absolute advantage in producing the four major products of small scale industries. As is also revealed in Table 6.10, region III firms utilize labor-intensive techniques as revealed by the high labor-capital ratios. But such absolute advantages that are due to favorable factor endownment tended to be counter-balanced by material input costs which are higher in region III than in region II. The fact that most material inputs used in region III are purchased from regions I and II and in uneconomical quantities means that material input costs are higher in region III. However, since region III makes much use of cheap apprentice labor and virtually no hired labor as in regions I and II, region III still enjoys absolute cost advantages when compared to regions I and II.

As was revealed in Table 6.9, region II enjoys a comparative advantage in gara dyeing being the least cost producer of all the three regions. Such comparative advantage stems from the fact that not only is labor-capital ratio in gara dyeing high for region II, material input costs are also the least. Also, region III's comparative advantage in blacksmithing is based on the fact that cheap labor is always utilized and material input costs are relatively low when compared to region I. Region III's comparative advantage in bread production is due, not to low cost of material input but

relatively abundant use of cheap labor as shown in Table 6.10.

## 6.7 Summary

The purpose of this chapter is to assess the efficiency of resource allocation among small scale industrial firms in Sierra Leone. Thus, the actual levels of performance of those firms have been compared with the predicted levels needed to maximize the total profits of the small scale industrial subsector. Any differences between the actual and the expected levels of performance therefore call for policy suggestions on how to bridge the gap.

A significant result of this analysis is that inefficiencies in resource allocation exist among Sierra Leone small scale industries. On the aggregate, the predicted average productivities[1] of labor and capital of .55 and 8.7 respectively, exceed the actually observed corresponding productivities of .39 and 6.8. These divergencies therefore require policies that are directed towards raising the productivities of resources in the small scale industrial subsector.

Although the predicted resource productivities exceed the actually observed data, the patterns of variation in industrial and locational resource utilizations remain the same for both the predicted results and observed data. For example, over 50 percent of small scale establishments are tailors and over 80 percent of these small establishments are located in rural areas, i.e., localities with less than 2,000 people. In agreement with observed data, the model predicted industrial and locational variations in regard to patterns of resource utilization. Thus, while the tailoring

[1]The productivity coefficients were computed from the aggregate results of Tables 6.3, 6.4, and 6.5.

industry alone contributed 44 percent of the total labor services utilized by the five major small scale industries, 49 percent of such labor services are also located in the rural areas. Also, whereas apprentice and hired labor types dominate total labor use in the carpentry and bakery industries respectively, proprietor family labor is the most important labor type in the gara dyeing industry. In addition, while the proprietor and family labor are the most important labor types utilized in region IV, apprentice labor dominates the proprietor/family and hired labor types in regions I, II and III. The preponderance of apprentice labor in large and small urban areas of Sierra Leone calls attention to the need for an evalutation of the apprenticeship system as a major vehicle for skill formation in small scale industry.

The model predicted that the relative scarcity of labor resource varies by region. Thus, labor is more constraining in regions II and III, as compared to regions I and IV, due to different rates of net migration among the regions. Therefore, the MVPs of labor in regions II and III exceed the observed wages specified in the model. In regions I and IV, the MVPs of labor equaled wage specifications. Since the model predicted zero MVPs for capital services in all industries, capital is considered a nonlimiting resource among Sierra Leone small scale industries. This result collaborates with an earlier regression analysis result which indicated that business success was negatively correlated with the level of initial capital [Liedholm and Chuta, 1976].

With respect to domestic trade, intraregional trade, which accounts for 92 percent of total regional production, far exceeds

the level of interregional trade. However, the products which dominate intraregional trade, as predicted by the model, are gara cloth and blacksmithing products, followed by carpentry and bakery products. The principle of comparative cost advantage has been utilized to explain the patterns of trade flows.

The composition of costs included in the determination of regional comparative advantages includes costs of labor, capital and material inputs as shown in Table 6.10. On the basis of such cost comparisons, region I possesses absolute disadvantages in producing each of the five major small scale industry products. Such cost disadvantages are mainly due to high building rentals, wages and electricity charges. On the other hand, region II has absolute advantages in producing most of the products of small scale industries. Such absolute advantages are mainly due to the use of cheap apprentice labor. In spite of such absolute disadvantages and advantages of regions I and III respectively, production and distribution of the products of small scale industries is based on comparative, not absolute cost advantages. In situations where two regions have the same comparative advantage in producing the same output, transportation costs played a major role in determining which region produced and distributed to other regions. One significant outcome of this analysis of comparative advantage is that the cost disadvantages of the firms in region I, the capital territory of Sierra Leone, are exogenous to those firms. This circumstance therefore calls for policy interventions that will reduce the high wages, rental and electrictiy charges of urban firms.

The industries most affected by the foreign trade section and

whose foreign trade patterns deviated from observed data are gara dyeing and blacksmithing industries. Thus, the predicted increases in gara dyeing exports and blacksmithing imports exceed actually observed data. Nevertheless, the model indicates that if a ready market was available, it was profitable to produce gara cloth for exports. In addition, the increased imports of blacksmithing products, indicate that foreign sources of those products are cheaper than some domestic sources.

# CHAPTER 7

# SHORT RUN POLICY ANALYSIS

## 7.1 Introduction

In the last chapter an attempt was made to compare the results of the model base run with actually observed data in order to evaluate the efficiency of resource utilization among small scale industries. In this chapter, sensitivity analysis will be undertaken to test the short run effects of changes in some policy variables on techniques of production, output, employment, profits and the directions of both foreign and domestic trade of the small scale industrial subsector in Sierra Leone. The "short run" period referred to in this thesis is a period of one or two years. Such a short run situation is forced to be effective in the model by the use of flexibility constraints. These constraints impose upper and lower limits on the number of representative firm types as was observed in the 1974/75 survey period. Thus, within such narrow limits of $\pm$ 10 percent, there is not enough flexibility for any long run adjustments.

## 7.2 Policy Variables

The policy variables include interest rates on capital, the levels of capacity utilization, effective demand and import duties on both intermediate inputs and some categories of final products

(competing imports).

In order to analyze the effects of different levels of interest rate, the capital coefficients were computed at 10 percent, 20 percent and 35 percent rates of interest as previously shown in Tables 4.6 - 4.9. If there are possibilities of factor substitution among small scale industries, one would expect that raising the rate of interest from 10 percent to 35 percent (price of labor remaining constant), would progressively increase the cost of capital, especially to those firms which employ capital-intensive techniques of production. An increase in the cost of capital would imply that costs can be lowered by moving to a new point on the same isoquant, so that more of the relatively cheaper labor-intensive techniques of production would be utilized. The ultimate result would mean increases in employment of labor services.

Tables 4.6 - 4.9 also show the different rates of excess capacity observed for the different representative firm types. The estimation of excess capacity is based on the difference between the number of hours each firm actually worked everyday and the maximum number of hours each firm thought it could work given its existing buildings, equipments and furniture and had no demand limitations. On the basis of such information, coefficients at 100 percent capacity utilization were recomputed for labor, output and material input costs as shown in Tables 4.6 - 4.9. It is assumed here than any increases in capacity utilization will generate proportional changes in labor utilizations, output and material input costs. Thus, although output-labor ratios remain constant (since both output and labor coefficients change in the same proportion), output-capital

ratios (capital productivities) increase due to higher rates of capacity utilization. In order to justify increases in the rate of capacity utilization in the model, regional demand coefficients have been increased also, by the regional average level of excess capacity observed for each industry [Liedholm and Chuta, 1976, p. 31].

If we assume that import duties on imported intermediate inputs constitute additional costs to small entreprenuers, then goverment policies that grant import rebates on imported raw materials would have the effect of reducing the costs of imported inputs, thus rendering small businesses more profitable. As was pointed out earlier in this thesis,[1] Sierra Leone small scale industries utilize imported raw materials, either directly or indirectly. The amount of imported raw materials varies, of course, from industry to industry. If we also assume that high tariffs on relatively cheap imported final products that compete with products of small scale industry, protect the small scale industries from declining, then policies that raise the tariffs on imported final products would tend to cause domestic production to be substituted for foreign imports. Such policies would therefore tend to encourage the utilization of domestic resources, thus increasing output and employment.

In order to examine the short run effects of certain trade policies on employment, output, domestic and foreign trade patterns and profits of the small scale industries, it was necessary to change the material input and import coefficients that were used for the initial run of the model. The alteration in the material input

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[1] See pages 69-73.

coefficients was made on the representative firm basis, in order to take into account the regional location of the firm type, the scale of operation, the variations in input combination, the various import content[1] of material input coefficient and the level of import duty that applies to the relevant component of the import content of the coefficient. Import duty rebates would necessarily reduce the value of the material input coefficient. The reductions were greatest for gara dyeing and least for blacksmithing industries. The reductions were also high for bakery since quota imports of wheat flour for the confectionary industry in Sierra Leone revealed an implicit tariff of about 167 percent on wheat flour.[2] In the model, imported final products were placed at a competitive disadvantage in the domestic market, by doubling the tariff import duties on the relevant 5-digit S.I.T.C.[3] products. Thus, import duty on imported tailoring and blacksmithing products were increased from 40 percent to 80 percent and from 2 3/4 percent to 6 percent respectively.

## 7.3 Policy Analysis with a Closed Model

Since most analytical research on the possibilities of labor-capital substitution and effects of different levels of capacity utilization have been undertaken within the framework of the classical and neoclassical production function [Arrow et al., 1961; Winston, 1974], it will be important to verify the differential impact

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[1] Import content here refers to the percentage of the total material input purchased items originating from outside Sierra Leone.

[2] See page 71.

[3] See page 111.

of foreign trade on the sensitivity analysis. Thus, the short run policy analysis that will be undertaken in this chapter will be undertaken both in a closed model (without foreign trade) and in an open model (with foreign trade). The results of the policy analysis with the colsed model will now be presented.

## 7.4 Results of the Short Run Policy Analysis with the Closed Model

### 7.4.1 Effects of Levels of Interest Rate

Table 7.1 reveals that at the existing levels of capacity utilization, increasing the rate of interest on capital from 10 percent to 35 percnet did not change the level of output, given the level of aggregate demand for the products of small scale industries. However, the quantity of labor services utilized increased from 24,903,010 hours to 25,056,401. Although employment of labor services increased at higher rates of interest rate, the elasticities of employment with respect to the rate of interest are .6, zero and .24[1] between the ranges of 10-20 percent, 20-35 percent and 10-35 percent rates of interest respectively. Table 7.1 also reveals that as the rate of interest was raised from 10 percent to 35 percent, subsector profits declined from Le 5,174,714 to Le 4,072,066. Thus the profit elasticity of interest rate over the 10 percent to 35 percent range of interest rate is -1.4. It can be concluded that while a one percentage increase in the rate of interest leads to

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[1]The elasticity coefficients have been computed from Table 7.1. The formula used to compute the coefficients is:

$$\text{Employment elasticity of the rate of interest} = \frac{\text{percentage change in labor services}}{\text{percentage change in the rate of interest}}$$

a less than one percent increase in employment, profits decline by a greater than one percent increase in the rate of interest.

Table 7.1 Predicted Aggregate Gross Output Values, Labor and Capital Services Utilization and Profits at Different Policy Levels for the Closed Model,[a] 1974/75

| Policy Variable | Gross Output Values (leones) | Labor Services (hours) | Capital Services (leones) | Profits (leones) |
|---|---|---|---|---|
| 1. Existing capacity utilization 10% rate of interest | 13,784,399 | 24,903,010 | 1,282,649 | 5,174,714 |
| 2. Existing capacity utilization 20% rate of interest (base run) | 13,784,399 | 25,051,310 | 1,598,074 | 4,864,787 |
| 3. Existing capacity utilization 35% rate of interest | 13,784,399 | 25,056,401 | 2,389,475 | 4,072,066 |
| 4. 100% capacity Utilization 20% rate of interest | 14,325,802 | 25,782,742 | 1,469,772 | 4,972,663 |

[a]In the linear programming closed model, both labor and capital services were absolutely uncontstrained. Thus, it was possible to verify the extent, if any, of labor-capital substitution possibilities, in the absence of competing imports.

### 7.4.2 The Effects of Level of Capacity Utilization

The effect of a higher level of capacity utilization with the closed model can be seen by comparing the results of policy variables (2) and (4) in Table 7.1. By enabling the small scale industralists to operate at 100 percent capacity utilization through an increase in the effective demand for their products, output values, labor services and profits increased from Le 13,784,399 to Le 14,325,802, 25,051,310

hours to 25,782,742 hours and Le 4,864,787 to Le 4,972,663 respectively. Thus output values, labor services and profits increased by 4 percent, 3 percent and 2 percent respectively. In addition to the gains in output, employment and profits, an 8 percent savings in capital services occurred, due to a higher level of capacity utilization.[1]

## 7.5 Results of the Short Run Policy Analysis With an Open Model

In this section, the results of the short run policy analysis with the open model will be presented. Discussions will include the effects of changes in the rate of interest, levels of capacity utilization, and certain trade policies on the small scale industrial subsector. At the end of this chapter, an attempt will be made to summarize the significant results of the analyses with the closed and open models.

## 7.6 The Effects of Changing the Rate of Interest on Output, Employment, Profits and Trade Patterns

### 7.6.1 The Number of Firms and Choice of Production Technique

As Tables 7.2 and 7.3 reveal, the sensitivity of firm numbers to changes in interest rate of 20 percent and 35 percent varies by industry and by location. With respect to firm numbers, Table 7.3 shows that the tailoring industry in region IV has the greatest decline in firm numbers (62 percent fall), followed by blacksmithing industries in regions III and IV with declines of 54 percent and 20 percent respectively, and tailoring industry in region I, with a

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[1] Computed from the capital services data of Table 7.1.

Table 7.2 Predicted Number of Firms at Different Levels of Interest Rate by Industry and Region, 1974/75

Region I (Localities with over 100,000)

| Industry and firm type / Level of Interest rate | Tailoring | | | Gara dyeing | | | Carpentry | | Blacksmithing | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|
| | P111 | P112 | P113 | P311 | P312 | P313 | P411 | P412 | P511 | P811 |
| 10% and 20% | 565 | 153 | 179 | 3 | 18 | 1 | 62 | 21 | 12 | 12 |
| 35% | 463 | 125 | 166 | 3 | 18 | 1 | 62 | 20 | 11 | 11 |

Region II (Localities with 20,000-100,000)

| Industry and firm type / Level of Interest rate | Tailoring | | | | Gara dyeing | | | Carpentry | | | Blacksmithing | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P121 | P122 | P123 | P124 | P321 | P322 | P323 | P421 | P422 | P423 | P521 | P522 | P821 | P822 | P823 |
| 10% and 20% | 152 | 296 | 123 | 101 | 11 | 11 | 67 | 55 | 56 | 33 | 13 | 0 | 5 | 1 | 9 |
| 35% | 124 | 337 | 123 | 96 | 11 | 11 | 67 | 55 | 56 | 31 | 13 | 0 | 5 | 1 | 9 |

Region III (Localities with 2,000-20,000)

| Industry and firm type / Level of Interest rate | Tailoring | | | | Gara dyeing | Carpentry | | | Blacksmithing | | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | P131 | P132 | P133 | P134 | P331 | P431 | P432 | P433 | P531 | P532 | P831 |
| 10% and 20% | 89 | 580 | 267 | 178 | 246 | 170 | 197 | 1 | 72 | 23 | 132 |
| 35% | 89 | 580 | 267 | 178 | 241 | 179 | 197 | 1 | 20 | 23 | 158 |

Region IV (Localities with less than 2,000)

| Industry and firm type / Level of Interest rate | Tailoring | | | Carpentry | | | Blacksmithing | | |
|---|---|---|---|---|---|---|---|---|---|
| | P141 | P142 | P143 | P441 | P442 | P443 | P541 | P542 | P543 |
| 10% and 20% | 1144 | 10354 | 837 | 1565 | 1333 | 1333 | 1513 | 3025 | 1513 |
| 35% | 1144 | 2646 | 837 | 1565 | 1333 | 1333 | 1513 | 2200 | 1100 |

decline in firm numbers of about 16 percent. The only industries that showed increases in firm numbers are carpentry and bakery industries in region III with percentage increases of 2.4 percent and 20 percent respectively, and tailoring industry of region II where the number of tailors rose by 1 percent. Some industries in certain locations did not change in firm numbers as shown in Table 7.3.

Table 7.3 Predicted Magnitude and Direction of Change in Firm Numbers by Industry and Location, Resulting from a Rise in the Rate of Interest from 20 Percent to 35 Percent, 1974/75

| | Tailoring | Gara Dyeing | Carpentry | Black-smithing | Bakery |
|---|---|---|---|---|---|
| Region I | 16% fall | No change | 1% fall | 8% fall | 8% fall |
| Region II | 1% rise | No change | 1% fall | No change | No change |
| Region III | No change | 2% fall | 2.4% rise | 54% fall | 20% rise |
| Region IV | 62% fall | - | No change | 20% fall | - |

In the tailoring industry, the 16 percent and 62 percent declines in regions I and IV are due mainly to the low output-capital and labor-capital ratios of the firm types in those two regions as shown in Table 4.10. In region I, the number of firm types P111 and P112, (modern capital intensive embroidery firms) fell to their minimum levels due to very low productivity of capital among those firms. Likewise, regions IV tailoring firm types (P142, P143), though traditional firms, fell to their minimum levels owing to low capital productivity. But, although, the number of firms in region II rose by 1 percent, it will be noticed that the number of

tailoring firm type, P124, declined by 5 percent while the number of tailoring firm type, P122, increased by 14 percent as shown in Table 5.1. As is revealed in Table 4.10, firm P124 is a modern tailoring firm, having the lowest output-capital and labor-capital ratios in the region, while P122 is a traditional tailoring firm with the highest output-capital and labor-capital ratios.

In the blacksmithing industry, the greatest declines in firm numbers occurred among firm types with low output-capital and labor-capital ratios. For example the firm types P511, P522, P531, P542, P543, declined in numbers due to their relative inefficiencies as revealed in Tables 4.10 and 7.3. In region IV where the number of blacksmiths fell by 20 percent, the number of P541 firm type, which has a relatively high output-capital ratio, increased to their maximum level allowed in the program.

While no substantial changes in firm numbers occurred in the gara dyeing and carpentry industries, the bakery industry of region III experienced a 20 percent increase in firm numbers as revealed in Tables 7.2 and 7.3. The explanation for the substantial increase in the number of traditional bakers in region III is the high capital productivity of the traditional bakery firm type, P831, as shown in Table 4.10. Thus, whereas the number of modern, capital-intensive, bakery firm types, P811, declined by 8 percent due to a 15 percent change in interest rate, the traditional labor-intensive firm type, P831 increased by 20 percent.

It can be concluded that a change of interest rate from 20 percent to 35 percent resulted to the increase in the number of traditional firms and a decline in the number of the modern capital

intensive ones. But, the result of the analysis also shows that traditional firms with low output-capital ratios also declined in number.[1]

7.6.2 Output and Employment

If one assumes that capital is the scarce factor of production in most developing countries, then an increase in the price of capital would result in a substitution of labor intensive production process for the capital intensive one, so that on the aggregate, employment should increase. Such an increase in employment has not resulted from the sensitivity analysis.[2] As Tables 7.4 and 7.5 reveal, an increase of the rate of interest from 10 percent to 20 percent had no effect on either employment or output of the small scale industry sector. A further increase of the rate of interest from 20 percent to 35 percent, led to declines of 21 percent and 18 percent on subsector aggregate output and employment. In fact, as employment declined by 18 percent, the level of capital services utilized increased by 13 percent owing to the increase in the rate of interest.

Although both aggregate output and employment declined due to a change of the rate of interest from 20 percent to 35 percent, the

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[1]This would indicate that productivity is not only a function of factor proportions, but also a function of other variables like management, quality of resource, level of capacity utilization, etc.

[2]Since the capital variable is measured as the value of annual capital services in the model (see pp. 38-44), the picture of labor-capital substitution possibility is distorted. Increases in the rate of interest are simply reflected in increases in the value of capital services utilized. Therefore, the model is incapable of revealing how much physical capital is substituted for by labor services due to increases in the rate of interest.

Table 7.4 Predicted Gross Output, Labor and Capital Services Utilizations at Different Levels of Interest Rate by Industry and Location, 1974/75

| Region | Level of Interest Rate | Tailoring | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | | Bakery | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | O | L | K | O | L | K | O | L | K | O | L | K | O | L | K | O | L | K |
| I | 10% | 1,323,399 | 2,618,203 | 209,076 | 168,475 | 35,560 | 1,302 | 482,486 | 1,278,923 | 34,033 | 12,588 | 15,248 | 5,419 | 1,422,828 | 625,895 | 62,484 | 3,409,776 | 4,573,829 | 312,314 |
| | 20% | 1,323,399 | 2,618,203 | 233,046 | 168,475 | 35,560 | 2,070 | 482,486 | 1,278,923 | 44,238 | 12,588 | 15,248 | 6,893 | 1,422,828 | 625,895 | 86,299 | 3,409,776 | 4,573,829 | 372,546 |
| | 35% | 1,147,528 | 2,281,666 | 233,141 | 168,475 | 35,560 | 3,294 | 472,994 | 1,274,142 | 60,230 | 11,088 | 13,431 | 8,096 | 1,304,259 | 601,574 | 120,827 | 3,104,344 | 4,206,373 | 425,588 |
| II | 10% | 791,050 | 930,167 | 76,124 | 322,371 | 164,134 | 2,421 | 1,235,493 | 1,693,827 | 60,943 | 12,675 | 27,911 | 1,547 | 236,253 | 98,099 | 35,733 | 2,597,842 | 2,914,138 | 176,768 |
| | 20% | 791,050 | 930,167 | 89,600 | 322,371 | 164,134 | 4,374 | 1,235,493 | 1,693,827 | 86,938 | 12,675 | 27,911 | 1,560 | 236,253 | 98,099 | 36,058 | 2,597,842 | 2,914,138 | 218,530 |
| | 35% | 793,189 | 947,056 | 113,135 | 322,371 | 164,134 | 7,759 | 1,216,501 | 1,682,616 | 123,679 | 12,675 | 27,911 | 1,859 | 236,253 | 98,099 | 54,254 | 2,580,989 | 2,919,816 | 300,686 |
| III | 10% | 623,261 | 1,219,308 | 57,655 | 588,245 | 309,019 | 2,462 | 1,113,068 | 2,668,799 | 29,318 | 117,763 | 304,152 | 6,980 | 289,310 | 268,086 | 8,224 | 3,731,647 | 4,769,364 | 104,639 |
| | 20% | 623,261 | 1,219,308 | 69,550 | 588,245 | 309,019 | 3,939 | 1,113,068 | 2,668,799 | 59,590 | 117,763 | 304,152 | 11,772 | 289,310 | 268,086 | 11,142 | 3,731,647 | 4,769,364 | 155,993 |
| | 35% | 623,261 | 1,219,308 | 90,495 | 575,749 | 302,824 | 7,238 | 1,141,794 | 2,761,014 | 96,915 | 45,170 | 149,773 | 4,761 | 344,598 | 319,318 | 15,168 | 2,730,572 | 4,752,237 | 214,577 |
| IV | 10% | 2,856,016 | 5,937,289 | 334,560 | | | | 347,898 | 1,312,066 | 132,214 | 1,458,268 | 4,748,536 | 170,939 | | | | 4,662,182 | 11,997,891 | 637,713 |
| | 20% | 2,856,016 | 5,937,289 | 386,716 | | | | 347,898 | 1,312,066 | 183,435 | 1,458,268 | 4,748,536 | 229,935 | | | | 4,662,182 | 11,997,891 | 800,086 |
| | 35% | 1,360,599 | 2,568,654 | 252,026 | | | | 347,898 | 1,312,066 | 281,292 | 1,199,994 | 4,067,031 | 266,768 | | | | 2,908,491 | 7,947,751 | 800,086 |
| Total | 10% | 5,593,726 | 10,704,967 | 677,415 | 1,079,091 | 508,513 | 6,185 | 3,178,945 | 6,953,615 | 256,508 | 1,601,294 | 4,791,695 | 184,885 | 1,948,391 | 992,080 | 106,441 | 14,401,447 | 24,255,222 | 1,231,434 |
| | 20% | 5,593,726 | 10,704,967 | 778,912 | 1,079,091 | 508,513 | 10,383 | 3,178,945 | 6,953,615 | 374,201 | 1,601,294 | 4,791,695 | 250,160 | 1,948,391 | 992,080 | 133,499 | 14,401,447 | 24,255,222 | 1,547,155 |
| | 35% | 3,924,577 | 7,016,684 | 688,797 | 1,066,595 | 502,519 | 18,291 | 3,179,187 | 7,029,838 | 562,116 | 1,268,927 | 4,258,146 | 281,484 | 1,885,110 | 1,018,991 | 190,249 | 11,324,396 | 19,826,177 | 1,740,937 |
| | Percentage Changes Between 20% and 35% | 3% Fall | 35% Fall | 12% Fall | 1% Fall | 1% Fall | 76% Rise | Negligible Rise | 1% Rise | 50% Rise | 21% Fall | 11% Fall | 13% Rise | 3% Fall | 3% Rise | 43% Rise | 21% Fall | 18% Fall | 13% Rise |

Note O = total value of output in Leones
L = total hours of labor services input
K = total value of capital services input in Leones

effects of such a change vary by industry and location. The industry that shows the greatest decline (21 percent) in value of output is the blacksmithing industry as shown in Tables 7.4 and 7.5. Such a decline is due not only to the relative inefficiencies of blacksmithing firm types in regions I, II and IV but also due to the competitive advnatage of the foreign imported blacksmithing products over the locally produced items. The percentage declines in the values of output of the other industries are not substantial. On the whole, both output and employment declined in the tailoring, gara dyeing and blacksmithing industries; both rose in the carpentry industry; but while output rose in the bakery industry, employment declined as Table 7.4 shows.

Table 7.5 Predicted Changes in Output, Labor and Capital Services Utilization Resulting from Increasing the Rate of Interest by Region, 1974/75

| | ΔO | ΔL | ΔK |
|---|---|---|---|
| Region I | 9% Fall | 8% Fall | 14% Rise |
| Region II | 6% Fall | .2% Rise | 38% Rise |
| RegionIII | 46% Fall | .4% Fall | 38% Rise |
| Region IV | 38% Fall | 34% Fall | No Change |

Note: ΔO = change in the Leone value of output
ΔL = change in the hours of labor services
ΔK = change in the Leone value of capital services

Table 7.5 also reveals declines in output values, and employment for regions I, III and IV. But whereas regions III shows the greatest declines in output values, region IV shows the greatest

decline in employment. According to Table 7.3, regions III and IV, experienced the greatest declines in firm numbers due to a 15 percent change of interest rate on capital. But a closer examination of regional variations in changes in output and employment reveals that in region II while output declined by 6 percent, employment rose by an insignificant .2 percent.

### 7.6.3 Output-Employment Tradeoffs

A tradeoff between output and employment is predicted for the bakery industry. A closer examination of the bakery industry in Table 7.4 reveals that on the aggregate, output values declined by 3 percent while employment increased by 3 percent, given a 15 percent change in the rate of interest. A further examination of the bakery industries of regions I and II will throw some light on the changes predicted at the aggregate level. In region I bakery output fell by 8 percent and employment declined by 4 percent, in region III both output values and employment rose by 19 percent respectively. While a high interest rate led to a greater percentage decline in output than in employment with a modern capital intensive bakery firm, the same percentage change in interest rate led to equal percentage increases in both output and employment with a traditional labor intensive bakery firm type. On the aggregate, the net effect was a decline in output value and a rise in employment. It should be recalled from Table 4.10 that whereas the representative type bakery firm, P811, in region I, has a high output-capital ratio of 16.5 and a very low labor-capital ratio of 7.2, the representative firm type, P831, in region III, has both a higher

output-capital ratio (26.0) and a high labor-capital ratio (23.6). But, if it is remembered that the modern bakery firms in region I control 70 percent of the predicted total value of bread output in Sierra Leone,[1] it will not be surprising that an 8 percent fall in the number of modern bakery firms in region I should have a great impact on total bread output value, hence the trade-off.

In conclusion, although an increase in the rate of interest from 10 percent to 20 percent, had no impact in the open model, a further increase from 20 percent to 35 percent rate of interest had far reaching effects. The analysis also suggests that an increase in the price of capital from 20 percent to 35 percent has differential impacts on industries and locations. Among the industries which produce tradeable goods, like tailoring, gara dyeing and blacksmithing, both output and employment fell. This indicates that foreign trade could have some effects on the results that are to be expected from domestic policy actions. In the bakery industry, there was a tradeoff between output and employment. Thus, as output fell by 3 percent, employment rose by 3 percent.

### 7.6.4 Profits and Trade Patterns

As Table 7.6 shows, the aggregate profits of the small scale industry subsector continuously declined as the rate of interest on capital was changed from 10 percent to 35 percent. Thus, an initial 10 percent change in interest rate led to a decline in profits by 9 percent while a further increase of interest rate from 20 percent to 35 percent, brought about a profit decline of about

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[1] Computed from Table 7.4

130 percent.

Table 7.6 Predicted Patterns of Subsector Profits and Foreign Trade at Different Levels of Interest Rates, 1974/75

| Interest Rate | Profits | Tailoring Imports | Blacksmiths Imports | Gara Exports |
|---|---|---|---|---|
| 10% | 3,764,713 | 792,476 | 75,552 | 485,911 |
| 20% | 3,434,122 | 792,476 | 75,552 | 485,911 |
| 35% | -930,405 | 2,495,813 | 404,408 | 475,117 |
| Percnetage changes between 20% and 35% | 137% Fall | 210% Rise | 435% Rise | 2% Fall |

With respect to trade patterns, since the same production patterns were predicted for the interest rates of 10 percent and 20 percent, foreign exports, foreign imports and domestic trade patterns remained the same at the interest rates of 10 percent and 20 percent. But, a change of interest rate from 20 percent to 35 percent, resulted in a reduction of gara exports by a two percent, and substantial increases of the relatively lower cost tailoring and blacksmithing imports by 210 percent and 435 percent respectively. Such increased importation of tailoring and blacksmithing output helped to fill the domestic demand for the products of those industries where domestic production declined as a result of changing the interest rate from 20 percnet to 35 percent.

### 7.6.5 Elasticity Coefficients

As a result of the predicted percentage changes in value of output, labor and capital services utilization and profits, some meaningful elasticity coefficients can be computed, given the relevant percentage change in the rate of interest. Thus, it will be possible to estimate the magnitude of change in a policy variable, given a one percentage change in the rate of interest, (over the interest rate range of 20 percent and 35 percent). Since our aggregate data on Table 7.6 reveals that changing the interest rate from 20 percent to 35 percent led to a decline of output, employment and profits by 21 percent, 18 percent and 130 percent respectively and an increase in the value of capital services utilized by 13 percent, the elasticity of output, employment, profits and capital, given a one percent increase in the rate of interest, over the relevant range of interest rate, (20-35 percent), becomes -1.4, -1.2, -8.7 and .9 respectively. Thus, the greatest adverse impact of the change in interest rate is on profits, followed by output and employment. It is important also to note that whereas the elasticity of profits with respect to interest rates is -8.7 over the 20-35 percent range of interest rate, the elasticity of profit coefficient is only -.6 over a lower range of interest rate, i.e., 10-20 percent.

## 7.7 The Effects of Level of Capacity Utilization on Output, Employment and Resource Productivities

### 7.7.1 Choice of Production Technique

In general, the firm types which experienced the greatest decline in numbers were mostly capital intensive firms such as P411, P511, P811, P522, P321, P124, and P134 as shown in Table 7.7. These

Table 7.7 Predicted Number of Firms at Different Levels of Capacity Utilization by Industry and Location, 1974/75

Region I (Localities over 100,000)

| Industrial Firm Type / Level of Capacity Utilization | Tailoring | | | Gara Dyeing | | | Carpentry | | Blacksmithing | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|
| | P111 | P112 | P113 | P311 | P312 | P313 | P411 | P412 | P511 | P811 |
| Existing | 565 | 153 | 179 | 3 | 18 | 1 | 62 | 21 | 12 | 12 |
| 100% | 463 | 125 | 147 | 3 | 18 | 1 | 50 | 17 | 11 | 9 |

Region II (Localities - 20,000-100,000)

| Industrial Firm Type / Level of Capacity Utilization | Tailoring | | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P121 | P122 | P123 | P124 | P321 | P322 | P323 | P421 | P422 | P423 | P521 | P522 | P821 | P822 | P823 |
| Existing | 152 | 296 | 123 | 101 | 11 | 11 | 67 | 55 | 56 | 33 | 13 | 0 | 5 | 1 | 9 |
| 100% | 124 | 284 | 101 | 83 | 11 | 11 | 67 | 53 | 29 | 37 | 13 | 1 | 7 | 1 | 9 |

Region III (Localities - 2,000-20,000)

| Industrial Firm Type / Level of Capacity Utilization | Tailoring | | | | Gara Dyeing | Carpentry | | | Blacksmithing | | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | P131 | P132 | P133 | P134 | P331 | P431 | P432 | P433 | P531 | P532 | P831 |
| Existing | 89 | 580 | 267 | 178 | 246 | 170 | 197 | 1 | 72 | 23 | 132 |
| 100% | 89 | 580 | 267 | 0 | 65 | 147 | 197 | 1 | 0 | 23 | 140 |

Region IV (Localities - less than 2,000)

| Industrial Firm Type / Level of Capacity Utilization | Tailoring | | | Carpentry | | | Blacksmithing | | |
|---|---|---|---|---|---|---|---|---|---|
| | P141 | P142 | P143 | P441 | P442 | P443 | P541 | P542 | P543 |
| Existing | 1144 | 10354 | 837 | 1565 | 1333 | 1333 | 1513 | 3025 | 1513 |

firms, as Table 7.9 reveals, have very low output-capital ratios even at both levels of capacity utilization. It can thus be said that high rates of capacity utilization favors those firms with initial high output-capital ratios. Hence, high rates of capacity utilization has adverse effects even on traditional firms, which though having high rates of increases in capital productivity due to increases in capacity utilization, have very low initial levels of capital productivity. Examples of such traditional firm types are P412, P422, P431 and P531 as shown in Tables 7.7 and 7.9.

### 7.7.2 Number of Firms

In the shortrun, the effect of increased rate of capacity utilization on the number of firms is an overall decline of 18 percent as shown in Table 7.8. However, the rates of decline also vary by

Table 7.8 Predicted Changes in the Number of Firms at 100 Percent Level of Capacity Utilization by Industry and Region, 1974/75

| | Tailoring | Gara Dyeing | Carpentry | Black-smithing | Bakery | Average Decline by Region |
|---|---|---|---|---|---|---|
| Region I | 18% fall | no change | 19% fall | 31% fall | 25% fall | 17% |
| Region II | 12% fall | no change | 17% fall | 8% rise | 13% rise | 2% |
| Region III | 16% fall | 74% fall | 6% fall | 76% fall | 6% rise | 33% |
| Average Decline by Industry | 15% | 25% | 14% | 33% | 6% | 18% |

Table 7.9 Predicted Changes in Capital Productivities Due to Different Capacity Utilization Levels, 1974/75

Region I

| Industrial Firm Type / Variable | Tailoring | | | Gara Dyeing | | | Carpentry | | Blacksmithing | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|
| | P111 | P112 | P113 | P131 | P132 | P133 | P141 | P142 | P151 | P181 |
| O/K at Existing Level of Capacity Utilization | 4 | 3 | 14 | 25 | 112 | 184 | 13 | 9 | 2 | 17 |
| O/K at 10% Level | 5 | 4 | 18 | 29 | 112 | 216 | 13 | 11 | 2 | 23 |
| Percentage Change | 25% | 33% | 25% | 16% | 0% | 17% | 0% | 22% | 0% | 35% |

Region II

| Industrial Firm Type / Variable | Tailoring | | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P211 | P212 | P213 | P214 | P231 | P232 | P233 | P241 | P242 | P243 | P251 | P252 | P281 | P282 | P283 |
| O/K at Existing Level of Capacity Utilization | 6 | 13 | 10 | 7 | 25 | 105 | 184 | 43 | 40 | 5 | 8 | 1 | 5 | 31 | 44 |
| O/K at 100% Level | 8 | 18 | 14 | 11 | 29 | 123 | 216 | 62 | 40 | 6 | 10 | 1 | 7 | 31 | 54 |
| Percentage Change | 33% | 38% | 40% | 57% | 16% | 17% | 17% | 44% | 0% | 20% | 25% | 0% | 40% | 0% | 23% |

Region III

| Industrial Firm Type / Variable | Tailoring | | | | Gara Dyeing | Carpentry | | | Blacksmithing | | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | P311 | P312 | P313 | P314 | P331 | P341 | P342 | P343 | P351 | P352 | P381 |
| O/K at Existing Level of Capacity Utilization | 4 | 10 | 12 | 6 | 149 | 10 | 76 | 57 | 9 | 21 | 26 |
| O/K at 100% Level | 8 | 16 | 16 | 10 | 172 | 12 | 87 | 67 | 12 | 27 | 37 |
| Percentage Change | 50% | 60% | 33% | 67% | 15% | 20% | 14% | 18% | 33% | 29% | 42% |

industry and location. Whereas, the gara dyeing and blacksmithing industries show the highest rates of decline, tailoring, carpentry and bakery industries show the least declines. Table 7.8 also reveals that region III showed the greatest decline in the number of firms, followed by region I with a decline of 7 percent. Region II showed the least decline.

In order to explain the predicted patterns of decline in firm numbers by industry and location, it is necessary to more closely examine Table 7.9. It will be discovered from Table 7.9 that both gara dyeing and blacksmithing firms showed the least percentage increases in capital productivities when compared with tailors or bakers, for example. In the three regions, the range of increases in capital productivities for gara firms is 15-17 percent and 0-33 percent for the blacksmithing firms. For the tailoring firms, the rates of increases in capital productivities range between 25-33 percent for region I, 33-57 percent for region II and 33-67 percent for region III. While in the bakery industry the rates of capital productivity increases is 35 percent for region I, 23-40 percent for region II and 42 percent for region III, such rates in the carpentry industry are still higher than the rates computed for gara and blacksmithing industries. Thus, it can be said that the rates of increases in capital productivities were important in determining the rates at which industrial firms declined.

### 7.7.3 Output and Employment

Another significant result of the sensitivity analysis which also stands contrary to existing theoretical postulate relates to

the effect of high rates of capacity utilization on output and employment. One would expect that any increases in the level of capacity utilization will bring about increases in aggregate output and also employment [Winston, 1971]. The result of the sensitivity analysis reveals that with an increase in the rate of capacity utilization, both output and employment declined by .4 percent and .8 percent respectively as shown in Table 7.10. However, some variations by industry in output and employment do also occur. As has already been mentioned, increases in output and employment occurred both in tailoring and bakery industries. Output and employment in the tailoring industry increased by 7 percent and 5 percent respectively while in the bakery industry increases in output and employment of about .4 percent and 8 percent were predicted. In the gara dyeing industry, output and employment declined by 45 percent and 46 percent respectively while in the blacksmithing industry, output and employment also declined by 6 percent and 4 percent respectively.

It can also be concluded that an increase in the level of capacity utilization has the effect of increasing the capital productivities of all the production processes. But, the industries which suffer a decline in firm numbers are those which originally operated at near the level of full capacity. In such industries, the gain in increased capital productivities resulting from the higher rate of capacity utilization is minimal. Also the production process types which decline more in number are those which originally had a relatively low level of output-capital ratio, irrespective of whether such production process types are modern or traditional.

Table 7.10 Predicted Output Values, Labor and Capital Utilization at Different Levels of Capacity Utilization by Industry and Region, 1974/75

| Region | Level of Capacity Utilization | Tailoring | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | | Bakery | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | O | L | K | O | L | K | O | L | K | O | L | K | O | L | K | O | L | K |
| I | Existing | 1,323,399 | 1,618,203 | 209,076 | 168,475 | 35,560 | 1,302 | 482,486 | 1,278,923 | 34,033 | 12,588 | 15,248 | 5,419 | 1,422,828 | 625,895 | 62,484 | 3,409,776 | 4,573,829 | 312,314 |
| | 100% | 1,389,446 | 2,746,164 | 190,896 | 140,091 | 37,185 | 1,790 | 267,807 | 1.056,028 | 20,739 | 11,088 | 13,431 | 6,072 | 1,472,625 | 666,489 | 64,164 | 3,281,057 | 4,494,849 | 283,661 |
| II | Existing | 791,050 | 930,167 | 76,124 | 322,371 | 164,134 | 2,421 | 1,235,493 | 1,693,827 | 60,943 | 12,675 | 27,911 | 1,547 | 236,253 | 98,099 | 35,733 | 2,597,842 | 2,914,138 | 176,768 |
| | 100% | 950,868 | 1,120,425 | 75,929 | 292,366 | 192,090 | 1,470 | 1,363,726 | 1,281,569 | 91,632 | 15,847 | 37,009 | 2,580 | 83,949 | 153,419 | 1,938 | 2,706,756 | 3,006,464 | 173,549 |
| III | Existing | 623,261 | 1,219,308 | 57,655 | 588,245 | 309,019 | 2,462 | 1,113,068 | 2,668,799 | 29,318 | 117,763 | 304,152 | 6,980 | 289,310 | 268,086 | 8,224 | 2,731,047 | 4,769,364 | 104,639 |
| | 100% | 791,386 | 1,363,762 | 51,758 | 162,073 | 93,610 | 936 | 1,196,526 | 2,773,955 | 53,319 | 22,425 | 115,529 | 828 | 399,750 | 400,239 | 10,920 | 2,572,160 | 4,769,365 | 117,761 |
| IV | Existing | 2,855,951 | 5,937,289 | 386,716 | | | | 347,823 | 1,336,177 | 157,138 | 1,458,268 | 4,748,536 | 229,935 | | | | 4,662,042 | 12,052,002 | 773,789 |
| Total | Existing | 5,593,661 | 10,704,967 | 729,571 | 1,079,091 | 508,713 | 6,185 | 3,118,870 | 5,641,549 | 281,432 | 1,601,294 | 5,095,847 | 243,881 | 1,948,391 | 992,080 | 106,441 | 13,401,307 | 24,309,333 | 1,367,510 |
| | 100% | 5,987,651 | 11,199,195 | 705,299 | 594,530 | 274,201 | 4,196 | 3,175,882 | 6,859,318 | 322,828 | 1,507,628 | 4,914,505 | 239,415 | 1,956,324 | 1,075,461 | 77,022 | 13,346,201 | 24,102,906 | 1,348,760 |
| Percentage Changes by Industry | | 7% Rise | 5% Rise | 3% Fall | 45% Fall | 46% Fall | 32% Fall | 0% | 22% Rise | 15% Rise | 6% Fall | 4% Fall | 2% Fall | .4% Rise | 8% Rise | 28% Fall | .4% Fall | .8% Fall | 1% Fall |

Although the result of the sensitivity analysis in an open model revealed that both aggregate output values and employment declined, differential impacts of higher levels of captacity utilization on the five major industries is quite noticeable. For example, both output values and employment increased in the tailoring and bakery industires, while both declined in the gara dyeing industry. As was previously pointed out, since all the gara dyeing firms operated near the level of full capacity utilization, they relatively gained less from increased rates of capacity utilization.

## 7.8 The Effects of Trade Policies on Output and Employment

The result of the sensitivity analysis revealed no short run output and employment effects from policies of granting import rebates or increasing the cost of foreign imports of competing final products. But the main impacts of those policies in the short run were reflected on profits.

From the result of the initial run of the model, total material input costs and sectoral profits amounted to Le 4,030,797 and Le 3,434,122 respectively. With the removal of the duties on imported material inputs, material input costs fell to Le 2,510,926 while profits rose to Le 4,953,939. Thus profits increased by the same amounts that costs were reduced. Also, doubling the custom duties on imported final products that compete with domestically produced products did not reduce the value of imports.[1] Rather,

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[1] It has not been possible to incorporate in the model income elasticity coefficients for the competing imports or cross elasticity coefficients of domestically produced items vis-a-vis competing imports. Thus, a horizontal demand curve for foreign imports is assumed here. Due to such weaknesses of the model, the results have to be interpreted with caution.

sectoral profits fell to Le 3,156,224. The extra cost increases were absorbed in the objective function by the optimising scheme, thus indicating that it was still profitable to import those products, even at the high tariff level.

Although the model predicts increased profits due to the granting of import rebates, the output and employment impacts of such policy measures could not be predicted by the model. A respecification of the model to include expenditure and investment decisions of the representative firm types over time will highlight the extent to which sectoral profits could be ploughed back in order to create more output and employment. Other policy measures such as subsidizing the raw material input purchases of small entrepreneurs would have the same effect of increasing profits. On the other hand, the model predicts that policies such as raising tariffs on imported final products may not protect the small industry products in the domestic market. Depending on the income elasticities of demand for foreign imports, foreign products would still be imported only at a high cost and loss of material welfare to consumers.

## 7.9 Summary

The results of the short run policy analysis with the closed model have revealed that a one percent increase in the rate of interest will result in .24 percent increase in employment and 1.4 percent decline in the profits of small scale industries. Also, enabling the small scale industries to operate at full capacity utilization level through an increase in the effective demand for their products resulted in 4 percent, 3 percent, 2 percent and 8

percent gains in output values, employment, profits and capital savings respectively. However, the results of the same analysis carried out in an open model differ from those of a closed model due to the effect of foreign trade.

The results of the short run policy analysis with the open model reveal that competing imports can have a neutralizing effect on domestic policies that are aimed at achieving increased employment through the use of interest rates. Thus, by raising the rate of interest on capital from 20 percent to 35 percent, output values, employment and profits among small scale industries declined by 21 percent, 18 percent and 130 percent respectively. Although, on the aggregate both output and employment declined, the only case of increased employment of labor services occurred in the bakery industry where the number of modern capital-intensive firms declined while the number of traditional firms increased.[1] But the result of this increased employment was a decline in the value of bread output.

The foreign trade sector also has a neutralizing effect on domestic policies that are aimed at raising the level of capacity utilization among small scale industries. Although higher level of capacity utilization increased capital productivities among small scale industries, it in effect altered the comparative advantage configurations of the different small scale industries, given the existing levels of capacity utilization. With inefficient firms still in existance, imports of competing goods displaced some

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[1]The bakery industry of Sierra Leone is the only small scale industry with the most clean-cut distinction between traditional (labor intensive) and modern (capital-intensive) technologies. See Chapter 4 of this thesis.

domestic producers, but subsector output and employment remained almost the same, while the aggretate number of firms declined.

The impacts of a policy of granting customs duty rebates on material inputs had the short run effect of increasing the profits of small scale industralists without any immediate effects on output and employment. The short run analysis also revealed that increasing the level of tariffs on competing imports may not have the immediate effect of causing a substitution of domestic production for foreign importation of competing products.

# CHAPTER 8

# LONG RUN POLICY ANALYSIS WITH AN OPEN MODEL

## 8.1 Introduction

In order to carry out a long run policy analysis on the model, some modifications had to be made on the basic model. First, all the flexibility constraints[1] that were meant to limit the growth in firm numbers to realistic annual levels were discarded. Second, in order to project the model results to a ten year period, the resource, demand and trade coefficients that were used in the basic model were also projected to 1985. Such projections required making some assumptions with respect to some important parameters.

The annual rate of growth in demand for each regional industrial product was obtained from the following equation:

$$d_r = P_r + ed \cdot \frac{y}{p}r$$

where $d_r$ = annual rate of growth in demand,

$P_r$ = population growth rate,

ed = income elasticity of demand and

$\frac{y}{p}r$ = annual rate of growth in per capita Gross Domestic Product (GDP)

If it is assumed that Sierra Leone population grows at an annual

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[1] See page 113.

rate of 2.2 percent [Government of Sierra Leone, 1975; World Bank Atlas, 1975, p. 6], and that the annual growth rate in per capita GDP is 2.1 percent [Government of Sierra Leone, 1973], then, regional product demand constraints were projected to grow at annual rates of 4.8 percent, 5.16 percent, 6 percent, 2.5 percent and 5.45 percent for tailoring, gara dyeing, carpentry, blacksmithing and bakery products respectively, over the next ten years. The income elasticity coefficients used for deriving the annual rate of growth in product demand are 1.22, 1.41, 1.90, .16 and 1.55 for tailoring, gara dyeing, carpentry, blacksmithing and bakery products respectively [Byerlee and King, 1976]. Each regional labor resource constraint was assumed to grow at the same rate as annual population growth rate (2.2 percent). Also, capital constraints were projected at the annual rate of growth of the Sierra Leone manufacturing sector, i.e., 3 percent [Government of Sierra Leone, 1975, p. 1]. Finally, since the value of the relevant 5-digit S.I.T.C.[1] blacksmithing imports increased at an annual rate of 25 percent while the value of the relevant 5-digit S.I.T.C. tailoring imports declined at an annual rate of 17 percent over the period, 1969-1973 [Quarterly trade statistics], the import coefficients that were used to project future trends in the model, were adjusted accordingly.

What follows are the results of the long run sensitivity analysis to test the effects of some policy variables on the choice of production techniques, output, employment, profits and trade patterns. Since the results that would soon be presented exaggerate the

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[1]See pages 111-112.

situations that might occur in the long run, it is important that these results be interpreted as indicating the probable directions that the small scale industrial subsector would go rather than what might actually occur. These results therefore, serve a useful guide to policy makers as to what can be expected in extreme circumstances.

## 8.2 Effects of the Rate of Interest

In the short run, the scope for substitution among production process types was limited by the narrow flexibility bounds within which firms can adjust in response to any policy intervention. With the removal of those bounds for our long run analysis, it is anticipated that the policy variables will yield differential impacts on output and employment in the long run, as distinct from the short run.

### 8.2.1 Effects of the Rate of Interest on the Choice of Production Technique

Table 8.1 shows the production processes that would maximise the profits of the subsector by 1985. Also, Table 8.2 sheds light on the rationale behind the choice of those production techniques. Since in the model, labor and capital have been constrained, and since the model results indicated that the level at which those resources were constrained proved effective, i.e., labor and capital resources earned positive value of marginal productivities, the costs of production per unit of output that have been presented in Table 8.2 include only labor and capital costs.[1] Indeed, the model

[1]Material input costs were not constrained in the model.

Table 8.1 Projected Number of Firms at Different Levels of Policy Variables, 1985

**Region I**

| Policy Variable \ Industrial Firm Type | Tailoring | | | Gara Dyeing | | | Blacksmithing | | Bakery | |
|---|---|---|---|---|---|---|---|---|---|---|
| | P111 | P112 | P113 | P131 | P132 | P133 | P141 | P142 | P151 | P181 |
| a - 10% Interest Rate | 0 | 0 | 0 | 0 | 1312 | 0 | 0 | 0 | 0 | 20 |
| b - 20% Interest Rate | 0 | 0 | 0 | 0 | 1312 | 0 | 0 | 0 | 0 | 20 |
| c - 35% Interest Rate | 0 | 0 | 0 | 0 | 1312 | 0 | 0 | 0 | 0 | 20 |
| d - Duty Free Raw Materials | 0 | 0 | 0 | 0 | 1312 | 0 | 0 | 0 | 0 | 20 |
| e - Double Tariff on Final Products | 0 | 0 | 552 | 0 | 534 | 0 | 0 | 0 | 0 | 20 |

**Region II**

| Policy Variable \ Industrial Firm Type | Tailoring | | | Gara Dyeing | | | | Carpentry | | | Blacksmithing | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P211 | P212 | P213 | P214 | P231 | P232 | P233 | P241 | P242 | P243 | P251 | P252 | P281 | P282 | P283 |
| a - 10% Interest Rate | 0 | 0 | 0 | 506 | 12 | 0 | 0 | 432 | 0 | 0 | 0 | 0 | 27 | 0 | 0 |
| b - 20% Interest Rate | 0 | 0 | 0 | 559 | 133 | 0 | 0 | 434 | | | | | 9 | 2 | 0 |
| c - 35% Interest Rate | 0 | 377 | 38 | 441 | 0 | 0 | 0 | 434 | 0 | 0 | 0 | 0 | 0 | 12 | 0 |
| d - Duty Free Raw Materials | 0 | 0 | 0 | 520 | 145 | 0 | 0 | 444 | 0 | 0 | | | 10 | 1 | 0 |
| e - Double Tariff on Final Products | 445 | 0 | 0 | 510 | 0 | 0 | 0 | 433 | 0 | 0 | 0 | 0 | 9 | 9 | 0 |

**Region III**

| Policy Variable \ Industrial Firm Type | Tailoring | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | Bakery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P311 | P312 | P313 | P314 | P331 | P341 | P342 | P343 | P351 | P352 | P381 | |
| a - 10% Interest Rate | 0 | 2745 | 0 | 0 | 0 | 0 | 752 | | | | 39 | |
| b - 20% Interest Rate | 0 | 2251 | 0 | 0 | 0 | 0 | 746 | 0 | 0 | 0 | 277 | |
| c - 35% Interest Rate | 0 | 2150 | 0 | 0 | 78 | 0 | 745 | 0 | 0 | 0 | 276 | |
| d - Duty Free Raw Materials | 0 | 0 | 0 | 0 | 1757 | 0 | 720 | | | | 274 | |
| e - Double Tariff on Final Products | 0 | 2430 | 0 | 0 | 0 | 0 | 749 | 0 | 0 | 0 | 191 | |

**Region IV**

| Policy Variable \ Industrial Firm Type | Tailoring | | | Carpentry | | | Blacksmithing | | |
|---|---|---|---|---|---|---|---|---|---|
| | P411 | P412 | P413 | P441 | P442 | P443 | P451 | P452 | P453 |
| a - 10% Interest Rate | 7177 | 0 | 0 | 4181 | 0 | 0 | 0 | 8104 | 0 |
| b - 20% Interest Rate* | 7177 | 0 | 0 | 4181 | 0 | 0 | 0 | 8104 | 0 |
| c - 35% Interest Rate | 7177 | 0 | 0 | 4181 | 0 | 0 | 0 | 8104 | 0 |
| d - Duty Free Raw Materials | 7177 | 0 | 0 | 4181 | 0 | 0 | 0 | 8104 | 0 |
| e - Double Tariff on Final Products | 7177 | 0 | 0 | 4181 | 0 | 0 | 0 | 8104 | 0 |

*Policy variable (b) is the base run.

Table 8.2 Projected Unit Costs[a] of Production by Industry, Representative Firm Type and Location, 1985 (Leone)

| Region | | Tailoring | | | | Gara Dyeing | | | Carpentry | | | Blacksmithing | | | Bakery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | Firm Type | P111 | P112 | P113 | | P311 | P312 | P313 | P411 | P412 | | P511 | | | P811 | | |
| | Unit Costs | .72 | .78 | .31 | | .29 | .15 | .35 | .72 | .27 | | .74 | | | .14 | | |
| II | Firm Type | P121 | P122 | P123 | P124 | P321 | P322 | P323 | P421 | P422 | P423 | P521 | P522 | | P821 | P822 | P823 |
| | Unit Costs | .54 | .45 | .32 | .29 | .29 | .61 | .35 | .18 | .37 | .31 | .56 | 1.3 | | .21 | .11 | .23 |
| III | Firm Type | P131 | P132 | P133 | P134 | P331 | | | P431 | P432 | P433 | P531 | P532 | | P831 | | |
| | Unit Costs | .82 | .50 | .87 | .70 | .43 | | | .40 | .10 | .21 | .56 | .85 | | .52 | | |
| IV | Firm Type | P141 | P142 | P143 | | | | | P441 | P442 | P443 | P541 | P542 | P543 | | | |
| | Unit Costs | .17 | .36 | .66 | | | | | .45 | 1.9 | 1.1 | .47 | .42 | .55 | | | |

[a]Costs include labor and capital costs.

chose those production techniques for which average factor costs of production with respect to labor and capital were minimum, given the relevant rate of interest. For example, in the tailoring industry and at 10 percent and 20 percent rates of interest, the optimum firm types selected were P124 in region II, P132 in region III and P141 in region IV with minimum unit factor costs of 29 cents, 50 cents, 17 cents in regions II, III nad IV respectively. It will be noticed that in region I, none of the tailoring production processes was chosen. This is because it was cheaper to fill the tailoring output demand in region I from foreign sources. It is important to notice that raising the rate of interest to 35 percent reduced the number of production process type P124 and introduced the firm types P122 and P123. Capital requirements per unit value of output are 7 cents and 9 cents for P122 and P123 respectively, whereas the process type P124 uses 14 cents of capital per unit value of output. Thus, the higher rate of interest had the effect of reducing the number of the relatively capital intensive production processes.

In the gara industry, the long run solution chose the production process types P312 and P321 at 10 percent and 20 percent rates of interest. As is shown in Table 8.2, these two firms have the minimum costs of producing gara cloth in regions I and II respectively. But at an interest rate of 35 percent, the process type P321 dropped out of the solution, as shown in Table 8.1, and was replaced by P331. Whereas P321 uses 4 cents of capital to produce a unit value of output, P331, being relatively less capital intensive, utilized only .6 cents to produce one unit value of gara output.

Table 8.1 reveals also that at interest rates of 10 percent,

20 percent and 35 percent, region I will not produce any carpentry output. As Table 8.2 reveals, unit costs of production are higher in region I than in regions II and III. In the latter regions, only process types P421 and P432, with unit factor costs of 18 cents and 10 cents will produce for distribution to other regions. In the blacksmithing industry, the only optimum-sized blacksmithing firm is P542, and is located in the rural areas, to satisfy most of the blacksmithing output needs of region IV.

In the bakery industry, the modern bakery firm type, P811, with a unit factor production cost of 14 cents entered the solution at the same level irrespective of the rate of interest, as shown in Tables 8.1 and 8.2. But, in region II, the same modern type of bakery firm with a higher unit cost of production (26 cents), declined in number but finally dropped out of the solution as the interest rate rose from 10 percent to 35 percent. At the 35 percent rate of interest, the bakery firm, P822, using an intermediate technology,[1] with the minimum factor cost of production of 11 cents per unit value of output, and relatively less capital intensive, dominated the bakery production in region II. The traditional bakery firm P823, did not enter the optimum plan at any interest value, due to relatively higher production costs, as Table 8.1 shows.

It can be concluded that in the long run, only the minimum cost (optimum size) firms, modern or traditional, will dominate production in the small scale industrial subsector. But, it is clear from Table 8.1 that higher rates of interest within the relevant

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[1]See page.

range, will reduce the number of or eliminate the relatively capital intensive production process types, and substitute relatively more labor intensive firm types. The output and employment effects of such substitutions among production process types, resulting from changes in the rate of interest, will be considered next.

### 8.2.2 Output Values and Employment Effects of Changes in the Rate of Interest

Table 8.3 reveals that, on the aggregate, a change of interest rate from 10 percent to 20 percent will have favorable effects on output values, but little or no effects on employment. Thus, gross value of output will increase from Le 29,230,884 to Le 29,845,694, a gain of only 2 percent while employment will not change. However, a further increase of interest rate from 20 percent to 35 percent has adverse effects on both output values and employment.[1] As Table 8.3 reveals, output will decline from Le 29,845,694 to Le 29,167,144 while employment falls from 27,400,186 hours to 27,397,691. In short, by raising interest rates from 20 percent to 35 percent, output will decline by 2 percent while employment will also decline but by an insignificant amount.

While on the aggregate the output and employment effects of changing the rate of interest rate will not be favorable in the long run, the effects at industry level vary. As Table 8.3 reveals, the only industry with a favorable output and employment effects of changes in interest rate from 10 percent to 20 percent is gara industry.

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[1] These predicted trends do not change even when labor supplies for regions I, II and III were projected at annual population growth rates of 6 percent, 7 percent and 5 percent respectively. See page

Table 8.3 Projected Gross Output Values, Labor and Capital Services Utilization at Different Levels of Policy Variables by Industry and Location, 1985

| Region | Policy Variable | Tailoring | | | Gara Dyeing | | | Carpentry | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | O | L | K | O | L | K | O | L | K |
| I | a) 10% Rate of Interest | 0 | 0 | 0 | 10,597,024 | 1,894,028 | 62,959 | 0 | 0 | 0 |
| | b) 20% Rate of Interest | 0 | 0 | 0 | 10,597,024 | 1,894,028 | 91,816 | 0 | 0 | 0 |
| | c) 35% Rate of Interest | 0 | 0 | 0 | 10,597,024 | 1,894,028 | 139,035 | 0 | 0 | 0 |
| | d) Duty Free Raw Materials | 0 | 0 | 0 | 10,597,024 | 1,894,028 | 91,816 | 0 | 0 | 0 |
| | e) Double Tariff on Final Products | 1,813,320 | 3,883,396 | 134,158 | 4,313,118 | 771,108 | 37,381 | 0 | 0 | 0 |
| II | a) 10% Rate of Interest | 1,184,546 | 1,340,715 | 175,388 | 79,092 | 31,857 | 1,666 | 3,004,992 | 2,291,601 | 56,977 |
| | b) 20% Rate of Interest | 1,308,619 | 1,145,647 | 191,686 | 876,603 | 347,790 | 35,044 | 3,018,904 | 2,303,004 | 70,274 |
| | c) 35% Rate of Interest | 1,394,108 | 1,422,879 | 249,219 | 0 | 0 | 0 | 3,018,904 | 2,303,004 | 95,538 |
| | d) Duty Free Raw Materials | 1,217,320 | 1,066,564 | 178,444 | 955,695 | 378,604 | 38,149 | 3,088,464 | 2,359,022 | 71,984 |
| | e) Double Tariff on Final Products | 1,476,040 | 1,389,997 | 219,886 | 0 | 0 | 0 | 3,011,948 | 2,298,859 | 70,148 |
| III | a) 10% Rate of Interest | 1,636,020 | 2,539,179 | 131,763 | 0 | 0 | 0 | 2,067,248 | 3,310,636 | 16,546 |
| | b) 20% Rate of Interest | 1,341,596 | 2,082,246 | 128,311 | 0 | 0 | 0 | 2,050,754 | 3,286,709 | 26,879 |
| | c) 35% Rate of Interest | 1,281,400 | 1,989,499 | 165,612 | 186,342 | 98,057 | 2,343 | 2,048,005 | 3,281,474 | 33,545 |
| | d) Duty Free Raw Materials | 0 | 0 | 0 | 4,197,473 | 2,205,257 | 28,115 | 1,979,280 | 3,169,178 | 25,918 |
| | e) Double Tariff on Final Products | 1,448,280 | 2,248,346 | 138,547 | 0 | 0 | 0 | 2,059,001 | 3,295,407 | 26,950 |
| IV | a) 10% Rate of Interest | 4,564,572 | 6,545,022 | 150,708 | 0 | 0 | 0 | 622,969 | 1,831,434 | 100,353 |
| | b) 20% Rate of Interest | 4,564,572 | 6,545,022 | 193,767 | 0 | 0 | 0 | 622,969 | 1,831,434 | 117,078 |
| | c) 35% Rate of Interest | 4,564,572 | 6,545,022 | 265,533 | 0 | 0 | 0 | 622,969 | 1,831,434 | 192,342 |
| | d) Duty Free Raw Materials | 4,564,572 | 6,545,022 | 193,767 | 0 | 0 | 0 | 622,969 | 1,831,434 | 117,078 |
| | e) Double Tariff on Final Products | 4,564,572 | 6,545,022 | 193,767 | 0 | 0 | 0 | 622,969 | 1,831,434 | 117,078 |
| Industry Total | a) 10% Rate of Interest | 7,385,138 | 10,424,916 | 457,859 | 10,676,116 | 1,925,885 | 64,625 | 5,695,209 | 7,433,671 | 173,876 |
| | b) 20% Rate of Interest | 7,214,787 | 9,772,915 | 513,764 | 11,473,627 | 2,241,818 | 126,860 | 5,692,627 | 7,421,147 | 214,231 |
| | c) 35% Rate of Interest | 7,240,080 | 9,957,400 | 680,364 | 10,783,166 | 1,992,085 | 141,378 | 5,689,878 | 7,415,912 | 321,425 |
| | d) Duty Free Raw Materials | 5,781,892 | 7,611,526 | 372,211 | 15,750,192 | 4,477,889 | 158,080 | 5,690,713 | 7,359,634 | 214,980 |
| | e) Double Tariff on Final Products | 9,302,212 | 14,066,761 | 686,358 | 4,313,118 | 771,108 | 37,381 | 5,693,918 | 7,425,700 | 214,980 |

| | | Blacksmithing | | | Bakery | | | Regional Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | O | L | K | O | L | K | O | L | K |
| I | a) 10% Rate of Interest | 0 | 0 | 0 | 2,371,380 | 1,041,689 | 103,993 | 12,968,404 | 2,935,717 | 116,952 |
| | b) 20% Rate of Interest | 0 | 0 | 0 | 2,371,380 | 1,041,689 | 143,158 | 12,968,404 | 2,935,717 | 234,974 |
| | c) 35% Rate of Interest | 0 | 0 | 0 | 2,371,380 | 1,041,689 | 209,225 | 12,968,404 | 2,935,717 | 348,260 |
| | d) Duty Free Raw Materials | 0 | 0 | 0 | 2,371,380 | 1,041,689 | 143,158 | 12,968,404 | 2,935,717 | 234,974 |
| | e) Double Tariff on Final Products | 0 | 0 | 0 | 2,371,380 | 1,041,689 | 143,158 | 8,497,818 | 5,696,193 | 314,697 |
| II | a) 10% Rate of Interest | 0 | 0 | 0 | 878,526 | 247,084 | 126,634 | 5,147,156 | 3,911,257 | 358,999 |
| | b) 20% Rate of Interest | 0 | 0 | 0 | 349,680 | 114,814 | 63,660 | 5,551,806 | 3,911,255 | 360,664 |
| | c) 35% Rate of Interest | 0 | 0 | 0 | 341,028 | 182,878 | 15,908 | 4,754,040 | 3,908,761 | 360,665 |
| | d) Duty Free Raw Materials | 0 | 0 | 0 | 353,799 | 107,127 | 72,087 | 5,615,278 | 3,911,257 | 360,664 |
| | e) Double Tariff on Final Products | 0 | 0 | 0 | 548,613 | 222,402 | 70,631 | 5,038,601 | 3,911,258 | 360,665 |
| III | a) 10% Rate of Interest | 0 | 0 | 0 | 85,059 | 79,019 | 2,424 | 3,788,327 | 5,928,834 | 150,733 |
| | b) 20% Rate of Interest | 0 | 0 | 0 | 604,137 | 559,879 | 23,271 | 3,996,487 | 5,928,834 | 178,461 |
| | c) 35% Rate of Interest | 0 | 0 | 0 | 601,956 | 559,803 | 26,591 | 4,117,703 | 5,928,833 | 228,091 |
| | d) Duty Free Raw Materials | 0 | 0 | 0 | 597,594 | 554,397 | 23,043 | 6,774,347 | 5,928,832 | 77,076 |
| | e) Double Tariff on Final Products | 0 | 0 | 0 | 416,571 | 385,081 | 16,005 | 3,923,852 | 5,928,834 | 181,502 |
| IV | a) 10% Rate of Interest | 2,139,456 | 6,247,924 | 243,110 | 0 | 0 | 0 | 7,326,997 | 14,624,380 | 494,171 |
| | b) 20% Rate of Interest | 2,139,456 | 6,247,924 | 332,250 | 0 | 0 | 0 | 7,326,997 | 14,624,380 | 643,095 |
| | c) 35% Rate of Interest | 2,139,456 | 6,247,924 | 510,531 | 0 | 0 | 0 | 7,326,997 | 14,624,380 | 968,406 |
| | d) Duty Free Raw Materials | 2,139,456 | 6,247,924 | 332,250 | 0 | 0 | 0 | 7,326,997 | 14,624,380 | 643,095 |
| | e) Double Tariff on Final Products | 2,139,456 | 6,247,924 | 332,250 | 0 | 0 | 0 | 7,326,997 | 14,624,380 | 643,095 |
| Industry Total | a) 10% Rate of Interest | 2,139,456 | 6,247,924 | 243,110 | 3,334,965 | 1,367,792 | 233,051 | 29,230,884 | 27,400,188 | 1,170,855 |
| | b) 20% Rate of Interest | 2,139,456 | 6,247,924 | 332,250 | 3,325,197 | 1,716,382 | 230,089 | 29,840,694 | 27,400,186 | 1,417,194 |
| | c) 35% Rate of Interest | 2,139,456 | 6,247,924 | 510,531 | 3,314,364 | 1,784,370 | 251,724 | 29,167,144 | 27,397,691 | 1,905,422 |
| | d) Duty Free Raw Materials | 2,139,456 | 6,247,924 | 332,250 | 3,322,773 | 1,703,213 | 238,288 | 32,685,026 | 27,400,186 | 1,315,809 |
| | e) Double Tariff on Final Products | 2,139,456 | 6,247,924 | 332,250 | 3,336,564 | 1,649,172 | 229,794 | 24,785,268 | 30,160,665 | 1,499,959 |

Note: O = Leone value of total output
L = hours of labor services input
K = Leone value of capital services input
The (b) policy variable is always the base run.

Being the least capital intensive industry, the change in interest rate from 10 percent to 20 percent channelled resources into gara dyeing. Thus, while the number of gara dyeing firm type P321 increased from 12 to 133, tailoring firm type, P132 declined from 2745 to 2251 and the carpentry firm types also declined from 752 to 746 as shown in Table 8.1. With the exception of employment in the bakery industry, both output and employment declined in the rest of the four industries. In the bakery industry, output declined while employment increased--a tradeoff that was also observed for the short run analysis.

### 8.2.3 Profit Effects of Changes in the Rate of Interest

By raising the rate of interest from 10 percent to 20 percent the value of the objective function declined from Le 12,549,259 to Le 11,929,840, a decline of about 5 percent and a profit elasticity[1] of interest rate of -.5. A further increase in the interest rate from 20 percent to 35 percent brought about a decline in profits from Le 11,929,840 to Le 10,818,881, another decline of 9 percent and a profit elasticity of about -.6. Raising the rate of interest from 10 percent to 35 percent will lead to a 14 percent decline in profits and a profit elasticity of interest rate of -.93 over the entire range of interest rate.

### 8.2.4 Effects of Interest Rates on Trade Patterns

By influencing production patterns, raising the rate of interest will have some effects on both domestic and foreign trade. As

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[1] Profit elasticity of interest rate $= \frac{\text{Percentage change in the level of profits}}{\text{Percentage change in the rate of interest}}$

Table 8.4 reveals, raising the rate of interest from 10 percent to 20 percent will reduce the volume of interregional trade by 19 percent but gara exports into foreign markets will also increase by 8 percent. A further increase of the rate of interest from 20 percent to 35 percent will neither increase nor decrease the volume of interregional trade but will result to a decline in the export of gara cloth. It is important to realize from Table 8.4 that the rate of interest has no effect whatsoever on the domestic and foreign trade in balcksmithing output. At all levels of interest rate no blacksmithing output values are traded interregionally while Le 110,147 worth of blacksmithing output will be imported from abroad. The industry whose interregional and foreign trade will be most affected by changes in the rate of interest is tailoring. By raising the rate of interest from 10 percent to 35 percent, interregional trade in tailoring output will fall from Le 640,002 to Le 285,830, a decline of about 55 percent. Also, raising the rate of interest from 10 percent to 35 percent will bring about an increase of foreign tailoring output imports from Le 2,578,312 to Le 2,970,228, an increase of about 15 percent. Thus, raising the interest rate from 10 percent to 35 percent will substitute foreign tailoring imports for domestic production to the detriment of domestic production and employment.

Table 8.4 Projected Patterns of Interregional and Foreign Trade at Different Levels of Policy Variables, 1985

| | Policy Variable | Interregional Trade | | | | | | Foreign Trade | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tailoring Output | Gara Output | Carpentry Output | Blacksmithing Output | Bakery Output | Total | Tailoring Imports | Blacksmithing Imports | Total Imports | Gara Exports |
| a) | 10% rate of interest | 640,002 | 851,585 | 1,709,937 | 0 | 816,851 | 4,018,375 | 2,578,312 | 110,147 | 2,688,459 | 9,708,151 |
| b) | 20% rate of interest | 345,588 | 402,337 | 1,724,879 | 0 | 780,557 | 3,253,361 | 2,997,824 | 110,147 | 3,107,971 | 10,502,928 |
| c) | 35% rate of interest | 285,830 | 745,068 | 1,728,148 | 0 | 780,558 | 3,539,604 | 2,970,228 | 110,147 | 3,080,375 | 9,814,668 |
| d) | Duty free raw materials | 0 | 40,722 | 1,798,275 | 0 | 780,558 | 2,619,535 | 4,429,843 | 110,147 | 4,539,990 | 14,778,338 |
| e) | Double tariff on final products | 452,611 | 931,727 | 1,719,447 | 0 | 759,187 | 3,862,872 | 909,348 | 110,147 | 1,019,495 | 3,346,959 |

Policy variable (b) is the base run.

## 8.3 The Effects of Trade Policies, Profits and Trade Patterns

### 8.3.1 Introduction

The two trade policy variables that were tested on the model projected run are import duties on raw material inputs and tariffs on competing small scale industry products. Such competing final products include the relevant 5-digit S.I.T.C. tailoring and blacksmithing products.[1] Thus some sensitivity analyses were carried out to test the effects of removing import duties on raw materials and the effects of raising tariffs on competing imports on profits, output, employment and trade patterns among small scale industries. In order to identify the effects of trade policies on the optimum plan, it is necessary to compare the model results at 20 percent rate of interest, 1985 base run, with the model results duty-free or at higher tariff levels, as shown on Tables 8.1, 8.3 and 8.4.

### 8.3.2 Number of Firms and Choice of Technique of Production

With the exception of gara industry the removal of custom duties on raw material inputs did not have any significant effect on the choice of production technique. In the gara industry, an additional and relatively efficient process type, P331, was brought into the solution, and a tailoring process type P132 was removed from the solution as shown in Table 8.1. This adjustment is expected because the gara industry depends mostly on imported raw materials while the tailoring industry depends on imported intermediate inputs to a much lesser extent. Also, the most significant change in firm numbers took

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[1] See page

place in the gara dyeing industry. As Table 8.1 reveals, the number of gara dyers increased from 1445 in regions I and II to 3214 in regions I, II and III, an increase of 122 percent. It should also be noted that because of the removal of custom duties, the level at which some existing production process types entered the solution increased. Thus P421 increased from 434 to 444, and P821 increased from 9 to 10 as shown in Table 8.1.

When the tariffs on imported tailoring and blacksmithing products were doubled, the consequence was that new tailoring firm types P113 and P121 entered the solution at the levels of 552 and 445 respectively, while the number of existing process type, P132 increased from 2251 to 2430. In effect, the number of tailoring firms increased from 2810 in regions I and II to 3937, an increase of 40 percent. Doubling the tariff on blacksmithing imports did not have any effect on the blacksmithing industry whatsoever. Moreover, although the number of tailoring firms increased, the number of firm types P312 and P831 declined drastically as shown in Table 8.1. The consequences of such adjustments would be discussed later on.

### 8.3.3 Profits

The removal of custom duties on the imported raw material inputs has a positive effect on the profit of the small scale industrial subsector. The elimination of import duties has the effect of increasing sectoral profits from Le 11,929,840 to Le 15,757,630, an increase of 32 percent. On the other hand, doubling the tariff rates on competing tailoring and blacksmithing products has the adverse effect of reducing sectoral profits from Le 11,929,840 to

Le 11,442,568, a decline of 4 percent. The reduction in sectoral profits is due to the higher cost of all the tailoring and blacksmithing output that were imported, despite the higher level of tariff.[1]

8.3.4 Output and Employment

Table 8.3 reveals that on the aggregate, the elimination of custom duties on raw material imports has the effects of increasing output values from Le 29,845,694 to Le 32,685,026, an increase of 10 percent while leaving the level of employment unchanged at the level of 27,400,186 hours of labor services. The greatest contributor to the increased aggregate output value is the gara industry where output values increased from Le 11,473,627 to Le 15,750,192, an increase of 37 percent. Although no significant changes in output and employment took place in the carpentry, blacksmithing and bakery industries, output and employment did decline in the tailoring industry. As Table 8.3 revelas, the tailoring output values declined from Le 7,214,787 to Le 5,781,892, a 20 percent decline and employment also declined from 9,772,915 hours of labor services to 7,611,526, a decline of 22 percent. It can be verified from Table 8.1 that while the number of gara dyeing firms increased by 122 percent, tailoring firms declined by 81 percent. This situation arises because gara dyeing firms depend to a great extent on imported intermediate inputs and therefore gained most from the removal of custom duties.

Doubling the tariffs on competing tailoring and blacksmithing products has the effect of reducing aggregate value of domestic

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[1] See Table 8.4.

output from Le 29,845,694 to Le 24,785,268, a decline of 17 percent but employment increased by 10 percent from 27,400,186 hours of labor services to 30,160,665. However, a closer examination of Table 8.3 shows some industrial variation in the output and employment effects. For example, whereas tailoring output values and employment increased, significant declines in output and employment occured in the gara dyeing industry but no significant changes occured in the carpentry, and bakery industries. While the tailoring industry experienced a positive production effect of the tariff, the blacksmithing industry experienced a neutral effect. This phenomenon could be due to the differential tariff levels imposed on the competing tailoring and blacksmithing products--80 percent for tailoring and only 6 percent for placksmithing products. However, the decline in the aggregate value of output could be due to the distorting effects of high tariffs on the competing tailoring products. Thus domestic allocation of scarce resources were no longer carried out according to comparative advantage configurations due to the high tariff levels.

### 8.3.5 Trade Patterns

The most significant effect of the elimination of custom duties on imported raw material inputs is the 41 percent increase in gara dyeing exports from Le 10,502,928 to Le 14,778,338 as shown in Table 8.4. However tailoring imports increased by 48 percent, from Le 2,997,824 to Le 4,429,843. The increasing profitability of producing for the export market, attracted resources away from the tailoring industry, thus leading to a decline in the number of tailoring firms, as was pointed out previously. With respect to interregional

trade, a substantial decrease of 81 percent was predicted by the model. Thus, the volume of interregional shipments of tailoring products decreased from Le 3,253,361 to Le 2,619,558. This decline in the volume of interregional trade is due to the decline in the number of tailoring firms, resulting from a shift of resources into the gara dyeing industry. With a decline in the domestic tailoring output production and interregional trade, tailoring imports increased by 48 percent as was previously pointed out.

One significant effect of doubling the tariffs on competing imports is that tailoring imports declined by 170 percent from Le 2,997,824 to Le 909,348. Such a decline in tailoring imports is due to the production effects of the tariff whereby domestic production of tailoring products increased to replace foreign imports. Another significant effect of the high level of tariff is the reduction of gara exports by 68 percent, from Le 10,502,928 to Le 3,346,959. With such a high tariff (80 percent) on competing tailoring imports, the domestic price of tailoring products will tend to rise far above domestic production costs. Thus, the tailoring industry will tend to look more profitable and resources will tend to move away from the gara industry into the tailoring industry. As Table 8.1 reveals, doubling tariffs led to a decline in the number of gara firms from 1445 in regions I and II to 534 in region I, a decline of 63 percent. Finally, Table 8.4 reveals that the blacksmithing industry is insensitive to either the elimination of custom duties on imported raw materials or the doubling of tariff levels on competing blacksmithing products.

## 8.4 The Effects of Differential Rates of Growth in Labor Supply

### 8.4.1 Introduction

Since the results of the short run and long run policy analyses revealed that labor, not capital,[1] is the limiting resource among small scale industries, it became necessary to test the effects of differential growth rates of labor supply, given the projected 1985 demand projections and current levels of money wages,[2] and input-output coefficients.

### 8.4.2 Marginal Value Productivities of Labor

Table 8.5 reveals that when labor supply was made to grow at an annual rate of 2.2 percent, all categories of labor earned marginal value products which are greater than the money wages stipulated in the model.[3] For example, in the Greater Freetown, the largest urban area, the MVP of proprietor and family and hired labor are Le 3.3 and Le 2.7 per hour respectively for 1985. For the localities with 20,000 - 100,000 people, the MVPs of hired and apprentice laborers are Le 2.7 and Le 2.4 per hour respectively. These MVPs which are higher than the acquisition costs of labor, indicate that industrial firms will profitably employ more labor services,[4]

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[1] In the short run and long run analyses, labor earned positive marginal productivities while capital earned zero MVP when capital was priced at either 10 percent or 20 percent rate of interest.

[2] Since money wages rise over the years due to inflation, the assumption of current levels of money wages can be unrealistic. But this assumption helps to bring into clear focus the results of the policy analyses.

[3] See page 196.

[4] See Glenn Johnson, 1972, pp. 185-196.

Table 8.5 Projected Shadow Prices for the Different Categories of Labor Resource and at Different Levels of Growth Rate in Labor Supply, 1985

| Locality Size (Population) | Labor Type | Shadow Prices (Leones per hour) | |
|---|---|---|---|
| | | Growth Rate of 2.2% | Growth Rate of 2.2% - 7%[1] |
| Over 100,000 | Proprietor Labor | 3.3 | 3.3 |
| | Hired Labor | 2.7 | 0 |
| | Apprentice Labor | 0 | 0 |
| 20,000 - 100,000 | Proprietor Labor | .98 | 1.3 |
| | Hired Labor | 2.7 | .10 |
| | Apprentice Labor | 2.4 | 0 |
| 2,000 - 20,000 | Proprietor Labor | 1 | 1.03 |
| | Apprentice Labor | .99 | .18 |
| Less than 2,000 | Proprietor Labor | 0 | 0 |

[1]Based on the 1963 and 1975 census results, labor supply in the various size localities were made to grow at the following annual rates of population growth:

over 100,000 - 8 percent
20,000 - 100,000 - 7 percent
2,000 - 20,000 - 5 percent
less than 2,000 - 2.2 percent

given the existing levels of money wages. But at higher rates of growth in labor supply, the proprietor and family labor still earned high MVPs while the employment of hired workers and apprentices reached a point where these labor categories earned low ar zero MVPs, owing to increased utilization of these labor services.

### 8.4.3 Growth Rates of Firm Numbers, Output, Employment and Profits

The impact of differential growth rates of labor supply on the number of firms, output, employment and profits can be seen from

Table 8.6. By increasing the growth rates of labor supply from 2.2 percent to 5 percent, 7 percent and 6 percent for localities with the population of 2,000 - 20,000, 20,000 - 100,000 and over 100,000, the annual growth rates of firm numbers, output, employment and profits almost doubled between 1974/75 and 1985. As Table 8.6 shows, the annual rate of growth of firm numbers, output, employment, and profits increased from -.8 percent, 12.3 percent, 1.3 percent, 24.7 percent to 9.3 percent, 21.5 percent, 3.1 percent and 50.8 percent respectively. The policy implications of the benefits from increased growth rates of labor supply, for small scale industry, will be discussed in the next chapter.

## 8.5 Summary

The long run policy analysis revealed that the choice of production methods involves a mixture of both modern firms and traditional firms,[1] given the projected levels of effective demand and competing imports. Thus, only the minimum cost firms (as shown in Table 8.2) were chosen to produce in the long run situation.

Although in both the short run and long run situations, high rates of interest tended to induce a substitution of labor-intensive process types for the capital-intensive ones, higher interest rates increased the domestic costs of production thus improving the competitive position of imported products. As a result, output values, employment and profits declined while the imports of competing goods increased.

The long run policy analyses results revealed that a policy of

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[1] A similar result was revealed in the short run analysis.

Table 8.6 Projected Growth Rates of Firm Numbers, Output Values, Employment and Profits for Alternative Rates of Growth in Labor Supply, 1985

| Policy Run | No. of Firms | Output Values | Labor Services | Profits |
|---|---|---|---|---|
| A. Base Run 1974/75 | 27,405 | Le 13,401,447 | 24,255,222 hours | Le 3,434,122 |
| B. Projected 1985 run at an overall 2.2 percent growth rate in labor supply | 25,206 | Le 29,845,694 | 27,845,694 hours | Le 11,929,840 |
| C. Projected 1985 run at labor supply growth rates of:[1] 6 percent for localities with over 100,000 people; 7 percent for localities with 20,000 - 100,000 people; 5 percent for localities with 2,000 - 20,000 people; 2.2 percent for localities of less than 2,000 people. | 52,956 | Le 42,240,097 | 31,881,400 hours | Le 20,885,631 |
| B - growth rate for 1974/75 - 1985 | -8% | 123% | 13% | 247% |
| B - annual growth rate | -.8% | 12.3% | 1.3% | 24.7% |
| C - growth rate for 1974/75 - 1985 | 93% | 215% | 31% | 508% |
| C - Annual growth rate | 9.3% | 215% | 3.1% | 50.8% |

[1]These differential growth rates have been combined from the results of 1963 and 1975 population census of Sierra Leone.

granting custom duty rebates on imported inputs has a favorable effect of increasing output values, gara cloth exports and profits without significant changes in employment. This long run policy result differs from the short run policy result where only profits increased as a result of eliminating custom duties.

In the short run, doubling tariffs on competing imports resulted in reduced profits since imports still came in at the high tariff level. But in the long run, with the elimination of high cost firms, minimum cost firms increased in number, thus eliminating the importation of tailoring imports by 170 percent. Although employment increased by 10 percent due to the substitution of domestic production for foreign imports, output values declined by 17 percent due to the distorting effects of the high tariff level.

Another significant result of the long run policy analysis is that the blacksmithing industry will become a rural industry. Our analysis reveals that the blacksmithing firms in region IV are the least cost (in terms of labor and capital) producers of hoes, matchets and other services related to farming.

Finally, the policy analysis of increasing the annual growth rates of labor supply has significant results for the small scale industry subsector and the Sierra Leone economy as a whole. As Table 8.6 reveals, higher rates of growth in labor supply resulted in the increased rates of growth in firm numbers, output, employment and profits from -.8 percent, 12.3 percent, 1.3 percent and 24.7 percent to 9.3 percent, 21.5 percent, 3.1 percent and 50.8 percent respectively between 1974/75 and 1985. These results have policy implication which will be discussed in the next chapter.

# CHAPTER 9

# SUMMARY AND POLICY IMPLICATIONS

## 9.1 Introduction

This study utilizes a linear programming model to evaluate the efficiency of resource allocation among small scale industries in Sierra Leone and to analyse the effects of various policy variables on these industries. A one year sample survey of Sierra Leone small scale industries was undertaken in 1974/75 and detailed input-output data were generated on the daily economic activities of 366 firms. The results of this study will be summarized, followed by a discussion of the policy implications of the research findings.

## 9.2 The Small Scale Industrial Subsector in Sierra Leone

The evidence generated by our study has revealed that the small scale industrial establishments dominated the industrial sector in terms of both the number of firms and total employment. Small scale establishments accounted for over 95 percent of the employment and 43 percent of the value added of the industrial sector in Sierra Leone. One of the most striking results of the survey, however, was the discovery that the vast majority of these firms were located in rural areas. Thus, 95 percent of the industrial establishments, 86 percent of the industrial employment, and 75 percent of the industrial value added was generated by rural small scale industries.

In terms of specific industries, tailoring was the most important activity, accounting for 31 percent of the employment and 37 percent of the value added within the small scale sector. Blacksmithing, carpentry, baking, and gara dyeing followed tailoring in importance, but by quite a wide margin.

The total labor input varies quite widely from industry to industry and by location, being significantly lower in the villages than in the larger urban locations. Apprentices and proprietors supply the vast majority of the small scale industry labor. With the exception for the "modern" blacksmiths, all the major types of small scale industries in Sierra Leone must be considered to be economically viable. "Traditional" and "modern" gara dyers, "traditional" carpenters, and "traditional" bakers generate the highest rate of economic profit, exceeding 100 percent in each instance. Nevertheless, small scale industries in Sierra Leone, perceive their major problems to include lack of capital, and effective demand for their products, and the scarcity and rising cost of material inputs.

## 9.3 Results of the Base Run

The purpose of the base run is to obtain "optimal" solutions of the model in order to evaluate the efficiency of resource use among small scale industries in Sierra Leone. Such an evaluation has important policy implications which will be pointed out later on.

One significant result of the analysis of the base run is that inefficiencies in resource allocation exist among the small scale industries in Sierra Leone. For example, the predicted average productivities of labor and capital are .55 and 8.7 leones per unit of

labor and capital services respectively as compared to the corresponding actual average productivities of .39 and 6.8. However, the patterns of variation by industry and location in the utilization of labor, labor types and capital are the same for both predicted results and actual data. For example, the tailoring industry, and the rural areas were predicted to have contributed 40 percent respectively of total labor services utilized by the five major small scale industries. In addition, while apprentice and hired labor types dominate the total labor use in carpentry and bakery industries respectively, proprietor and family labor proved to be the most important labor type in gara dyeing industry. Apart from industrial variation, there are locational variations in the type of labor utilized. Thus, while regions I-III rely mostly on apprentice labor, proprietor and family labor dominate in rural areas.

The predicted patterns of interregional trade also conformed to the observed patterns. The principle of comparative advantage was utilized to explain the directions of trade. The analysis revealed that the firms in region I have absolute disadvantages in producing all the small scale industry products. Such absolute disadvantages were due to high costs of electricity, workshop rentals and wages on hired labor. Firms in region III enjoyed absolute advantages in the production of almost all the small scale industry products. The basis of such an absolute cost advantage is the widespread use of cheap apprentice labor in region III.

## 9.4 The Results of the Short Run Policy Analyses with Closed and Open Models

### 9.4.1 Introduction

The purpose of the short run policy analyses was to test the effects of different levels of interest rates, capacity utilization and trade policies on output, employments, profits and trade patterns among the small scale industries in Sierra Leone. In order to isolate the effects of foreign trade on the results of the analyses, it was necessary to utilize a closed model (without foreign trade) and an open model (with foreign trade) in the analyses. The results of these analyses will now be summarized at the aggregate and specific industry levels.

### 9.4.2 Aggregate Results

The results of the short-run policy analysis with the closed model reveal that at a given level of output, employment increased by .6 percent when the rates of interest were raised from 10 percent to 35 percent. But, profits also declined by 21 percent due to the same change of the rate of interest. The result of our analyses with the closed model also reveals that by enabling the small scale industries to operate at a higher level of capacity utilization, output values, hours of labor services and profits of the major small scale industries increased by 4 percent, 3 percent and 2 percent respectively. These results will now be contrasted with the results of the open model.

The results of the open model reveal that by raising the rate of interest from 10 to 35 percent, aggregate values of gross output and employment declined by 21 percent and 18 percent

respectively. At the higher rate of interest, the cost structures of industrial firms increased. As a result, the value of imports of tailoring and blacksmithing products increased by 210 percent and 435 percent respectively while profits of the entire subsector declined by 137 percent.

The effect of a higher level of capacity utilization in the open model also differs from the result of the closed model. In the open model domestic production of high cost firms was displaced by imports, even though capital productivities of individuals increased due to high rates of capacity utilization. Thus, the aggregate number of firms declined by 18 percent, the value of output and employment remained almost the same. But, higher rates of capacity utilization resulted in a one percent savings in capital services.

In the short run policy open model, the effect of granting import rebates on imported material inputs increased the profits of the entire subsector by 23 percent. On the other hand, doubling the tariffs on competing imports did not reduce the value of foreign imports as anticipated. Rather, sectoral profits declined due to the increased tariff level.

### 9.4.3 Specific Industry Results

The summary of the results of the short run policy analyses relating to specific industries will be based on the open model. Although higher rates of interest resulted in a general decline in output and employment among small scale industries, the greatest decline in the value of output was predicted for the blacksmithing industry. This particular phenomenon is due to the relative

inefficiencies of blacksmithing firm types in general.[1] The only case of increased employment at higher interest rates was predicted for the bakery industry. By increasing the rate of interest from 20 percent to 35 percent, the number of traditional labor intensive firms increased while the number of modern capital intensive firms declined. However, this increase in employment was accompanied by another unique result - a trade off between output and employment in the bakery industry. With the substitution of labor intensive bakery firms for the capital intensive ones, output values of the entire bakery industry declined while employment increased.

The greatest impact of increases in the levels of capacity utilization was predicted for the tailoring and bakery industries where both output values increased by seven percent and eight percent respectively and employment increased by five percent only in the tailoring industry. But, the largest declines in output values and employment of 45 percent and 46 percent respectively were predicted for the gara dyeing industry. Since gara firms operated closer to full capacity than tailoring and bakery firms, the gara dyeing firms were placed at a comparative disadvantage when all firms were made to operate at full capacity.

## 9.5 The Results of the Long Run Policy Analysis (Open Model)

### 9.5.1 Introduction

The purpose of the long run policy analysis is to project the consequences of alternative policies through 1985, while permitting

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[1] See Table 4.10 of Chapter 4.

the necessary adjustments in the number of firms by industrial type and location. The results of the long run policy analysis of the effects of levels of interest rates, trade policies and differential rates of labor supply among small scale industries in Sierra Leone will now be summarized.

### 9.5.2 Aggregate Results

The difference in the results of short run and long run effects of raising the rate of interest from 10 percent to 35 percent is a matter of degree. The predicted declines in output values, employment and profits are only .2 percent, zero percent and 14 percent respectively, for the long run situation. Thus, the significant effect of higher interest rates in the longrun is the large decline in the profits of the subsector.

The effects of trade policies in the long run analysis differ from those of the short run. For example, while the short-run policy of import rebates led to only an increase in profits for the subsector, the long run analysis also predicted a 10 percent increase in output values. Secondly, although profits declined in the short run and long run situations due to a policy of doubling the tariffs, the long run analysis highlights a 10 percent decline in the value of output and a 17 percent rise in employment.

Finally, the long run policy analysis reveals that the rate of growth in the supply of the different categories of labor has an impact on output, employment and profits of small scale industries. Our analysis reveals that the annual rates of growth in output values, employment and subsector profits more than doubled over the period,

1974/75-1985, when the rate of annual labor supply is increased from an overall average of 2.2 percent to six percent, seven percent, five percent and 2.2 percent for regions I, II, III and IV respectively.

### 9.5.3 Specific Industry Results

Our analysis predicted the greatest decline in output and employment for the tailoring industry due to a rise of interest rate from 10 to 35 percent. Since the increase in the rate of interest led to increases in cost structures of small scale industries, foreign competing imports were placed at a competitive advantage, over the domestically produced goods of small scale industries. Thus, the imports of tailoring products increased by 15 percent. On the other hand, the industry least affected by a rise of interest rates from 10 to 35 percent is the gara industry, where output values and employment increased by about one percent and three percent respectively.

The long run policy analysis also reveals that the gara dyeing industry gained most from customs duty rebates on imported intermediate inputs. Since about 90 percent of purchased inputs into gara dyeing is imported,[1] a policy of import duty rebates resulted in a 122 percent increase in the number of gara dyeing firms, and increases of 37 percent, 50 percent and 41 percent in output values, employment and gara exports respectively.[2] On the other hand, while resources were attracted into the gara dyeing industry, the number of firms in the tailoring industry declined by 81 percent.

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[1] See Chapter 3.

[2] Computed from Tables 8.3 and 8.4.

The effect of doubling the tariffs on competing imports was very significant for the tailoring industry. As a result of increased tariffs, the imports of tailoring products declined by 170 percent, domestic production of tailoring output increased by 29 percent and domestic tailoring employment increased by 44 percent.[1] However, the gara dyeing industry experienced the greatest decline due to the increased tariff levels. With the expansion of domestic production and employment in the tailoring industry, resources moved out of the gara industy at a high cost to the Sierra Leone economy. Not only did output and employment decline in the gara industry, gara dyeing exports outside Sierra Leone fell by 68 percent,[2] a loss of foreign exchange.

## 9.6 Policy Implications

### 9.6.1 Introduction

The results of this study have some important policy implications which are relevant for the small scale industry subsector as a whole; other implications of the study are either location or industry specific, while others highlight further research efforts that are needed to enhance our understanding of the small scale industry subsector.

### 9.6.2 Implications for the Subsector

Since the results of this study indicate that the small scale industrial establishments dominated the industrial sector of Sierra Leone in terms of both number of firms and employment, it is

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[1] Computed from Table 8.3.

[2] Computed from Table 8.4.

desirable that policy makers focus attention in this subsector as a priority area for development purposes. Moreover, since the results of this study reflect the importance of rural small scale industries, there is the need for policy makers to ensure that rural industries are incorporated into both industrial and rural studies in developing countries.

An important implication of the study for the small scale industry sector as a whole is that the rate of interest cannot be relied upon as an effective instrument for generating output and employment among small scale industries. Other measures such as customs duty rebates increasing the rates of capacity utilization and the supply of trained manpower for the subsector as a whole need be pursued. On the other hand, trade policies that protect small scale industries by raising the tariff levels on competing imports, lead to malallocation of resources.

One of the measures that has been adopted for promoting small scale industries is import duty rebates on imported raw materials [Schippers, 1970].[1] The results of this study reveal that customs duty rebates on imported inputs is the most effective short run and long run policy for increasing the profits of the small scale entrepreneurs. Since about 90 percent of the funds used for expansion of small scale industries were reinvested profits [Liedholm and Chuta, 1976, p. 102], the implication of this finding becomes very significant.

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[1] Import duty relief has been mentioned as the most important factor in the promotion of rural industry [United Nations, 1974].

Under the existing excess capacities,[1] an effective way of increasing the rate of capacity utilization is to increase the level of effective demand for the products of small scale industries. The level of effective demand can be increased through indirect policies of increasing rural farm incomes[2] and/or encouraging both the domestic and foreign consumption of the products of small scale industries. In view of the high and positive income elasticities of demand for the products of small scale industries in Sierra Leone [Byerlee et al., 1976], policies which contribute to increasing rural farm incomes will be an effective means of generating output and employment among small scale industries.

Since our analysis suggests that trained manpower plays an important role in the success of small scale industries, policies should encourage the informal apprenticeship system currently being utilized for manpower recruitment and training in the subsector. For example, minimum wage laws, which increase the attractiveness of the formal sector (for example, government and large scale industries), by increasing the wages in that sector, deprive the small scale industrialists of the required manpower [I.L.O., 1970].

The results of our analysis indicate that increasing tariff rates on competing imports distorts the existing comparative advantage among the small scale industries. Since high tariffs tend to raise the domestic price of the protected commodities thus enhancing

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[1] See pages 92-94.

[2] Farm incomes can be increased through granting of export duty rebates or subsidizing the use of improved seed varieties and fertilizer [see Spencer and Byerlee, 1976].

their competitive position, resources are eventually transferred from the nonprotected to the protected industries. If resources are less productive in the protected industries than in the non-protected ones, the output values of small scale industries will decline. In the Sierra Leone case, doubling tariffs did not only lead to a 10 percent decline in output values, but foreign exports of small scale industry products (gara cloth) declined by 68 percent.

### 9.6.3 Location Specific Policy Implications

The results of the analysis of comparative advantage revealed that firms in region I of Sierra Leone, i.e., the capital territory of the country, have absolute disadvantages in producing all the small scale industry commodities. Such absolute disadvantages were a result of high rental charges on buildings, electricity bills and wages of hired labor. Therefore, policies which reduce such costs could improve the profitability of urban small scale industries. Most developing countries have created industrial estates as a device for providing buildings and energy supplies for industralists. While, the modern medium sized firms,[1] employing more than ten workers, might be able to utilize such facilities in Sierra Leone it is doubtful if the widely dispersed one to five-man firms, which constitute about 56 percent of all the industral firms in localities with excess of 2,000 people [Chuta and Liedholm, 1975, p. 15], would have access to industrial estates. Therefore, policy instruments which aim at

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[1]The modern bakeries in Sierra Leone are examples of the modern medium-sized firms.

reducing building rentals and electricity charges to urban firms should be structured to reach a widely dispersed target group. In addition, a policy of increasing the legal minimum wages above observed levels of labor productivity affects the wage structures of urban small scale industrial firms and reduces their profitiability and therefore ability to hire more workers.

### 9.6.4 Industry Specific Policy Implications

A significant finding of our analysis is that since a foreign market exists for the products of the gara dyeing industry, gara exports should be aggressively promoted. Several measures have been taken recently in some developing countries to promote the foreign exports of indigenous handicrafts. Exports of handicrafts have been promoted by displaying such products domestically and abroad. For example, the Philippine government includes trade attaches in her foreign embassies [Schippers, 1970]. Recently, the government of Sierra Leone has planned to create an Export Promotion Council which will undertake the analysis of foreign market potentials for local handicrafts such as gara dyeing industry products [Okafor, 1975]. However, there is an important need to eliminate the imperfections that relate to accessibliity[1] to the existing and potential foreign

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[1] During our field survey in Sierra Leone, it was discovered that an African government had impounded about Le 800 worth of gara cloth belonging to one of our respondents for not possessing the appropriate trade documents. Another respondent shipped gara cloth to the U.S.A. by air instead of shipping them by sea. The air mail charges were 53 percent more than sea shipment. Most gara dyers do not recognize that gara cloth could be shipped to the U.S.A. and Europe by parcel post. [Wahlman and Chuta, 1977].

markets both in Africa and European countries. For example, the Small Industries Development organization in Tanzania is assisting small entrepreneurs with advice concerning access to foreign markets and the quality control of products [Tanzania, 1974]. The dissemination of information about foreign markets can be achieved through the institutions of industrial cooperatives or extension services.

An important result of our long run policy analysis is that the blacksmithing industry will become a rural industry.[1] This raises important implications relating to accessibility to some inputs such as iron scrap, iron rails and rail sleepers which are necessary for manufacturing agricultural tools and equipment and are mostly found in urban centers. Due to the scarcity of these inputs in rural areas, their prices have soared in recent years,[2] thus contributing to the lack of viability of the blacksmithing industry.[3] Amidst the scarcity of inputs into the blacksmithing industry, exports of iron scraps into Europe have continued annually. For example, in 1971, Sierra Leone exported about Le 651,000 of iron, steel and nonferrous scrap.[4] There is a need, therefore, to arrange for a steady supply of the necessary inputs such as iron bars and scrap to rural blacksmiths at reasonable prices.

Although our short run and long run policy analyses revealed that by increasing the rate of interest from 10 to 35 percent

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[1]See Table 8.1.

[2]See Chapter 3.

[3]See Liedholm and Chuta [1976] for a discussion on the profitability of small scale industries in Sierra Leone.

[4]See Government of Sierra Leone, Quarterly Trade Statistics.

employment increased in the bakery industry, the accompanying declines in output values indicate an output-employment trade off in the bakery industry.[1] Interest rate policies which are intended to bring about labor-capital substitution, should consider the implications of such a trade off in terms of aggregate bread demand and quality of bread. Other policies for generating both output and employment in the bakery industry could focus on the elimination of the quota on flour imports. This strategy which would reduce the cost of wheat flour by 75 percent, could lead to increases in profits, output and employment, as the results of this study have shown.

### 9.6.5 Further Research Needs

The results of this study have highlighted at least three areas of needed research. These areas of research include working capital needs of small scale entrepreneurs, the computation of elasticities of domestic demand for foreign competing imports and of labor supply and demand, and growth potentials among small scale industries.

Although the linear programming model indicates that fixed capital is not a constraining resource among small scale industries, our model is incapable of assessing the importance of working capital as a productive resource. This limitation of our model is due both to inadequate information on working capital and modeling. More research efforts are needed to collect the relevant data on working capital to enable an improved modelling of the subsector.

In incorporating the foreign trade sector into our linear programming model, perfect elasticity conditions were assumed for

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[1] See Tables 7.4 and 8.3.

the domestic demand for the competing imports of the products of small scale industries. It is likely that the exact nature of these elasticities may affect the magnitude of our results. In order to obtain more realistic results from the linear programming model, it is necessary to investigate the magnitudes of these elasticities. In addition, our 1985 projections of output and employment at different levels of growth rate in labor supply assumed constant money wages. Since these money wages change over time due to changes in minimum wage laws and inflation, they influence the extent to which labor can be absorbed into the subsector. In order to obtain improved results from our model, there is a need to investigate the nature of the demand functions facing different categories of labor in small scale industry. Furthermore, research is required to identify policy interventions that are needed for attracting young school leavers into rural and urban small scale industries.

Finally, since our model is inadequate for predicting realistic growth rates for specific industries and the subsector as a whole, research is needed to investigate the dynamic nature of small scale industries. For example, it is important to verify if profits generated through some policy interventions are reinvested, which industries reinvest profits, and the implications of such reinvestments for employment and output. On the other hand, there is the need to verify which industries disinvest and the implications of such disinvestments for employment and output. The results of these investigations will highlight what the growth patterns will be among small scale industries over time. In addition, our model is inadequate for predicting how the interaction of farm and nonfarm activities

of rural small scale industry entrepreneurs affects the process of rural development. The nature of such interactions needs investigation.

## 9.7 Conclusion

The results of this study have highlighted the impact of alternative policies on the development of small scale industries. First, our analysis suggests that the rate of interest may not be an effective policy of increasing output and employment among small scale industries. Rather, other measures such as granting customs duty rebates, increasing the demand for small scale industry products and the expansion of trained manpower to small scale industries should be relied upon for generating more output and employment among small scale industries. On the other hand, our analysis reveals that a policy of raising the level of tariffs on the competing imported products of small scale industries will distort the pattern of resource allocation among small scale industries with adverse effects on output and/or employment.

Secondly, our analysis has revealed that the comparative disadvantage of large urban small scale industry firms is due to the high rental costs on buildings, electricity charges, and wages of hired labor. We have therefore suggested that any policy efforts aimed at reducing such high costs should be structured to reach a widely dispersed target group.

Thirdly, our findings suggest that producers of export oriented handicrafts such as gara dyers and rural blacksmiths need assistance

on accessibility to foreign markets and steady supplies of iron scrap and iron bars at low costs respectivley.

Finally, this research has highlighted certain issues, both of static and dynamic nature, that require further investigation, in order to improve the results of this study.

# APPENDIX 2.1

## PHASES I AND II QUESTIONNAIRES FOR THE SURVEY OF SMALL SCALE INDUSTRIES IN SIERRA LEONE, 1974/75

Phase I ... Survey of Rural Small Industries

Locality_____ Street, Section or Compound_____ Name of Enumerator_____

DATE _____

| Number (1) | Type of Activity (2) | Identification (3) | Workshop Description | | | | Number of Workers | | | | Number of Machines Used | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Temporary (4) | Mud (5) | Cement (6) | House (7) | Proprietor (8) | Full-time (9) | Apprentice (10) | Total (11) | Powered (12) | Non-powered (13) |
| 1. | | | | | | | | | | | | |
| 2. | | | | | | | | | | | | |
| 3. | | | | | | | | | | | | |
| 4. | | | | | | | | | | | | |
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| 10. | | | | | | | | | | | | |
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| 15. | | | | | | | | | | | | |
| 16. | | | | | | | | | | | | |
| 17. | | | | | | | | | | | | |
| 18. | | | | | | | | | | | | |
| 19. | | | | | | | | | | | | |
| 20. | | | | | | | | | | | | |

FORM RER/SSI 1: INVENTORY OF BUILDINGS (Twice Yearly)

Locality _____ Enterprise _____

Date of Visit _____ NAME OF ENUMERATOR _____

| Establishment No. | Dimension of floor space | Kinds of material built of or description | Year built | Value when built | How much worth if sold now | Monthly rental value | Do you live in this building or premises of building |
|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | |

FORM RLR/SSI:2

## INVENTORY OF EQUIPMENT AND FURNITURE (Twice Yearly)

Locality_____ Enterprise_____ Establishment No._____ Name of Enumerator_____

Date of Visit_____

| Type | No. | Source of Equipment or brand name | Place of purchase | Year bought or made | | | Unit Purchase Price | | How many more years do you expect to use equipment | Price of a new one in 1974 | If sold how much will get for it? | Monthly rental (or imported) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | New | Used | | If bought | If given | | | | |
| | | | | Yr. | Yr. | How old when bought | Le. cents | Le. cents | | Le | Le | Le |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) | (m) |
| | | | | | | | | | | | | |
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FORM MER/SSI: 3 INVENTORY OF MATERIALS AND OUTPUT (Twice Yearly)

LOCALITY_____ ENTERPRISE_____ DATE_____

ESTABLISHMENT NO_____ NAME OF ENUMERATOR_____

| I T E M | Quantity | | Value | |
|---|---|---|---|---|
| | Unit | No. | Rs | Cents |
| (a) | (b) | (c) | (d) | (e) |
| | | | | |
| | | | | |
| | | | |

FORM HER/SSI-4 LABOUR INPUT DATA (Twice Weekly)

1st Day of Visit _____ Locality _____ Enterprise _____ Establishment No. _____

2nd Day of Visit _____ Name of Enumerator _____

| Date | ITEM | Qt. | Date Begun | Date Finished | PROPRIETOR | | | FAMILY LABOUR | | | APPRN-TICES | HIRED LABOUR | | | Wages Paid In | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Enterprise Related | Non-Enterprise Related | | M | F | C | | | | | Cash | ITEM | | Kind | |
| | | | | | Hrs | Type | Hrs | Hrs | Hrs | Hrs | No. | Hrs | No. | Hrs | Le | | Qt. | Value Le | |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) | (m) | (n) | (o) | (p) | (q) | (r) | (s) | |

Form SSI-5 OUTPUT DATA (Twice Weekly)

1st Day of Visit _____ Locality _____ Enterprise _____ Establishment No. _____

2nd Day of Visit _____ Name of Enumerator _____

| TOTAL OUTPUT | | SALES | | | | | Type of Purchaser | Destination of purchase | Consumption within establishment | | GIFTS | | | Amount Stored | | Other Income | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Cash | | Credit | | | | | | | | | | | | | |
| ITEM | Unit | No. | Qt. | Value Le | Qt. | Value Le | | | Qt. | Value Le | Qt. | Value Le | Type of recipient | Location of recipient | Qt. | Value Le | Source | Value Le |
| (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) | (m) | (n) | (o) | (p) | (q) | (r) | (s) | (t) |
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FORM RAR/SSI-6: M I S C E L L A N O U S  I N P U T  D A T A (Weekly)

Date of Visit_____ Locality_____ Enterprise_____ Establishment No._____

Name of Enumerator_____

| I T E M | Origin or Brand Name | C A S H | | | C R E D I T | | | Purchased from | Location of Seller |
|---|---|---|---|---|---|---|---|---|---|
| | | Quantity | | Value | Quantity | | Value | | |
| | | Unit | No. | | Unit | No. | | | |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| 1. Raw Materials: | | | | | | | | | |
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| 2. Lubricants | | | | | | | | | |
| 3. Fuel | | | | | | | | | |
| 4. Transportation | | | | | | | | | |
| 5. Administration - receipt books, attendance book, pen, pencils, etc. | | | | | | | | | |
| 6. Repair | | | | | | | | | |
| 7. Maintenance | | | | | | | | | |
| 8. Spare parts | | | | | | | | | |
| 9. Commission on Sales | | | | | | | | | |
| 10. Tools and equipment | | | | | | | | | |
| 11. Other (specify) | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

FORM R.R/SOI: 6 (Continued)

| ITEM (a) | Origin or Brand (b) | CASH Quantity Unit (c) | CASH Quantity No. (d) | CASH Value (e) | CREDIT Quantity Unit (f) | CREDIT Quantity No. (g) | CREDIT Value (h) | Purchased From (i) | Location of Seller (j) |
|---|---|---|---|---|---|---|---|---|---|
| (MONTHLY) | | | | | | | | | |
| 12. Electricity bill (How many kilowats) | | | | | | | | | |
| 13. Rent on Equipment | | | | | | | | | |
| 14. Rent on Building | | | | | | | | | |
| 15. Telephone Bill | | | | | | | | | |
| 16. Wages and Salaries | | | | | | | | | |
| 17. Water rate | | | | | | | | | |

FORM RER/SSI-7: FINANCIAL INFORMATION (Once Monthly)

LOCALITY_____ ENTERPRISE_____

ESTABLISHMENT NO._____ NAME OF ENUMERATOR_____

DATE OF VISIT_____

| Date of Transaction | Transaction | Amount Le | Duration Yr. | Repayment Date | Amount to be paid Le |
|---|---|---|---|---|---|
| | Sources of Borrowing: | | | | |
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| | Lendings To Whom: | | | | |
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# PHASE II

## SMALL SCALE INDUSTRIES QUESTIONNAIRES

FORM RER/SSI-8 GENERAL CHARACTERISTICS OF ENTERPRENEURS

LOCALITY _____ ENTERPRISE _____

ESTABLISHMENT NO. _____ NAME OF RESPONDENT _____

NAME OF ENUMERATOR _____ DATE OF VISIT _____

NAME OF PROPRIETORS (1) _____

(2) _____ NAME OF MANAGER

(3) _____

1. Nationality _____
2. Tribe _____
3. Age _____
4. Place of birth _____
5. Last place of residence _____
6. Christian/Moslim/Neither _____
7. Single/Married/Separated/Widowed _____
8. Number of Children _____
9. Father's major occupation _____
10. Father's previous occupation _____
11. Mother's Major Occupation _____
12. Mother's previous occupation _____
13. Level of Education:

(a) no schooling Yes ☐ No ☐

(b) level of primary school education completed _____

(c) level of secondary school education completed _____

(d) number of years of adult education _____

(e) Other (specify) _____

14. What other training did you have?

(a) Trade school? Yes ☐ No ☐

(b) Other (specify) _____

15. Which year did you establish this business? _____

16. What were your reasons for joining this business?

(a) hope of making more money (profits)? Yes ☐ No ☐

(b) family enterprise? Yes ☐ No ☐

(c) previous experience? Yes ☐ No ☐

(d) Father's major occupation? Yes ☐ No ☐

(e) Prestige among my people? Yes ☐ No ☐

(f) Personal security? Yes ☐ No ☐

(g) Other (specify) _____

17. Were you apprenticed before? Yes ☐ No ☐

18. If yes, in which enterprise? _____

19 And for how long? _____

19. What form of ownership is your business?

(a) individual Yes ☐ No ☐

(b) partnership Yes ☐ No ☐

(c) Cooperative Yes ☐ No ☐

(d) private company Yes ☐ No ☐

(e) family Yes ☐ No ☐

20. How much initial capital did you have to start this business?

Le _____

21. What were the sources of this initial capital?

| | | |
|---|---|---|
| (a) | Personal savings from | How much? |
| | ( i) Agriculture | Le _____ |
| | ( ii) Government Employment | _____ |
| | ( iii) Trade | _____ |
| | ( iv) Business | _____ |
| | ( v) Other (specify) | _____ |
| (b) | Loans from | |
| | ( i) Commercial Banks | _____ |
| | ( ii) Government Development Bank | _____ |
| | ( iii) African Development Bank | _____ |
| | ( iv) Friends | _____ |
| | ( v) Money Lenders | _____ |
| | ( vi) Family | _____ |
| | ( vii) Cooperatives | _____ |
| | (viii) OSUSU | _____ |
| | ( ix) Others (specify) | _____ |
| (c) | Gifts | _____ |
| (d) | Partnership | _____ |
| (e) | Others (specify) | _____ |

22. Since you established this business, have you increased your original size?

Yes ☐ No ☐

If yes, what were the sources of the funds used for the expansion and how much?

| Source | | How much? |
|---|---|---|
| (a) | Reinvested profits? | Le _____ |
| (b) | Got loans from government development bank? | _____ |
| (c) | Got loans from commercial banks? | _____ |
| (d) | Got loans from the cooperatives | _____ |
| (e) | Got loans from money lenders | _____ |
| (f) | Other (specify) _____ | |

23. Do you plan to expand this business in the next one year? Yes ☐ No ☐

24. From what sources do you expect to get the funds for this future expansion?

(a) Reinvestment of profits _____

(b) Loan from the government _____

(c) Loan from commercial banks _____

(d) OSUSU _____

(e) Others (specify) _____

25. How many hours do you work every day? _____

26. If you had enough customers to purchase all your products and you had all the raw materials you needed, with your existing equipments and buildings:

(a) How many more hours would you work? _____

(b) How many more workers would you hire? _____

27. Have you ever applied for government assistance? Yes ☐ No ☐

28. If yes did you obtain the assistance? Yes ☐ No ☐

29. Into what uses did you put the assistance?

(a) Buy new equipments Yes ☐ No ☐

(b) Provide working capital Yes ☐ No ☐

(c) Set up buildings Yes ☐ No ☐

(d) Other (specify) Yes ☐ No ☐

30. If you have not applied for government assistance, why not?

_____

_____

31. What types of assistance do you think that the government should give to business men?

(a) _____

(b) _____

(c) _____

32. Has your output increased, decreased or remained the same compared with:

(a) Last one year? _____

(b) Last five years? _____

33. What of the following changes have taken place since your firm was established?

(a) Established other branches? Yes ☐ No ☐

(b) Expanded your original size? Yes ☐ No ☐

(c) Rebuilt your establishment? Yes ☐ No ☐

(d) Bought better machines? Yes ☐ No ☐

(e) Introduced a new product? Yes ☐ No ☐

(f) Introduced better marketing arrangements? Yes ☐ No ☐

34. What have been the difficulties in building up this business?

(a) Insufficient demand _____

(b) Lack of technical advice _____

(c) Troubles with equipment _____

(d) Lack of skilled labor _____

(e) Poor transport facilities _____

(f) Lack of capital _____

(g) Scarcity of materials _____

(h) Scarcity of spare parts _____

(i) High cost of equipments and materials _____

(j) Other (specify) _____

35. Which of the above is the greatest difficulty? _____

_____

36. What is the duration of apprenticeship in this business?

_____

37. Do you charge any learning fee? Yes ☐ No ☐

38. If yes, how much? Le _____

39. Has the number of firms in your industry in this locality <u>increased</u>, <u>decreased</u> or <u>remained the same</u> compared with:

(a) Last one year? _____

(b) Last five years? _____

40. Do you keep record of your purchases and sales? Yes ☐ No ☐

41. If no, why not? _____

_____

42. If yes, what record books do you have?

(a) _____

(b) _____

(c) _____

43. How often do you try to find out if you are gaining or losing in your business?

(a) Everyday? Yes ☐ No ☐

(b) Once a week? Yes ☐ No ☐

(c) Once every two weeks? Yes ☐ No ☐

(d) Once a month? Yes ☐ No ☐

(e) Other (specify) _____ Yes ☐ No ☐

(f) None of the above _____

44. Do you have an account in any bank? Yes ☐ No ☐

45. If yes, what type of account?

Savings account? Yes ☐ No ☐

Current account? Yes ☐ No ☐

46. Have you ever attempted to obtain loans from any bank? Yes ☐ No ☐

47. If yes, did you get the loan? Yes ☐ No ☐

48. If you have not attempted to borrow money from any bank, why not?

_____

_____

# APPENDIX 2.2

# ORGANIZATION OF FIELD WORK, DATA COLLECTION, HANDLING AND PROCESSING

## APPENDIX 2.2

## ORGANIZATION OF FIELD WORK, DATA COLLECTION, HANDLING AND PROCESSING

The purpose of this appendix is to describe how the field work of data collection for small scale industries in Sierra Leone was organized, and to explain how some of the logistical problems were overcome. Therefore topics that would be discussed include: (1) the recruitment and training of enumerators, (2) the placement of enumerators in the field, (3) frequency of visits to respondents, (4) distribution of work load, (5) supervision of field work, and (6) data handling and processing. Each of these topics will now be discussed in greater detail.

### 1. Recruitment[1] and Training of Enumerators

A two stage procedure was used to select the enumerators. In the first stage, all candidates were interviewed and information relating to academic credentials, letters of recommendations, ability to speak native languages, previous job experience, and attitudes were considered. In most cases, a high school qualification was the minimum that was required for considering the recruitment of an enumerator. An enumerator must speak the language of the proprietor he is interviewing although it is not advisable that he be a resident of the same area. So long as they speak the local language, enumerators seem to have little difficulty being accepted by the host

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[1]The recruitment and training of enumerators for the small scale industry study were undertaken along side the other studies in the Rural Employment Research Project (see footnote on page 29 ).

community. After this first stage of recruitment, successful candidates were announced and admitted into a general training course.

The general training period lasts for approximately two weeks. At the end of the general training period, the candidates were given a written test after which successful ones were assigned to the studies in which they performed best. These successful candidates were then given a final intensive and specialized training for another three to seven days before being assigned to the field. Since supervisors cannot always be available to enumerators, the enumerators were provided with reference manuals in which the survey instruments and methods are explained in detail.

## 2. Placement of Enumerators in the Field

Usually, enumerators were placed in their respective localities by the senior officials of the research project. On arriving at the locality, the enumerators were introduced to the paramount chief, the town chief or the town speaker. This introduction was followed by the assembling together of the section chiefs and elders to welcome the enumerator into the community. At this time, the senior research officer emphasized the advantages of the study and asked for the cooperation of the chief and his community. Most of the time, it became the responsibility of the chief and his men to provide accommodation for enumerators. After being settled in the community, the enumerator took responsibility for identifying his respondents, establishing rapport with them, and starting data collection.

### 3. Frequency of Visits

Each of the questionnaires that was used to obtain stock data was administered at the beginning and at the end of the survey period. This procedure enabled us to obtain accurate information not only with respect to the stock of existing assets, but also concerning what changes (net investment) may have taken place over the one year period.

Since it was considered at the time of the survey that most of our respondents traditionally did not keep records of their transactions, the length of memory recall became of primary consideration in collecting our daily input-output data. On the basis of the results derived from the pretesting of the questionnaire, we decided to interview respondents twice every week in order to gather data on daily hours input and output. On each day, data were obtained for the previous four days starting with the latest and leading on to the earliest date. This way, data were collected for eight days each week, with one day overlap. The one day overlap was necessary to check response consistency, and to necessitate the enumerator probing of the respondent, where inconsistent response was suspected. More frequent visits tended to disrupt the activities of the entrepreneurs and thus engender lack of cooperation. On the other hand, longer periods of memory recall tended to generate very unreliable data, particularly, with respect to daily hours actually worked and output.

Also, on the basis of the pretesting of questionnaires, we found that respondents could recall how much they had spent on all categories of intermediate inputs in the last one week. In

connection with financial transactions, we found that entrepreneurs could recall how much money was borrowed, lent out, saved, paid in wages, house and equipment rents, electricity bills, taxes and water rates in the last one month. Therefore, information concerning all intermediate inputs and financial transactions were collected weekly and monthly respectively. The weekly material input questionnaire was administered on the last day of visit each week to each respondent while the monthly financial input questionnaire was administered on the first day of visit to each respondent during each month (see the accompanying schedule of monthly distribution of workload).

## 4. Distribution of Work-Load

In each of the 24 enumeration areas, (localities with less than 2,000 people) each enumerator was responsible for gathering data from four small scale industry households in addition to the twenty farm households. This workload was considered to be adequate in view of the seasonal nature of farm activity and the supposedly lower volume of industrial production in the enumeration areas.

In all localities with above 2,000 people, the distribution of work-load was different. In the four localities with greater than 20,000 people, we selected thirty industrial firms and placed two of our enumerators there. Thus each of our enumerators worked half time with fifteen respondents. In each of the localities with 2,000 to 20,000 people, we selected fifteen respondents and placed one enumerator to interview them, also on a half-time basis. Because of the integrated nature of the Sierra Leone project, our small scale industry enumerators also worked half-time collecting information

## A.2 A Schedule for the Distribution of Workload for Two Hypothetical Months

| Questionnaire | Date | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| | Week Day | | | | | | | | | | | | | | | | | | | | |
| | M | T | W | T | F | S | S | M | T | W | T | F | S | S | M | T | W | T | F | S | S |
| | First Week in Locality | | | | | | | | | | | | | | | | | | | | |
| Building stock | $X^A$ | $X^A$ | $X^B$ | $X^B$ | $X^C$ | $X^C$ | | | | | | | | | | | | | | | |
| Equipment stock | $X^A$ | $X^A$ | $X^B$ | $X^B$ | $X^C$ | $X^C$ | | | | | | | | | | | | | | | |
| Output and material stock | $X^A$ | $X^A$ | $X^B$ | $X^B$ | $X^C$ | $X^C$ | | | | | | | | | | | | | | | |
| Daily labor input | | | | | | | | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | |
| Daily output | | | | | | | | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | Rest | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | Rest |
| Weekly material input | | | | | | | | | | | $X_7^A$ | $X_7^B$ | $X_7^C$ | | | | | $X_7^A$ | $X_7^B$ | $X_7^C$ | |
| Monthly financial input | | | | | | | | | | | | | | | | | | | | | |
| Entrepreneurial characteristics | As soon as sufficient rapport is established with respondents | | | | | | | | | | | | | | | | | | | | |

Note: a) X means fill out a particular (row) questionnaire for a particular (column) date.
b) Superscript alphabet means particular firm group for which particular (row) questionnaires are to be filled for a particular (column) date.
c) Subscript means the length of memory recall for which the particular row questionnaire has to be completed for the particular commun date.
d) Week days start on Monday (1st) for the first month and end on Saturday (1st) for the second hypothetical month.

A.2 (Continued)

| Questionnaire | Date | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | Week Day | | | | | | | | | | | | | | | | | | | | |
| | M | T | W | T | F | S | S | M | T | W | T | F | S | S | M | T | W | T | F | S | S |
| Building stock | | | | | | | | | | | | | | | | | | | | | |
| Equipment stock | | | | | | | | | | | | | | | | | | | | | |
| Output and material stock | | | | | | | | | | | | | | | | | | | | | |
| Daily labor input | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | |
| Daily output | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | Rest | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | Rest | $X_4^A$ | $X_4^B$ | $X_4^C$ | $X_4^A$ | $X_4^B$ | $X_4^C$ | Rest |
| Weekly material input | | | | $X_7^A$ | $X_7^B$ | $X_7^C$ | | | | | $X_7^A$ | $X_7^B$ | $X_7^C$ | | | | | $X_7^A$ | $X_7^B$ | $X_7^C$ | |
| Monthly financial input | | | | | | | | | | | $X_{30}^A$ | $X_{30}^B$ | $X_{30}^C$ | | | | | | | | |
| Entrepreneurial characteristics | As soon as sufficient rapport is established with respondents | | | | | | | | | | | | | | | | | | | | |

A.2 (Continued)

| Questionnaire | Date | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 13 | 14 | 15 | 6 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| | Week Day | | | | | | | | | | | | | | | | | | | |
| | M | T | W | T | F | S | S | M | T | W | T | F | S | S | M | T | W | T | F | S |
| Building stock | | | | | | | | | | | | | | | | | | | | |
| Equipment stock | | | | | | | | | | | | | | | | | | | | |
| Output and material stock | | | | | | | | | | | | | | | | | | | | |
| Daily labor input | $x_4^A$ | $x_4^B$ | $x_4^C$ | $x_4^A$ | $x_4^B$ | $x_4^C$ | | $x_4^A$ | $x_4^B$ | $x_4^C$ | $x_4^A$ | $x_4^B$ | $x_4^C$ | | $x_4^A$ | $x_4^B$ | $x_4^C$ | $x_4^A$ | $x_4^B$ | $x_4^C$ |
| Daily output | $x_4^A$ | $x_4^B$ | $x_4^C$ | $x_4^A$ | $x_4^B$ | $x_4^C$ | Rest | $x_4^A$ | $x_4^B$ | $x_4^C$ | $x_4^A$ | $x_4^B$ | $x_4^C$ | Rest | $x_4^A$ | $x_4^B$ | $x_4^C$ | $x_4^A$ | $x_4^B$ | $x_4^C$ |
| Weekly material input | | | | $x_7^A$ | $x_7^B$ | $x_7^C$ | | | | | $x_7^A$ | $x_7^B$ | $x_7^C$ | | | | | $x_7^A$ | $x_7^B$ | $x_7^C$ |
| Monthly financial input | | | | | | | | | | | | | | | | | | | | |
| Entrepreneurial characteristics | As soon as sufficient rapport is established with respondents | | | | | | | | | | | | | | | | | | | |

relating to rice processing and market prices.

Since each enumerator was to interview fifteen small scale industry respondents, visiting each respondent twice weekly, the respondents in each locality were divided into three groups--A, B and C--according to proximity. Thus, it was possible (as shown in the schedule) to visit each group of respondents twice out of 7 days of the week. Moreover this arrangement facilitated the supervision of field work since it was easy to know which respondents would be interviewed on particular days of the month. During the early part of the field survey, schedules of monthly distribution of workload, (as has been illustrated in the schedule) were distributed to all the enumerators to ensure that all respondents were visited according to schedule, and that the right questionnaires were being administered.

## 5. Supervision of Field Work

The reliability of data collected during a field survey depends most importantly on the quality of field supervision that accompanies the process of data collection. The process of data collection for the small scale industry study was supervised within the framework of the overall supervisory arrangement of the Sierra Leone project. Different kinds of field supervision were done with different intensities and at different points in time.

In order to pay salaries and also correct the mistakes that occurred in the process of data collection, routine monthly visits were made to the different localities, where our enumerators were posted. In addition to routine monthly visits, surprise visits

were made to ensure that enumerators stayed in their respective localities, to do their jobs. Also, spot checks were carried out on enumerators to verify that the right kinds of questions were being asked. Finally, frequent visits were made to ensure continuity in the data collection process. Frequent visits were made during festive occasions, weekends and immediately after the payment of monthly salaries. At these times, most enumerators were highly tempted to travel out of their localities, quite to the detriment of data collection. Usually, enumerators could travel out of their localities provided they obtained prior approval from the head office.

### 6. Data Handling, Storage and Processing

According to our original estimation, a total of 2,970 sets of questionnaires were to be filled out for 270 respondents in the small scale industry study between August 1974 and June 1975. Each monthly set of questionnaires for every establishment contained ten sheets of paper. By our calculation, 2,970 sets of questionnaires were to generate a total of about 143,600 computer cards. Such an amount of data suggested making adequate arrangements for advance printing and collation of questionnaires, delivery of questionnaires to field enumerators, receiving completed questionnaires, sorting and stacking them at the head office for immediate editing, coding, keypunching, verification and magnetic taping of data for shipment to the United States. The amount of data anticipated, necessitated providing adequate office accommodations, equipment and materials, and strong logistical support. The different aspects of data handling and processing will now be discussed.

a. Questionnaire Handling

The delivery of sets of questionnaires to field enumerators, and the recovery of completed ones were done within the overall logistical arrangement of the project. Close to the end of each month, trips were planned to different parts of the country for the purpose of paying salaries of enumerators and checking the completed questionnaires for errors. Before such trips, bundles containing sets of questionnaires for each enumerator in each locality were prepared. During the trips, these bundles were distributed and completed questionnaires were recovered simultaneously and checked. On arrival at the office, questionnaires were sorted by localities from which they were collected and re-checked at the office to ensure that each set had the correct identification number, and any errors that skipped field supervision were detected immediately. Control books were utilized to record any problems the enumerators might have had in the field with respect to supply of materials, problem of cooperation, etc. After completed questionnaires were edited and corrected, they were stacked and ready for coding.

b. The Coding Scheme

The coding scheme that was adopted by the project and therefore used by each study component uniquely identifies each computer card. Data were coded from completed and edited questionnaires straight on to coding sheets similar to the fortran coding forms with 80 columns. The coding was done by a clerical staff of six individuals, specially recruited and trained for the coding purpose.

The least qualified of the clerical staff possessed a high school certificate. All the coding was done under strict supervision. To facilitate the coding process, a special coding manual had to be written to describe very precisely what was to be done. In developing the codes, enough familiarity was established with items that were involved in each enterprise and for different localities. Thus codes were developed for localities, establishments, stock items, flow items, measurement units, sources of inputs, destination of output, types of recipients, etc. After assembling the item codes, tables were developed to identify each column of the card with item codes or quantities or values for each class of data.

After the coding was done, random checks were undertaken to ensure that the correct codes were being used in the right columns, that each firm was correctly identified, and that all the data were being coded. After the edit work, coded sheets were submitted for keypunching in Freetown. Some of the keypunched data were automatically verified. Others were verified manually. Errors were corrected and omissions incorporated and re-verified. All keypunched data were put on magnetic tape and shipped to Michigan State University.

c. Data Processing

The next stage in data handling was data processing to ensure that data were good enough for analysis. This involved writing edit programs to check for correct dates and item codes, missing quantities and values and identification numbers. It also involved matching dates and identification numbers for different data

categories to check for inconsistencies. For example, we tried to find out if there existed labor data for which there were no corresponding output data or stock data or material input data and vice versa. The edit programs were written by specialized staff of the computer center at Michigan State University. After the edit programs were run through the computer, all the necessary corrections were made on raw data listings and re-run to ensure that optimum consistency had been achieved. Several re-runs were done before this optimum was arrived at. Final stages of data processing before the start of analysis included annualization of data.

d. Annualization of Data

The annulization of data was necessary for several reasons. First, for most firms, data were not collected for all days of the first and last months. Secondly, the survey did not run for complete twelve months of the year. Thirdly, there existed some obvious cases of missing data, the values of which had to be inputed. In order to obtain complete data for the first and the last months, daily averages had to be utilized for each firm based on when data collection began and ended for that particular firm. In order to substitute for missing data we relied essentially on monthly indices that were constructed from the input-output data of the firms that stayed on the survey for ten to eleven months. Separate indicies were constructed for specific regional and industry categories. The data for July 1975 were obtained as follows. Respondents were asked by June 1975 to indicate whether July input or output would remain the same or increase or decrease as compared to June

data. The answer varied of course depending on locality and type of enterprise. The problem here was how to determine the magnitude of rise or fall. In order to solve this problem, the average monthly changes between April and June were used to scale each firm's June data up or down in order to obtain the July data. If July data was anticipated to remain the same as June data, then no adjustments were required.

e. Standard Data Files

After data processing had been completed, we created ten standard data files. Each such binary file provided a storage for all the information contained in each questionnaire. Every time each binary file was updated, corrected, indexed or adjusted, the old file was purged, thus, keeping each file in a current status. Relevant information could therefore be pooled from specified files in order to carry out the various kinds of analysis.

# APPENDIX 5

# THE LINEAR PROGRAMMING TABLEAU

The Linear Programming Tableau - Region 1

| Row Number | Column Name / Row Name | Unit | Production Activities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Tailoring | | | Gara Dyeing | | | Carpentry | | Black-smithing | Bakery |
| | | | P111 | P112 | P113 | P311 | P312 | P313 | P411 | P412 | P511 | P811 |
| 1 | Objective Function | le. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | F11 | hrs. | 1417 | 980 | 1945 | | | | | | | |
| 3 | H11 | " | 0 | 815 | 44 | | | | | | | |
| 4 | A11 | " | 500 | 9 | 5045 | | | | | | | |
| 5 | M11 | le. | 382 | 536 | 469 | | | | | | | |
| 6 | Z11 | le. | 225 | 408 | 243 | | | | | | | |
| 7 | F31 | hrs. | | | | 1815 | 1380 | 1286 | | | | |
| 8 | H31 | " | | | | 805 | 20 | 422 | | | | |
| 9 | A31 | " | | | | 0 | 44 | 0 | | | | |
| 10 | M31 | le. | | | | 3348 | 6320 | 2263 | | | | |
| 11 | Z31 | le. | | | | 264 | 70 | 18 | | | | |
| 12 | F41 | hrs. | | | | | | | 1711 | 1375 | | |
| 13 | H41 | " | | | | | | | 0 | 3918 | | |
| 14 | A41 | " | | | | | | | 17,124 | 0 | | |
| 15 | M41 | le. | | | | | | | 1340 | 7749 | | |
| 16 | Z41 | le. | | | | | | | 345 | 1088 | | |
| 17 | F51 | hrs. | | | | | | | | | 446 | |
| 18 | H51 | " | | | | | | | | | 0 | |
| 19 | A51 | " | | | | | | | | | 775 | |
| 20 | M51 | le. | | | | | | | | | 560 | |
| 21 | Z51 | le. | | | | | | | | | 552 | |
| 22 | F81 | hrs. | | | | | | | | | | 3672 |
| 23 | H81 | " | | | | | | | | | | 48,486 |
| 24 | A81 | " | | | | | | | | | | 0 |
| 25 | M81 | le. | | | | | | | | | | 86,148 |
| 26 | Z81 | le. | | | | | | | | | | 7168 |
| 27 | LF1 | hrs. | | | | | | | | | | |
| 28 | LH1 | " | | | | | | | | | | |
| 29 | LA1 | " | | | | | | | | | | |
| 30 | M1 | le. | | | | | | | | | | |
| 31 | Z1 | le. | | | | | | | | | | |
| 32 | Y1 | le. | -1011 | -1073 | -3285 | -6591 | -8077 | -3316 | -4567 | -9492 | -1008 | -118,569 |
| 33 | S111 | no. | 1 | | | | | | | | | |
| 34 | Y111 | " | 1 | | | | | | | | | |
| 35 | S112 | " | | 1 | | | | | | | | |
| 36 | U112 | " | | 1 | | | | | | | | |
| 37 | S113 | " | | | 1 | | | | | | | |
| 38 | U113 | " | | | 1 | | | | | | | |
| 39 | E311 | " | | | | 1 | | | | | | |
| 40 | S312 | " | | | | | 1 | | | | | |
| 41 | U312 | " | | | | | 1 | | | | | |
| 42 | E313 | " | | | | | | 1 | | | | |
| 43 | S411 | " | | | | | | | 1 | | | |
| 44 | U411 | " | | | | | | | 1 | | | |
| 45 | S412 | " | | | | | | | | 1 | | |
| 46 | U412 | " | | | | | | | | 1 | | |
| 47 | S511 | " | | | | | | | | | 1 | |
| 48 | U511 | " | | | | | | | | | 1 | |
| 49 | S811 | " | | | | | | | | | | 1 |
| 50 | U811 | " | | | | | | | | | | 1 |
| 51 | D11 | le. | 1011 | 1073 | 3285 | | | | | | | |
| 52 | D13 | " | | | | 6591 | 8077 | 3316 | | | | |
| 53 | D14 | " | | | | | | | 4567 | 9492 | | |
| 54 | D15 | " | | | | | | | | | 1008 | |
| 55 | D18 | " | | | | | | | | | | 118,569 |

(Continued)

The Linear Programming Tableau - Region 1

| Row Number | Column Name / Row Name | Unit | Labor Hiring Activities | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | LF11 | LH11 | LA11 | LP31 | LH31 | LA31 | LF41 | LH41 | LA41 | LF51 | LH51 | LA51 | LF81 | LH81 | LA81 |
| 1 | Objective Function | le. | -.35 | -.1 | -.02 | -.84 | -.15 | -.01 | -.51 | -.2 | -.12 | -.30 | -.15 | -.08 | -.54 | -.15 | -.08 |
| 2 | F11 | hrs. | -1 | | | | | | | | | | | | | | |
| 3 | H11 | " | | -1 | | | | | | | | | | | | | |
| 4 | A11 | " | | | -1 | | | | | | | | | | | | |
| 5 | M11 | le. | | | | | | | | | | | | | | | |
| 6 | Z11 | le. | | | | | | | | | | | | | | | |
| 7 | F31 | hrs. | | | | -1 | | | | | | | | | | | |
| 8 | H31 | " | | | | | -1 | | | | | | | | | | |
| 9 | A31 | " | | | | | | -1 | | | | | | | | | |
| 10 | M31 | le. | | | | | | | | | | | | | | | |
| 11 | Z31 | le. | | | | | | | | | | | | | | | |
| 12 | F41 | hrs. | | | | | | | -1 | | | | | | | | |
| 13 | H41 | " | | | | | | | | -1 | | | | | | | |
| 14 | A41 | " | | | | | | | | | -1 | | | | | | |
| 15 | M41 | le. | | | | | | | | | | | | | | | |
| 16 | Z41 | le. | | | | | | | | | | | | | | | |
| 17 | F51 | hrs. | | | | | | | | | | -1 | | | | | |
| 18 | H51 | " | | | | | | | | | | | -1 | | | | |
| 19 | A51 | " | | | | | | | | | | | | -1 | | | |
| 20 | M51 | le. | | | | | | | | | | | | | | | |
| 21 | Z51 | le. | | | | | | | | | | | | | | | |
| 22 | F81 | hrs. | | | | | | | | | | | | | -1 | | |
| 23 | H81 | " | | | | | | | | | | | | | | -1 | |
| 24 | A81 | " | | | | | | | | | | | | | | | -1 |
| 25 | M81 | le. | | | | | | | | | | | | | | | |
| 26 | Z81 | le. | | | | | | | | | | | | | | | |
| 27 | LF1 | hrs. | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | |
| 28 | LH1 | " | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | |
| 29 | LA1 | " | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 |
| 30 | M1 | le. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 31 | Z1 | le. | | | | | | | | | | | | | | | |
| 32 | Y1 | le. | | | | | | | | | | | | | | | |
| 33 | S111 | no. | | | | | | | | | | | | | | | |
| 34 | Y111 | " | | | | | | | | | | | | | | | |
| 35 | S112 | " | | | | | | | | | | | | | | | |
| 36 | U112 | " | | | | | | | | | | | | | | | |
| 37 | S113 | " | | | | | | | | | | | | | | | |
| 38 | U113 | " | | | | | | | | | | | | | | | |
| 39 | E311 | " | | | | | | | | | | | | | | | |
| 40 | S312 | " | | | | | | | | | | | | | | | |
| 41 | U312 | " | | | | | | | | | | | | | | | |
| 42 | E313 | " | | | | | | | | | | | | | | | |
| 43 | S411 | " | | | | | | | | | | | | | | | |
| 44 | U411 | " | | | | | | | | | | | | | | | |
| 45 | S412 | " | | | | | | | | | | | | | | | |
| 46 | U412 | " | | | | | | | | | | | | | | | |
| 47 | S511 | " | | | | | | | | | | | | | | | |
| 48 | U511 | " | | | | | | | | | | | | | | | |
| 49 | S811 | " | | | | | | | | | | | | | | | |
| 50 | U811 | " | | | | | | | | | | | | | | | |
| 51 | D11 | le. | | | | | | | | | | | | | | | |
| 52 | D13 | " | | | | | | | | | | | | | | | |
| 53 | D14 | " | | | | | | | | | | | | | | | |
| 54 | D15 | " | | | | | | | | | | | | | | | |
| 55 | D18 | " | | | | | | | | | | | | | | | |

(Continued)

The Linear Programming Tableau - Region 1

| Row Number | Column Name / Row Name | Unit | Material Input Activities | | | | | Capital Activities | | | | | Income Activity | RHS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | M11 | M31 | M41 | M51 | M81 | Z11 | Z31 | Z41 | Z51 | Z81 | CY1 | |
| 1 | Objective Function | le. | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 1 | = 0 |
| 2 | F11 | hrs. | | | | | | | | | | | | ≤ 0 |
| 3 | H11 | " | | | | | | | | | | | | ≤ 0 |
| 4 | A11 | " | | | | | | | | | | | | ≤ 0 |
| 5 | M11 | le. | -1 | | | | | | | | | | | = 0 |
| 6 | Z11 | le. | | | | | | -1 | | | | | | ≤ 0 |
| 7 | F31 | hrs. | | | | | | | | | | | | ≤ 0 |
| 8 | H31 | " | | | | | | | | | | | | ≤ 0 |
| 9 | A31 | " | | | | | | | | | | | | ≤ 0 |
| 10 | M31 | le. | | -1 | | | | | | | | | | = 0 |
| 11 | Z31 | le. | | | | | | | -1 | | | | | ≤ 0 |
| 12 | F41 | hrs. | | | | | | | | | | | | ≤ 0 |
| 13 | H41 | " | | | | | | | | | | | | ≤ 0 |
| 14 | A41 | " | | | | | | | | | | | | ≤ 0 |
| 15 | M41 | le. | | | -1 | | | | | | | | | = 0 |
| 16 | Z41 | le. | | | | | | | | -1 | | | | ≤ 0 |
| 17 | F51 | hrs. | | | | | | | | | | | | ≤ 0 |
| 18 | H51 | " | | | | | | | | | | | | ≤ 0 |
| 19 | A51 | " | | | | | | | | | | | | ≤ 0 |
| 20 | M51 | le. | | | | -1 | | | | | | | | = 0 |
| 21 | Z51 | le. | | | | | | | | | -1 | | | ≤ 0 |
| 22 | F81 | hrs. | | | | | | | | | | | | ≤ 0 |
| 23 | H81 | " | | | | | | | | | | | | ≤ 0 |
| 24 | A81 | " | | | | | | | | | | | | ≤ 0 |
| 25 | M81 | le. | | | | | -1 | | | | | | | = 0 |
| 26 | Z81 | le. | | | | | | | | | | -1 | | ≤ 0 |
| 27 | LF1 | hrs. | | | | | | | | | | | | ≤ 1,783,616 |
| 28 | LH1 | " | | | | | | | | | | | | ≤ 745,448 |
| 29 | LA1 | " | | | | | | | | | | | | ≤ 2,049,534 |
| 30 | M1 | le. | 1 | 1 | 1 | 1 | 1 | | | | | | | ≥ 0 |
| 31 | Z1 | le. | | | | | | 1 | 1 | 1 | 1 | 1 | | ≤ 339,397 |
| 32 | Y1 | le. | | | | | | | | | | | 1 | = 0 |
| 33 | S111 | no. | | | | | | | | | | | | ≥ 463 |
| 34 | Y111 | " | | | | | | | | | | | | ≤ 565 |
| 35 | S112 | " | | | | | | | | | | | | ≥ 125 |
| 36 | U112 | " | | | | | | | | | | | | ≤ 153 |
| 37 | S113 | " | | | | | | | | | | | | ≥ 147 |
| 38 | U113 | " | | | | | | | | | | | | ≤ 179 |
| 39 | E311 | " | | | | | | | | | | | | = 40 |
| 40 | S312 | " | | | | | | | | | | | | ≥ 41 |
| 41 | U312 | " | | | | | | | | | | | | ≤ 18 |
| 42 | E313 | " | | | | | | | | | | | | = 1 |
| 43 | S411 | " | | | | | | | | | | | | ≥ 50 |
| 44 | U411 | " | | | | | | | | | | | | ≤ 62 |
| 45 | S412 | " | | | | | | | | | | | | ≥ 17 |
| 46 | U412 | " | | | | | | | | | | | | ≤ 21 |
| 47 | S511 | " | | | | | | | | | | | | ≥ 11 |
| 48 | U511 | " | | | | | | | | | | | | ≤ 13 |
| 49 | S811 | " | | | | | | | | | | | | ≥ 10 |
| 50 | U811 | " | | | | | | | | | | | | ≤ 12 |
| 51 | D11 | le. | | | | | | | | | | | | = 1,817,814 |
| 52 | D13 | " | | | | | | | | | | | | = 46,180 |
| 53 | D14 | " | | | | | | | | | | | | = 415,440 |
| 54 | D15 | " | | | | | | | | | | | | = 12,588 |
| 55 | D18 | " | | | | | | | | | | | | = 1,173,833 |

The Linear Programming Tableau - Region II

| Row Number | Column Name | | Production Activities | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Tailoring | | | | Gara Dyeing | | | Carpentry | | | Black-smithing | | Bakery | | |
| | Row Name | Unit | P121 | P122 | P123 | P124 | P321 | P322 | P323 | P421 | P422 | P413 | P521 | P522 | P821 | P822 | P823 |
| | Objective Function | le. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | F12 | hrs. | 644 | 833 | 1148 | 927 | | | | | | | | | | | |
| 57 | H12 | " | 0 | 58 | 0 | 1 | | | | | | | | | | | |
| 58 | A12 | " | 130 | 266 | 990 | 1122 | | | | | | | | | | | |
| 59 | M12 | le. | 99 | 111 | 615 | 306 | | | | | | | | | | | |
| 60 | Z12 | le. | 101 | 59 | 180 | 343 | | | | | | | | | | | |
| 61 | F32 | hrs. | | | | | 1815 | 1780 | 1286 | | | | | | | | |
| 62 | H32 | " | | | | | 805 | 118 | 422 | | | | | | | | |
| 63 | A32 | " | | | | | 0 | 0 | 0 | | | | | | | | |
| 64 | M32 | le. | | | | | 3201 | 916 | 2200 | | | | | | | | |
| 65 | Z32 | le. | | | | | 264 | 24 | 18 | | | | | | | | |
| 66 | F42 | hrs. | | | | | | | | 1238 | 1626 | 775 | | | | | |
| 67 | H42 | " | | | | | | | | 91 | 326 | 1127 | | | | | |
| 68 | A42 | " | | | | | | | | 3980 | 19956 | 3381 | | | | | |
| 69 | M42 | le. | | | | | | | | 807 | 6080 | 2647 | | | | | |
| 70 | Z42 | le. | | | | | | | | 162 | 240 | 1950 | | | | | |
| 71 | F52 | hrs. | | | | | | | | | | | 1124 | 190 | | | |
| 72 | H52 | " | | | | | | | | | | | 70 | 1338 | | | |
| 73 | A52 | " | | | | | | | | | | | 953 | 589 | | | |
| 74 | M52 | le. | | | | | | | | | | | 130 | 520 | | | |
| 75 | Z52 | le. | | | | | | | | | | | 120 | 1020 | | | |
| 76 | F82 | hrs. | | | | | | | | | | | | | 1040 | 72 | 1032 |
| 77 | H82 | " | | | | | | | | | | | | | 7223 | 14528 | 3140 |
| 78 | A82 | " | | | | | | | | | | | | | 927 | 0 | 0 |
| 79 | M82 | le. | | | | | | | | | | | | | 16,362 | 14,356 | 2728 |
| 80 | Z82 | le. | | | | | | | | | | | | | 6824 | 912 | 114 |
| 81 | LF2 | hrs. | | | | | | | | | | | | | | | |
| 82 | LH2 | " | | | | | | | | | | | | | | | |
| 83 | LA2 | " | | | | | | | | | | | | | | | |
| 84 | M2 | le. | | | | | | | | | | | | | | | |
| 85 | Z2 | le. | | | | | | | | | | | | | | | |
| 86 | Y2 | le. | -634 | -771 | -1870 | -2341 | -6591 | -2518 | -3316 | -6956 | -9614 | -9496 | -975 | -1042 | -32,538 | -28,419 | -5016 |
| 87 | S121 | no. | 1 | | | | | | | | | | | | | | |
| 88 | U121 | " | 1 | | | | | | | | | | | | | | |
| 89 | S122 | " | | 1 | | | | | | | | | | | | | |
| 90 | U122 | " | | 1 | | | | | | | | | | | | | |
| 91 | S123 | " | | | 1 | | | | | | | | | | | | |
| 92 | U123 | " | | | 1 | | | | | | | | | | | | |
| 93 | S124 | " | | | | 1 | | | | | | | | | | | |
| 94 | U124 | " | | | | 1 | | | | | | | | | | | |
| 95 | S321 | " | | | | | 1 | | | | | | | | | | |
| 96 | U321 | " | | | | | 1 | | | | | | | | | | |
| 97 | S322 | " | | | | | | 1 | | | | | | | | | |
| 98 | U322 | " | | | | | | 1 | | | | | | | | | |
| 99 | S323 | " | | | | | | | 1 | | | | | | | | |
| 100 | U323 | " | | | | | | | 1 | | | | | | | | |
| 101 | S421 | " | | | | | | | | 1 | | | | | | | |
| 102 | U421 | " | | | | | | | | 1 | | | | | | | |
| 103 | S422 | " | | | | | | | | | 1 | | | | | | |
| 104 | U422 | " | | | | | | | | | 1 | | | | | | |
| 105 | S423 | " | | | | | | | | | | 1 | | | | | |
| 106 | U423 | " | | | | | | | | | | 1 | | | | | |
| 107 | S521 | " | | | | | | | | | | | 1 | | | | |
| 108 | U521 | " | | | | | | | | | | | 1 | | | | |
| 109 | E522 | " | | | | | | | | | | | | 1 | | | |
| 110 | S821 | " | | | | | | | | | | | | | 1 | | |
| 111 | U821 | " | | | | | | | | | | | | | 1 | | |
| 112 | E822 | " | | | | | | | | | | | | | | 1 | |
| 113 | S823 | " | | | | | | | | | | | | | | | 1 |
| 114 | U823 | " | | | | | | | | | | | | | | | 1 |
| 115 | D21 | le. | 634 | 771 | 1870 | 2341 | | | | | | | | | | | |
| 116 | D23 | " | | | | | 6591 | 2518 | 3316 | | | | | | | | |
| 117 | D24 | " | | | | | | | | 6956 | 9614 | 9496 | | | | | |
| 118 | D25 | " | | | | | | | | | | | 975 | 1042 | | | |
| 119 | D28 | " | | | | | | | | | | | | | 32,538 | 28,419 | 5016 |

(Continued)

The Linear Programming Tableau - Region II

| Row Number | Column Name / Row Name | Unit | Labor Hiring Activities | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | LF11 | LH11 | LA11 | LF31 | LH31 | LA31 | LF41 | LH41 | LA41 | LF51 | LH51 | LA51 | LF81 | LH81 | LA81 |
| | Objective Function | le. | -.35 | -.1 | -.02 | -.84 | -.15 | -.01 | -.51 | -.08 | -.02 | -.30 | -.13 | -.08 | -.54 | -.15 | -.08 |
| 56 | F12 | hrs. | -1 | | | | | | | | | | | | | | |
| 57 | H12 | " | | -1 | | | | | | | | | | | | | |
| 58 | A12 | " | | | -1 | | | | | | | | | | | | |
| 59 | M12 | le. | | | | | | | | | | | | | | | |
| 60 | Z12 | le. | | | | | | | | | | | | | | | |
| 61 | F32 | hrs. | | | | -1 | | | | | | | | | | | |
| 62 | H32 | " | | | | | -1 | | | | | | | | | | |
| 63 | A32 | " | | | | | | -1 | | | | | | | | | |
| 64 | M32 | le. | | | | | | | | | | | | | | | |
| 65 | Z32 | le. | | | | | | | | | | | | | | | |
| 66 | F42 | hrs. | | | | | | | -1 | | | | | | | | |
| 67 | H42 | " | | | | | | | | -1 | | | | | | | |
| 68 | A42 | " | | | | | | | | | -1 | | | | | | |
| 69 | M42 | le. | | | | | | | | | | | | | | | |
| 70 | Z42 | le. | | | | | | | | | | | | | | | |
| 71 | F52 | hrs. | | | | | | | | | | -1 | | | | | |
| 72 | H52 | " | | | | | | | | | | | -1 | | | | |
| 73 | A52 | " | | | | | | | | | | | | -1 | | | |
| 74 | M52 | le. | | | | | | | | | | | | | | | |
| 75 | Z52 | le. | | | | | | | | | | | | | | | |
| 76 | F82 | hrs. | | | | | | | | | | | | | -1 | | |
| 77 | H82 | " | | | | | | | | | | | | | | -1 | |
| 78 | A82 | " | | | | | | | | | | | | | | | -1 |
| 79 | M82 | le. | | | | | | | | | | | | | | | |
| 80 | Z82 | le. | | | | | | | | | | | | | | | |
| 81 | LF2 | hrs. | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | |
| 82 | LH2 | " | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | |
| 83 | LA2 | " | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 |
| 84 | M2 | le. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 85 | Z2 | le. | | | | | | | | | | | | | | | |
| 86 | Y2 | le. | | | | | | | | | | | | | | | |
| 87 | S121 | no. | | | | | | | | | | | | | | | |
| 88 | U121 | " | | | | | | | | | | | | | | | |
| 89 | S122 | " | | | | | | | | | | | | | | | |
| 90 | U122 | " | | | | | | | | | | | | | | | |
| 91 | S123 | " | | | | | | | | | | | | | | | |
| 92 | U123 | " | | | | | | | | | | | | | | | |
| 93 | S124 | " | | | | | | | | | | | | | | | |
| 94 | U124 | " | | | | | | | | | | | | | | | |
| 95 | S321 | " | | | | | | | | | | | | | | | |
| 96 | U321 | " | | | | | | | | | | | | | | | |
| 97 | S322 | " | | | | | | | | | | | | | | | |
| 98 | U322 | " | | | | | | | | | | | | | | | |
| 99 | S323 | " | | | | | | | | | | | | | | | |
| 100 | U323 | " | | | | | | | | | | | | | | | |
| 101 | S421 | " | | | | | | | | | | | | | | | |
| 102 | U421 | " | | | | | | | | | | | | | | | |
| 103 | S422 | " | | | | | | | | | | | | | | | |
| 104 | U422 | " | | | | | | | | | | | | | | | |
| 105 | S423 | " | | | | | | | | | | | | | | | |
| 106 | U423 | " | | | | | | | | | | | | | | | |
| 107 | S521 | " | | | | | | | | | | | | | | | |
| 108 | U521 | " | | | | | | | | | | | | | | | |
| 109 | E522 | " | | | | | | | | | | | | | | | |
| 110 | S821 | " | | | | | | | | | | | | | | | |
| 111 | U821 | " | | | | | | | | | | | | | | | |
| 112 | E822 | " | | | | | | | | | | | | | | | |
| 113 | S823 | " | | | | | | | | | | | | | | | |
| 114 | U823 | " | | | | | | | | | | | | | | | |
| 115 | D21 | le. | | | | | | | | | | | | | | | |
| 116 | D23 | " | | | | | | | | | | | | | | | |
| 117 | D24 | " | | | | | | | | | | | | | | | |
| 118 | D25 | " | | | | | | | | | | | | | | | |
| 119 | D28 | " | | | | | | | | | | | | | | | |

(Continued)

The Linear Programming Tableau - Region II

| Row Number | Column Name / Row Name | Unit | Material Input Activities M12 | M32 | M42 | M52 | M82 | Capital Activities Z12 | Z32 | Z42 | Z52 | Z82 | Income Activity CY2 | RHS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Objecitve Function | le. | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 1 | = 0 |
| 56 | F12 | hrs. | | | | | | | | | | | | ≤ 0 |
| 57 | H12 | " | | | | | | | | | | | | ≤ 0 |
| 58 | A12 | " | | | | | | | | | | | | ≤ 0 |
| 59 | M12 | le. | -1 | | | | | | | | | | | ≤ 0 |
| 60 | Z12 | le. | | | | | | -1 | | | | | | ≤ 0 |
| 61 | F32 | hrs. | | | | | | | | | | | | ≤ 0 |
| 62 | H32 | " | | | | | | | | | | | | ≤ 0 |
| 63 | A32 | " | | | | | | | | | | | | ≤ 0 |
| 64 | M32 | le. | | -1 | | | | | | | | | | = 0 |
| 65 | Z32 | le. | | | | | | | -1 | | | | | ≤ 0 |
| 66 | F42 | hrs. | | | | | | | | | | | | ≤ 0 |
| 67 | H42 | " | | | | | | | | | | | | ≤ 0 |
| 68 | A42 | " | | | | | | | | | | | | ≤ 0 |
| 69 | M42 | le. | | | -1 | | | | | | | | | = 0 |
| 70 | Z42 | le. | | | | | | | | -1 | | | | ≤ 0 |
| 71 | F52 | hrs. | | | | | | | | | | | | ≤ 0 |
| 72 | H52 | " | | | | | | | | | | | | ≤ 0 |
| 73 | A52 | " | | | | | | | | | | | | ≤ 0 |
| 74 | M52 | le. | | | | -1 | | | | | | | | = 0 |
| 75 | Z52 | le. | | | | | | | | | -1 | | | ≤ 0 |
| 76 | F82 | hrs. | | | | | | | | | | | | ≤ 0 |
| 77 | H82 | " | | | | | | | | | | | | ≤ 0 |
| 78 | A82 | " | | | | | | | | | | | | ≤ 0 |
| 79 | M82 | le. | | | | | -1 | | | | | | | = 0 |
| 80 | Z82 | le. | | | | | | | | | | -1 | | ≤ 0 |
| 81 | LF2 | hrs. | | | | | | | | | | | | ≤ 841,608 |
| 82 | LH2 | " | | | | | | | | | | | | ≤ 191,515 |
| 83 | LA2 | " | | | | | | | | | | | | ≤ 1,667,017 |
| 84 | M2 | le. | 1 | 1 | 1 | 1 | 1 | | | | | | | ≥ 0 |
| 85 | Z2 | le. | | | | | | 1 | 1 | 1 | 1 | 1 | | ≤ 219,257 |
| 86 | Y2 | le. | | | | | | | | | | | 1 | = 0 |
| 87 | S121 | no. | | | | | | | | | | | | ≥ 124 |
| 88 | U121 | " | | | | | | | | | | | | ≤ 152 |
| 89 | S122 | " | | | | | | | | | | | | ≥ 284 |
| 90 | U122 | " | | | | | | | | | | | | ≤ 347 |
| 91 | S123 | " | | | | | | | | | | | | ≥ 101 |
| 92 | U123 | " | | | | | | | | | | | | ≤ 123 |
| 93 | S124 | " | | | | | | | | | | | | ≥ 83 |
| 94 | U124 | " | | | | | | | | | | | | ≤ 101 |
| 95 | S321 | " | | | | | | | | | | | | ≥ 11 |
| 96 | U321 | " | | | | | | | | | | | | ≤ 14 |
| 97 | S322 | " | | | | | | | | | | | | ≥ 11 |
| 98 | U322 | " | | | | | | | | | | | | ≤ 14 |
| 99 | S323 | " | | | | | | | | | | | | ≥ 67 |
| 100 | U323 | " | | | | | | | | | | | | ≤ 81 |
| 101 | S421 | " | | | | | | | | | | | | ≥ 45 |
| 102 | U421 | " | | | | | | | | | | | | ≤ 55 |
| 103 | S422 | " | | | | | | | | | | | | ≥ 46 |
| 104 | U422 | " | | | | | | | | | | | | ≤ 56 |
| 105 | S423 | " | | | | | | | | | | | | ≥ 31 |
| 106 | U423 | " | | | | | | | | | | | | ≤ 37 |
| 107 | S521 | " | | | | | | | | | | | | ≥ 13 |
| 108 | U521 | " | | | | | | | | | | | | ≤ 15 |
| 109 | E522 | " | | | | | | | | | | | | = 1 |
| 110 | S821 | " | | | | | | | | | | | | ≥ 5 |
| 111 | U821 | " | | | | | | | | | | | | ≤ 7 |
| 112 | E822 | " | | | | | | | | | | | | = 1 |
| 113 | S823 | " | | | | | | | | | | | | ≥ 9 |
| 114 | U823 | " | | | | | | | | | | | | ≤ 11 |
| 115 | D21 | le. | | | | | | | | | | | | = 1,092,948 |
| 116 | D23 | " | | | | | | | | | | | | = 300,000 |
| 117 | D24 | " | | | | | | | | | | | | = 721,771 |
| 118 | D25 | " | | | | | | | | | | | | = 14,667 |
| 119 | D28 | " | | | | | | | | | | | | = 246,426 |

The Linear Programming Tableau - Region III

| Row Number | Column Name / Row Name | Unit | Production Activities: Tailoring P131 | Tailoring P132 | Tailoring P133 | Tailoring P134 | Gara Dyeing P331 | Carpentry P431 | Carpentry P432 | Carpentry P433 | Black-smithing P531 | Black-smithing P532 | Bakery P831 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Objective Function | le. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 120 | F13 | hrs. | 398 | 680 | 1162 | 1021 | | | | | | | |
| 121 | A13 | " | 100 | 245 | 40 | 763 | | | | | | | |
| 122 | M13 | le. | 46 | 166 | 198 | 205 | | | | | | | |
| 123 | Z13 | " | 61 | 57 | 45 | 107 | | | | | | | |
| 124 | F33 | hrs. | | | | | 1193 | | | | | | |
| 125 | A33 | " | | | | | 62 | | | | | | |
| 126 | M33 | le. | | | | | 1679 | | | | | | |
| 127 | Z33 | " | | | | | 16 | | | | | | |
| 128 | F43 | hrs. | | | | | | 1960 | 331 | 8226 | | | |
| 129 | A43 | " | | | | | | 8322 | 4071 | 45,116 | | | |
| 130 | M43 | le. | | | | | | 1262 | 603 | 5976 | | | |
| 131 | Z43 | " | | | | | | 120 | 36 | 468 | | | |
| 132 | F53 | hrs. | | | | | | | | | 1173 | 1893 | |
| 133 | A53 | " | | | | | | | | | 1817 | 1971 | |
| 134 | M53 | le. | | | | | | | | | 228 | 71 | |
| 135 | Z53 | " | | | | | | | | | 152 | 36 | |
| 136 | F83 | hrs. | | | | | | | | | | | 1928 |
| 137 | A83 | " | | | | | | | | | | | 93 |
| 138 | M83 | le. | | | | | | | | | | | 1361 |
| 139 | Z83 | " | | | | | | | | | | | 84 |
| 140 | LF3 | hrs. | | | | | | | | | | | |
| 141 | LA3 | " | | | | | | | | | | | |
| 142 | M3 | le. | | | | | | | | | | | |
| 143 | Z3 | " | | | | | | | | | | | |
| 144 | Y3 | " | -246 | -596 | -520 | -678 | -2389 | -3203 | -2749 | -26,904 | -1396 | -750 | -2181 |
| 145 | S131 | no. | 1 | | | | | | | | | | |
| 146 | U131 | " | 1 | | | | | | | | | | |
| 147 | S132 | " | | 1 | | | | | | | | | |
| 148 | U132 | " | | 1 | | | | | | | | | |
| 149 | S133 | " | | | 1 | | | | | | | | |
| 150 | U133 | " | | | 1 | | | | | | | | |
| 151 | S134 | " | | | | 1 | | | | | | | |
| 152 | U134 | " | | | | 1 | | | | | | | |
| 153 | S331 | " | | | | | 1 | | | | | | |
| 154 | U331 | " | | | | | 1 | | | | | | |
| 155 | S431 | " | | | | | | 1 | | | | | |
| 156 | U431 | " | | | | | | 1 | | | | | |
| 157 | S432 | " | | | | | | | 1 | | | | |
| 158 | U432 | " | | | | | | | 1 | | | | |
| 159 | E433 | " | | | | | | | | 1 | | | |
| 160 | S531 | " | | | | | | | | | 1 | | |
| 161 | U531 | " | | | | | | | | | 1 | | |
| 162 | S532 | " | | | | | | | | | | 1 | |
| 163 | U532 | " | | | | | | | | | | 1 | |
| 164 | S831 | " | | | | | | | | | | | 1 |
| 165 | U831 | " | | | | | | | | | | | 1 |
| 166 | D31 | le. | 246 | 596 | 520 | 678 | | | | | | | |
| 167 | D33 | " | | | | | 2389 | | | | | | |
| 168 | D34 | " | | | | | | 3203 | 2749 | 26,904 | | | |
| 169 | D35 | " | | | | | | | | | 1396 | 750 | |
| 170 | D38 | " | | | | | | | | | | | 2181 |

(Continued)

The Linear Programming Tableau - Region III

| Row Number | Column Name / Row Name | Unit | Labor Hiring Activities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | LF13 | LA13 | LF33 | LA33 | LF43 | LA43 | LF53 | LA53 | LF83 | LA83 |
| | Objective Function | le. | -.35 | -.02 | -.84 | -.01 | -.51 | -.02 | -.30 | -.02 | -.54 | -.02 |
| 120 | F13 | hrs. | -1 | | | | | | | | | |
| 121 | A13 | " | | -1 | | | | | | | | |
| 122 | M13 | le. | | | | | | | | | | |
| 123 | Z13 | " | | | | | | | | | | |
| 124 | F33 | hrs. | | | -1 | | | | | | | |
| 125 | A33 | " | | | | -1 | | | | | | |
| 126 | M33 | le. | | | | | | | | | | |
| 127 | Z33 | " | | | | | | | | | | |
| 128 | F43 | hrs. | | | | | -1 | | | | | |
| 129 | A43 | " | | | | | | -1 | | | | |
| 130 | M43 | le. | | | | | | | | | | |
| 131 | Z43 | " | | | | | | | | | | |
| 132 | F53 | hrs. | | | | | | | -1 | | | |
| 133 | A53 | " | | | | | | | | -1 | | |
| 134 | M53 | le. | | | | | | | | | | |
| 135 | Z53 | " | | | | | | | | | | |
| 136 | F83 | hrs. | | | | | | | | | -1 | |
| 137 | A83 | " | | | | | | | | | | -1 |
| 138 | M83 | le. | | | | | | | | | | |
| 139 | Z83 | " | | | | | | | | | | |
| 140 | LF3 | hrs. | 1 | | 1 | | 1 | | 1 | | 1 | |
| 141 | LA3 | " | | 1 | | 1 | | 1 | | 1 | | 1 |
| 142 | M3 | le. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 143 | Z3 | " | | | | | | | | | | |
| 144 | Y3 | " | | | | | | | | | | |
| 145 | S131 | no. | | | | | | | | | | |
| 146 | U131 | " | | | | | | | | | | |
| 147 | S132 | " | | | | | | | | | | |
| 148 | U132 | " | | | | | | | | | | |
| 149 | S133 | " | | | | | | | | | | |
| 150 | U133 | " | | | | | | | | | | |
| 151 | S134 | " | | | | | | | | | | |
| 152 | U134 | " | | | | | | | | | | |
| 153 | S331 | " | | | | | | | | | | |
| 154 | U331 | " | | | | | | | | | | |
| 155 | S431 | " | | | | | | | | | | |
| 156 | U431 | " | | | | | | | | | | |
| 157 | S432 | " | | | | | | | | | | |
| 158 | U432 | " | | | | | | | | | | |
| 159 | E433 | " | | | | | | | | | | |
| 160 | S531 | " | | | | | | | | | | |
| 161 | U531 | " | | | | | | | | | | |
| 162 | S532 | " | | | | | | | | | | |
| 163 | U532 | " | | | | | | | | | | |
| 164 | S831 | " | | | | | | | | | | |
| 165 | U831 | " | | | | | | | | | | |
| 166 | D31 | le. | | | | | | | | | | |
| 167 | D33 | " | | | | | | | | | | |
| 168 | D34 | " | | | | | | | | | | |
| 169 | D35 | " | | | | | | | | | | |
| 170 | D38 | " | | | | | | | | | | |

(Continued)

The Linear Programming Tableau - Region III

| Row Number | Column Name / Row Name | Unit | Material Input Activities M13 | M33 | M43 | M53 | M83 | Capital Activities Z13 | Z33 | Z43 | Z53 | Z83 | Income Activity CY3 | RHS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Objective Function | le. | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | = 0 |
| 120 | F13 | hrs. | | | | | | | | | | | | ≤ 0 |
| 121 | A13 | " | | | | | | | | | | | | ≤ 0 |
| 122 | M13 | le. | -1 | | | | | | | | | | | = 0 |
| 123 | Z13 | " | | | | | | -1 | | | | | | ≤ 0 |
| 124 | F33 | hrs. | | | | | | | | | | | | ≤ 0 |
| 125 | A33 | " | | | | | | | | | | | | ≤ 0 |
| 126 | M33 | le. | | -1 | | | | | | | | | | = 0 |
| 127 | Z33 | " | | | | | | | -1 | | | | | ≤ 0 |
| 128 | F43 | hrs. | | | | | | | | | | | | ≤ 0 |
| 129 | A43 | " | | | | | | | | | | | | ≤ 0 |
| 130 | M43 | le. | | | -1 | | | | | | | | | = 0 |
| 131 | Z43 | " | | | | | | | | -1 | | | | ≤ 0 |
| 132 | F53 | hrs. | | | | | | | | | | | | ≤ 0 |
| 133 | A53 | " | | | | | | | | | | | | ≤ 0 |
| 134 | M53 | le. | | | | -1 | | | | | | | | = 0 |
| 135 | Z53 | " | | | | | | | | | -1 | | | ≤ 0 |
| 136 | F83 | hrs. | | | | | | | | | | | | ≤ 0 |
| 137 | A83 | " | | | | | | | | | | | | ≤ 0 |
| 138 | M83 | le. | | | | | -1 | | | | | | | = 0 |
| 139 | Z83 | " | | | | | | | | | | -1 | | ≤ 0 |
| 140 | LF3 | hrs. | | | | | | | | | | | | ≤ 1,975,399 |
| 141 | LA3 | " | | | | | | | | | | | | ≤ 2,678,383 |
| 142 | M3 | le. | 1 | 1 | 1 | 1 | 1 | | | | | | | ≥ 0 |
| 143 | Z3 | " | | | | | | 1 | 1 | 1 | 1 | 1 | | ≤ 131,047 |
| 144 | Y3 | " | | | | | | | | | | | 1 | = 0 |
| 145 | S131 | no. | | | | | | | | | | | | ≥ 89 |
| 146 | U131 | " | | | | | | | | | | | | ≤ 109 |
| 147 | S132 | " | | | | | | | | | | | | ≥ 580 |
| 148 | U132 | " | | | | | | | | | | | | ≤ 708 |
| 149 | S133 | " | | | | | | | | | | | | ≥ 267 |
| 150 | U133 | " | | | | | | | | | | | | ≤ 327 |
| 151 | S134 | " | | | | | | | | | | | | ≥ 178 |
| 152 | U134 | " | | | | | | | | | | | | ≤ 218 |
| 153 | S331 | " | | | | | | | | | | | | ≥ 207 |
| 154 | U331 | " | | | | | | | | | | | | ≤ 253 |
| 155 | S431 | " | | | | | | | | | | | | ≥ 147 |
| 156 | U431 | " | | | | | | | | | | | | ≤ 179 |
| 157 | S432 | " | | | | | | | | | | | | ≥ 161 |
| 158 | U432 | " | | | | | | | | | | | | ≤ 197 |
| 159 | E433 | " | | | | | | | | | | | | = 1 |
| 160 | S531 | " | | | | | | | | | | | | ≥ 72 |
| 161 | U531 | " | | | | | | | | | | | | ≤ 88 |
| 162 | S532 | " | | | | | | | | | | | | ≥ 23 |
| 163 | U532 | " | | | | | | | | | | | | ≤ 29 |
| 164 | S831 | " | | | | | | | | | | | | ≥ 130 |
| 165 | U831 | " | | | | | | | | | | | | ≤ 158 |
| 166 | D31 | le. | | | | | | | | | | | | = 623,261 |
| 167 | D33 | " | | | | | | | | | | | | = 222,000 |
| 168 | D34 | " | | | | | | | | | | | | = 1,693,836 |
| 169 | D35 | " | | | | | | | | | | | | = 54,705 |
| 170 | D38 | " | | | | | | | | | | | | = 283,658 |

The Linear Programming Tableau - Region IV

| Row Number | Column Name / Row Name | Unit | Production Activities: Tailoring P141 | Tailoring P142 | Tailoring P143 | Carpentry P441 | Carpentry P442 | Carpentry P443 | Blacksmithing P541 | Blacksmithing P542 | Blacksmithing P543 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Objective Function | le. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 171 | F14 | hrs. | 917 | 437 | 441 | | | | | | |
| 172 | M14 | le. | 17 | 10 | 13 | | | | | | |
| 173 | Z14 | " | 27 | 30 | 54 | | | | | | |
| 174 | F44 | hrs. | | | | 438 | 401 | 87 | | | |
| 175 | M44 | le. | | | | 21 | 0 | 1 | | | |
| 176 | Z44 | " | | | | 28 | 43 | 42 | | | |
| 177 | F54 | hrs. | | | | | | | 1487 | 771 | 110 |
| 178 | M54 | le. | | | | | | | 19 | 4 | 1 |
| 179 | Z54 | " | | | | | | | 26 | 41 | 44 |
| 180 | LF4 | hrs. | | | | | | | | | |
| 181 | M4 | le. | | | | | | | | | |
| 182 | Z4 | " | | | | | | | | | |
| 183 | Y4 | " | -636 | -194 | -143 | -149 | -40 | -46 | -338 | -264 | -98 |
| 184 | S141 | no. | 1 | | | | | | | | |
| 185 | U141 | " | 1 | | | | | | | | |
| 186 | S142 | " | | 1 | | | | | | | |
| 187 | U142 | " | | 1 | | | | | | | |
| 188 | S143 | " | | | 1 | | | | | | |
| 189 | U143 | " | | | 1 | | | | | | |
| 190 | S441 | " | | | | 1 | | | | | |
| 191 | U441 | " | | | | 1 | | | | | |
| 192 | S442 | " | | | | | 1 | | | | |
| 193 | U442 | " | | | | | 1 | | | | |
| 194 | S443 | " | | | | | | 1 | | | |
| 195 | U443 | " | | | | | | 1 | | | |
| 196 | S541 | " | | | | | | | 1 | | |
| 197 | U541 | " | | | | | | | 1 | | |
| 198 | S542 | " | | | | | | | | 1 | |
| 199 | U542 | " | | | | | | | | 1 | |
| 200 | S543 | " | | | | | | | | | 1 |
| 201 | U543 | " | | | | | | | | | 1 |
| 202 | D41 | le. | 636 | 194 | 143 | | | | | | |
| 203 | D43 | " | | | | | | | | | |
| 204 | D44 | " | | | | 149 | 40 | 46 | | | |
| 205 | D45 | " | | | | | | | 338 | 264 | 98 |
| 206 | D48 | " | | | | | | | | | |

(Continued)

The Linear Programming Tableau - Region IV

| Row Number | Column Name / Row Name | Unit | Labor Hiring Activities LF14 | LF44 | LF54 | Material Input Activities M14 | M44 | M54 | Capital Activities Z14 | Z44 | Z54 | Income Activities CY4 | RHS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Objective Function | le. | -.09 | -.09 | -.09 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | = 0 |
| 171 | F14 | hrs. | -1 | | | | | | | | | | ≤ 0 |
| 172 | M14 | le. | | | | -1 | | | | | | | = 0 |
| 173 | Z14 | " | | | | | | | -1 | | | | ≤ 0 |
| 174 | F44 | hrs. | | -1 | | | | | | | | | ≤ 0 |
| 175 | M44 | le. | | | | | -1 | | | | | | = 0 |
| 176 | Z44 | " | | | | | | | | -1 | | | ≤ 0 |
| 177 | F54 | hrs. | | | -1 | | | | | | | | ≤ 0 |
| 178 | M54 | le. | | | | | | -1 | | | | | = 0 |
| 179 | Z54 | " | | | | | | | | | -1 | | ≤ 0 |
| 180 | LF4 | hrs. | 1 | 1 | 1 | 1 | 1 | 1 | | | | | ≤ 12,038,001 |
| 181 | M4 | le. | 1 | 1 | 1 | | | | | | | | ≥ 0 |
| 182 | Z4 | " | | | | | | | 1 | 1 | 1 | | ≤ 809,098 |
| 183 | Y4 | " | | | | | | | | | | 1 | = 0 |
| 184 | S141 | no. | | | | | | | | | | | ≤ 837 |
| 185 | U141 | " | | | | | | | | | | | ≤ 1144 |
| 186 | S142 | " | | | | | | | | | | | ≤ 8736 |
| 187 | U142 | " | | | | | | | | | | | ≤ 12,012 |
| 188 | S143 | " | | | | | | | | | | | ≤ 837 |
| 189 | U143 | " | | | | | | | | | | | ≤ 1144 |
| 190 | S441 | " | | | | | | | | | | | ≤ 1333 |
| 191 | U441 | " | | | | | | | | | | | ≤ 1833 |
| 192 | S442 | " | | | | | | | | | | | ≤ 1333 |
| 193 | U442 | " | | | | | | | | | | | ≤ 1833 |
| 194 | S443 | " | | | | | | | | | | | ≤ 1333 |
| 195 | U443 | " | | | | | | | | | | | ≤ 1833 |
| 196 | S541 | " | | | | | | | | | | | ≤ 1100 |
| 197 | U541 | " | | | | | | | | | | | ≤ 1513 |
| 198 | S542 | " | | | | | | | | | | | ≤ 2200 |
| 199 | U542 | " | | | | | | | | | | | ≤ 3025 |
| 200 | S543 | " | | | | | | | | | | | ≤ 1100 |
| 201 | U543 | " | | | | | | | | | | | ≤ 1513 |
| 202 | D41 | le. | | | | | | | | | | | = 2,856,016 |
| 203 | D43 | " | | | | | | | | | | | = 25,000 |
| 204 | D44 | " | | | | | | | | | | | = 347,892 |
| 205 | D45 | " | | | | | | | | | | | = 1,591,890 |
| 206 | D48 | " | | | | | | | | | | | = 244,474 |

The Transportation, Export and Import Activities for All Regions

| Row Number | Column Name / Row Name | Unit | Tailoring Output Transportation Activities | | | | | | | | | Gara Output Transportation Activities | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | T12 | T13 | T14 | T21 | T23 | T24 | T31 | T32 | T34 | G12 | G13 | G14 | G21 | G23 | G24 | G31 | G32 | G34 |
| 1 | Objective Function | le. | -.02 | -.02 | -.03 | -.02 | -.02 | -.003 | -.02 | -.02 | -.002 | -.02 | -.02 | -.03 | -.02 | -.02 | -.003 | -.02 | -.02 | -.002 |
| ⋮ | | | | | | | | | | | | | | | | | | | | |
| 51 | D11 | le. | -1 | -1 | -1 | 1 | | | 1 | | | | | | | | | | | |
| 52 | D13 | le. | | | | | | | | | | -1 | -1 | -1 | 1 | | | 1 | | |
| 53 | D14 | le. | | | | | | | | | | | | | | | | | | |
| 54 | D15 | le. | | | | | | | | | | | | | | | | | | |
| 55 | D18 | le. | | | | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | | | | |
| 115 | D21 | le. | 1 | | | -1 | -1 | -1 | | 1 | | | | | | | | | | |
| 116 | D23 | le. | | | | | | | | | | 1 | | | -1 | -1 | -1 | | 1 | |
| 117 | D24 | le. | | | | | | | | | | | | | | | | | | |
| 118 | D25 | le. | | | | | | | | | | | | | | | | | | |
| 119 | D28 | le. | | | | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | | | | |
| 166 | D31 | le. | | 1 | | | 1 | | -1 | -1 | -1 | | | | | | | | | |
| 167 | D33 | le. | | | | | | | | | | | 1 | | | 1 | | -1 | -1 | -1 |
| 168 | D34 | le. | | | | | | | | | | | | | | | | | | |
| 169 | D35 | le. | | | | | | | | | | | | | | | | | | |
| 170 | D38 | le. | | | | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | | | | |
| 202 | D41 | le. | | | 1 | | | 1 | | | 1 | | | | | | | | | |
| 203 | D43 | le. | | | | | | | | | | | | 1 | | | 1 | | | 1 |
| 204 | D44 | le. | | | | | | | | | | | | | | | | | | |
| 205 | D45 | le. | | | | | | | | | | | | | | | | | | |
| 206 | D48 | le. | | | | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | | | | |
| 207 | Ge | le. | | | | | | | | | | | | | | | | | | |
| 208 | TM | le. | | | | | | | | | | | | | | | | | | |
| 209 | BM | le. | | | | | | | | | | | | | | | | | | |

(Continued)

The Transportation, Export and Import Activities for All Regions

| Row Number | Column Name / Row Name | Unit | Carpentry Output Transportation Activities | | | | | | | | | Blacksmith Output Transportation Activities | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C12 | C13 | C14 | C21 | C23 | C24 | C31 | C32 | C34 | B21 | B23 | B24 | B31 | B32 | B34 |
| 1 | Objective Function | le. | -.02 | -.02 | -.03 | -.02 | -.02 | -.003 | -.02 | -.02 | -.002 | -.02 | -.02 | -.003 | -.02 | -.02 | -.002 |
| ⋮ | | | | | | | | | | | | | | | | | |
| 51 | D11 | le. | | | | | | | | | | | | | | | |
| 52 | D13 | le. | | | | | | | | | | | | | | | |
| 53 | D14 | le. | -1 | -1 | -1 | 1 | | | 1 | | | | | | | | |
| 54 | D15 | le. | | | | | | | | | | 1 | | | 1 | | |
| 55 | D18 | le. | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | |
| 115 | D21 | le. | | | | | | | | | | | | | | | |
| 116 | D23 | le. | | | | | | | | | | | | | | | |
| 117 | D24 | le. | 1 | | | -1 | -1 | -1 | | 1 | | | | | | | |
| 118 | D25 | le. | | | | | | | | | | -1 | -1 | -1 | | 1 | |
| 119 | D28 | le. | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | |
| 166 | D31 | le. | | | | | | | | | | | | | | | |
| 167 | D33 | le. | | | | | | | | | | | | | | | |
| 168 | D34 | le. | | 1 | | | 1 | | -1 | -1 | -1 | | | | | | |
| 169 | D35 | le. | | | | | | | | | | | 1 | | -1 | -1 | -1 |
| 170 | D38 | le. | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | |
| 202 | D41 | le. | | | | | | | | | | | | | | | |
| 203 | D43 | le. | | | | | | | | | | | | | | | |
| 204 | D44 | le. | | | 1 | | | 1 | | | 1 | | | | | | |
| 205 | D45 | le. | | | | | | | | | | | | 1 | | | 1 |
| 206 | D48 | le. | | | | | | | | | | | | | | | |
| ⋮ | | | | | | | | | | | | | | | | | |
| 207 | Ge | le. | | | | | | | | | | | | | | | |
| 208 | TM | le. | | | | | | | | | | | | | | | |
| 209 | BM | le. | | | | | | | | | | | | | | | |

(Continued)

The Transportation, Export and Import Activities for All Regions

| Row Number | Column Name / Row Name | Unit | Bakery Output Transportation Activities | | | | | | | | | Gara Export Activities | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | K12 | K13 | K14 | K21 | K23 | K24 | K31 | K32 | K34 | $G1_g'$ | $G2_g'$ | $G3_g'$ | Ge |
| 1 | Objective Function | 1e. | -.02 | -.02 | -.03 | -.02 | -.02 | -.003 | -.02 | -.02 | -.002 | -.001 | -.02 | -.02 | .5 |
| ⋮ | | | | | | | | | | | | | | | |
| 51 | D11 | 1e. | | | | | | | | | | | | | |
| 52 | D13 | 1e. | | | | | | | | | | -1 | | | |
| 53 | D14 | 1e. | | | | | | | | | | | | | |
| 54 | D15 | 1e. | | | | | | | | | | | | | |
| 55 | D18 | 1e. | -1 | -1 | -1 | 1 | | | 1 | | | | | | |
| ⋮ | | | | | | | | | | | | | | | |
| 115 | D21 | 1e. | | | | | | | | | | | | | |
| 116 | D23 | 1e. | | | | | | | | | | | -1 | | |
| 117 | D24 | 1e. | | | | | | | | | | | | | |
| 118 | D25 | 1e. | | | | | | | | | | | | | |
| 119 | D28 | 1e. | 1 | | | -1 | -1 | -1 | | 1 | | | | | |
| ⋮ | | | | | | | | | | | | | | | |
| 166 | D31 | 1e. | | | | | | | | | | | | | |
| 167 | D33 | 1e. | | | | | | | | | | | | -1 | |
| 168 | D34 | 1e. | | | | | | | | | | | | | |
| 169 | D35 | 1e. | | | | | | | | | | | | | |
| 170 | D38 | 1e. | | 1 | | | 1 | | -1 | -1 | -1 | | | | |
| ⋮ | | | | | | | | | | | | | | | |
| 202 | D41 | 1e. | | | | | | | | | | | | | |
| 203 | D43 | 1e. | | | | | | | | | | | | | |
| 204 | D44 | 1e. | | | | | | | | | | | | | |
| 205 | D45 | 1e. | | | | | | | | | | | | | |
| 206 | D48 | 1e. | | | 1 | | | 1 | | | 1 | | | | |
| ⋮ | | | | | | | | | | | | | | | |
| 207 | Ge | 1e. | | | | | | | | | | -1 | -1 | -1 | 1 |
| 208 | TM | 1e. | | | | | | | | | | | | | |
| 209 | BM | 1e. | | | | | | | | | | | | | |

(Continued)

The Transportation, Export and Import Activities for All Regions

| Row Number | Column Name / Row Name | Unit | Tailoring Import Activities | | | | | Blacksmith Import Activities | | | | RHS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TM | TMg1 | TMg2 | TMg3 | TMg4 | BM | BMg2 | BMg3 | BMg4 | | |
| 1 | Objective Function | 1e. | -1,439,740 | -.001 | -.02 | -.02 | -.03 | -43,903 | -.02 | -.02 | -.03 | =0 | |
| 51 | D11 | 1e. | | 1 | | | | | | | | = | As |
| 52 | D13 | 1e. | | | | | | | | | | = | shown |
| 53 | D14 | 1e. | | | | | | | | | | = | for |
| 54 | D15 | 1e. | | | | | | | | | | = | Region I |
| 55 | D18 | 1e. | | | | | | | | | | = | |
| 115 | D21 | 1e. | | | 1 | | | | | | | = | As |
| 116 | D23 | 1e. | | | | | | | | | | = | shown |
| 117 | D24 | 1e. | | | | | | | | | | = | for |
| 118 | D25 | 1e. | | | | | | | 1 | | | = | Region II |
| 119 | D28 | 1e. | | | | | | | | | | = | |
| 166 | D31 | 1e. | | | | 1 | | | | | | = | As |
| 167 | D33 | 1e. | | | | | | | | | | = | shown |
| 168 | D34 | 1e. | | | | | | | | | | = | for |
| 169 | D35 | 1e. | | | | | | | | 1 | | = | Region III |
| 170 | D38 | 1e. | | | | | | | | | | = | |
| 202 | D41 | 1e. | | | | | 1 | | | | | = | As |
| 203 | D43 | 1e. | | | | | | | | | | = | shown |
| 204 | D44 | 1e. | | | | | | | | | | = | for |
| 205 | D45 | 1e. | | | | | | | | | 1 | = | Region IV |
| 206 | D48 | 1e. | | | | | | | | | | = | |
| 207 | Ge | 1e. | | | | | | | | | | ≤ | 0 |
| 208 | TM | 1e. | -1,028,386 | 1 | 1 | 1 | 1 | | | | | ≤ | 0 |
| 209 | BM | 1e. | | | | | | -42,728 | 1 | 1 | 1 | ≤ | 0 |

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