FIRM EFFICIENCY AND FIRM SIZE

By

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Declaration

This dissertation represents my own original work. This work has not previously been submitted to any other institution of learning for similar purposes.

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APPROVAL

This dissertation of **Mukosha Bona Chitah** is approved as fulfilling part of the requirements for the award of the degree of Master of Arts in Economics by the University of Zambia.

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ABSTRACT

Firm Efficiency and Firm Size

Productivity achievement has become an illusory and diminutive economic objective for most struggling Third World countries. For instance, on the performance of the Zambian economy we note that the Gross Domestic Product (GDP) *per capita* has declined from about 500 United States Dollars to about 250 United States Dollars today. In the last three years, the GDP of the country has consistently declined by an average of about 4%. Against this background of general economic malaise, we also find specific negative performance at the sectoral and industrial level. For example the labour productivities in the manufacturing subsectors, such as food and textiles, were declining and were actually negative between 1980 and the early 90s. Given that these are two of the most significant sectors for an industrialising or developing economy as technological and supply responses are likely to yield the highest returns, it therefore represents a serious problem in achieving developmental goals for all concerned with the Zambian economy. In addition to that, the index of labour employment, the output by subsector and investments all show negative trends over this same time period. In short, the case of the manufacturing sector in Zambia is gloomy and depressed.

Given the above economic environment, it is expedient to attempt to discern as precisely as possible the status of Zambian firms. If the general economic and specific firm performance indicators are all mostly negative we require to be able to isolate the causes as well as the effects attributable to certain identifiable causes. One way of approaching this problem, as has been done in this study is to take account of all related

information to production, labour and employment, capital utilisation and raw materials utilisation for firms and see how each firm or groups of firms access and utilise these inputs. This means that we set a criteria of efficiency. Generally we do this by either price or allocative efficiency, technical efficiency and/or managerial efficiency.

Price or allocative efficiency entails we determine how the firm makes use of the factors of production in relation to profit maximisation subject to the prices or costs of these factors of production i.e. wages, interest and rent. Technical efficiency, which is the concept relied upon in this study entails that we try to determine how effectively an economic unit or firm will organise its inputs such as labour, capital (machinery , equipment and land) in maximising its output. If, two or more, n, different firms (where n is any number of firms) use identically the same labour, capital, raw materials and land and yet produce two different outputs or yield, then obviously the firm that has the greater output is more efficient than the other.

In the following pages investigations on the performance of the firms is made on an industry level as well as a sectoral level by application of a deterministic parametric production function. This is the Cobb - Douglas production function. The regression equations used are the non - linear and linear least squares as well as the maximum likelihood least squares. In this respect, both the industry and sectoral production functions are of the 'average' type. Unlike in the stochastic approach therefore, we are not accounting for efficiency effects attributable to random events such as machinery breakdown or idle time.

In the determination of the efficiency levels in relation to the size of the firm, the most pertinent indicators or factors are then the parameters so derived. Parameters such as that of labour, capital or raw materials actually are also elasticity estimates. They enable us to determine the proportionate change in the variable due to a unit change. Thus we are able to determine the rate of resource utilisation per unit of output. In addition the constant represents the technical coefficient, allowing for comparison across the board of the more technically efficient group of firms, given the size of the coefficient. Other non linear variables such as the correlation coefficient and correlation matrices that are generated allow for a comparison of the fit of the function and the relationship between the different variables, for example, we can determine whether the resource use is labour or capital intensive and therefore see how this fits in with the expectations of either small firms that should be labour intensive and therefore promote employment or large firms that could be capital intensive and therefore do not promote as much labour employment. With this approach we are able to therefore compare the performance of the various groups of firms i.e. small, medium or large sized firms production functions with the 'best practice' function or one that has exhibited the best efficiency or performance given the above factors.

Having made the above analysis, the study then attempts to isolate the causes for such differences by categorising the firms according to their sizes in order to gauge the optimal size out of all the firms. This is done with the objective of identifying the size of firm that maximises output given an equivalent amount of inputs. This is justified by the fact that all resources are scarce and optimisation of resource use is an alternative way to productivity enhancement and economic growth and development.

The study concludes, on the basis of available evidence that as much as small scale firms may be desirable as the seem to be an answer for employment creation, yet due to the sometimes harsh economic adjustment measures such as structural adjustment programmes, their inability to access capital renders them susceptible to economic demise and they suffer a much higher risk of liquidation and bankruptcy than medium - large scale firms.

Acknowledgements

The realities, sometimes of initiating or commencing anything are not quite that easy. There are what are sometimes called "teething problems". However, what matters is that such constraints, if at all they are constraints - I prefer to term them 'a learning experience', for everyone involved - are soon learnt and resolved. This I believe is the situation that has prevailed in that I was in the first intake after the Economics Department re - commenced the post - graduate programme. In all these endeavours therefore, I wish to most sincerely acknowledge and extend my gratitude to my supervisor, Professor V.Seshamani, who, over the time period it took to develop this study from the research proposal, guided, corrected and suggested accordingly at various stages, for the improvement of the paper. I also thank Professor Finn Forsund for assistance with the RPED data. Further thanks go to Dr. I. Mwanawina and the rest of the Departmental members whose support I have received throughout both the course work and research work.

To Elita my beloved wife, Musonda - Kunda, Kafumba - Mwelwa and Chilufya - Mulamba my children, thank for your patience.

May I lastly dedicate this to Noble Kafumba-Mwelwa.

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CHAPTER ONE

BACKGROUND TO FIRM EFFICIENCY AND FIRM SIZE

1.0 INTRODUCTION

Enhancing productivity and attaining increased efficiency are objectives that are normally sought to be achieved at both enterprise level and national level. Enhancing productivity and increasing efficiency in the economy ultimately leads to increases in the output of goods and services, so increasing both national output, wealth and therefore, consequently, social welfare This leads the economy towards a state of *Pareto optimality*. Efficiency and productivity growth at the macroeconomic level presupposes, naturally, efficiency and productivity at the microeconomic level.

The Zambian economy has seen a steady state of economic decline (various World Bank publications, Government of the Republic of Zambia Budget and Economic Reports), in which implied and explicit inefficiencies in resource utilisation and production have caused poor economic performance. This decline is recorded to have been worse in some sectors than others. Essentially therefore, the concept of determining and where possible accounting and determining the different efficiency levels in the economy becomes necessary in order to determine resource optimisation in the economy. This means an analysis of the performance of firms at the microeconomic level.

At the microeconomic level, the concept of productivity is linked closely with the concept of efficiency. In the context of this study, efficiency will be decomposed into technical efficiency and price (or allocative) efficiency. What these two concepts imply respectively involves the capacity of the firm to produce optimal output, and to employ factors of production in such a manner as to maximise profits, by equating the marginal factor cost to the marginal revenue product. Efficiency of firms and the size of firms are both factors that influence the efficiency with which the economy functions (Bain 1968, Farrell 1957, Lau and Yotopoulos 1971, Henderson and Quandt 1980, De Valk 1992). Large firms will often experience economies of scale which enable them to produce at lower cost and are, as a consequence, competitive. At the same time, the case for small firms is that they are better managed, more labour intensive and therefore offer more employment opportunities (Koutsoyiannis 1985, Page 1984). This leads to the need to determine factors affecting the efficiency aspects of small firms as compared to large firms as well as the existence of economic relationships between the efficiency of firms and the overall structure within which firms are organised and function. Industrial organisation depends on the level of economic activity and competitiveness. Theoretically, the market structure as a form of industrial organisation is analysed from the perspective of perfect, monopolistic, and oligopolistic competition and monopoly. In general, the efficiency of market structures is understood to vary, with perfect competition being the most optimal in terms of resource allocation and output and monopoly being the least efficient, except where economies of scale and declining average costs restrict competition as is the case with natural monopolies (Koutsoyannis 1985, Henderson and Quandt 1980).

What this implies is that the greater the number of firms, the higher the efficiency of a given market structure. The size or scale of firms limits the number of firms that may compete or exist in any one type of structure. This proposition, therefore, creates the necessity to investigate and determine the varying levels of efficiency that may exist among firms of different sizes. This facilitates investigations into the type of market structure, which can then be linked to the efficiency of the firms under that respective structure.

The measurement of efficiency is made by means of a production function. This is done in terms of the different rates of utilisation of resources, and other economic variables, such as the profit function and/or the cost function (Timmer 1971, Lau and Yotopoulos 1971, Moussa and Jones 1991, Farrell 1957, Varian 1992).

Efficiency is also a function of the management of the firm. In here, there are again different factors that account for the type of management that exits within the firm (Koutsoyannis 1985, Child 1974, Porter 1985, Mintzeberg 1983). These factors influence the level of performance of the firm and are discussed in the context of managerial efficiency. Factors thought to influence managerial efficiency and hence the overall efficiency

efficiency of the firm include the age of the managers, company objectives and strategies, ownership control and education, among others (Child, 1974). Such factors relate to the organisational capabilities of management in maximising the efficiency of utilisation of factors of production. On this basis, it is quite pertinent to assess the correlation of the said factors to the performance or efficiency of a given firm.

1.1 Purpose of the Study

This study on firm efficiency and firm size has been undertaken at a time that Zambia has been implementing a radical and orthodox Structural Adjustment Programme (SAP). During this period, SAP in Zambia has been designed in terms of the traditional objectives of economic stabilisation, in the short term, as well the attainment of economic growth in the medium to the long term. It is expected that during the short run period, stabilisation would have been achieved, through constraining demand by way of tight monetary policy and contractionary fiscal policy. In the medium to the long term, there are expected to occur supply side responses to the initial policy measures after achieving stabilisation. The supply side responses are designed or expected to be in the form of capital formation and increased capacity utilisation, which will increase the overall supply of goods and services in the economy. In short, firms are expected to become more efficient and increase productivity (Khan and Knight, 1982). The efficiency of firms is attained through the a package of policy measures inclusive of privatisation of state owned enterprises (SOE), liberalisation and deregulation of the markets and prices. As inefficient firms close or restructured and the efficient firms continue operations, employment creation occurs and structural rigidities are eliminated, thus leading to better and increased use of resources and output.

In the context of this study, however, SAP is only incidental. Nevertheless, the policy reform measures are considered in so far as they affect the analysis of the data, and in so far as they are directly relevant in the determination and analysis of the operational efficiency and productivity of the enterprises.

The manufacturing sector in Zambia has been cited to have experienced certain difficulties in the period following the implementation of a rapid industrialisation policy. Problems of distortion in the initial phases of the development of the manufacturing sector, which are discussed later, contributed partly to the problems of the manufacturing sector in Zambia (Seidman 1979). In order to advance to the level of policy critique, empirical verification must partly be made available to assess the operations and performance of firms.

This research will partly assess the effect of policy measures on the firms as well as focus on analysing efficiency and productivity of some 200 odd firms in Zambia.

The data analysis will examine the economic relationships that may be a function of firm size or alternatively influence firm efficiency. This will be at both intra sectoral and inter sectoral levels. Such relationships include aspects of:

i) labour productivity ;

ii) input - output efficiency i.e. raw material conversion rates;

iii) unit production costs;

iv) pricing efficiency, investments and profitability levels;

v) capacity utilisation rates.

The study will analyse on a comparative basis, the variances, if any, that may emanate from the levels of market structure concentration. Market structure concentration is regarded as being linked to the overall efficiency and performance of the enterprises and therefore, the economy. The concentration level is measured by way of the Herfindahl index.

Micro economic theory espouses that large firms, given their ability to achieve economies of scale, are inherently efficient. They are, therefore, able to operate under decreasing unit costs of production. This enables them to achieve increased productivity levels. By corollary, smaller firms are assumed to be less efficient in this instance.

However, it has been appreciated that smaller firms are likely to be better managed due to the comparatively less complex nature of their operations (Koutsoyiannis, 1985). Other authors (e.g. Page, 1984) point out that small firms tend to be labour intensive. This attribute of small-sized firms leads to the promotion of more job creation opportunities. It is noted that this was the main justification for the Indian government's policy approach towards the promotion of small scale enterprises.

Smaller firms tend to operate in market structures with relatively low concentration ratios. Consequently the overall market structures function more competitively, and hence promote more efficiency within the enterprises and the economy as a whole.

Thus we see two different strands of argument that are presented in a more traditional nature for the different scale of firm operations. However, for the larger firms, as will be discussed below, it has been observed that there is a tendency for the firms to be organised in market structures that are oligopolistic in nature with either a high degree of product differentiation or a low degree of product differentiation. Small sized firms on the other hand tend to be organised in monopolistic markets with often a high degree of product differentiation (Bain, 1968; De Valk, 1992).

1.2 Organisation of the Thesis

The first part presents the introduction and rationale of the study as well as providing the background. The second part is a survey of the relevant literature on the subject of the issue under consideration. This also looks at both the main elements of the existing literature as well as the areas of possible deficiency in which this paper makes a contribution. In addition the theoretical framework is discussed under this section. Part three is involved with discussing the model for data analysis and the sampling methodology for the sample of firms that were involved in the study. Part four deals with the background of the aspects that have influenced the current rate of manufacturing performance and the current state of the manufacturing sector. Parts five, six and seven are dealing with data analyses and interpretation of the data. The last part looks at the summary , conclusions and policy options.

1.3 Macroeconomic Background

The basic objective of the macroeconomic policy over time has been the attainment of economic stability. This has entailed the management of aggregate demand and aggregate supply in such a manner as to ensure maximum growth.

From 1964 up until 1984, the policy regarding various key economic variables such as interest rates, exchange rates, prices etc. was one of controls by way of administrative management (O'Neil et al, 1986). Following initial experimentation with the auctioning system for foreign exchange in which the exchange rate was determined by a system of bidding, other more flexible measures were introduced. However, there was a policy reversal in 1987 when the IMF sponsored programme was abandoned. It was not until about 1990 that there were again relaxations in the various controls and a shift towards a market economy.

The objective of the government in the initial stages following independence was to achieve development in the shortest possible time. This entailed rapid investment in the productive, social and service sectors. Consequently, the state had to meet expenditures in conformity with the targets of the Transitional and First National Development Plans in terms of the required investments. The effects of this developmental effort was that the foreign reserves and financial resources of the government were put under severe strain. This, coupled with the reliance on copper as the main source of foreign exchange and as the major contributor to government revenue led to the government budget moving from a surplus to a deficit (Bank of Zambia Annual Reports, various). From 1975 onwards, the government budget systematically recorded a deficit that rose from -K299 million to -K396 million in 1983. Again, between 1988 and 1992 the budget recorded deficits continuously from -K2, 626 million to -K17, 376 million.

Thus, the country experienced macroeconomic imbalance since the early 70's and by 1978, the Zambian Government sought and obtained Balance of Payments support from the (IMF).

The expenditure on the social and commercial programmes by the Zambian Government led to the budgetary deficit with the transmission mechanism through the balance of payments being such that the latter also experienced a deficit.

1.3.1 Gross Domestic Product

The changes in the Zambian economic environment have been quite volatile over time, particularly during the period between the early 70's up to the 90's. The 60's were more of the growth years for the Zambian economy.

The Gross Domestic Product, at current prices, grew from 30, 020 million kwacha to 1, 640, 747 million kwacha in 1993. In real terms, however, there was only a minimal increase from 2, 247 million kwacha to 2, 311 million kwacha during the same period. There was again a real decline in 1994 down to 2,160 million kwacha (Ministry of Finance, 1994).

What was once a positive balance of payments position has deteriorated over time. Table 1 shows the balance of payments position during the period 1988 - 1993. With the exception of 1990 and 1991, the overall balance of payments position was negative.

1.3.2 Balance of Payments

Table 1 Balance of Payments:1988 - 1993

(US $ Mn)

YEAR	1988	1989	1990	1991	1992	1993
exports	1151	1237	1155	1104	1177	1004
imports	668	717	895	747	828	895
trade balance	484	520	260	357	349	109
overall balance	-344	-234	395	136	-400	-394

Source: Bank of Zambia, Annual Report, 1994.

The implications for the commercial sector in general and for the performance of enterprises in particular is that the economy had less foreign exchange available for the importation of inputs, such as capital goods, spare parts and raw materials. The lesser the availability of inputs, the lower the capacity utilisation of the plants and the lesser the general productivity and efficiency.

1.3.3 Exchange Rate

The foreign exchange rate plays a significant role in allocating resources efficiently. The level of the exchange rate also influences the consumption pattern of the economy in terms of imported goods. A lower exchange rate will tend to promote the importation of goods at the cost of local manufacturing and will therefore most likely influence the development of a distorted consumption pattern (Seidman 1979). This distortion may occur in the form of industry becoming capital intensive relative to the available resources due to the cheaper foreign exchange that is available and/or the importation of consumer goods. Whatever the case, there will be considerable pressure on the balance of payments exerted by this type of demand.

In order to address the supposed overvaluation of the exchange rate, the Zambian government devalued the kwacha and during the mid 80's adopted a policy of auctioning foreign exchange in order to try and arrive at a realistic exchange rate. The exchange rate policy effectively shifted from a rigidly controlled one during this interim period, to a flexible policy. However, in 1987, when the IMF sponsored programme was suspended, a controlled exchange rate policy was re-introduced. Thus, it was not until 1993, when the kwacha was made convertible and exchange controls were completely removed that the country went back to a market determined exchange rate policy.

Between October 1992 and December 1994 the Kwacha rate per United States Dollar, depreciated from K320.15 to K682.80 to US $1 . This massive depreciation was due to an attempt to re-align the kwacha value. However, the negative effect of such massive depreciation is that the currency may be undervalued and also makes imports unaffordable and consequently stifle investment in required areas such as capital equipment.

1.3.4 Interest Rates

Interest rates are significant as they affect the distribution of loanable funds and to some extent affect the level of private savings which goes towards creating surplus for re - investment purposes by the commercial sector through financial intermediaries. Interest rates together with the exchange rate have been utilised in the 90's especially as part of a policy package of SAP. Given the experience of high inflation in Zambia, real interest rates were negative. As such, they could not offer any incentive for savings. To make them positive therefore, it was necessary that they be higher than the rate of inflation. This policy was actively pursued during 1993. Note that previously, as with the exchange rate, the policy was such that interest rates were controlled until 1992. The policy of attempting to achieve real interest rates resulted in astronomically high nominal rates. This was so since the Government pursued tight fiscal and monetary policies designed to attain a balanced budget and low inflation. However, this also entailed a rise in the rate of interest and a depreciation of the exchange rate. The rise in interest rates had the expected effect of restricting investment and working capital. As will be shown later, the survey from which the data was collected reveals this result among the firms. The high cost of bank borrowing whether through short term or long term was a major constraint in not being able to increase capacity utilisation.

Between March 1990 and December 1993, maximum lending rates rose from 35% to 119%. This rising trend in interest rates, made it extremely difficult for investors to access loanable funds. Therefore interest rates are a double - edged sword.

1.3.5 Inflation

In 1976 the annual rate of inflation was 21%. By 1978 it had declined to 10%. There was a rise in 1981 to 11.5% and further to 25% in 1984. During this period it will be appreciated that the rate of inflation was fairly stable. Following the earlier attempts at liberalisation (1985-87), when there was also a rapid growth in the money supply, the average annual rate of inflation jumped from 56% in 1985 to 111% by 1991. By December 1992 it was 191%, declining to 138% by December 1993.

Generally, the economic environment deteriorated. How the productive or real sector of the economy has performed against this background, has been a subject of considerable debate. Part of the objective of this investigation is to try and determine the performance of firms under the current economic policy reforms.

1.4 Historical Development and Performance of the Manufacturing Sector in Zambia.

Zambia's initial growth rates in the manufacturing sector and the economy as a whole were high in the post 1964 period. From this perspective the period of Zambia's performance could be categorised into:

i) the initial high growth rate period, 1964 to 1970;

ii) the static growth period, 1971 to 1985; and

iii) the period of economic decline, 1985 to 1995/96.

Table 1.1 shows the performance of the Gross Domestic Product between 1988 and 1993. The primary sector performed poorly during this period and registered a decline or negative growth. The secondary sector, including the manufacturing registered a minimal growth rate, from 678 million kwacha to 765 million kwacha.

TABLE 1.1 GROSS DOMESTIC PRODUCT BY SECTOR AT CONSTANT (1977) PRICES 1988 - 1993.

GDP BY SECTOR AT CONSTANT 1977 PRICES							
year		1988	1989	1990	1991	1992	1993
primary sector							
agriculture	k'mn	597	600	594	555	429	569
fishing		436	4224	387	407	272	414
mining&quarrying		160	176	163	148	157	155
secondary sector		678	657	708	712	734	765
manufacturing		547	544	586	586	619	655
tertiary sector		972	964	955	944	930	950
TOTAL GDP		2247	2224	2213	2208	2094	2287

Source: Bank of Zambia Annual Report, 1993.

The historical development of the manufacturing sector in Zambia has been such that the sector experienced rapid growth in a short space of time between 1964 and 1980. In 1954, manufacturing contributed 3.3%

to Gross Domestic Product (GDP). In 1963 the contribution of manufacturing to GDP was 6.1% which rose to 10.5% in 1967. During the next two decades the trend in the development of the manufacturing in terms of its contribution to GDP was as follows: 15% during the period 1975-1980, 17% during 1980-1985, 33.7% for 1980-1990 and 27% for 1991 (Bank of Zambia Annual Reports, 1964-1993; Republic of Zambia Economic Reports 1970-1994). The growth of the manufacturing sector was 11% between 1954 to 1963 and doubled to 22% between 1963 to 1967. During this period of rapid growth, Zambia registered higher growth rates than set by the United Nations' programme on the growth for the decade (Seidman 1979). This contrasts sharply with the decline or negative growth of the manufacturing sector of -19% during the period 1993-1994. This decline, more than any other indicator, shows vividly the problems that have beset the manufacturing sector and which require resolving. However, just how severe the constraints are and in what respects is something that has to be determined by investigation and analyses and is outside the immediate scope of this study.

TABLE 1.2 MANUFACTURING PERFORMANCE AT CONSTANT 1977 PRICES:, 1988 - 1992.

MANUFACTURING PERFORMANCE AT CONSTANT 1977 PRICES					
year		1989	1990	1991	1992
food,beverages & tobacco		268	284	323	369
textiles & leather industry		83	72	66	51
wood & wood products		9	10	12	12
paper & paper products		36	34	33	32
chemicals,rubber & plastics		38	39	35	36
non metallic mineral products		33	23	22	21
basic metal products		3	2	2	

Source: Bank of Zambia Annual Report, 1993.

Further evidence on the performance of the manufacturing sector is provided in Table 1.2. From the table is observed that the sectoral performances were on average poor and of course consistent with the overall performance of the Gross Domestic Product.

The performance of the food sector was comparatively the best having registered a growth from K268 million kwacha to K369 million. The metals sector declined from K3 million to K2 million. Over the same period, the textile sector declined from K83 million to K51 million. The wood sector registered a positive growth from K9 million to K12 million.

TABLE 1.3 INDEX OF INDUSTRIAL PRODUCTION:1980 - 1989

industry*	factory index	value added (k mil)	%	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	av % chane p.a
ming	11	503	55	100	91	95	93	89	87	87	84	81	82	-2
mfg-food	54	68	8	100	104	106	115	115	111	104	112	124	116	1.6
f,d,t	10	27	3	100	99	90	78	71	80	88	83	91	96	-.4
tex,fwr	56	72	8	100	118	120	113	121	153	133	114	142	148	4
wd, fr	14	17	2	100	104	98	77	64	71	65	67	71	83	-2
p,p	18	20	2	100	124	125	136	133	122	126	193	191	200	8
c,g,r	37	60	7	100	100	86	104	93	90	99	96	106	97	-.3
gl,c	13	18	2	100	101	99	94	78	85	98	125	117	117	1.7
i,s	5	8	1	100	92	80	81	82	96	90	92	90	72	-4
m,m,m	64	65	7	100	98	100	95	115	113	118	127	133	133	3
omfg	1	723	.1	100	100	114	91	116	81	142	50	62	75	-3.1
mfg	272	357	39	100	105	103	104	105	111	109	113	123	122	2
elec	1	54	6	100	106	115	109	106	109	106	91	91	73	-3.4
ming, mfg	283	861	94	100	97	98	97	97	96	97	95	98	99	-.1
ming, mfg,elrec	284	915	100	100	98	99	98	96	97	97	96	99	98	-.3

Source:Kmietyowicz Z.W. Output, Employment and Productivity in Zambian Industry, 1980 - 1989; School of Business and Economic Studies, University of Leeds, England.

*ming-mining, f-food, t-tobacco, i-iron, s-steel, d-drink, tex-textile, fwr-footwear,wd-wood, fr-furniture, p-paper, p-printing, c-chemicals, g-glass, m-machinery/metals, elec-electricity, omfg- other manufacturing.

Table 1.3 above shows the index of industrial production for the period 1980 - 1989. Column 3 gives the value added for the sectors in value terms, while column 4 gives the value added in percentage terms. From the table the importance of manufacturing to the Zambian economy is emphasised in that it is the second biggest sector after mining. This, then makes manufacturing the biggest and the most important sector.

However, it should be noted that after adjusting for processing functions, such as smelting, that are performed in the mining sector and when these are attributed to the manufacturing sector as they should be, then the value added in the manufacturing sector rises to about 60% (Kmietowicz 1994).

In the World Bank survey data that this study draws upon, four sectors are considered, namely:-

i) metals and metal fabrication,

ii) wood and wood processing,

iii) textile and leather,

iv) food.

It will be observed from Table 1.3 that these sectors accounted for about 25% of the total value added out of the proportion of 39% attributable to the manufacturing sector. For the period under consideration it will be observed that wood and wood products registered the highest overall average annual growth rate of 4.4%, although the current situation has slightly changed with the food sector registering the highest growth rate of all the manufacturing sub sectors. It is perhaps because of this that we see that the manufacturing sector registered the highest average annual growth rate of 2.2%.

In the initial stages i.e. from 1964-65, the manufacturing base was minimal, as already indicated. The sector later experienced new investments mostly in the food and clothing sub sectors. The other sub sectors in which investments grew by between 60-80% included metal fabrication and manufacturing. Some of the factors that have been identified in the growth and expansion of the manufacturing sector are as follows:

i) the break up of the Federal government structure comprising Nyasaland, Southern Rhodesia and Northern Rhodesia (now Malawi, Zimbabwe and Zambia respectively). The Federal Government of Rhodesia and Nyasaland existed between 1953 and 1963. This break up led to resources being released from the as a result of the Federal contributions ceasing and therefore the demands from the two countries, Southern Rhodesia and Nyasaland to Northern Rhodesia. It is estimated that Zambia lost 19.4 million pounds per year over the ten year period of the Federation. This amounted to a total of 194 million pounds over the entire period. This system of inter-territorial transfers worked negatively against the then Northern Rhodesia up until 1963.

ii) Following the break up of the Federation, Northern Rhodesia was able to establish its own Ministry of Commerce and Industry and no longer needed to rely on Southern Rhodesia. This allowed Northern Rhodesia and soon after independence, the new Republican state, Zambia, to formulate its own respective industrial policies.

iii) Zambia was able to recover the main mineral rights from the British South African Company (BSA), which allowed for increased revenue sources to the government.

Furthermore, the government deliberately tried to enhance manufacturing growth by the formulation of an industrial policy, beginning with the industrial development policy of 1964. The government, during the latter part of the 60's strengthened the role of the Industrial Development Corporation (INDECO). The Corporation subsequently invested so heavily in the manufacturing sector that economy came to be dominated by the parastatal sector to the extent of 75% at one time (Turok 1979). These policy aspects were complemented in their effect by the promulgation of the 1968 Mulungushi and 1971 Matero Reforms.

Notwithstanding the advances made in the growth of the sector during this period, it was argued that the pattern of manufacturing investments was misdirected (Seidman 1979). Seidman argued that the investments in manufacturing were made on the basis of 'distorted' market forces which sent wrong (price) signals to the planning authorities as most investment was by INDECO and a minor proportion by the private sector. Seidman further argued that the market forces were distorted as there were distorted competition structures. The distortion in the market structures arose due to the structure and size of the economy which was relatively small to the extent that competitiveness in the production sector in Zambia was not developed in the context of traditional market economies in the West. Consequently, the basis of investment was influenced by the tastes and demand patterns of the affluent and would therefore not be responsive to growth in the long term. Examples of such investments are those in the car industry, radio assembly etc. In this context, Zambia did not yet possess the expertise to manufacture cars and other consumer products and as such she would only at best undertake last stage assembly operations. This would ultimately be inefficient and therefore costly to the economy. What was required were rural, agro based industries that would exploit rational linkages and facilitate growth through the utilisation of appropriate technology. In this regard the use of any technology has implications in terms of technical efficiency. If the technology is inappropriate, firms will be inefficient technically and most likely allocatively also. This suggests that the firms' output and capacity utilisation levels will be low and the firms will either make financial and economic losses or not be as profitable as they should be. This was the situation that was to later face the State Owned Enterprises in particular and other private firms in general. The firms that were so established have been criticised as being capital intensive in most cases and according to the proponents of appropriate technology this was one reflection of the inappropriateness of the firms' technologies. This perhaps is at the root of the problem of the manufacturing sector in Zambia.

1.5 Conceptual Definitions Relating to Efficiency and Productivity.

1.5.1 Market Structure and Market Concentration

This is a form or manner in which firms are organised. It has certain characteristics in terms of sellers and buyers. It refers to the composition of firms. Composition refers to the number of firms, their size and concentration. A high market concentration denotes a few firms and a low market concentration denotes several firms. Other aspects of structure refer to product differentiation and barriers to entry. Elements of structure involve the distribution of input coefficients i.e. input per unit of output. Market structures are designated in the following categories - perfect competition, monopolistic and oligopolistic competition and monopoly (Bain 1957, De Valk 1992, Dixon 1980).

1.5.2 Herfindal Index

Part of the process of determining the level of competition in terms of the degree of concentration is done through a form of measurement known as the Herfindal index. The basis of the index lies in the oligopolistic approach inherent in the Cournot - Nash Equilibrium (Davies 1988).

$$H = 1 + (cv)/N^{2}$$

where,

cv = the coefficient of variation.

N = the number of producers or sellers

H is defined as the **Herfindahl index** and lies between 0 and 1. The lower the concentration the lower the index and the higher the degree of concentration the higher the index.

The index is said to have an inverse relation to firm numbers and is positively related to the size of firm inequalities. The index assists to assess the degree of competition or the type of market structure. This is used together with other efficiency estimates in gauging the efficiency of the firms and the market structures.

1.5.3 Efficiency

Efficiency is linked to the appropriateness of chosen technology. Technology's role is to facilitate or retard the influence of a firm's growth. Changes in efficiency induce changes in productivity. The measurement of efficiency is done by way of a production function which will satisfy the properties of homogeneity and monotonocity (De Valk) i.e. as a result of the function being homogenous and monotonically increasing.

1.5.3.1 Technical Efficiency

A firm is said to be more technically efficient than another firm if it consistently produces more quantities of output from the same quantities of measurable inputs, or if the firm achieves a given output with fewer inputs for a given state of technology. Alternatively technical efficiency can be measured by the level of unit costs of production attained by an industry supplying any output it produces. The degree of technical efficiency is measured by the relation of attained unit costs to the minimum attainable unit costs (Bain 1968).

Technical efficiency therefore refers to scale parameters in the production function and price (allocative) efficiency which describes maximising behaviour (Lau and Yotopoulos, Mouzza and Jones, Farrell).

1.5.3.2 Price Efficiency

Price efficiency is more of a behavioural concept, which denotes maximisation of profits under conditions where the value of the marginal product is equal to the price of the factor of production. A firm is said to be price efficient when it maximises profit. Profits are maximised under two sets of conditions:

i) by equating the marginal cost to marginal revenue i.e.

$$MC = MR.$$

ii) by equating the marginal revenue product to the marginal factor cost i.e.

$$MRP = MFC$$

1.5.3.3 Economic Efficiency

Efficiency is a relative concept which requires that the performance of an economic unit must be compared with some set standard. As such economic efficiency can be measured at three levels. These are at macro, industry and micro levels (Forsund and Hjalmarsson 1987). Overall efficiency is accounted for, by deriving different quantities of output from a given level of measurable inputs.

At the macro level, efficiency is concerned with the level of allocative efficiency, defined by the well known Pareto efficiency conditions (Moussa and Jones).

At the industry level, the concern is with the relative performance of firms in industry, where the best practice firms or frontier production function serve as the basis for performance assessment. Such efficiency measures show the likelihood of total production and the potential for increased production by employing additional resources for those firms that are best practice firms. At the micro level the main area of concern is that of the rate of resource utilisation at the firm level.

1.5.3.4 Productivity

This is a concept closely related to that of efficiency. Productivity is concerned with the use of resources i.e. inputs or factors of production, with a given state of technology, demand and socio-economic environment, such that the output depends on the performance and of the use of resources such as inputs in the production process and how these are used subject to such factors as the state of technology or the level of demand and other socio-economic factors. Productivity can be said to increase when fewer resources are used to produce greater amounts of output and vice-versa (Downes A.S, 1994). Productivity is often measured partially by a ratio of output to an aggregate index of inputs.

1.5.4 Total Factor Productivity

Total factor productivity refers to an increase in the amount of output over a given time period (growth in output) while utilising a lesser increase in inputs over the same time period. Consequently, the increase in output is not explained by an increase in raw materials alone, but by other factors as well such as capital and labour. For instance, assume there is an increase of 10% in output while at the same time there is only a 6% increase in the utilisation of resources. The difference of 4% shows that increase in output is greater than the actual increase in inputs. This increase in the output is attributable to the total utilisation of factors (Nishimizu and Page, 1982).

1.5.5 Managerial Efficiency and Organisational Structure

For purposes of this research, managerial efficiency is reflected ultimately in the efficiency of the firm. Managerial efficiency by itself is not really measurable. As such it is determined on the basis of proxy, by the performance levels of the firms. Managerial efficiency is reflected through the trends and results of the growth of the firm, the capital structure, profitability, gearing (debt-equity ratios), sales turnover, investments. Other than such easily quantifiable data, firm efficiency is assumed to be a function of its organisational structure (Mintzeberg 1983, Porter 1987). The effectiveness of the firms' management comes from how it divides its labour into various functions and how those functions are co-ordinated (ibid.). The composition of the division of labour and the co-ordination of the functions is then seen to significantly influence how efficient management performs its functions.

1.5.6 Production Function

Koutsoyiannis (1985) defines the term production function, assuming constant returns to scale, as the representation of the technology of a firm or industry or the economy as a whole in which by a method of a production process, factor inputs are incorporated, for the production of one unit of output. This is to say that if we assumed to have capital and labour as units of production, the production function(s) that may face any firm using these factors, are the various units of output that are facilitated by the combination of these two factors.

An efficient production function is the best possible output that could be achieved by the combination of any two or more factor inputs.

1.5.7 Frontier Production Function

The frontier production function is referred to as the elements of the firms' production function that yield the optimal or maximum output for any given set of inputs in comparison or relative to a given set of production functions relevant to the industry (Førsund and Hjalmarsson, 1987).

The frontier production function is also said to be the function, or level of output for any combination of inputs, that is optimal or the maximum achievable and therefore one of potential attainment by a firm (Aigner and Chu, 1968).

1.5.8 Profit Function

Profit is defined as the current revenue minus the current total variable costs, which is given by the product of the unit price by the total output minus the product of the unit costs by the total inputs. The profit function gives the maximised value of the profit for various observed values (Lau and Yotopoulos, 1971).

1.5.9.Unit Output Price Profit Function

This is given by the division of the profit function by the unit price.

1.5.10 Small Scale Firm

The Small Scale Industry Organisation (SIDO) under the Ministry of Commerce and Industry defines small scale firm by means of monetary value and labour. Formally, small scale is defined as that firm which employs capital assets including working capital up to the value of K50 million and/or employing a total labour force of up to a maximum of 100 employees.

CHAPTER TWO

LITERATURE REVIEW

2.0 LITERATURE REVIEW

The subject matter of firm efficiency, firm size and other related issues such as the efficiency of the functioning of the market structures and the competitive level of the economy have been areas of substantial research and investigation in other countries. The general objectives of the research have been, firstly, to analyse the efficiency of resource utilisation of the firms and secondly, to make policy recommendations regarding the effectiveness of the particular and general effects of the policy framework that directly impinge on the performance of industries.

Efficiency and productivity studies are a necessary aspect of the performance assessment of industry as resources are scarce and their optimal utilisation leads to consumer benefits, lower costs of production and more efficient utilisation of resources in the economy. In addition, it increases the financial and economic returns to the industry through increased profitability and expansion of business operations and investments. This, on the macro level, results in increased national income.

The measurement of efficiency is based on the use of econometric models that facilitate the estimation of production frontiers. The review that is presented immediately below examines the different types of frontiers that measure technical or price efficiency.

2.1 Production Functions

The pioneering article in the field of efficiency studies in the contemporary context was written by Farrell (1957). The rationale of the article was that firstly, the relative efficiencies of the theoretical foundations of different economic systems should be subjected to empirical testing.

Secondly, if economic planning was to concern itself with particular industries, then it was important to know how far a given industry could be expected to increase output by increasing its efficiency and without therefore increasing its absorption of resources. The article observed that the convenient manner of measuring productivity or efficiency was by the measurement of average productivity of labour. This clearly was inadequate as a fuller measure of efficiency required the inclusion of technical efficiency, price efficiency and also scale efficiency (Forsund 1992).

Farrell decomposed the efficiency concept into three categories:

i) technical efficiency,

ii) price efficiency; and

iii) overall or economic efficiency.

These components of efficiency are depicted diagrammatically in Figure 1.

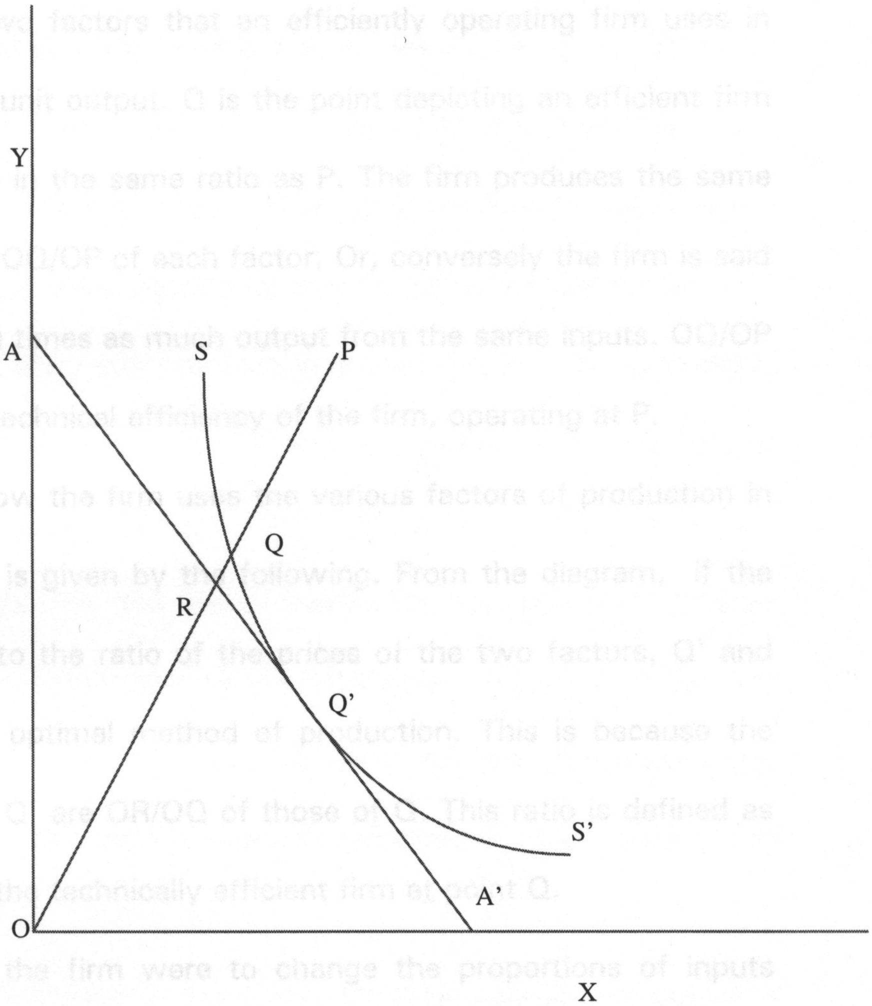


Figure 1

In Figure 1, the point P represents the inputs of two factors, per unit output, that the firm uses. The isoquant SS' shows the various combinations of the two factors that an efficiently operating firm uses in order to produce each unit output. Q is the point depicting an efficient firm using the same factors in the same ratio as P. The firm produces the same output as P using only OQ/OP of each factor. Or, conversely the firm is said to be producing OP/OQ times as much output from the same inputs. OQ/OP is then defined as the technical efficiency of the firm, operating at P.

A measure of how the firm uses the various factors of production in relation to their prices is given by the following. From the diagram, if the slope of AA' is equal to the ratio of the prices of the two factors, Q' and not Q, represents the optimal method of production. This is because the costs of production at Q' are OR/OQ of those of Q. This ratio is defined as the price efficiency of the technically efficient firm at point Q.

Furthermore, if the firm were to change the proportions of inputs until the same as those represented by Q', while technical efficiency were constant, the costs would be reduced by a factor OR/OQ.

This ratio measures the price efficiency of firm P as well. The overall efficiency is given by the ratio OR/OP which is equal to the product of the technical and price efficiency.

Using agricultural data from the United States, Farrell drew efficiency measures based on the variables, land, labour, materials and capital\machinery. He found that the most efficient combinations were those of land, labour and raw materials as well as those of land, labour, raw materials and capital. Other input combinations were found to be inefficient. It was observed that this approach of efficiency measures was most suited to industrial data.

The Farrell study set the basic framework for efficiency related studies that have been undertaken since that time. However, it did not address the issues that may be involved in other sectors of the economy such as manufacturing. This aspect is developed through other studies that are discussed below.

Another influential article in the theory of micro economic production functions is by Aigner and Chu (1968). The objective of the article was to explain how to estimate an industry production function given a deterministic production process i.e. the observations are all determined within the best practice production function.

The production function, given the cost functions and efficiency criteria, was estimated using a Cobb - Douglas model by means of single and two stage least squares.

Peter de Valk (1992), observes that industrial performance measurement is a difficult and complex concept. Performance therefore should be viewed as a relative concept which must be seen in relation to a select set of objectives. In this perspective, it matters significantly from which point of view that performance is evaluated, e.g. a firm may maximise profits but fall short of some national objective of expanding industrial exports. In his study, Peter de Valk notes that standards are required for the evaluation of data. The data require to be compared against the 'best' practice firms. These are the firms that are within the most efficient attainable range of production functions. Performance is related to the firm level and industry level such that there exists a basis for analysing the firms by linking them to the structure of the markets. In the performance related studies such as this one, the variables that are examined are - capacity utilisation; total factor productivity; financial variables such as profitability; costs of production and investments.

The De Valk study is based on a framework which encompasses two major market structures.

These are the oligopolistic and monopolist structural models. The prices in both the product market and the labour market are significant in the study.

The study assesses the performance of the Tanzanian textile firms compared to that of textile firms in other parts of the world such as Southern Africa and Europe. The study reveals poorer performance in the Tanzanian case than elsewhere.

The above study mainly focused on an intra - industry efficiency assessment. It thus did not delve into the details of inter industry analysis or firm size analysis or comparisons.

Moussa and Jones (1991), look at efficiency and the unit size of an enterprise. The study is based on Egyptian farm data. They focus specifically on the decomposition of efficiency in terms of technical and factor price efficiency. In essence, they draw extensively on the issues raised by Farrell (1957). However, unlike the original investigation, they do not adopt a Production Function but use the Unit Output Price (UOP) Profit Function in the estimation of efficiency. The findings of the study are that there is equal relative price efficiency for both small and large units. This means that both small and large firms had the same relative price efficiency estimate parameters. They also find that there is no absolute price efficiency among the large farms. Similarly, they also find the lack of any absolute price efficiency among the small firms.

One surprising result of the study was the lack of equal relative price efficiency among the small firms

which suggested that the small firms are not able to allocate their resources effectively and be able to maximise profits. A similar result was obtained as regards the large units. Another result that the study found was that there were constant returns to scale for both small and large units.

As regards the input and factor demand elasticities, the findings were that the machinery or capital (and land) were significant in increasing output.

The conclusion of the Moussa and Jones study is that economic efficiency is not adversely affected by size. In addition, technical efficiency also does not seem to be significantly influenced by the size. However, they conclude that there is a positive response to an increase in the factors of production i.e. capital, labour and that capital (technology) is the more important factor of production.

Timmer's study (1971) concerned itself with the spatial determination of technical efficiency in the context of a firm operating on the best obtainable production function. He used agricultural data from the United States in which 47 states were represented.

He observed that inefficiency will exist due to divergence in the marginal revenue product from the marginal costs. The study was restricted to the determination of a technical efficiency measure utilising the Cobb - Douglas production function and the log linear form of regression analysis.

The study found little major differences in the efficiencies at state economy level.

The major limitation of this study was that by aggregating the data it glossed over the details of specific micro issues pertaining to individual units.

One of the studies that apply firm size and efficiency as in the case of Moussa and Jones is the study by Page Jr (1984). The study was influenced significantly by the need to develop and promote small level enterprises in India. It looked at the performance of the Indian manufacturing sector. The analysis was made by way of utilising a translog production function in the estimation of technical efficiency. Total factor productivity estimates were also made use of. The study found that the variables including the size of the firm which were made in measuring technical efficiency were correlated with some explanatory variables. However, firm size was not very much related to productive efficiency.

Differences in output and productivity could partly be explained by managerial capabilities or the type of technology or the differences in the firms' endowments. This study would have been meaningful if the causal relationships in such variations had been further investigated, rather than assume that such variances are due to random occurrences.

Lau and Yotopoulous, (1971), focused their study on the analysis of relative efficiencies of firms/farms. One of their main investigative areas was in determining the extent to which efficiency increases occur without an increase in the resources utilised. The analysis uses the measures of partial productivity index of labour as a measure of economic efficiency. Price or allocative efficiency is also determined separately.

The study rejects the hypothesis of equal relative efficiency among small and large units. However, the hypothesis of relative economic efficiency was not rejected. They concluded from these results that smaller firms had a higher level of technical and price efficiency. This result was made more significant by the recording of higher relative profits by the smaller sized firms.

2.2 Industrial, Market Structures and Efficiency

Førsund and Hjalmarsson (1987), study the industrial structure of the Swedish economy with specific reference to selected Swedish firms in agriculture (dairy), steel (pig iron production), manufacturing (cement) and the Norwegian aluminium industries. The ultimate aim of the study is the presentation of a theoretical basis and estimation methods for the empirical analysis of industrial structure. In this respect their main concern is the presentation of what they consider a deviation from the mainstream and traditional approach to structure. The traditional approach to structure is explained in the context of market structures, where the major issues of concern are industry concentration, barriers to entry, product differentiation etc. In this respect efficiency as associated with economic efficiency is defined in terms of *Pareto efficiency.* The efficiency conditions are determined in terms of the theory of perfect competition.

Forsund and Hjalmarsson are concerned with structure in terms of structural rationalisation based on the dynamic production theory, in which production is considered in the short term. Structure from this perspective is associated with the various components of the firms internal and external environment. This concerns issues such as the distribution of wages, profits, costs assets and age of capital.

The above study is quite relevant in so far as the presentation of an analytical model is concerned. The study restricts itself to the development of a theoretical basis for the analysis of industrial structure more than anything else. It diverges from the intended study in that the proposed study places emphasis on the actual determination of efficiency and the investigation of related factors, in terms of size, that may influence efficiency aspects.

2.3 Managerial Efficiency and Stochastic Events

In the analysis of efficiency by use of production functions, there are different types of production functions that may be adopted. As presented later, we see that these may either take into account only the inputs and outputs in determining efficiency, or they attempt to isolate the contribution that other events - stochastic - have on the performance of the firm. Consequently, factors such as the managerial ability or machinery idle time or lack of raw materials are stochastic events which directly impact of inputs and output and therefore affect performance or efficiency (Forsund, Lovell, Schmidt 1981).

Managerial factors have for long been identified as being critical in determining the performance of firms. Such managerial factors constitute the management as a team and the organisational abilities of the management in harnessing resources which include human, capital and raw materials. In management terms, the determinants of efficiency are analysed from two general theories, namely universality theory and contingency theory (Child 1974). According to Child, influences affecting performance are made complex by the fact that some of these are external to the firm, while others are internal and therefore incorporate the managerial function of the firm.

Under universal theory it is expected that the presence of certain attributes will, of themselves, be conducive to superior performance. Under contingency theory , the proposition is that the attributes contributing to superior performance will alter according to the circumstances. Both approaches however assume that some factors can be isolated and identified in explaining managerial efficiency. With universal theory Child distinguishes four variables that account for the managerial responsibility in the firms' performance of efficiency. These are:

i)age:

it is hypothesised that the more youthful the managers the more likely the firms will perform better.

ii)company objectives:

The two efficiency related objectives are said to be that of the rate of growth and the achievement of net profit targets. It is expected that more conservative\inefficient managers will be risk averse and therefore have stable financial performance, such that the profit and growth rate achieved are minimal. This may result in the underutilisation of resources in the firm and the returns on the asset base of the firm will be comparatively lower.

iii) ownership and control:

the extent to which a firm is controlled by its professional management and the actual owners or shareholders, where such an ownership structure exists, is expected to influence the objectives that the firm sets and the efficiency with which it executes such objectives.

iv) allocation of human resource, the size of the company and the bureaucracy :

these factors lead to the overall consideration of the organisational structure of the firm. The lack of an appropriate structure denotes the inability of the firm to appropriately formulate its objectives and mission and the strategies to meaningfully realise these goals and targets. The firm that sets for itself coherent and consistent objectives and allocates human resources in such a way that the use of all resources is optimised, will naturally tend to achieve the best in terms of performance and may possibly be denoted a 'best practice firm'.

From the research conducted by Child, the results were that efficiency could be related or be correlated with management in terms of the age, the organisational structure i.e. allocation of resources.

The study by Child is relevant to my research in so far as the managerial factors that affect the performance of enterprises have been included in the survey of the data to be used. This includes data on the ownership, investments, growth and selected strategies that are deemed as critical in the performance of the firm. The issues that are raised by authors such as Mintzeberg (1983) and Porter (1987) on the effective organisation of firms and the consequent formulation and implementation of successful strategies are partly not within the realm of relevance to this study and will be excluded to a great extent. Also to be excluded will be issues that focus strongly on the creation of competitive advantages as exposed by Porter as these are more oriented towards the study of management science.

The theoretical basis of the research rests on the theory of the firm and that of industrial organisation.

From the theory of the firm, the relevant aspects are production and technological theory, on which efficiency aspects with respect to the production function are based.

Drawing from both the theory of the firm and industrial organisation theory, the research focuses on the theory of market structures. As oligopoly theory therefore lies at the heart of industrial organisation (Dixon , 1988), industrial organisation analyses how the firms are organised and how this organisation constitutes a certain form of structure. The firms within this structure behave or conduct themselves in a certain way with regard for instance to the pricing practices, output practices, product differentiation etc. The organisation of firms in any structure will involve a given number of firms. The number of firms within a given structure determines the competition in that structure. The element and degree of competition influences the behaviour and responses of each firm towards the other. Related to this is also the performance levels of the firms under each structure with respect to their profitability.

The degree of profitability of firms may appropriately be a function of the competition or number of firms, the barriers to entry, the output and pricing practices. All these issues outlined, are analysed within a framework popularised by Bain (1968) called the Structure -Conduct - Performance paradigm.

Generally, perfect competition is modeled as the most desirable and efficient form of market structure. In the extreme case, monopoly is normally seen as the most inefficient case in terms of pricing, output and resource allocation.

Nevertheless, in all forms of market structures, firms are deemed to be operating efficiently only when they are able to determine price on the basis of:

marginal revenue = marginal cost

in the product market

and

marginal revenue product = marginal physical product

in the labour market.

In addition to the above, efficiency is also assessed on the basis of the factor utilisation in a manner that ensures the most effective derivation of output per standard input; labour productivity; capacity utilisation; production cost; rates of return on investments.

2.4 Description of Production Frontiers

In the analysis of the data, the Cobb - Douglas production function will be used in the derivation of the parameter estimates for elasticitiies and technical coefficient. Of the various literature that exists on frontier production function analysis, Forsund el at (1981) have done a survey. This survey has looked at the definitional issues of efficiency, the theoretical underpinnings, which are based on the input utilisation and output derived from the given set of inputs. The survey extends its discussion to the different econometric models. The different models considered are defined as ;

a) deterministic non - parametric frontiers

This is based on Farrell's initial exposition of efficiency measures based on the definition of technical and allocative efficiencies. It assumes, as has been shown, an isoquant that characterises the frontier technology.

b) deterministic parameter frontiers

This is based on a production function normally of the Cobb - Douglas form or a variant of that. Aigner and Chu (1968) were among the first to use this approach and it has been extensively applied since. In this case the observations so derived from the function can be above or below the function. It has been associated with the simplicity of specifying technological function form specification in mathematical terms. The weakness lies in the inability to obtain statistical properties such as standard errors.

c) deterministic statistical frontiers

These are of the exponential form in most cases. They restrict the observations to lie below or on the function. It may of course be computed by ordinary least squares or corrected least squares.

d) stochastic frontiers

All the above three frontiers are said to be deterministic. This means that all firms all firms have common production, cost and profitability frontiers. However, in practice firms performance may be affected by other factors that are unique to the particular operations of that firm i.e. random occurrences or events. Such random effects or factors as lack of inputs due to delivery constraints, poor machinery, which are not captured in the other models are compesated for here.

The survey also considers various pertinent issues in efficiency estimation such as the interest or rationale for the non - frontier efficiency models. It alludes to the interest that arises out of determining the structure of efficient production technology by use of production frontiers. However, non - frontier efficiency estimation methods are also considered. This approach has been used by Lau and Yotoplous (1971) . A case by case analysis of firms is not possible by this methodology, only that for a given number of firms or a group of firms. Ultimately, this leads to the use of the Cobb - Douglas production function. Other issues raised are concerned with philosophical aspects regarding for instance 'average' or 'frontier' functions e.g. when computing the production function for an industry do you take an 'average' of the firms i.e. add the firms production functions as given by ordinary least squares or the best possible single output.

2.5 Relevance of the Study

Industrial development is a function of the growth and expansion of industrial output. The process of industrial growth is dependent on the efficiency and expansion of the domestic capacity and the improvement in the level of technology as well as the performance of that technology.

For any government officials and economic analysts that are concerned with the appraisal and focus on the sectors that are to be most effectively supported within the context of national economic growth and efficient resource utilisation, the determination of how efficiently industries are performing and the factors most significant in influencing that performance have to be identified and where possible their effects isolated and measured.

This also entails the appraisal of factor productivity. This involves the assessment of the performance of the individual factors of production.

The study will be concerned with investigating the efficiencies and productivity of the manufacturing sector. In this instance the study will partially extend the assessment to the market structures and how these impact on the firms.

CHAPTER THREE

RESEARCH METHODOLOGY AND HYPOTHESES

3.0 RESEARCH METHODOLOGY

The methodological approach of the data collection and analysis is made from two perspectives. In the first instance, the initial research part comprises the sampling methodology and the data collection periods. The second perspective or phase of the methodological approach comprises data analysis and report writing.

3.1 Sampling Methodology

The sample selection procedure which was done during 1993 was based on a stratified sampling process. The sampling frame that was used was the list of the manufacturing enterprises in Zambia as listed by the Central Statistical Office, CSO. In particular, within the manufacturing sector, a sector that was purposively selected, four sub sectors were due for actual inclusion in the study and these were the food, textile, metal and metal fabrication and wood and wood manufacturing. The objective was to include as many firms as possible in the sample from these sub sectors if the were at that time operational. Given the time period that the survey was taking place it became quite a common experience to find a number of firms had closed down due to the economic recession caused principally by initial Government stabilisation measures that curtailed supply side response through stringent demand management policies.

3.2 Data Collection

The actual process of collecting data from the firms was based on a principally structured questionnaire in which the collection was done by means of personal interviews by teams from the Departments of Economics of the universities of Oslo and Zambia.

The actual data collection has been over a three year period, including 1993, 1994 and 1995.

3.3 Data Type

The type of data collected has been therefore cross sectional data. The three year period over which the survey has been undertaken while providing a good coverage in attempting to show the changes in the economy , given that stabilisation measures are short term covering a period of about 12 - 24 months and that the survey should in principle capture the effects of the stabilisation measures, cannot however constitute an adequate time frame for the consideration of a time series study.

3.4 Production, Profit, and Cost Function Models

This section looks at some of the attributes of three of the popular approaches in analysing or assessing firm efficiency. Although not all three models will be used in the analysis of the data, a discussion of the models is relevant in view of the closeness in the analytical approach of the models. However it may be necessary to show comparative results that obtain by utilising both the production and cost function models. Reasons are given as to why the profit function model cannot be used in this case. The models are:-

i) the production function approach,

ii) the profit function approach and

iii) the cost function approach.

Each of these models has its own attraction and advantages that go towards justifying its use. The profit function is sometimes preferred over the other two approaches (Moussa and Jones). However, the use of the profit function imposes certain data requirements which are more involving as the data should provide prices of the factors of production and the input and output quantities of the products in order to compute the profit function. This is not the case for the cost and production functions. The use of the cost or production function in the estimation of efficiency frontiers then becomes a matter of choice and the resulting analysis is not compromised (Aigner and Chu 1968, Forsund, Lovell and Schmidt 1980)

3.4.1 The Production Function

It has already been stated that an efficient production function depicts the maximum output obtained from a combination of a given set of inputs under specified technological constraint. The production function further provides concepts that enhance its usefulness in most areas of micro economic analysis (Koutsoyiannis 1987, Chiang 1979). Some of the main concepts that are derived from the production function are:

i) the marginal productivity of factors of production;

ii) marginal elasticity of substitution;

iii) factor intensity;

iv) efficiency of production; and

v) returns to scale.

The general mathematical form of the production function is given as follows:-

$$Q = f(L, K, R, s, y)......................(1)$$

where,

L = labour input

K = capital input

R = raw material input

s = scale parameter

y = efficiency parameter

In the general form given in equation (1) the production function is a purely technological relation between the quantities of inputs and quantities of output.

From the above function, the marginal productivity of each factor of production is obtained by the partial differentiation of the production function, with respect to that factor; thus:

$$MPl = \frac{\partial Q}{\partial L}$$

$$MPk = \frac{\partial Q}{\partial L}$$

where MPl = marginal productivity of labour and MPk = marginal productivity of capital.

Graphically, the slope of the marginal product of capital is shown by the slope of the production function for the specific factor, for instance:

$$Q = f(L)\bar{k},s,y \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where,

$\bar{k}, \bar{s}, \bar{y}$ denote the constant terms for the variables, capital, scale and efficiency respectively.

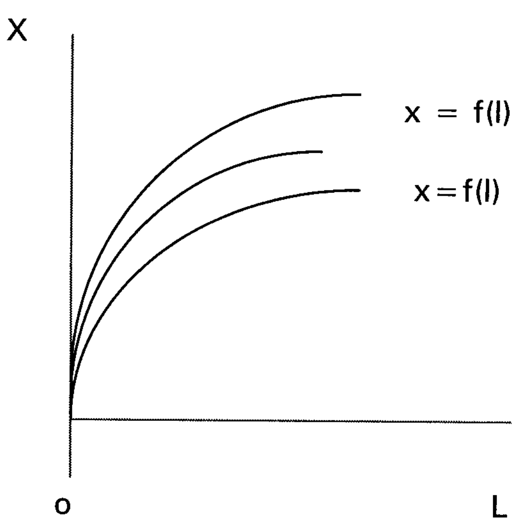


Figure 2.1

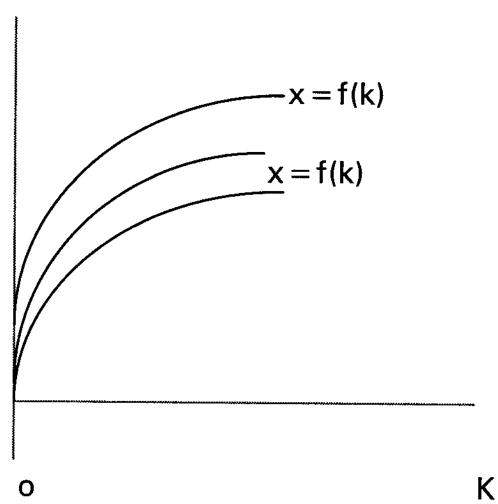


Figure 2.2

Source: Koutsoyiannis A: (1985).

Forsund F. (1992).

Figures 2.1 and 2.2 above show the production function for a single commodity. The variables are defined as follows:

$X = Q - R$

from equation 1, Q = total output and R = total cost of inputs.

Therefore,

X = the value added and,

X is then an increasing function of labour, L, as shown in figure 2.1, and an increasing function of capital, K, as shown in figure 2.2. This means that, as labour increases, the value added (output) increases and as capital increases, the value added similarly increases (Forsund 1992, Koutsoyiannis 1985). The more efficient a firm is in the utilisation of its inputs, the higher the production function that the firm will be on.

The study adopts a form of the Cobb - Douglas production function for the data analysis as we see in the next section and the rationale for the adoption of the parametric approach is given later. Suffice it to say at this stage that the Cobb - Douglas production function has had the advantage of being one of the most convenient and relatively easier mathematical functions to handle compared to say the Constant Elasticity of Substitution Function or Unit Output Price Profit Function or even the non parametric approaches using convex hulls in the form of isocost and isoquant curves as in the original work by Farrell.

The Cobb - Douglas production function is depicted as follows:

$$Y = \alpha K^{\beta 1} L^{\beta 2} R^{\beta 3} + Ui \qquad (3)$$

which in log linear form is

$$\ln Y = \alpha + \beta 1 \ln K + \beta 2 \ln L + \beta 3 \ln R + Ui$$

where,

Y = the output measured quantitatively or in monetary terms.

K = the capital input measured by the value of total capital related to production i.e. fixed assets plus financial assets.

L = labour input which is measured in form of total manpower employment or the total compensation cost (wage, salary plus all other benefits).

R = a component of any of the inputs for which it may be desirable to isolate or identify the particular causal effect e.g. in addition to the two factor inputs labour and capital, one may want to see the impact of raw materials' utilisation on the overall efficiency. In this case raw material will be represented by the coefficient, R.

Apart from the variables given above, other issues that require to be clarified in the context of the function are:-

a) the factor intensity is measured by the ratio $\beta 1/\beta 2$

b) the efficiency of the factors of production is measured by the coefficient α, where a higher value for α for one firm or sector over the other denotes a higher respective level of efficiency.

c) the returns to scale are given by the sum of the parameters $\beta 1$, $\beta 2$ etc. The model is based on the assumption of constant returns to scale.

The Cobb - Douglas production function can also be interpreted as follows, from the general form:

i) the slope of the coefficients, the βs, each measures the partial elasticity of Y with respect to K and L i.e. the percentage change in Y for a given percentage change in K and L. Or alternatively, each parameter measures the partial elasticity of output with respect to labour input/capital input respectively while holding capital/labour constant (Gujarati 1995).

ii) the sum of the parameter coefficients the β's relates information about the returns to scale i.e. the response in output due to a proportionate variation or change in inputs. Consequently the returns to scale are categorised as:

i) constant when the sum of the parametric coefficients is equal to 1 in a manner such that doubling inputs doubles output.

ii) if the said sum is less than 1, then there will be decreasing returns to scale such that doubling of inputs results in less than double of output.

iii) conversely, if the sum of the parameters is greater than 1 then doubling the input will result in more than double of the output.

From the above, the Cobb - Douglas production function can be estimated or computed either as

i)an unrestricted function, in which case the sum

$$\beta 1 + \beta 2 + \beta 3 = 1 \qquad ....(4)$$

is estimated explicitly as it stands.

ii) a restricted function in which one of the parameters is eliminated thus and a restriction or constraint is imposed on one or all of the parameters,

$$\beta 1 = 1 - \beta 2 - \beta 3 \qquad ....(5)$$

and subsequently substituting for $\beta1$ as appropriate. In this instance the Cobb - Douglas production function can be reformulated by using equation (5) as follows:-

$$\ln Y = \alpha + (1 - \beta2 - \beta3) \ln K + \beta2 \ln L + \beta3 \ln R \quad ...(6)$$

and,

$$\alpha \geq 0;$$

$$(1\text{-}\beta2\text{-}\beta3) = \beta1.$$

From equation (6) it is then possible to run or estimate the following ratios:

i)the output - capital ratio, (Y/L),

ii) the output - labour ratio, (Y/L), and

iii) (K/L), the capital - labour ratio, by estimating equation (7) and making the relevant substitutions to compute each ratio:-

$$\ln (Y/K) = \ln K + \beta2 \ln (K/L) + Ui \quad ......(7)$$

3.1.2 The Profit Function

The profit function is formulated on the underlying assumption that the firm maximises its profits by maximising the difference between total costs and total revenue. Specifically the Unit Output Price Profit Function (UOP Profit Function), has the following specification, originating from the Cobb - Douglas production function (Moussa and Jones):

$$\ln \Pi = \ln A + d\ D + a1 \ln W + a2 \ln r + (1 - u) \ln P + b1 \ln S + b2 \ln K \quad ....(8)$$

where,

Π = the actual money profit

w = the wage rate

r = the machinery wage/cost

u = a1 + a2 = the coefficients of variable inputs, labour and machinery respectively

D = dummy variable , 1 = large firms

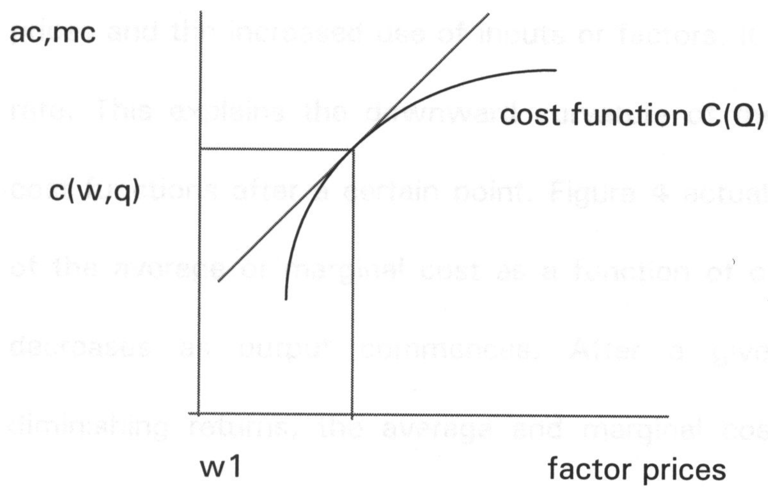
0 = otherwise

P = the unit output price

In order to model the data using the UOP Profit function, it is necessary there be information available on product prices, wages, interest rates as well as the quantities.

3.1.3 The Cost Function

From the production function, the cost function can be derived, since the existence of the production function implies that there are underlying costs of production. The efficient cost function is that function which minimises the cost of production for a firm. In this context therefore the cost function is derived from the technological relationship underlying the production function (Koutsoyiannis 1985, Varian 1992). On the basis that the production function represents the optimal output, the cost function, being derived from the production function, represents the minimum cost of producing a given output.



note: ac = average cost; mc = marginal cost

Figure 3

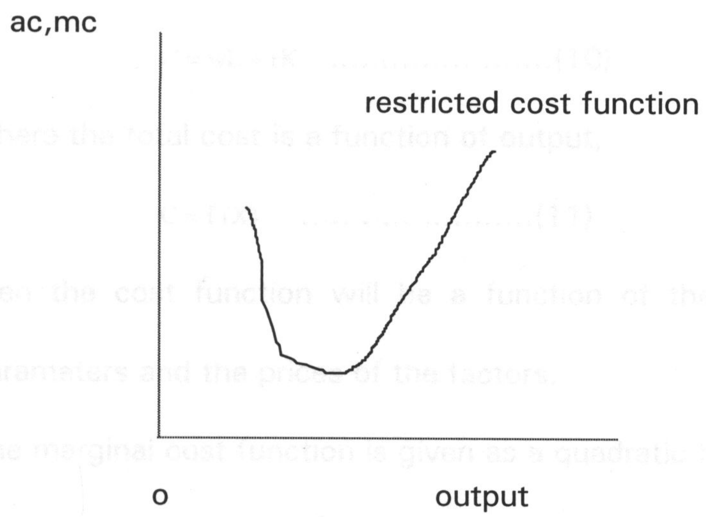


Figure 4

Source: Varian, H: Microeconomic Analysis, W.W. Norton & Co, New York, 1992.

Figure 3 shows the behaviour of the cost function, when the cost is dependent on the factor or input prices. The higher the factor or input prices, the higher the cost. Although cost increases with both higher input prices and the increased use of inputs or factors, it does so at a decreasing rate. This explains the downward curvature of the average and marginal cost functions after a certain point. Figure 4 actually shows the behaviour of the average or marginal cost as a function of output. The cost initially decreases as output commences. After a given point, and due to diminishing returns, the average and marginal costs start to increase at higher levels of output.

The Cobb - Douglas production function can be used for deriving the cost function. Assuming the Cobb - Douglas is of the form:

$$X = \alpha K^{\beta 1} L^{\beta 2} \quad \text{..............} (9)$$

and the cost equation,

$$C = wL + rK \quad \text{......................}(10)$$

where the total cost is a function of output,

$$C = f(X) \quad \text{.......................}(11)$$

then the cost function will be a function of the output, the production parameters and the prices of the factors.

The marginal cost function is given as a quadratic function of the form:-

$$Y = \beta o + \beta 1 X + \beta 2 X^2 \quad \text{......}(12)$$

The total cost function which shows the total cost and output is given as follows:

$$Y = \beta o + \beta 1 X + \beta 2 X^2 + \beta 3 X^3 \quad \text{.............}(13)$$

3.2 Rationale For the Choice of the Model

Preference has already been shown in this study to utilise the Cobb - Douglas production function. In this part some of the other models are very briefly discussed for purposes of examining some of their major advantages or disadvantages in relation to the Cobb - Douglas model.

The Unit Output Price Profit Function is strongly favoured over other functions by Moussa and Jones (1991) and Lau and Yotopoulos (1971). Before going on to look at the reasons why the UOP profit function is preferred over the other models by the said authors, I wish to firstly consider the main weaknesses of the other models.

i) One approach would be to simply take the productivity of labour as a single factor input. This is extremely simple in approach but earlier objections to this have been observed (Farrell 1957). The principal weakness seems to lie in its inability to consider issues which affect average and marginal productivity.

ii) The second approach is that of total factor productivity or overall efficiency. This makes comparisons on the basis of measures which relate output to a weighted average of inputs, which is basically an output - cost ratio . This has the weakness of not being able to disaggregate efficiency into technical and price (allocative) efficiency (Lau and Yotoplous 1971).

iii) Simultaneous equation bias is often predominant in the Cobb - Douglas production function, such that input variables are likely to be correlated with the error term in the equation suggesting that they are not exogenous, although this weakness is eliminated under the method of two stage least squares (TSLS).

iv) The frontier production function or Farrell measures of efficiency provide a deterministic frontier in which production has to occur on or below the isoquant, which suggests that variations in efficiency are due relative to the common frontier only (see figure 1). Account is not made for factors outside the influence of the firm. This is most suited to the measurement of technical efficiency and not allocative or price efficiency.

The UOP profit function possesses the following qualities:

i) it accounts for differences in output among producers from a given set of measured inputs and therefore gives the technical efficiency element.

ii) it accounts for differences in the ability of producers to maximise profits and so gives the price efficiency component (allocative efficiency).

iii) it accounts for differences that each producer may be faced with concerning input prices, which may differ from market to market.

Considering the above, a mathematical illustration of the foregoing is given as shown below:-

Assume, that the fixed form of the function is

$$Y = Y(N, M, K) \qquad (14)$$

where,

Y = output

N = labour

M = machinery

K = other fixed inputs

The profit function is introduced by means of a Cobb - Douglas production function as follows

$$Y = \Pi = A\ N^{a1}\ M^{a2}\ S^{b1}\ K^{b2} \qquad (15)$$

where,

Y = output measured as Π = Profit

A = technical constant

N = labour

M = machinery

S = scale parameter

a1, a2 = elasticity of output with respect to labour and machinery

b1 and b2 = elasticity of output with respect to fixed inputs e.g. land

Assume now that there are two firms with two identical production functions:

$$Q1 = A1\ f(X1)\ ;\ Q2 = A2\ f(X2) \qquad (16)$$

where,

Q = output

A = technical coefficient

F = production function

X = vector of inputs employed

The two functions can differ by a scale parameter such that Firm 1 is technically more efficient than Firm 2 if $A1 > A2$.

Price efficiency is given by MPi = Pi, where i = the ith firm. Where the above condition is fulfilled, then the firm meets the profit maximising condition.

3.3 The Profit Function

Consider a general production function (Lau and Yotopoulos):

$$Q = F(Xi,....,Xm; Yi,.....,Yn) \quad ....(17)$$

where,

Q = output

Xi = variable inputs

Yi = fixed inputs

Profit = Total revenue - total variable costs

or, $\Pi = TR - TVC$

$$P' = pF(Xi,....Xm;Yi,....Yn) - \Sigma CiXi \quad ....(18)$$

i = 1,...,n

where,

P = profit

p = unit price of output

Ci = unit price of the ith variable input

The fixed cost is for the usual reasons ignored as it falls away after differentiation and does not therefore impact on price.

Assuming profit maximisation obtains, then:

$$MP = p \frac{\partial F(Xi;Y)}{\partial Ci} = Ci, \quad i=1,.......,m..................(19)$$

$$C' = \frac{Ci}{Pi} \quad \text{the normalised price of the ith input}$$

$$\frac{\partial F}{\partial Xi} = Ci, \quad i = 1,.....,m \qquad ....(20)$$

$$P = \frac{P'}{p} \sum_i CiXi = F(Xi,.....,Xm;Yi,.....,Yn) \quad .... (21)$$

Equation (15) may be solved for optimised quantities of variable inputs, denoted as X* as the functions of the quantities of fixed inputs.

$$X^*i = fi(c,y) \quad i = 1,.....,m \quad ....(22)$$

where c and y = vectors of the normalised input prices and quantities of fixed inputs.

By substituting equation(16) into equation(12), we get the profit function:

$$\Pi = p[F(X^*i,...,X^*m;\ Yi,...Yn)\ \Sigma CiXi^*,\ I = 1,..,n$$

$$= G\ (\ P,\ Ci',....,C'm;\ Yi,...,Yn) \quad ....(23)$$

$$\Pi = pG^*\ (Ci,...,Cm;Yi,....,Yn) = \text{the profit function} \ ....(24)$$

$$\Pi^* = \frac{\Pi}{P} = G^*\ (Ci,....,\ Cm;Yi,....Yn) = \text{the unit output} \ .... (25)$$

price profit function.

The maximisation of the profit function in equation (12) is identical to the maximisation of the UOP profit function in equation (16) as they yield identical values for the optimal X*i's. Hence the Π^* in equation (25) gives the maximised value of the UOP profit in equation (12).

The above model of the UOP profit function would have been the optimal one to use for the reasons outlined under the rationale for the model. However, as has been pointed out the lack of specific information on the factor prices such as wages, profits, interest rates and the corresponding units of output in quantitative terms put a constraint or limitation on the possibility of using the model.

In this study the data is modelled on the basis of a parametric approach using the Cobb - Douglas production function. In this instance there does not arise any constraints on the basis of there being inadequate information for the regression analysis to be able to effectively specify the relationships, if any, that may exist among the variables under consideration.

3.4 Hypotheses of the Study

The tests for efficiency are based on the criteria of the definition of firm size. The firms are defined into two categories of large and small firms.

This study intends to study the efficiency of the level or size of the enterprises given their relative levels of capital and labour intensities.

The following null hypotheses will be tested:

1) The main hypothesis of the study is the test of equal technical efficiency among the small sized firms and the large sized firms. In this instance the coefficient, αs, represents the technical efficiency for the small firms, where, αl, denotes the technical efficiency for the large firms.

The premise is that small scale firms are more efficient than large firms. The null hypothesis is then given as:-

$$H0: \alpha s = \alpha l$$

$$H1: \alpha s \neq \alpha l$$

2) The other hypothesis is based on the need to test for constant returns to scale among the different sized firms of large and small. The sum of the βs is therefore assumed to be different for either size firms and is

likely to be either increasing or alternatively decreasing given the efficiency of the firm size.

$$H0: \beta1 + \beta2 + \beta3 = 1$$

$$H1: \beta1 + \beta2 + \beta3 \neq 1$$

3.5 Data Sources

The study draws and has utilised extensively the data that has been collected through the World Bank Regional Private Enterprise Development (RPED) Study in Zambia, which as stated earlier is a survey that has been done on an annual basis between 1993 and 1995. Other data sources that have been used included the Central Statistical Office, various library publications, Bank of Zambia, Ministry of Finance and other relevant institutions and government ministries e.g. Commerce and Industry.

The RPED study was based on a random sample of a total of 200 manufacturing firms, drawn from four major sub-sectors of manufacturing.

3.6 Sample Distribution and Data Collection

The data was collected by means of direct interview procedures using a questionnaire.

The firms were located along the line of rail. The major proportion, about 60%, of the firms were located in Lusaka and the balance of almost 40% on the Copperbelt (Kitwe and Ndola). The balance which was quite negligible, was from Livingstone.

3.7 Data

The type of data collected included among others the following that have been used in my study:

- ownership and the structure of ownership
- capital structure
- operations
- sales, profits, investments, financing, labour strength by category of operation (direct and indirect), costs, production levels (capacity utilisation)
- product lines, expansion efforts

3.7.1 Data Analysis

The analysis of the data has been done by the use of a Cobb - Douglas production function on two levels. The first level comprises the use of an unrestricted production function using non - linear least squares. Although non linear least squares have been used it should be noted that there is no loss of computational efficiency as the non linear least squares estimate give exactly the same results as the linear least squares function. On the second level a restricted production function is used. Again non linear least squares are adopted for the regression analysis. In addition to the restricted non linear least squares, the regression modelling is also made by the use of maximum likelihood function. In the case of the restricted maximum likelihood function the model is made at two levels again. The first process of the likelihood estimation involves the estimation of a function in which the residuals are minimised. This is then followed by the substitution of the first estimated results into the final equation which estimates the frontier production function, thus:

$e = lyi - l\alpha - \beta 1lx1i - \beta lx2i - \beta lx3i$ ....(26) where e = sum of the residuals

lxi = the log of the ith input variable

and the variables are in logarithms.

After estimating equation (26), this is then substituted into equation number (6) in order to obtain the maximum likelihood estimates for the frontier production function.

The analysis gives the results of the three different models of the regression estimates based on:

a) the non - linear regression estimates whose results are the same as the linear regression estimates unless the results are non linear and are unrestricted.

b) the non linear restricted regression function.

c) the maximum likelihood function with restrictions of the parameters.

CHAPTER FOUR

CHARACTERISTICS OF THE MANUFACTURING SECTOR

4.0 THE FIRMS AND GENERAL ENVIRONMENT

The sample size for the RPED survey was 215, although this number did not remain constant in the remaining two years of the study and varied between 205 - 210. These firms ranged from the very small, employing only one person, who would be the proprietor himself, to large firms employing 600 odd persons.

At this stage it is expedient to examine the characteristics of the firms as the same will be utilised in the next section on the data analyses. For instance, it may be desirable to try and identify if the ownership of the firm in any way influences the performance by virtual of the firm being a parastatal or state owned enterprise, or privately owned enterprise. In such cases the use of dummy variables will be used to try and isolate the influences accordingly. It is again of necessity that some background to the manufacturing sector be presented for a clearer perception of the background influencing the performance and therefore the behaviour of the firms in the country subject to the economic conditions prevailing.

4.1 Labour Productivity and Employment

Appendix 13, shows both the rate of change over time of labour productivity as well as the labour productivity by sub sector over time, for the period 1980 - 1989.

Labour productivity in this instance has been computed as the proportion of the change in output to the proportion of the change in labour employment for each respective period (Kmietowicz 1994). The broad picture that emanates from the appendices (13 and 14), is that employment in the manufacturing sector recorded an average growth rate of 2% over the nine year period. Of the four sub sectors under consideration in this study, it will be observed that the metal and metal fabrication sub sector registered the highest growth rate of 3.1%, while food had a growth rate of 2%, wood and wooden products actually declined by -1% as textile grew by 2.2%. It can be seen therefore that these four sub sectors registered increasing labour productivity growth rates and from that perspective they were more efficient than the other sub sectors. In general, employment increased only marginally.

The purpose of this study is to investigate and determine the differences that arise, if any, with respect to efficiency, due to the different size of firms and their resource endowments. In order to effectively show this, it is necessary that the relevant economic background on the one hand and the particular composition of the firm in terms of the characteristics of the firm, on the other are discussed . With respect to the characteristics of the firm, it will be shown in the next section that some of these such characteristics do or do not have a direct effect on the efficiency performance of the firm. Or, alternatively to try to establish the link or causation in the differences in the behaviour of the firms.

TABLE 4.0 SIZE DISTRIBUTION OF ESTABLISHMENTS BY NUMBER OF EMPLOYEES 1993

	TOTAL	FIRM EMPLOYMENT SIZE:-			
		1-19	20-99	100-999	1000+
food processing	323(100%)	180(56%)	95(29%)	36(11%)	12(4%)
textiles	326(100%)	221(68%)	71(22%)	30(9%)	4(1%)
wood products	179(100%)	137(77%)	32(18%)	10(6%)	0
fabricated metal	185(100%)	98(53%)	65(35%)	22(12%)	0

Source:CSO Manufacturing Register and The Zambian Programme on Regional Enterprise Enterprise Development: Final Report, 1994. Department of Economics', University of Oslo and University of Zambia.

4.2 Firm Distribution by Sector

Table 4.1 shows the total number of firms from which the sample was drawn for the four selected industries from the Regional Enterprise Development Programme in Zambia (RPED). The wood sector has the biggest number of the smallest firms at 77% of the total firms, followed by the textile sector, with 68%. The metals sub sector has the highest employee category of 47% followed by the food and food processing sub - sector with medium - large firms at 44% of the firms within the sub sector.

TABLE 4.1: SIZE OF FIRM AT START OF BUSINESS

	food	textiles	wood	fabricated metals	all
employees at start up	58	45	41	26	44
employment bracket at start up- 1-5	9	28	22	17	76
- 6-20	20	12	9	9	50
- 21-100	12	13	2	10	37
- 101+	3	5	2	1	11
na	16	9	6	10	41
total no. of firms	60	67	41	47	215
current employment	120	68	54	74	81
age of firm (no of years)	19	17	16	18	17

Source: Zambian RPED Study: Final Report, The World Bank; The Universtities of Oslo and Zambia, August 1994.

4.3 Firm Size, Start up and Growth

Table 4.1 shows the employment characteristics of firms at the time of start up. The lowest number of employees in general, given by the second row is found to be in the fabricated metals sub - sector. The highest number of employees is in the food sector. When employment is categorised by size as in Table 4.1 of 1-5, 6 - 20 etc. we find that at the time of starting up the firm the food sub - sector had the highest number of employees, while the wood sector had the lowest number of firms with the lowest employment category. Textiles had the highest number of firms with the lowest employment category of 1 - 5 employees at start up. The sub sector with the highest number of employees was textiles which was followed by the food sub sector.

Labour or employment growth are indicative of partial factor productivity as the growth of employment, under certain conditions, reflects an increase in productivity. The importance of Table 4.1 is in the extent that we are able to determine or observe the increase in employment and hence implied improved performance of the firm.

TABLE 4.2: FIRM BY START - UP EMPLOYMENT AND FIRM GROWTH

	start up employment		1 - 5	6 - 20	total
	21 - 100	101 +			
no. of firms	76	50	37	11	174
average employment: at start	2	12	47	458	44
at present	9	29	117	374	60
growth rate(%)	278	131	164	17	195

Source: Compiled from 1993 RPED data for Zambia.

In order to more vividly illustrate the effect of employment changes vis - a -vis growth, Table 4.2 gives the growth rate in the level of employment per employment category between the time the firm was set up and the time of the survey, 1993. From this table it could be hypothesised on the basis of the results that the category of 1 - 5 was most efficient in creating employment as it registered a growth of 278%, while the category with the highest number of employees at start up of 101 and above registered the least growth of 17%. In this instance the small sized firm seem to be more efficient in the creation of employment. However this assertion must be stated with caution as it could be that the large sized firms already having created so much employment, are less technically and economically inclined to increase employment.

4.4 Output, Capital Employed and Labour

Table 4.3 which is shown below gives the output, employment and capital by industrial structure and by size. The top half of the table shows that the food sub sector registered the highest output in value terms and was followed by the metals sub sector. In terms of capital available to the firm, the food sector again had the highest value of capital employed and was followed by the textiles, metals and lastly the wood sector.

The bottom half of the table shows the above data by firm size. The biggest firm size of 101 plus ranks first in all the areas of output, labour and capital. The firm size category of 101+ constituted 82%, 74% and 78% of the total contribution to output labour and capital respectively. The second biggest contributor was the 21 - 100 employment category which was responsible for 16%, 21% and 18% of the output, labour and capital respectively. Similarly, the 6 - 20 category was third and the last was the 1-5 size.

TABLE 4.3: OUTPUT, EMPLOYMENT AND CAPITAL BY INDUSTRY SIZE.

	food		textiles		wood		metals		total
no. of firms	53		56		44		50		204
output (k'mil)	51924	59%	17384	20%	3965	5%	14110	16%	87384
average	1154		310		92		288		453
labour total	6745	44%	4198	27%	1861	12%	2502	16%	15306
average	127		75		42		50		75
capital (K'mil)	77250	48%	40648	25%	12556	8%	29916	19%	160371
total average	1679		767		330		623		867

	SIZE CATEGORY								**TOTAL**
	1 - 5		**6 - 20**		**21 - 100**		**101+**		
no. of firms	**52**		**53**		**64**		**34**		**203**
output (K'mil)									
total	338	.4%	1734	2%	13970	16%	71342	82%	87384
average	7		35		233		2301		453
labour total	149	1%	630	4%	3223	21%	11304	74%	15306
average	3		12		50		332		75
capital (K'mil)	3253	2%	2944	2%	29754	18%	124419	78%	160371
total average	64		63		522		4147		867

Source: Compiled and adapted from the RPED data and The Zambian RPED Study: 1994 World Bank; Universities of Oslo and Zambia.

4.5 Import Content

In table 4.4 the import content of each firm size and firm category is given. The import content for the food sub sector is 15% which is given in the last row, whereas the total import content across the board for all sub sectors is 14% and this is given in the very last column.

TABLE 4.4: IMPORT CONTENT BY INDUSTRY AND SIZE CATEGORY(%)

	food	textiles	wood	metals	industry total
1 - 5	0	18	2	24	14
6 - 20	16	43	4	32	22
21 - 100	11	22	22	54	28
101+	23	35	37	83	40
all size category	15	27	9	45	25

Source: Zambian RPED Report, World Bank, 1994. The Universities of Zambia and Oslo, Norway.

The respective import content for the sectors is given under the respective column. In this instance note that for the food sub sector, firm sizes of 1 - 5 had no import component in their raw material consumption. This contrasts with the 83% import component of the metals sub sector for the large firm firms.

The characterisation of the external sector participation by the firms is lucidly given in table 4.5. There is extremely little external; activity, indicating a rather inward oriented manufacturing sector.

4.6 Summary to the Chapter

This chapter has tried to provide a background to the characteristics of the manufacturing sector both generally and specifically for the firms that constituted the

TABLE 4.5: EXPORTERS BY SIZE AND INDUSTRY

	food	textiles	wood	metals	all sectors
1 -5	1	0	0	0	1
6 - 20	0	0	0	0	0
21 - 100	0	1	0	0	1
100+	3	5	2	2	12
all size categories	4	6	2	2	14

Source: Zambian RPED Report, World Bank, 1994. The Universities of Zambia and Oslo, Norway.

sample and the firms outside the sample. The objective was not therefore to be critical or assess the manufacturing sector at this stage. It was to form a basis for the data analyses and interpretation in the sections that follow immediately.

CHAPTER FIVE

DATA ANALYSIS AND PRESENTATION: 1993 DATA

5.0. DATA ANALYSIS AND PRESENTATION

This chapter presents the computation results of the data by parametric and non parametric methods through the use of the production function and the computation of simple correlation relationships respectively among the input variables. The data that is considered here is for 1993 only. The next Chapter, Chapter Six, discusses the data for 1994, while Chapter Seven looks at the data and results of the 1995 data, as well as carrying out the hypotheses testing.

5.1 Production Function Specification

The data has been analysed by using a Cobb - Douglas production function of the form:

$$Yi = \alpha \; X1i^{\beta 1} \; X2i^{\beta 2} \; X3i^{\beta 3} + Ui \text{ ....(27)}$$

which is transformed from the non linear model to the log - linear model in order to facilitate the derivation of least squares, from which inferences on elasticities can be made, as follows,

$$\ln Yi = \alpha + \beta 1^{*} \ln X1i + \beta 2^{*} \ln X2i + \beta 3^{*} \ln X3i + Ui \text{...(28)}$$

where,

the variables and parameter or variable coefficients are defined as follows:

Yi = the total output of the ith category of firms and the ith industry, measured in monetary terms like all the other variables, capital, labour and raw materials, using the local currency the kwacha and is in thousands (k'000).

α = the technical efficiency parameter. The higher the value of the parameter, the more efficient the sector or industry performance technically. The technical parameter that is of use for purposes of interpretation of results in this research study is that of the Maximum Likelihood Estimator (MLE). This is computed by firstly obtaining the residual, which is the difference between the observed and the predicted values

$$\text{Residuals} = Yi - \hat{Y}i$$

and the residuals are regressed on the initial non - linear least squares estimate (NLLSE), (Timmer 1971, Walters 1963,1968).

$\beta 1$ = the parameter coefficient for the capital variable $X1 = K$. It represents the partial output elasticity for capital.

$\beta 2$ = the partial elasticity of output for labour, $X2 = L$.

$\beta 3$ = the partial elasticity of output for the raw material inputs, $X3 = R$.

Equation (27) is the unrestricted regression function.

5.2. Firm Size Categorisation

The following is the approach used in the analysis of the data and in its presentation. The firms have been categorised into different sizes that reflect their scale for each particular size under consideration. The categorisation of the firms is made on the basis of their labour size. This is the number of full-time employees only - the part-time and/or casual labour has been excluded. The number of employees has been used in determining the firm size because, firstly, this is represented in absolute terms. As such it is easier to compare directly without the necessity of adjustment. For instance, if the size was based on sales revenue the aspect of inflationary adjustment would be paramount in order to maintain the real changes over the nominal changes and therefore facilitate the means to compare the sizes in monetary value terms over a time period; although this is not being done here. Secondly, the presentation of firm size in monetary terms necessitates the conversion of local currencies into foreign currency by use of the exchange rates as the appropriate adjustment factor in order to make any comparisons with foreign firms or studies. Thirdly, we note that firms were operating under a contractionary economic environment in which their capacity utilisation rates were low. This meant that in terms of sales revenue the firms were registering lower than average sales revenue. Using sales revenue as a criterion for the determination of the size of the firm would then include such errors of measurement that the size of the firm would be understated particularly vis - a - vis the capital asset base of the firm which would be disproportionate to the sales revenue categorisation.

The firms have been classified or grouped as follows:

i) the small size category, S1, of firm comprising 1-5 employees.

ii) the small size category, S2, comprising 6 -20 employees.

iii) the medium size category, M1, comprising 21 - 49 employees.

iv) the medium size category, M2, comprising 50 - 100 employees

v) the large scale employee category, L, of 101 or more employees.

5. 2.1 Rationale for Firm Categorisation Approach

This categorisation of the firms is drawn extensively from the approach of the study on the Indian manufacturing sector (Page Jnr., 1978). In the Zambian Small Scale Industries Organisation Act, a small scale firm, as previously defined, is one with less than 100 employees and a large scale firm is one with greater than 100 employees. These definitions do not in any way restrict the disaggregation of small or large into other units in order to facilitate analyses. This is precisely what has been done here.

The main reasons for adopting a rather detailed categorisation is really to determine the differences that may be exhibited from the micro unit size of the firm to the large unit of the firm. One wishes to obtain as much available evidence as there may be in order to see the justification for pursuing any form of industrial policy should any such evidence exist. Theoretically, the assumption of perfect competition justifies more than anything else the analyses of firms from the smallest possible size.

The above categorisations are then made in each of the individual sectors of manufacturing, textile, wood and metals. So, for each sector, there are five (05) levels of analysis according to the firm size category of S1, S2, M1, M2 and L. These are given in table 13 which shows the distribution of the firms by firm size category for 1993 and 1994 respectively. The last column gives the total number of firms for each firm size for the year. The disaggregated number of firms which is done by the number of employees and classified as S1, S2, M1, M2 and L is given in the rest of the columns as appropriate and for each sector as the table clearly shows.

TABLE 5.1 DISTRIBUTION OF FIRMS BY SIZE AND SECTOR: 1993 AND 1994

FIRM SIZE BY NO. OF EMPLOYEES	S1 1-5	S2 6-20	M1 21-49	M2 50-100	L 101+	TOTAL
SECTOR FOOD93	1	14	9	9	13	46
94	0	13	10	9	13	45
TEXTILE 93	16	11	7	7	6	47
94	20	9	8	4	7	48
WOOD 93	14	14	4	1	5	38
94	16	10	6	1	4	37
METAL 93	12	5	11	5	9	42
94	12	9	12	6	4	43

Source: Compiled from the RPED data.

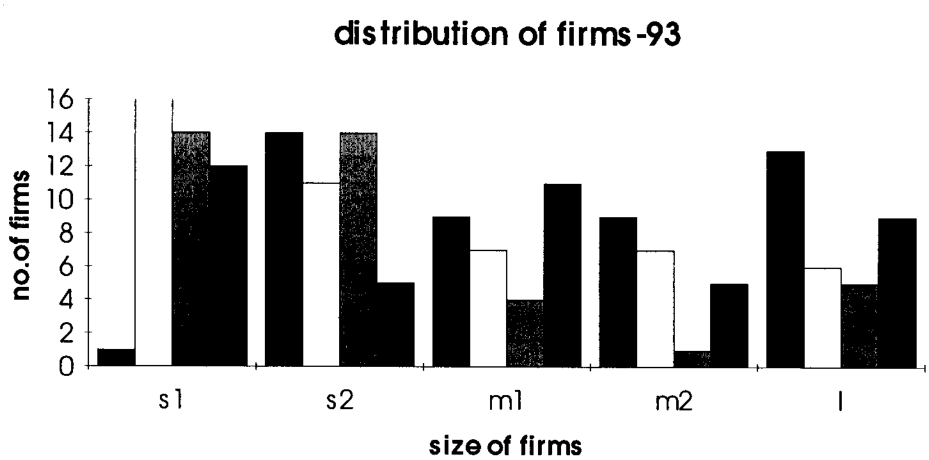


Figure 5

Figure 5 above is the graphical representation of table 13 which gives the distribution of the firms by size for 1993 and 1994 respectively. In the graph the first bar shows the employment for the food sector, the second for the textile sector, the third for the wood and the last one for the metal sector.

The analysis of the data is made on an intra - sectoral level, in which all the firms within the sector are analysed specifically within that sector. The other level of analysis is on an inter sectoral level in which the firms are analysed on an inter sectoral level such that the different classes or categorisations of the firms are compared across the sectors. Clearly, the above classification and mode of analytical approach is best intended to facilitate the comparison of the results in terms of efficiency and other aspects of performance. This is done for the firms in terms of their different sizes according to which the firms are classified. Though this approach the analysis is best intended to derive comparative results of firm differences or similarities as the case may be.

5.3. Intra Sectoral Firm Analysis: The Firm Production Function

The results presented below are the regression results of the log linear function in equation (27). For the actual computations equation (6) is substituted into equation (27) to obtain as before,

$$\ln Y = \ln\alpha + (1-\beta 2-\beta 3)\ln K + \beta 2\ln L + \beta 3\ln R,$$

where, $\sum \beta i = 1, \quad i=1,2,3.$

and $\alpha \geq 0$;

The results that have been computed in the section below will be used as the 'average' firm performance and will in later sections be compared against the 'best practice' performance which is the performance of the industry as a whole.

The results below are given on a comparative basis. The comparison is with respect to the regression analysis that is done for the following: -

(a) unrestricted non linear least squares (URNLLSE),

(b) restricted non linear least squares (RNLLSE),

(c) maximum likelihood least squares (MLE).

All of the above three approaches and results give the frontier production function.

5.4 The Food Sector.

COMPARATIVE INTRA-SECTORAL RESULTS OF THE LOG LINEAR REGRESSION USING A COBB-DOUGLAS PRODUCTION FUNCTION.

a) results of unrestricted log non - linear least squares

b) results of restricted log non - linear least squares

c) results of restricted maximum likelihood log linear least squares.

Table 5.2 shows the analysis of the food sector, from which the results of the firm production function are derived. The following equations are derived on the basis of the results in the table. Equations (ia) - (iva) are based on the unrestricted least squares.

ia) $\ln\hat{Y} = -3.9 + 0.69\ln K + 1.4\ln L + 0.33\ln R$

iia) $\ln\hat{Y} = -0.9 + 0.14\ln K + 0.2\ln L + 0.3\ln R$

iiia) $\ln\hat{Y} = -2.7 - 0.03\ln K + 0.97\ln L + 0.96\ln R$

$$\text{iva) } \ln \hat{Y} = 2.5 - 0.003\ln K + 0.09\ln L + 0.83\ln R$$

TABLE 5.2 FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION.

FIRM SIZE:BY EMPLOYEE SIZE CATEGORY	FACTOR ELASTICITIES α	$\beta1$	$\beta2$	$\beta3$	$\beta1+\beta2+\beta3$	R^2
S1: 1-5*						
S2: 6-20 a	-3.9	0.69	1.4	0.33	2.42	22
S2 b	1.11	0.6	0.16	-	0.76	
S2 c	21.1	0. 6	0.16	0.0	0.76	
M1: 21-49 a	-0.9	0.14	2.02	0.31	2.47	34
M1 b	6.7	0.06	-	-	0.06	23
M1 c	26.7	0.06	0.0		0.06	
M2: 50-100 a	-2.7	-0.03	0.97	0.96	1.9	68
M2 b	3.3	0.5			0.5	12
M2 c	23.3	0.5	0.0		0.5	
L: 101+ a	2.5	-0.003	0.89	0.83	1.7	88
L b	6.4	0.18			0.18	1
L c	26.4	0.18	0.0		0.18	

Source: Derived from regression analysis of the RPED compiled 1993 data.

* No analysis has been made for this employee size category as there were insufficient observations to perform regression analysis.

5.4.1 Technical Efficiency

The most efficient categories of firm size for the foods sector are M1 and L - the medium and large size groups. They exhibit the largest efficiency parameters for both the unrestricted least squares and restricted least squares. The least efficient is the smallest firm size, S2. Effectively these groups are able to combine the inputs in a manner that maximises output more efficiently than the others.

Table 5.2A FACTOR INTENSITIES (CAPITAL-LABOUR RATIOS):FIRM CATEGORY SIZES S2 - L.

capital-labour ratio S2 a	0.49
b	3.75
c	3.75
capital-labour ratio M1 a	0.07
b	
c	
capital-labour ratio M2 a	-
b	
c	
capital-labour ratio L a	0.03
b	
c	

Source: Derived from Table 5.2

5.4.2 Returns to Scale

The results of unrestricted least squares show that there are increasing returns to scale for all different categories. With restrictions however all the different categories show decreasing returns to scale.

5.5 The Textile Sector

5.5.1 CORRELATION MATRICES FOR THE FACTOR INPUTS

The correlation matrices have been computed for each of the individual size categories of the firms.

TABLE 5.3 CORRELATION MATRICES

FIRM SIZE	output-	inputs-		
	lsales	lcapital	llabour	lrawmaterial
FIRM SIZE S2				
lsales	1.0			
lcapital	0.359	1.0		
llabour	-0.023	-0.15	1.0	
FIRM SIZE M1				
lsales	1.0			
lcapital	0.12	1.0		
llabour	0.47	0.015	1.0	
lrawmaterial	0.41	-0.49	0.19	1.0
FIRM SIZE M2				
lsales	1.0			
lcapital	0.39	1.0		
llabour	0.28	0.46	1.0	
lrawmaterial	0.82	0.359	0.308	1.0
FIRM SIZE L				
lsales	1.0			
lcapital	0.09	1.0		
llabour	0.26	-0.21	1.0	
lrawmaterial	0.94	0.11	0.25	1.0

Source: Computed from RPED data:1993

The first issue to note are the generally low correlation values indicating lack of problems of multicollinearity.

The substitution relationship of capital for labour is given by the negative results that are obtained for S2 and L firm sizes. The other two show positive correlation coefficients. The explanation for this apparent theoretical contradiction lies in the fact the firms in these categories comprise firms with small levels of capital ownership as well as those with high levels of capital ownership. Yet due to the low levels of capacity utilisation, the effect of the extent or degree of capital on production output in relation to the labour cannot be specified in terms of substitution of one factor for another but rather as a complementary element of the production process.

The overall effect of this is that the firm groups in which these experiences emanate such as M2 and S2 here are inefficient and this inefficiency is largely on the part of the larger firms within the group, are reflected as a total level of technical inefficiency for the group, as a whole.

5.5.2 Technical Efficiency

The technical efficiency parameters are the highest for the medium size group of M1, making it the most efficient at 1.8 for unrestricted least squares, 2.7 and 22.7 for the restricted non-linear least squares and MLE. The next highest is -0.55 for S1, -2.1 for the large and lastly -2.3 for the medium group M2.

5.5.3 Constant Returns to Scale

The unrestricted least squares show increasing returns to scale for all the size categories of the firms. However, the other two models show decreasing returns to scale.

5.5.4 Factor Intensity

The capital labour ratios in Table 5.3A show that the size L represents the size with the highest capital intensity in the textile sector. This is followed by S2, S1 and lastly M2.

TABLE 5.3A FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION

FIRM SIZE	FACTOR ELASTICITIES					R^2
	α	β1	β2	β3	β1+β2+β3	%
S1a, 1-5	-0.55	0.33	0.83	0.64	1.8	63
S1b	0.5	0.4	0.13		0.53	62
S1c	20.5	0.4	0.13		0.53	
S2a, 6-20	-4.3	0.75	0.12	0.6	1.47	80
S2b	0.09	0.5	0.1		0.6	51
S2c	20.1	0.5	0.1		0.6	
M1a, 21-49	1.8	0.13	0.54	0.5	1.17	77
M1b	2.7	0.15	0.4		0.55	87
M1c	22.7	0.15	0.4		0.55	
M2a,50-100	-2.3	0.26	-0.22	1.1	1.14	
M2b	-1.7	0.22	-0.3		-0.08	94
M2c	18.3	0.22	-0.3		-0.08	
La, 101+	-2.1	0.05	0.16	1.1	1.31	98
Lb	-0.07	-0.07	0.5		0.43	96
Lc	20.5	-0.001	-0.01		-0.011	

Source: Computed from RPED data:1993

TABLE 5.3B FACTOR INTENSITIES

capital-labour ratio: S1 a	0.397
b	3.07
c	3.07
capital-labour ratio S2 a	6.25
b	5.0
c	5.0
capital-labour ratio M1 a	0.24
b	0.375
c	0.375
capital-labour ratio M2 a	-
b	-
c	-
capital-labour ratio L a	0.31
b	7.0
c	7.0

Source:Computed from RPED data: 1993

TABLE 5.4 CORRELATION MATRICES FOR FACTOR INPUTS: TEXTILE

FIRM SIZE	output	inputs-		
	lsales	lcapital	llabour	lrawmaterial
FIRM SIZE S1				
lsales	1.0			
lcapital	0.72	1.0		
llabour	-0.44	-0.25	1.0	
FIRM SIZE S2				
lsales	1.0			
lcapital	0.65	1.0		
llabour	-0.226	-0.09	1.0	
lrawmaterial	0.21	-0.14	-0.33	1.0
FIRM SIZE M1				
lsales	1.0			
lcapital	0.85	1.0		
llabour	0.47	0.3	1.0	
lrawmaterial	0.86	0.77	0.2	1.0
FIRM SIZE M2				
lsales	1.0			
lcapital	0.006	1.0		
llabour	-0.2	0.22	1.0	
lrawmaterial	0.9	-0.2	-0.2	-1.0
FIRM SIZE L				
lsales	1.0			
lcapital	0.6	1.0		
llabour	0.26	-0.21	1.0	
lrawmaterial	0.937	0.1	0.25	0.1

Source: Computed from RPED data 1993

From the previous table, it is shown that there is a high level of correlation between the capital usage and the output of products. This correlation is more pronounced for the small scale firms. For the large scale firms the correlation between capital and output is minimal. There is, similarly a poor correlation between labour and capital use for all the firms. The correlation between labour and output is highest for the large firms.

5.6 The Wood and Wood Manufacturing Sector.

TABLE 5.4A FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION

FIRM SIZE*	FACTOR ELASTICITIES					R^2 %
	α	β1	β2	β3	β1+β2+β3	
S1a, 1-5	3.85	-0.07	-0.37	0.67	0.23	49
S1b	1.9	0.08	0.22		0.3	48
S1c	21.9	0.08	0.22	0	0.3	
S2a, 6-20	-4.0	0.07	1.29	1.18	2.54	87
S2b	-0.03	0.03	-0.14		-0.11	82
S3c	20	0.03	-0.14	0	-0.11	
La, 101+	10.0	0.11	-0.21	0.25	0.15	46
Lb	6.8	0.04			0.04	51
Lc	26.8	0.04	0		0.04	

Source: Computed from RPED data:1993

* Firm size classifications M1 and M2 are omitted due to their having insufficient observations i.e. the difference between the number of observations and the number of variables could not facilitate a regression computation.

5.6.1 Technical Efficiency

The technical coefficients are generally the highest for this sector. The S1 and L categories have coefficients of

3.85 and 10.0 respectively, whereas in the previous sectors the highest coefficients were 1.8 for textile in the M1 category and 2.5 for food in the L category.

5.7 The Metals and Metal Fabrication Sector.

TABLE 5.4B FACTOR INTENSITIES.

capital-labour ratio S1 a	1.89
b	0.36
c	0.36
capital-labour ratio S2 a	0.054
b	-
c	-
capital-labour ratio L a	-
b	
c	

Source: Computed from RPED data:1993

The highest capital - labour ratio is surprisingly for the smallest size of S1 and the smallest ratio is for the large size, L at -0.052.

The input correlation coefficients are quite low for S1 and S2 and exhibit a negative relationship in one or two cases. However, the correlations are higher for the large group than the other two.

5.7.1 Technical Efficiency

In general the metals sector exhibits the highest set of technical coefficients. Within the sector, the large group has the highest coefficient, followed by S1, S2, M2 and M1 respectively. However the fit of the model as given by the

correlation coefficient, R^2, is highest for M2, S1, M1 and L respectively.

TABLE 5.6 CORRELATION MATRICES FOR FACTOR INPUTS

FIRM SIZE	output	inputs-		
	lsales	lcapital	llabour	lrawmaterial
FIRM SIZE,S1				
lsales	1.0			
lcapital	0.12	1.0		
llabour	0.19	0.8	1.0	
lrawmaterial	0.69	0.14	-0.9	1.0
FIRM SIZE, S2				
lsales	1.0			
lcapital	0.14	1.0		
llabour	0.088	-0.155	1.0	
lrawmaterial	0.9	0.08	-0.1	1.0
FIRM SIZE, L				
lsales	1.0			
lcapital	0.56	1.0		
llabour	0.71	0.78	1.0	
lrawmaterial	0.63	-0.05	0.5	1.0

Source: Computed from RPED data:1993

TABLE 5.7 FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION

FIRM SIZE	FACTOR ELASTICITIES					R^2 %
	α	β1	β2	β3	β1+β2+β3	
S1a, 1-5	7.12	-0.38	-0.17	0.64	0.09	
S2b	6.8	-0.32	0.81		0.49	30
S2c						
S2a, 6-20	4.8	0.09	-1.3	0.84	-0.37	90
S2b	2.6	0.42			0.42	23
S2c	22.6	0.42			0.42	
M1a, 21-49	1.2	0.046	0.065	0.879	0.99	87
M1b	1.19	0.05	0.07		0.12	87
M1c	21.2	0.05	0.07		0.12	
M2a, 50-100	3.65	-0.066	-1.67	1.27	-0.46	99
M2b	9.3	-0.22			-0.22	11
M2c	29.4	-0.22			-0.22	
La, 101+	10.03	0.12	-0.2 1	0.25	0.16	46
Lb	5.14	0.36			0.36	
Lc	25.1	0.36			0.36	

Source: Computed from RPED data:1993

TABLE 5.7A FACTOR INTENSITIES.

capital - labour ratio S1 a	2.235
b	-
c	
capital labour ratio S2 a	-
b	
c	
capital-labour ratio M1 a	0.71
b	0.7
c	0.7
capital-labour ratio M2 a	0.04
b	
c	
capital-labour ratio L a	-
b	
c	

Source: Derived from Table 5.7

The factor intensities above show that S1 had the highest capital - labour ratio. This was followed by M1, M2, L and lastly S2.

5.8 Inter - Industry Production Function by Firm Size

In this section the firms have been assessed across the board by their particular size. This has entailed that the data for each particular size has been assembled for all firms for all sectors only in that particular firm classification. For instance, for the firm size S1, all the data for this group from the four sectors, food, textile, wood and metals has been collated and regression performed on that data set. This inter firm analysis facilitates an overall approach for comparative purposes. It also allows for general conclusions to be made on the firm size categories on as a whole and not just specific to the sector under consideration.

TABLE 5.8 FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION BY FIRM SIZE

FIRM SIZE	FACTOR ELASTICITIES					R^2 %
	α	β1	β2	β3	β1+β2+β3	
FIRM SIZE, S1a	2.5	0.015	0.014	0.68	0.7	61
S1b	1.88	0.049	0.25		0.29	61
S1c	21.8	0.049	0.25	0	0.29	
FIRM SIZE, S2a	-1.66	0.34	1.54	0.43	2.31	49
S2b	1.39	0.36	0.23		0.6	44
S2c	21.4	0.37	0.23	0	0.6	
FIRM SIZE, M1a	0.11	0.034	0.47	0.85	0.5	80
M1b	1.5	0.027	0.12		0.14	79
M1c	21.4	0.027	0.12	0	0.14	
FIRM SIZE, M2a	-1.15	0.05	-0.092	1.12	-0.04	94
M2b	-0.46	0.047	-0.16		-0.11	94
M2c	19.5	0.047	-0.16		-0.11	
FIRM SIZE, La	3.72	-0.02	0.03	0.82	0.83	71
Lb	1.9	0.13	0.02		0.15	71
Lc	21.8	0.22	0.12		0.34	

Source: Computed from RPED data:1993

The inter - industry table, 5.7 above, gives the elasticities and correlation coefficients for the computation done on the overall data that is given across the sectors by firm size i.e. group size S1 is taken for the Food, Textile, Wood and wood manufacturing and Metal and metal fabrication. This is done for all classifications of firm sizes. This is a sort of macro approach to the analysis as it focuses on the entire behaviour of the industry as defined by the sectors that are included in the sample.

The production function given by this approach constitutes the best practice production function for the firm size in that given classification i.e. S1, S2, M1, M2 and L. It is also on this approach that the hypotheses testing is done.

TABLE 5.8A FACTOR INTENSITIES

firm size S1 a capital - labour ratio	1.07
b	0.19
c	0.19
S2 a	0.22
b	1.56
c	1.56
M1 a	0.07
b	0.22
c	0.22
M2 a	-
b	-
c	-
L a	-
b	6.5
c	6.5

Source: Derived from Table 5.6

TABLE 5.9 INTER INDUSTRY COMPARISON OF FACTOR ELASTICITIES

parameters	factor elasticity by sector;firm size - food S2 M1 M2 L	textile S1 S2 M1 M2 L	wood S1 S2 L	metals S1 S2 M1 M2 L
α a	-3.9 -0.9 -2.7 2.5	-.55-4.3 1.8 -2.3-2.3	3.85 -4.0 10.0	7.14.8 1.2 3.7 10.0
b	1.11 6.7 3.3 6.4	0.5 0.08 2.7 -1.7 -0.06	1.9 -0.03 6.8	6.4 2.6 1.2 9.4 5.1
c	21.1 26.7 23.3 26.4	20.5 20 22.6 18 20.4	22 19.9 26.8	22.6 21 29 5.1
β1 a	0.69 0.14-.05-.003	0.3 0.8 0.1 0.3 0.05	-0.07 0.07 0.1	-0.4 0.1 0.05 -0.07
b	0.6 0.06 0.5 0.18	0.4 0.5 0.15 0.22 -0.06	0.08 0.03 0.03	-0.3.4.0 46-0.2 .36
c	0.6 0.05 0.46 0.18	0.4 0.5 0.15 0.22-0.006	0.07 0.03 0.04	-0.3 0.4 0.5-0.2 0.3
β2 a	1.4 2.0 1.0 0.1	0.8 0.1 0.5 0.2 0.2	-0.4 1.3 -0.2	-0.2-1.3.07-1.7-0.2
b	0.15	0.13 0.1 0.4 -0.3 0.5	0.22	0.8 0.07
c	0.15 0 0 0	0.13 0.1 0.4 -0.3 -0.06	0.07 -0.14 0	0.8 0 0.07 0 0
β3 a	0.3 0.3 1.0 0.8	0.6 0.6 0.5 1.1 1.1	0.7 1.2 0.3	0.6 0.8 0.9 1.3 0.3
b				
c	0 0 0 0	0 0 0 0	0 0 0	0 0 0 0

Source: Computed from RPED data:1993

5.8.1 Technical Efficiency

From Table 5.6A, the results of the Cobb - Douglas non linear least squares estimation show that in both small scale categories, S1 and S2, the metals sector had the highest technical efficiency. In the M1 category, textile was the most technically efficient sector. For M2 it was the metals sector again. Lastly in the large group, both wood and metals had the highest technical efficiency.

5.8.2 Factor Elasticities and Factor Intensities

Some interesting results arise from this analysis. It will be observed, that although S1 for wood was the most efficient, yet the capital elasticity was found to be negative - suggesting that any additional increase in capital would translate into 7% decline in output. At the same time the factor intensity ratio is 1.89, a positive value that shows that as capital increases, labour will be increasing. This result seems to be logical in view of the negative capital elasticity found above, since for any increase in capital input, there has to be an accompanying increase in the labour input, otherwise production would decline. Of the least efficient categories which is S2 in the food sector, the capital elasticity shows that for a 1% change in capital there will be a corresponding 0.69% increase in output and that for a 1% increase in the labour input there will be a 1.4% increase in output and lastly that for a 1% increase in raw material there will be a 0.3% increase in output. This shows the categories in the sectors with the most elastic categories of the whole industries.

5.9 The Industry Production Function

The industry production function defines the 'best practice' function against which the other groups can be compared. The data is presented below in a similar manner to the foregoing sections. The industry production function relates the entire firms within the particular industry.

TABLE 5.10 INDUSTRY FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION

SECTOR	FACTOR ELASTICITIES					$\% R^2$
	α	$\beta 1$	$\beta 2$	$\beta 3$	$\beta 1+\beta 2+\beta 3$	
FOOD a	1.6	0.26	0.22	0.55	1.03	75
b	1.8	0.26	0.18		0.44	76
c	21.8	0.26	0.18		0.44	
TEXTILE a	2.33	0.089	0.435	0.5	1.0	76
b	2.4	0.1	0.35		0.45	76
c	22.4	0.1	0.35		0.45	
WOOD a	3.18	0.038	0.93	0.3	1.27	69
b	3.4	0.03	0.58		0.61	69
c	23.4	0.03	0.6		0.61	
METAL a	1.86	0.06	0.14	0.79	0.99	88
b	1.8	0.06	0.14		0.2	88
c	21.9	0.06	0.14	0	0.2	

Source: Computed from RPED data:1993

TABLE 5.10A INDUSTRY FACTOR INTENSITIES

FOOD INDUSTRY capital-labour ratio a	1.18
b	1.44
c	1.44
TEXTILE INDUSTRY capital-labour ratio	0.20
b	0.28
c	0.28
WOOD AND WOOD MANUFACTURING	0.04
capital-labour ratio a	
b	0.05
c	0.05
METAL AND METAL FABRICATION	0.428
capital-labour ratio a	
b	0.42
c	0.42

Source: Derived from Table 5.10

An examination of the parameter estimates in Table 5.8 shows that the wood and wood manufacturing sector is the most technically efficient sector. The next most efficient sector is textile, followed by the metals and lastly the food sector.

From the sums of the parameter estimates, it will be seen that all the sectors, except for the metals, exhibited increasing returns to scale. The metals sector exhibited constant returns to scale.

The most capital intensive sector was the food sector as can be seen in Table 5.8A. This was followed by the metals, textile and lastly the wood sector.

The factor elasticities were rather low for all the sectors e.g. in the food sector, except for raw material where a unit percentage change would cause a 0.55% increase in output the other elasticities were below 30%.

CHAPTER SIX

DATA ANALYSIS AND PRESENTATION: 1994 DATA

6.0 INTRA - SECTORAL FIRM ANALYSIS: THE FIRM PRODUCTION FUNCTION

The analytical model for the data analysis remains the same as in the previous chapter. However about 30% of the firms were replaced for one reason or the other during 1994. Reasons for the replacement of the firms, where such an occurrence took place, pertained mostly to firm closures particularly in the textile industry.

The textile industry is normally regarded as the most responsive industry and is therefore, from experience, the most dynamic during a country's period of economic transition towards industrialisation (de Valk). From this perspective therefore it is extremely interesting to pay particular observation towards the trend or pattern of development of the textile industry. Towards this expectation or experience then, the textile industry should be a growth industry as well as one of the most productive and efficient industries.

6.1 The Food Sector: Results and Interpretation of the Log Linear Regression Analysis

The number of firms in the food sector was 45 during the 1994 survey. Of the 45 the firm distribution was as follows - there were no firms with employment of five or less employees in the S1 category. There were

13 firms in the S2 category, 10 M1, 9 in M2 and 13 in the large group category.

As in the previous Chapter, comparative results for three regression equations where the factor elasticities and factor intensities are concerned, are given as follows:-

a) the first row, (a), gives the results of the unrestricted non - linear least squares.

b) the second row, (b), gives the results of the restricted non - linear least squares.

c) the third and final row, (c), are the results of the maximum likelihood least squares.

Note that this is the approach to be adopted throughout the remaining sectors. As in the previous chapter the choice was between using the two stage least squares and the maximum likelihood least squares. Since the choice of instrumental variables were limited in the first case due to data restrictions, it was felt necessary to maintain a standardised approach for ease of reference.

TABLE 6.0 DISTRIBUTION OF FIRMS IN THE FOOD SECTOR

S1	S2	M1	M2	L
0	13	10	9	13

Figure 6

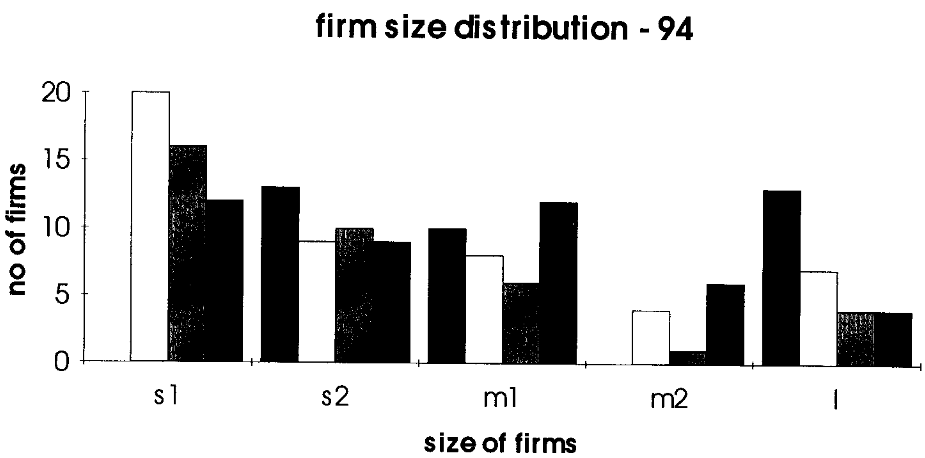


TABLE 6.1 CORRELATION MATRICES

Firm Size	Output	Inputs-		
S2	lsales	lcapital	llabour	lrawmat
lsales	1.0			
lcapital	0.46	1.0		
llabour	0.46	0.36	1.0	
lrawmaterial	0.74	-0.14	0.29	1.0
M1				
lsales	1.0			
lcapital	-0.16	1.0		
llabour	-0.58	-0.29	1.0	
lrawmaterial	0.8	-0.4	-0.4	1.0
M2				
lsales	1.0			
lcapital	-0.017	1.0		
llabour	0.25	0.22	1.0	
L				
lsales	1.0			
lcapital	0.6	1.0		
llabour	0.18	0.4	1.0	

Source: Computed from RPED data: 1994

In the above table the following characteristics are observed about the correlation relationships, with respect to multi - collinearity and serial correlation. For the first firm size category, S2, there is a positive relationship of 46% and 45% between capital and output and labour and output respectively. The correlation between capital and labour is 36%. The existence of the positive relationship in this last instance indicates corresponding increases or decreases of both inputs. This arises partly as a result of the labour and capital inputs being used in relatively low intensities under this firm size group.

The question of negative correlation is expected. The actual results for the groups M1 and M2 where capital and labour inputs are negatively correlated at rather low levels with the output can be explained by the proposition that the capital and labour inputs' intensities at the level of production i.e. capacity utilisation rates are below optimal efficiency. Under a case of inefficiency in the rate of employment of inputs the marginal rates of capital and the marginal rates of labour are therefore set at a level that is greater than the marginal physical products. An increase in any one of the inputs only results in a decline rate of increase in the output. This is a case of decreasing returns to scale.

From the correlation matrices above the most efficient size, in terms of the size that provides the strongest links among the variables is S2 which is followed by the large group, l, and M1 and lastly M2. This efficiency is interpreted in terms of the optimality of combination of the inputs in relation to the output.

The effects on technical efficiency are implicit at this stage and are discussed later.

TABLE 6.1A FACTOR ELASTICITIES

firm size	factor elasticity α	β1	β2	β3	β1+β2	R^2
S2 a	-3.9	0.5	0.02	0.87	0.52	88
b	-2.9	0.5	-0.4		0.1	87
c	17	0.5	-0.4		0.1	
M1 a	-0.8	0.23	0.003	0.83	0.233	65
b	-0.17	0.2	-0.02		0.18	73
c	19.8	0.2	-0.02	0	0.18	
M2 a	-6.9	-0.1	1.4		1.3	
b	3.9	0.02	0.5		0.52	55
c	23.9	0.02	0.5		0.52	
L a	5.5	0.6	-0.2		0.4	43
b	0.6	0.28	0.15		0.43	63
c	20.6	0.28	0.15		0.43	

Source:Computed from RPED data:1994

From the table above, based on the assumption of constant returns to scale, the results based on the three regression equations have been given for each category of firm size. The fits of the models given the coefficient of determination are reasonably significant in all cases.

6.1.1 Technical Efficiency

The technical efficiencies are as usual represented by the constant term. In the food sector as tabulated above, the most efficient firm size is the medium size category of M2. This is determined by the both the maximum likelihood results and those of the restricted form. The next most efficient is the large group, L, then M1 and lastly S2. What this partly means is that although the correlation coefficient was highest for the S2 group that pertained only to the level of the labour input and the capital input vis a vis the output. This in contrast to the amount of output that can *be produced by the inputs that are available in the most optimal manner,* which is what technical efficiency constitutes.

6.1.2 Factor Elasticities

From the factor elasticities in the above table it is observed that for each category *the following interpretations arise - for the first group S2, the* labour *input elasticities are negative, showing that any 1% change in that* input will result in a declining output of 0.4%. For M1, a 1% change in the labour input results in a 0.02% decline in the output.

The highest incremental change occurs for the M2 category where a 0.5% increase in output is obtained as contrasted to a 0.15% increase that is given for the large size category.

6.1.3 Returns to Scale

The first two categories, S2 and M1 all show results of less than one i.e.

$\beta 1 + \beta 2 < 1$

for all the three equations. This indicates decreasing returns to scale for the industry groups under consideration.

In the case of M2 the unrestricted least squares yield a return to scale coefficient of greater than one, demonstrating increasing returns to scale. However, although the other coefficients are greater than al the other cases they are still less than one, which again indicates decreasing returns to scale. The only indication of returns to scale is in the case of the medium-large group.

The above result seems to be consistent with the result on technical efficiency where the same category has been found to be the most technically efficient.

TABLE 6.1B Factor Intensities

capital-labour ratios **S2 a**	**25**
b	-
c	-
capital-labour ratios	76.6
M1 a	
b	-
c	-
capital-labour ratios	-
M2 a	
b	0.04
c	0.04
capital-labour ratios	-
L a	
b	1.86
c	1.86

Source: Computed from Table 6.1A

6.1 4 Factor Intensities

As has been seen from section (6.1.2) the factor intensities are more or less negative for S2 and M1 for the labour input. This result is consistent with the results of the factor intensities above. It will be noted that the sizes M2 and L will absorb additions of both labour and capital inputs with increasing output levels. This result is again confirmed by the returns to scale as given in section (6.1.3).

6.2 Textile Sector

TABLE 6.2 Correlation Matrices

firm size	output lsales	inputs- lcapital	llabour	lrawmaterial
S1				
lsales	1.0			
lcapital	0.28	1.0		
llabour	0.51	0.13	1.0	
lrawmaterial	-0.016	0.15	0.32	1.0
S2				
lsales	1.0			
lcapital	-0.38	1.0		
llabour	0.53	-0.72	1.0	
lrawmaterial	0.35	0.1	-0.09	1.0
M1				
lsales	1.0			
lcapital	0.57	1.0		
llabour	0.74	0.72	1.0	
lrawmaterial	0.09	-0.2	0.2	1.0
L				
lsales	1.0			
lcapital	0.69	1.0		
llabour	0.28	-0.13	1.0	
lrawmaterial	0.7	0.31	0.5	1.0

Source: Computed from RPED data:1994

From the correlation matrices for the textile industry the following points are interesting to note. Firstly, for the S1 group the inputs and the output are all positively correlated. In the next group, S2, there is a negative correlation between capital and output as well as between labour and capital. An increase in capital in the first case results in the decline of output. In the second case there is a negative relationship between capital and labour, simply meaning that as labour or capital increases the other factor input declines. This again is indicative of over employment of one of the factors of production in the production process. For M1, the variables are positively correlated. For the last group there is an inverse relationship that is exhibited between labour and capital the implication to be derived here is exactly the same as in the earlier case.

TABLE 6.3 Factor Elasticities

firm size	factor elasticities					
	α	β1	β2	β3	β1 + β2	R^2
a	4.8	0.18	1.05	-0.11	1.23	
b	4.9	0.17	0.94		1.11	36
c	24.9	0.17	0.94		1.11	
S2 a	0.99	-0.05	1.4	0.62	1.97	
b	5.9	-0.3	0.75		0.45	42
c	25.9	-0.3	0.75	0	0.45	
M1 a	5.7	-0.04	1.66	0.09	1.71	
b	5.9	0.12	0.93		1.05	55
c	25.9	0.12	0.93	Q	1.05	89
L a	-6.56	0.7	0.52	0.51	1.7	
b	0.38	0.44	0.11		0.55	83
c	20.4	0.44	0.11		0.55	

6.2.1 Technical Efficiency

The most efficient group in the textile industry is the M1 group whose efficiency parameter is 5.7 by the unrestricted least squares method, 5.9 and 25.9 by the restricted maximum likelihood and non linear least squares methods. The next most efficient is the S2 group, which is followed by S1. The least efficient group is the largest group, L, which has the most inefficient parameters of all. This is an interesting result overall and does raise some interesting issues in terms of both theoretical expectations and policy considerations which aspects are discussed in the last section. Nevertheless, examples of such considerations are for instance what accounts for the inefficiency in the large group? Or in comparison say to the food sector why are these results for the sectors not consistent with regard to the sizes? etc. In general we have a sector which has been extensively susceptible to the uncertainties of the stabilisation measures and the structural adjustment measures in curtailing supply response to the extent that this has perhaps been worsened by the import liberalisation of cheap textile imports. All these measures have therefore acted towards the generation of an uncompetitive production structure in the textile industry to the extent that the medium - large firms have of course been the most affected in terms of capacity utilisation effects and marketing absorption effects. All in all the economies of scale although likely to be present have not worked towards the realisation of an efficient production sector that may consistently be achieving declining unit costs of production and therefore systematically able to increase output to meet the declining purchasing power of the consumer and therefore one responsive to a declining market absorption capacity in this regard.

6.2.2 Factor Elasticities

The unit percentage for inputs for S1 induces the greatest change in the case of the labour input change as compared to the change in capital. The textile sector in this regard is rather labour intensive as well as being relatively more labour efficient. Whereas only a 0.17% capital input - output response is generated a 94% labour - output response is generated in this group. In addition it should be noted that this is the highest single input factor generating the said level of output response. Yet despite this, this is not the most efficient group as already observed.

The factor elasticities for the second group, S2, are negative for all three models for the capital input. In the maximum likelihood method and non linear least squares, an increase in capital of 1% results in the reduction of output by as much as 30%. The case for labour is somewhat different in that for the first case of unrestricted least squares, a unit change in labour results in 1.4% increase in output, and for the MLE an increase in labour results in 0.75% increase in output. The sector indicates a certain amount of labour efficiency and capital inefficiency the available technology in this respect is labour saving.

The M1 category has the most efficient technical coefficient as already discussed. The elasticities for the variables are such that although in the case of the unrestricted case the capital parameter is marginally negative at 0.04, the labour elasticity is 1.66. The remaining labour elasticities are relatively high at 0.93. There is a high labour change response rate.

6.2.3 Returns to Scale

The results for the returns to scale seem to conform to the earlier results that have been obtained. In the case of S1, there are increasing returns to scale in all the cases. For S2, there is increasing returns to scale in the case of unrestricted least squares but declining returns to scale for all the other cases. In the M1 case there are increasing returns to scale given by the unrestricted least squares and marginal increasing returns to scale may be observed for the other two. For the large group there is a similar result arising from the unrestricted least squares and declining returns to scale for the remaining results. The results are in conformity with the efficiency expectations as given by the α results.

TABLE 6.3A Factor Intensities

firm size	
S1 capital-labour ratios a	0.17
b	0.18
c	0.18
S2 capital-labour ratios a	-
b	-
c	-
M1 capital-labour ratios a	-
b	0.129
c	0.129
L capital-labour ratios a	1.4
b	4
c	4

6.2.4 Factor Intensities

In the case of the capital - labour ratios, the S1 group exhibits positive and the second highest factor intensity use. In the case of S2 the factor intensities are negative. This accounts for there being a decrease in one factor should the other increase and vice - versa, which shows idle and excess capacity in either capital or the labour input. The highest capital - labour coefficients are for the large sector, L, which are indicative of the high capitalisation rate in the industry category. This goes towards explaining the excess capacity that exists in this category which obviously manifests itself through inefficient productivity.

6.3 Wood and Wood Manufacturing: Results and Interpretation of the Log Linear Regression Analysis

In the table below showing the correlation matrices for this sector. The trend for the S1 group is generally that of positive correlation among the variables. For S2 there is an inverse relationship between labour and output. For M1 and L, there is an inverse relationship between capital and output. Again in L there is an inverse relationship between capital and labour. The last relationship is within expectations under the normal assumptions returns to scale. However the inverse relationships in the other cases are indicative of some element of inefficiency, which aspects is further investigated below.

The table showing the correlations of the various factor inputs and output demonstrate the following: In the first case, S1, there is a positive relationship between both capital and labour, although the stronger of the two relationships is between output and labour. There is a tendency for labour and capital increases to lead to output increases.

For S2 there is a negative relationship between labour inputs and output. This implies that the more labour input there is the lesser the degree of marginal product that is being contributed by the increase in labour and therefore the less efficient the output or in other words there is a tendency to obtain decreasing returns to scale.

In the last two cases there is a negative relationship between capital and output. Again the implication is that there will occur lesser output as a consequence of additional capital inputs.

TABLE 6.4 Correlation Matrices

firm size	output	inputs-		
S1	lsales	lcapital	llabour	lrawmaterial
lsales	1.0			
lcapital	0.24	1.0		
llabour	0.62	0.25	1.0	
lrawmaterial	0.12	-0.1	-0.18	1.0
S2				
lsales	1.0			
lcapital	0.17	1.0		
llabour	-0.13	0.12	1.0	
lrawmaterial	0.75	0.5	0.078	1.0
M1				
lsales	1.0			
lcapital	-0.17	1.0		
llabour	0.2	0.57	1.0	
lrawmaterial	0.26	-0.34	-0.39	1.0
L				
lsales	1.0			
lcapital	-0.29	1.0		
llabour	0.75	-0.15	1.0	
lrawmaterial	0.43	-0.72	-0.13	1.0

Source: Computed from RPED data :1995

TABLE 6.5 Factor Elasticities

firm size	factor elasticities					R^2
S1	α	β1	β2	β3	β1 + β2	
a	4.7	0.05	0.95	0.15	1.15	
b	2.27	0.35			0.35	19
c	22.3	0.35			0.35	
S2 a	-15.3	0.015	6.36	1.27	7.64	
b	5.7	-0.19	-0.9	0.8	-0.29	67
c	25.7	-0.19	-0.9	0.8	-0.29	
M1 a	5.2	-0.26	1.2	0.37	1.31	
b	6.9	-0.25	0.97		0.72	27
c	26.9	-0.25	0.97		0.72	
L a	6.2	-0.25	1.64		1.39	
b	9.49	-0.37			-0.37	59
c	29.5	-0.37			-0.37	

Source:Computed from RPED data:1994

6.3.1 Technical Efficiency

In the above table, the most efficient size as given by the constant term is the large group, L, followed by group M1, S2 and lastly S1.

6.3.2 Factor Elasticities

The unrestricted least squares give a high labour elasticity of 0.95 as opposed to the capital elasticity of 0.05 for the S1 group. From the NLLS and MLE the labour parameter is computed as zero. This does mean or imply that the labour input is not necessary and can therefore be done without. It implies rather that there is not as much labour requirement in the production process (See Forsund et al, 1991).

6.3.3 Returns to Scale

The unrestricted least squares give results showing increasing returns to scale in all cases of the firm size categories, with the highest returns occurring in the S2 category and the least in the S1 category. Interestingly, from the MLE and the NLLS there decreasing returns to scale in all cases. The closest to the constant returns to scale is the M1 category with the parameter sum of 0.72.

6.3.4 Factor Intensities

TABLE 6.5A Factor Intensities

firm size	
S1 capital-labour ratio a	0.05
S2 capital-labour ratio a	0.0002
b	0.21
c	0.21
M1 capital-labour ratio a	-
b	-
c	-
L capital-labour ratio a	-

Source:Computed from Table 6.5

Given the factor intensities obtaining above, the Wood sector seems to be of lower capital intensity than the preceding two sectors. This inference is made on the basis of what will be observed to be rather and comparatively lower factor intensity ratios. Related to this result is that of the observed technical parameters which are some of the highest in this sector as compared to the first two sectors, suggesting at this stage that the Wooden sector could be one of the most efficient sectors of all the sectors under consideration. The actual conclusions on the most efficient sectors are done later.

6.4 Metal and Metal Fabrication

The correlation among the groups under the Metals sector is observed to be as follows: In the first case there are all positive relationships among the variables, except for labour and output, indicating some element of excess labour requirements within this category, which is quite surprising given the fact that very small scale producers tend to almost always be labour intensive in organisation. However this may also reflect the low production levels and therefore correspondingly low output i.e. in terms of value added and total sales.

In the S2 category there is an inverse relationship between capital and output denoting a capital intensity constrained by the output and labour, similar to the S1 category. Any additional capital will at this stage only result in decreasing amounts of output.

Lastly, in the large group of this sector the labour input is inversely related to the output and capital variables suggesting once again that the production level is at its maximum with respect to the labour input. Increases in the output can be achieved through reduction in the labour input.

TABLE 6.6 Correlation Matrices

firm size	output	inputs-		
S1	**lsales**	**lcapital**	**llabour**	**lrawmaterial**
lsales	1.0			
lcapital	0.58	1.0		
llabour	-0.019	0.8	1.0	
lrawmaterial	-0.0056	0.45	-0.47	1.0
S2				
lsales	1.0			
lcapital	-0.22	1.0		
llabour	0.21	0.16	1.0	
lrawmaterial	0.9	-0.0.5	0.11	1.0
M1				
lsales	1.0			
lcapital	0.48	1.0		
llabour	0.43	0.37	1.0	
lrawmaterial	0.59	-0.08	0.37	1.0
M2				
lsales	1.0			
lcapital	0.58	1.0		
llabour	0.5	0.47	1.0	
lrawmaterial	0.98	0.58	0.6	1.0
L				
lsales	1.0			
lcapital	0.94	1.0		
llabour	-0.008	-0.08	1.0	
lrawmaterial	0.77	0.93	-0.17	0.76

Source:Computed from RPED data:1994

TABLE 6.7 Factor Elasticities

firm size	factor elasticities					
S1	α	β1	β2	β3	β1 + β2 + β3	R^2
a	7.8	0.37	-1.2	-0.4	-1.23	52
b	4.14	0.28	0.8		1.08	31
c	24.1	0.28	0.8		1.08	
S2 a	5.6	-0.4	0.8	0.7	1.1	89
b	5.9	-0.4	0.69		0.29	90
c	26	-0.4	0.69		0.29	
M1 a	0.5	0.34	-0.02	0.6	0.92	64
b	0.32	0.33	0.049		0.37	65
c	20	0.33	0.049		0.37	
M2 a	4.03	0.011	-1.03	1.2	0.18	99
b	1.03	-0.002	-0.17		-0.17	98
c	21	-0.002	-0.17		-0.17	
L a	-7.2	1.22	0.22		1.44	90
b	-4.15	1.15			1.15	89
c	15.8	1.15			1.15	

Computed from RPED data:1994

6.4.1 Technical Efficiency

A surprising result here is that of the large category firm size, L, being the most inefficient of all the categories.

The most efficient firm size is the small category, S2, which is followed by S1. M2 and M1 follow respectively.

6.4.2 Factor Elasticities

The factor input - output elasticities are all negative for the capital input at 0.4 for all regression equations, demonstrating that a unit percentage increase in the capital input will result in a 0.4% decline in output. In a converse manner the labour input coefficients are al negative for the M2 category. In this case a unit increase in labour results in a 1.03% decline in the case of unrestricted least squares and of 0.17% decline in the case of the MLE and NLLS. The other cases generally reflect direct relationships.

6.4.3 Returns to Scale

The results obtained show that in two cases S1 and L there will be experienced increasing returns to scale. All other cases are likely to exhibit decreasing returns to scale.

6.4.4 Factor Intensities

Category S2 has the lowest capital - labour ratio. This characteristic is consistent with the efficiency of the same category. It implies that the marginal productivities of labour and capital are set at the level of interest and wages as the factor returns to the both inputs.

wood and metals for analysis. This is done in order to derive the "best" production function within each sector. This therefore is the sector that shows the variance or deviation of the fitted firm size production function from the best practice production function. In other words the industry production function shows the optimal efficiency results.

TABLE 6.8 Correlation Matrices

industry/sector food	output lsales	inputs- lcapital	llabour	lrawmaterial
lsales	1.0			
lcapital	0.4	1.0		
llabour	0.77	0.62	1.0	
lrawmaterial	0.93	0.42	0.7	1.0
textile				
lsales	1.0			
lcapital	0.74	1.0		
llabour	0.89	0.74	1.0	
lrawmaterial	0.86	0.73	0.87	1.0
wood				
lsales	1.0			
lcapital	0.61	1.0		
llabour	0.8	0.82	1.0	
lrawmaterial	0.72	0.68	0.74	1.0
metal				
lsales	0.1			
lcapital	0.65	1.0		
llabour	0.84	0.73	1.0	
lrawmaterial	0.77	0.62	0.8	1.0

Computed from RPED data:1994

The results that are given by the industry analysis seem to be generally better than for actual sizes. This is partly as a result of the increase in the number of observations.

The correlation coefficients in the above table reflect a relatively high degree of correlation of 60% or more in all cases. In addition, all the correlation among the variables is positive, showing the general tendency of the variables to vary in the same direction.

TABLE 6.9 Factor Elasticities

industry	factor elasticities					R^2
food	α	β1	β2	β3	β1 + β2 + β3	
a	1.96	-0.07	0.36	0.85	1.14	88
b	2.4	-0.06	0.2		0.14	88
c	22.3	-0.06	0.2		0.14	
textile a	3.7	0.12	0.82	0.28	1.34	83
b	3.8	0.11	0.5		0.61	82
c	23.8	0.11	0.5		0.61	
metals a	3.6	0.05	0.97	0.27	1.29	74
b	3.6	0.11	0.53		0.64	73
c	23.6	0.11	0.53		0.64	
wood a	5	-0.012	0.94	0.35	1.278	69
b	5	-0.07	0.77		0.7	69
c	25	-0.73	0.77	0	0.7	

Source: Computed from RPED data:1994

6.5.1 Technical Efficiency

The most efficient industry is the Wood and Wooden Manufacturing. It has the highest efficiency parameter for all three models comprising the unrestricted least squares, NLLS and MLE of 5,5 and 25 respectively. The capital elasticities are negative for this sector and precisely -0.012%, -0.07% and -0.73% decline in output will result as a consequence of any increase in the capital input. Obviously, the capital intensity as will be observed in the table below is very low. The compounding effect of this is that the labour elasticity is rather high as shown by the fact that 0.94%, 0.77% and 0.77% change in output due to a unit percentage change in the labour input. With a low capital input intensity then the industry is capable of absorbing more labour input.

The least efficient of the industries is the food industry. This is somewhat surprising as this is in our view the sector that should be most responsive to the raw materials' sourcing, which is biased towards domestic sources as well as therefore being able to be the highest contributing sector to valed added. Neverthless, the results as they are derived show that it is the most inefficient user of resources in terms of output production.

In between the two sectors are the textile and metals industries. The textile industry is marginally more efficient than the metals industry.

6.6 Inter - Industry Production Function by Firm Size

The inter - industry production function is computed on the basis of all the data for a particular firm size group, for all groups under consideration.

TABLE 6.9 Correlation Matrices

firm size	output	inputs-		
S1	lsales	lcapital	llabour	lrawmaterial
lsales	1.0			
lcapital	0.32	1.0		
llabour	0.26	0.07	1.0	
lrawmaterial	0.25	0.05	0.37	1.0
S2				
lsales	1.0			
lcapital	0.32	1.0		
llabour	0.2	0.33	1.0	
lrawmaterial	0.9	0.37	0.17	1.0
M1				
lsales	1.0			
lcapital	-0.12	1.0		
llabour	0.047	0.4	1.0	
lrawmaterial	0.74	0.11	0.19	1.0
M2				
lsales	1.0			
lcapital	0.3	1.0		
llabour	0.36	0.13	1.0	
lrawmaterial	0.8	0.2	0.33	1.0
L				
lsales	1.0			
lcapital	0.005	1.0		
llabour	-0.007	0.37	1.0	
lrawmaterial	0.83	0.13	0.07	1.0

Source: Computed from RPED data: 1994

This facilitates the derivation of the best practice firm size production function. The firms may accordingly be compared by size in terms of their efficiency expectations.

The correlations of the inter - industry analysis show the same pattern of behaviour as in the industry analysis. The relations of the variables are all positive although not that high, averaging about 30% or so.

TABLE 6.10 Factor Elasticities

firm size S1	α	β1	β2	β3	β1 + β2 + β3	R^2
a	4.47	0.17	0.32	0.14	0.63	18
b	3.9	0.19	0.67		0.86	17
c	23.9	0.19	0.67	0	0.86	
S2 a	2.27	-0.019	0.2	0.84	1.059	82
b	2.3	-0.018	0.17		0.152	82
c	22.3	-0.018	0.17		0.152	
M1 a	5.7	-0.12	-0.08	0.7	0.5	60
b	4.1	-0.14	0.43		0.29	58
c	24	-0.14	0.4		0.26	
M2 a	2.6	0.06	0.44	0.6	1.1	67
b	3.1	0.06	-0.2		-0.14	67
c	23	0.06	-0.2	0.6	0.46	
L a	4.5	-0.07	-0.06	0.85	0.72	70
b	2.5	-0.07	0.16		0.09	68
c	22.5	-0.07	0.16	0.0004	0.09	

Source: Computed from RPED data:1994

6.6.1 Technical Efficiency

The most efficient firm size category when all the data is aggregated is the medium size category M1 as given by the efficiency parameters in the above table. This is followed by the small size S1 and next by the large medium size M2.

TABLE 6.10A Factor Intensities

firm size	
S1 capital-labour ratio a	0.53
b	0.28
c	0.28
S2 a	-
b	-
c	-
M1 a	12.5
b	-
c	-
M2 a	0.136
b	-
c	-
L a	1.16
b	-
c	-

Source: .Derived from Table 6.10

In view of the determination of the efficiencies above, we wish to determine the extent of factor intensity within each particular firm size category. This will partly assist in determining the appropriateness of input. M1 has the highest capital intensity. In this case it is suggestive that the capital utilisation rate is comparatively efficient.

6.7 Hypotheses Testing

The hypotheses that are being tested are given in Chapter Three.(see also Chapter 7, section 7.3,'Hypothesis Testing').

The first hypothesis is:

$$H0 : \beta 1 + \beta 2 + \beta 3 = 1$$

$$H1 : \beta 1 + \beta 2 + \beta 3 \neq 1$$

The second hypothesis is:

$$H0 : \alpha s = \alpha l$$

$$H1 : \alpha s \neq \alpha l$$

The decision making rule is that

i) if F* > Fcritical reject the null hypothesis H0.

ii) if F* < Fcritical accept H0.

The F values for the testing of the hypothesis are given in the table below.

industry/firm size	**F***	**Fcritical****	**decision making**
wood industry	8.4	2.294	reject H0
food industry	29	3.232	reject H0
textile industry	3.9	3.232	reject H0
metal industry	3.3	3.232	reject H0
inter-industry	0.87	3.232	accept H0
S1			
S2	4.2	3.245	reject H0
M1	48	3.259	reject H0
M2	0.19	3.522	accept H0
L	20.4	3.369	reject H0

* F = observed value

**Fcritical = theoretical F value at 0.05% level of significance

From the results obtained from the hypotheses tests we conclude that

6.7.1 Constant Returns to Scale

i) there does not exist constant returns to scale in the various firm size categories except in the case of S1 and M2. Therefore, the returns to scale varies among the different firm size groups. As such they may be increasing or decreasing returns to scale that may be experienced.

In the case of the firm size S1 and M2, there are constant returns to scale that accrue.

6.7.2 Technical Efficiency

ii) there does not exist equivalent technical efficiency levels between the small size firms and the large size firms. The efficiency levels among small sized firms and large sized firms are different.

CHAPTER SEVEN

DATA ANALYSIS AND PRESENTATION:1995 DATA

7.0 INTRA - SECTORAL FIRM ANALYSIS: The Firm Production Function

TABLE 7.1 Distribution of Firms by Size and Sector for 1995

SECTOR TOTAL NO. OF FIRMS	FIRM SIZE S1	S2	M1	M2	L
FOOD 31	8	4	12	-	7
TEXTILE 32	8	9	7	-	8
WOOD 33	10	3	12	8	3
METAL 38	6	7	11	8	6
TOTAL 134	32	23	42	16	24

Source: Compiled from RPED Survey data for 1995

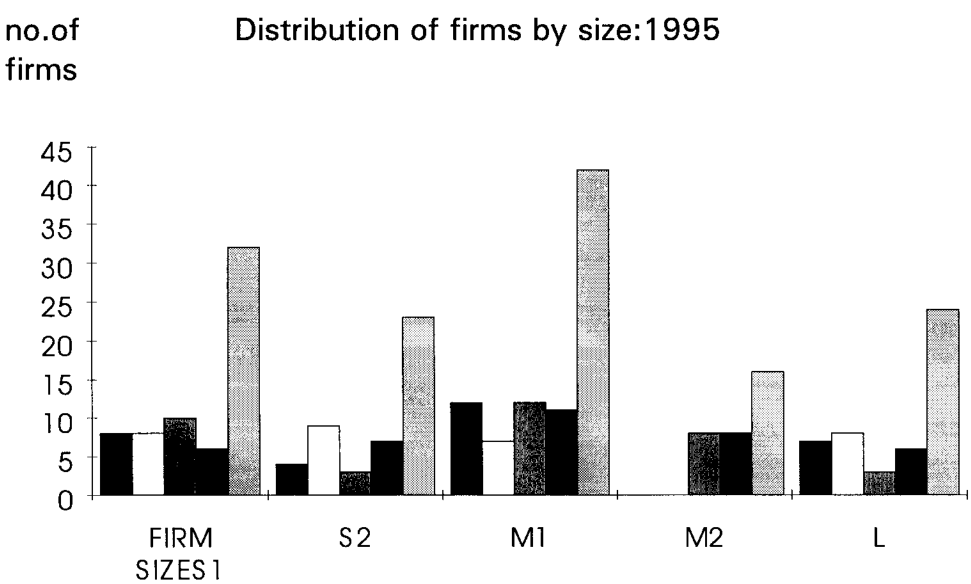


Figure 7

1995 was the last year in the series of the three - year Regional Programme on Enterprise Development (RPED). In this three year period, the Zambian economy had undergone quite severe recessionary experiences, which had resulted in continued contraction of the economy.

The number of firms during the 1995 survey, that were interviewed reduced somewhat, due mainly to the continued closures of firms and a few cases due to non - response. Table 7.1 shows the reduced number of respondent firms as compared to the previous years of the survey. Another noticeable feature of the 1995 data is that there are quite a rather higher proportion of missing data gaps as when compared to the previous years. This has reduced the number of firms that are actually included in the sample to 134 from the possible interviwed number of firms of about 180 for 1995. For the purposes of this work, this data relates to either of the following; raw material cost, total output as measured by total sales revenue, total number of full time employees, capital value computed as the gross of the replacement value of machinery, equipment and plant.

TABLE 7.2 CORRELATION MATRICES, BY FIRM SIZE CATEGORY.

SECTOR & SIZE	LOUTPUT- LSALES REVENUE	LINPUT- LCAPITAL	LLABOUR
FOOD S1			
LOUTPUT	1		
LCAPITAL	0.41	1.0	
LLABOUR	0.25	0.44	1
FOOD S3 loutput	1		
LCAPITAL	-3.0	1.0	
LLABOUR	-0.05	-0.5	1.0
FOOD M2 loutput	1.0		
LCAPITAL	0.29	1.0	
LLABOUR	0.69	0.31	1.0
FOOD LARGE,L.LOUTPUT	1.0		
LCAPITAL	-0.7	1.0	
LLABOUR	0.025	0.4	1.0
TEXTILE S2 LOUTPUT	1.0		
LCAPITAL	0.38	1.0	
LLABOUR	0.53	0.6	1.0
TEXTILE M1 LOUTPUT	1.0		
LCAPITAL	0.36	1.0	
LLABOUR	0.25	0.11	1.0
TEXTILE,L. LOUTPUT	1.0		
LCAPITAL	-0.47	1.0	
LLABOUR	0.12	0.13	1.0
WOOD S2 LOUTPUT	1.0		
LCAPITAL	-0.98	1.0	
LLABOUR	-0.88	0.78	1.0
WOOD,L. LOUTPUT	1.0		
LCAPITAL	0.95	1.0	
LLABOUR	-0.05	-0.33	1.0
METAL,S1. LOUTPUT	1.0		
LCAPITAL	0.32	1.0	
LLABOUR	-0.24	1.05	1.0
METALS,S2.LOUTPUT	1.0		
LCAPITAL	-0.4	1.0	
LLABOUR	0.6	0.13	1.0
METAL,L.	1.0		
LCAPITAL	-0.13	1.0	
LLABOUR	0.75	0.2	1.0

Source: derived from correlation matrices' analysis of 1995 data.

There seems little evidence of problems of multi - collinearity as well as serial correlation in the data for 1995 as is evidenced from Table 7.2, above. The correlations are, in general, rather low.

Table 7.3 below, shows the factor elasticities and the coefficient of determination.

7.1 Technical Efficiency

From Table 7.3 it is observed that the medium sized firms in the food sector are the most efficient given the results obtained by use of unrestricted least squares. By the same approach, the smallest firms within the food sector are found to be the least efficient.

By the use of the restricted least squares, i.e. with the restrictions on the parameters, of course, the small - medium firms are the most efficient. Again, as before, the least efficient firms are the large metal sector firms.

TABLE 7.3 FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION

SECTOR & FIRM SIZE	FACTOR ELASTICITIES AND COEFFICIENT OF DETERMINATION				
	α	β1	β2	β1+β2	R^2
FOOD S1 a	3.9	0.46	0.29	0.75	18
b	3.8	0.45		0.45	17
c	23	0.45		0.45	
food s3 a	23.9	-0.69	-1.3	-1.99	18
b	9.8	-0.14		-0.14	10
c	29.8	-0.14		-0.14	
food m1 a	-15.9	0.09	6.4	6.49	49
b	6.99	0.23		0.23	49
c	26	0.23		0.23	
food l a	20	-0.68	0.7	0.02	70
b	14.5	-0.67		-0.67	64
c	34.5	-0.67		-0.67	
TEXTILE s1 a	6.2	0.007	0.97	0.97	16
b	6.1	0.009		0.009	16
c	6.1	0.009		0.009	
textile s2 a	5.4	0.06	1.9	1.96	28
b	6.76	0.16		0.16	25
c	6.7	0.16		0.16	
textile m1 a	5.1	0.35	0.6	0.95	17
b	24.9	0.35		0.35	
textile l, a	16.9	-0.3	0.25	-0.05	25
b	9.02	-0.15		-0.15	10
c	29	-0.15		-0.15	
WOOD s1 b	6.8	0.23		0.23	10
c	26.8	0.23		0.23	
wood s2 a	11.5	-0.06	-1.2	-1.26	11
b	28.6	-2.0		-2.0	74
c	48	-2.09		-2.09	
wood,l a	9.4	-0.06	0.98	0.92	66
METAL S1 a	8.1	0.3	-1.67	-1.37	16
b	5.05	0.34		0.34	10
c	5.05	0.34		0.34	
metal s2 a	4.6	-0.19	3.2	3.01	66
b	10	-0.18		-0.18	47
c	8.3	-1.3		-1.3	
metal m1 a	9.5	-0.6	2.8	2.2	66
b	16	-0.83		-0.83	57
c	36	-0.83		-0.83	
metal l a	4.5	1.07	-1.15	-0.08	93
b	-2.38	1.15		1.15	91
c	17.6	1.15		1.15	

Source: Derived from the computed regression equations of the Cobb - Douglas production function of 1995 data.

note: a= unrestricted least squares. b=restricted least squares,β1+β2=1. c= maximum likelihood production function as defined in the text above.

Lastly, the third method of analysis compares as follows: the small - medium firms in the wood sector are the most efficient, while the inefficient firms are within the small - medium textile firms.

The pattern that emerges is that the results in this case are not conclusive - more will be discussed on this aspect of the analysis results in the last chapter.

TABLE 7.4 COMPUTED FACTOR INTENSITIES (CAPITAL - LABOUR RATIOS)*

SECTOR	FACTOR INTENSITY
FOOD S1	1.58
s3	0.53
m	0.014
TEXTILE S1	0.069
s2	0.03
m1	0.58
WOOD s2	0.05
INTER - INDUSTRY ANALYSIS BY FIRM SIZE	
S1	
M1	0.55
L	0.88

Source: Derived from Table 7.3

* Missing observations and results are due to indeterminate results obtained by division of positive and negative numbers.

The capital intensities are relatively graduated, apart from the small firms in the food sector where there is relatively high capital intensity, which seems as the source of some of the inefficiencies that are experienced.

7.2 INTER - SECTORAL FIRM ANALYSIS

7.2.1 The Industry Production Function

As in the previous sections, the inter - sectoral firm analysis is made by way of determining the production function for the respective sector. However, an assessment of the production functions by firm size is made on a cross - sectional basis, for all the firms within the respective firm size across all the sectors e.g. if S1 is taken, then all the firms in all the sectors within this category then represent one sample, this is done for all firm sizes. The results of these regression equations are given in Tables 7.5 and 7.6 below.

TABLE 7.5 FACTOR ELASTICITIES: CROSS - SECTIONAL FIRM SIZE RESULTS

FIRM SIZE	FACTOR ELASTICIES				
	α	β1	β2	β1+β2	R^2
S1 a	8.9	-0.16	1.02	0.9	10
b	8.6	-0.14		-0.14	10
c	28.6	-0.14		-0.14	
S2 a	9.7	0.23	-0.57	-0.34	9
b	6.5	0.22		0.22	10
c	26.5	0.22		0.22	
M1 a	18.8	-0.35	-0.63	-0.98	15
b	8.6	-0.05		-0.05	10
c	28	-0.05		-0.05	
L a	10.6	0.16	0.18	0.34	15
b	6.6	0.21		0.21	11
c	20.6	0.21		0.21	

Source: Computed from the 1995 RPED data

a = unrestricted least squares. b = restricted least squares. c = maximum likelihood least squares

In Table 7.6 below, the industry production function results have been presented. From these results, the aspect of efficiency as interpreted, shows that, in general, the food sector as being more technically efficient than the other firms. The metals sector is just that marginally more efficient than the *wood sector and the textile sector is the least efficient.*

TABLE 7.6 FACTOR ELASTICITIES: INDUSTRY PRODUCTION FUNCTION

SECTOR	FACTOR ELASTICITIES				
	α	β1	β2	β1 + β2	R^2
METAL a	8.06	-0.02	1.0	0.98	48
b	8.14	-0.019		-0.019	48
c	8.14	-0.019			
WOOD a	8.02	0.1	0.67	0.77	37
b	7.3	0.1		0.1	37
c	27.3	0.1		0.1	
TEXTILE a	4.6	0.3	0.75	0.85	57
b	4.8	0.3		0.3	57
c	24.8	0.3		0.3	
FOOD a	9.5	0.06		0.06	47
b	9.5	-0.067		-0.067	47
c	29.5	-0.067		-0.067	

Source: Computed from the 1995 RPED.

7.3 HYPOTHESES TESTING

TABLE 7.7 F - TEST CRITERIA FOR SIGNIFICANCE OF THE REGRESSION EQUATION

SECTOR	F*	Fcritical**	COMMENT
CROSS-SECTIONAL RESULTS BY FIRM SIZE S1	1.66	7.56	ACCEPT HO
S2	1.25	5.76	" "
M1	1.66	4.17	" "
M2	1.25	4.3	" "
L	1.25	4.24	" "
INDUSTRY PRODUCTION FUNCTION BY SECTOR			
METAL	12	4.24	REJECT HO
WOOD	5.5	4.32	" "
TEXTILE	28.5	4.15	" "
FOOD	13.8	4.15	" "

From the results of the hypotheses tests, first, the assertion or hypothesis that there are constant returns to scale among the different firm sizes in the different sectors is accepted, although this is not the case at the industry level.

Secondly, the hypothesis that there are the same efficiency levels among the small - medium sized firms as the large sized firms is rejected when the comparison is made on a cross - sectional level we also reject that there are the same, constant returns to scale. This means that there are, first, different efficiency levels among the

different industries. In addition there are also different returns to scale among the different sectors.

CHAPTER EIGHT

SUMMARY AND CONCLUSIONS OF FINDINGS AND RESULTS

8.0 Initial Efficiency Behavioural Patterns

The essence of all the preceding work has been to identify the behaviour of the microeconomic unit, the firm, under different resource constraints with respect to its optimal achievable performance.

From the results available from the production functions that were obtaining, a summary is made below.

8.1 Efficiency Rankings of the Firms on Intra Industry Level

The results of the intra firm production function, which are given by sector show the following:

8.1.1 Food Sector

TABLE 8 EFFICIENCY RANKING

Ranking in order of most efficient	FIRM SIZE		
	1993	1994	1995
1	M1	M2	L
2	L	L	M1
3	M2	M1	M2
4	S2	S2	S1

The most efficient group during 1993, as can be seen from the above table is M1, followed by L, M2 and lastly S2. From the food group, the medium size group is the most efficient and the small size group is the least efficient. The large groups are in the middle.

8.1.3 Wood and Wood Manufacturing

TABLE 8.2 EFFICIENCY RANKING

Ranking in order of most efficient	FIRM SIZE 1993	1994	1995
1	L	L	S2
2	S1	M1	S1
3	S2	S2	L
4		S1	

In the wooden sector, the largest firm size group was the most efficient, except in the last year, when the efficiency levels somewhat switched completely and the large size firms recorded a poorer production function than the rest.

8.1.4 Metal and Metal Manufacturing

TABLE 8.3 EFFICIENCY RANKING

Ranking in order of most efficient	FIRM SIZE 1993	1994	1995
1	L	S2	M1
2	S1	S1	S2
3	S2	M2	S1
4	M1	M1	L
5	M2	L	

In 1993 the large firm size group operated as the most efficient and in order of ranking, the small firm size groups S1 and S2 were the next most efficient.

In 1994, the most efficient in this sector were the small scale firms and the large scale firms were the most inefficient.

In the last year, 1995, the medium sized firms M1 and S2 had the highest recorded productivity. The largest firm in this industry had the lowest recorded productivity.

8.2 Efficiency Ranking of Firms on an Inter - Industry Level

TABLE 8.4 EFFICIENCY RANKING

Ranking in order of most efficient	FIRM SIZE	
	1993	1994
1	L	M1
2	S1	S1
3	S2	M2
4	M1	L
5	M2	S2

Table 8.4 gives the efficiency rankings for all the firms by the firm size category. On this basis of analysis we immediately have an improved analytical data base due to the increased number of observations as when compared to each individual group, which contains a lesser number of firms (see distribution of firms in the previous chapter).

declines to third position in 1995. This is followed by the textile sector, the metals and lastly the food sector. This ranking order is maintained during 1994. In 1995, the food sector displays the highest productivity levels and is followed by the metals sector.

8.4 Summary

From the results obtained that have been summarised in this chapter we note that there have been the following implications of the results:

8.4.1 Technological Change

There is no conclusive evidence of the most efficient firm size category. For instance, in the food sector, S2 which was the most efficient in 1993, was about the least efficient in 1994. In addition it is observed that in the other industries, the efficiency standards differ with various group classifications not being consistently representative of their initial efficiency levels. As an example, the most efficient group in the textile sector is M1 while for wood it is the large group and for metal it is M2.

However the overall result as given by the intra- [illegible]

[illegible]

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However the overall result as given by the intra - industry analysis for all observations within a particular class structure shows that the small sized firms are generally more efficient than the medium sized and large sized firms. In addition the increase in the level of the technical efficiency means that some element of technological change has occurred. In any event this positive technological change is in the form of better factor input management rather than new capital investment or superior technological acquisition. This observation is based on the fact that there was little or virtually **no new investments in firms during the three year duration of the study.**

8.4.2 Partial Factor Productivity

The efficiency in terms of contribution of each factor input is again not determined conclusively. However from the results that are available strong evidence exists to infer the following.

i) the level of factor elasticity is generally higher for capital in the L, or large size category than any other. this result is consistently derived throughout.

ii) Whereas for the food sector, the small category firm size S2 is rather capital intensive with a higher capital elasticity than for labour the other categories all reflect a lower labour elasticity than capital elasticity.

From this it is understood why partly the food sector is the most inefficient sector, since its utilisation of resources is rather capital intensive and this comparative capital intensity is inefficiently utilised.

Furthermore, the marginal productivity rates of the food sector are all paid at a higher rate than the real wage and interest rates to both labour inputs and capital inputs.

8.4.3 Effects of the Structural Adjustment Measures and General Economic Liberalisation

The RPED survey was conducted between 1993 and 1995 against the background of SAP. Some of the effects of this SAP through trade liberalisation and deregulation were extremely negative far as the productivity and actual survival of the Zambian industry was concerned. In the experience of cheap imports and import competition, end of financial repression, high tax rates, lack of production incentives and other similar experiences, we see that the environment was extensively unstable. This instability in the economic environment has had a direct effect on the productivity and therefore efficiencies of all firms within and outside our sample. It remains therefore to do two possible studies:

i) analyse enterprise development and performance following a period of relative stability in the environment

ii) compare the results during the structural adjustment period and the post structural adjustment period

The reasons for doing this are to be able to as much as possible account for the differences in the efficiencies that have obtained in this study. It must be cautioned however that I do not suggest that there are likely to be any differences or that if there are differences that are likely to be significant. It is probable that one would still end up with the same results obtaining here which are in favour of suggesting that larger firms may be more efficient than smaller firms.

8.5 Determinants of Efficiency

In as much as the rate of attained output differentials subject to the same or proportionate amounts of inputs differs and therefore accounts for differences in efficiency levels, there still remains the issue or question of what factors account for the variances in the different rates of efficiencies. There must exists some explanations as to why different producers, firms, entrepreneurs and managers are able and do obtain different levels of output given the same proportions of inputs. It is to this aspect of factors that possibly act as determinants to efficiency that obtains that we now turn to consider. In Page (1978), we note that regression functions were performed on Indian data as previously mentioned. By use of dummy variables, an attempt was made to account for the efficiency or effect of the determinants. In as much as the determinants can be analysed by using the coefficient of determination in order to gauge their explanatory powers with respect to the extent that they influence or actually account for the determination of the efficiency with which the firms or industries or firm size categories differ, at this point in my analyses, it is valid that a descriptive analysis of the factors can be made without recourse to regression analysis. Of course as part of the work that still requires to be done using this rich database would be the regression modelling of the factors with the objective of determining the relationship to the achieved efficiency.

8.6 Policy Recommendations

From the point of view of this study, the desired objective of any policy is to ensure the distribution of resources in an optimal manner. To this end, one needs to ensure:

i) optimal output through technical efficiency and technical progress that is output increasing, capital saving or/and labour saving.

ii) minimisation of resource misallocation

iii) creation of conditions in which resource allocation is made optimally with effect to the relevant wage and interest costs.

Some of the main constraints as perceived by the business firms and individual entrepreneurs have to be highlighted and addressed. In this regard, policy areas that require reform are:

a)<u>foreign trade - duty and tariff structure and imported competition</u>

The perceived "unfairness" of subsidised imports - 'dumping' - from within the Southern region should be controlled. The effect of 'dumping' has been to effectively reduce the market share of these affected firms and consenquentially reducing capacity utilisation rates and creating low capital - output ratios and bringing about capital inefficiency. At the same time due to the time lag of human resource rationalisation, there have been in other cases labour inefficiency in the form of structural unemployment. The overall effect has been the imbalance between the marginal productivity rates and the returns to factors in the form of interest rates, profits and wages. This characteristic is commonly exhibited especially in the small sized category (food sector is a clear example of this phenomenon), as well as in the other categories. We note that the large size of firm does not exhibit the most efficient degree of operations on a continuous and consistent basis due to the effect of both the low machinery capacity utilisation rates and the high labour employment levels.

Furthermore the foreign trade sector requires realignment in view of the fact that the duty and tariffs regime, according to some observations, are biased towards the development and promotion of local industry and manufacturing. The converse is experienced with regard to the duty and tariff structure which imposes higher rates on imported raw materials than on finished consumer goods which generate no value added and are therefore of less importance to the economy in terms of the development of a productive base.

b) financial sector - management of the 'post financial repression period'- interest rates and lending conditions

In the first instance the economic conditions facing most firms were such that they almost all required additional injection of capital. Working capital requirements or fixed capital investment are generally met through bank borrowing. In over 90% of the cases there was a definite desire to borrow but an unwillingness or total rejection to lend by the financial institutions.

In this regard therefore, the required reform is towards a permanently appropriate interest rate structure that would not impede the ability to borrow as well as the promotion of institutions to provide financing more readily than on the commercial conditions imposed by the commercial banking sector. *This therefore means that there must be some* developmental financial institutions of some sort able to react to the sort of economic conditions that prevail.

c) Industrial Policy Should be Non - Biased with respect to Size.

The main conclusion of this study is that there should equal opportunity provided to every category of firm size. The tendency of specifically focusing on any one type of firms is not in any way supported by the efficiency results obtained. The policy makers and technocrats should therefore when dealing with industries provide equal opportunity by availing resources to both small and large scale enterprises. What seems apparent from this study is that with more flexible lending policies and conditions and a more regulated foreign trade sector both small and large firms will perform with varying efficiency levels in the different sectors which seem to more or less average out. However, the small scale firms are likely to have greater growth potential as they tend to have a higher frequency of positive labour - output correlation coefficient and in some cases demonstrate higher labour elasticity coefficients.

APPENDIX 1: FOOD SECTOR DATA:1993				
OUTPUT (K'000)	CAPITAL (K'000)	LABOUR UNITS	RAW MATERIALS (K'000)
10900	80000	14	4800
45000	100000	17	12000
29400	72600	8	19100
35000	108000	20	66
25000	230000	17	4500
10300	10000	17	65000
75000	60000	15	600
10500	22340	13	21000
750000	50640	7	14500
105000	9000	13	1300
5000	75000	11	7500
80000	10500	31	45000
3984	3500	23	4820
25700	5800	22	14
12000	1110	35	2100
54800	42000	23	27000
180000	60000	26	2390
37400	60000	22	22200
19620	300000	42	77000
145000	55000	40	32880
19000	5000	68	76000
750000	250000	78	7071
248000	40000	53	79600
20000	35300	65	70000
938000	100000	53	20760
46600	91800	95	13924
269000	300000	55	70000
1900000	300000	83	8000
241000	300000	70	295000
1000000	250000	52	161000
2790000	1001500	293	8000
4710000	151000	144	84000
5100000	180000	455	342000
39418	263000	118	23000
200000	345000	208	214000
10418	1540000	140	1200000
106000	180000	120	14800
120000	320000	719	441000
11980	2000000	412	1950000
1200000	150000	171	2150000
762000	707000	412	2800000
993000	1900000	397	180000
912000	940000	425	635000
937000	4200	675	360000
99000	173000	642	357000
41400000	299000	430	471000

APPENDIX 2: DATA FOR FOOD:1994						
OUTPUT (K'000)		CAPITAL (K'000)		LABOUR UNITS		RAW MATERIAL (K'000)
841		6000		6		1040
24046		80000		15		6600
1603		175000		14		300
32414		250000		8		10000
3812		35000		16		5400
27466		60000		20		9065
6452		10000		17		17000
4809		2000		9		8700
21214		7000		17		6805
5983		48000		14		27700
48092		84000		17		12240
4399		400000		13		1450
19063		40000		40		15000
1601		150000		21		1500
99249		117		25		35000
4985		20000		26		4400
16130		330000		25		10300
61590		25000		35		23000
21651		365000		33		13000
27011		240000		47		3600
29110		540000		31		13000
243000		56000		84		455400
56018		500000		60		9000
126000		500000		58		72000
18383		640000		90		7030
54258		370000		70		11000
41060		213000		55		20500
101000		200100		75		175000
176000		1567000		88		93000
380000		4710000		82		70000
147000		1340000		110		21400
474000		1420000		423		400000
1520000		13000000		473		746000
323000		3500000		166		167000
267000		28000000		155		85500
2420000		44280		655		216000
1230000		5000000		579		545000
326000		1364000		350		270000
3060000		95000		150		245000
154000		3300000		611		49000

APPENDIX 3: FOOD SECTOR DATA FOR 1995

LABOUR (units)	CAPITAL (K'000)	OUTPUT (K'000)
2	35000	600
4	8021	9000
1	5000	14400
2		53892
4	2300	4500
3	3500	500
8	35000	4000
6	100000	108000
15	118000	760000
18	390000	6800
20	370000	4000
18	545000	300000
19	40000	180000
18	135000	200000
15	349987	1530900
13	93400	90000
13	510000	1435900
15	240000	7600
26	21000	274300
35	40000	150000
45	600000	27500
25	300000	35000
78	70000	163000
80	340395	152000
70	50500	600000
50	500	60000
70	28000	160000
90	800000	9465815
80	11515	2589000
588	1400000	4153000
125	340000	793230
175	1198000	1567000
150	9600000	388000
163	1000000	985500
716	4200000	853000
120	86000	10875000

APPENDIX 4: DATA FOR METAL SECTOR: 1993			
OUTPUT (K'000)	CAPITAL (K'000)	LABOUR UNITS	RAW MATERIAL (K'000)
2700	103000	3	991
6399	1240	3	236
19000	6300	5	8200
560	4240	1	288
192	354	2	62
9708	350	2	30
55600	2100	2	35
9400	4650	2	288
120	8000	4	390
45700	4580	1	342
420000	5000	15	1400
42000	90	12	23
75000	300000	15	453
120000	90083	18	30000
244000	24000	7	673
115000	131000	7	60
1600000	140000	46	13000
779000	312000	34	16000
296000	55500	34	200000
475000	240000	41	16600
60	1900	33	49
680	14600	25	526
651	172000	44	273
730	284921	30	180
2800	215000	33	1710
61	30000	38	18
80000	68000	57	19900
144000	710000	50	60000
10223	220000	62	78000
58000	600000	50	59000
17800	500000	85	14200
38200	245000	65	17500
40467	1237	108	64000
31012	5000000	243	21100
329000	250000	660	113000
22000	109800	179	18700
1400000	2100000	350	154000
3500000	950000	301	140000
843000	190000	150	172000
3400000	300000	269	200000
616000	50000	134	290000

APPENDIX 5: DATA FOR METALS SECTOR:1994

OUPUT (K'000)	CAPITAL (K'000)	LABOUR UNITS	RAW MATERIAL (K'000)
1870	900	3	140
1469	2500	5	50
347	1500	4	700
3687	20000	5	200
1099	7500	3	6100
3842	550	2	390
2084	4000	4	98
720	2	2	400
2701	1600	5	16
80	4200	4	77
347	15000	3	60
348	93000	4	1500
8015	190000	11	3500
6393	60000	17	7000
3519	100000	12	20000
54158	300000	8	7500
5279	50000	6	20
160	30000	10	350
2334	37000	28	493
139	710000	34	250
23463	135000	45	8000
13198	17400	45	6200
27862	83200	36	20000
17082	185000	22	53000
44580	155000	24	20000
87986	900000	40	36200
6452	35000	26	1200
58657	410000	37	15438
22981	75000	21	5748
28644	2000000	55	18000
13198	80000	74	2500
174000	1000000	62	100000
52792	1100	68	42508
25952	400000	60	19500
156000	1050000	91	55000
45459	280000	195	55000
26396	3120000	259	82600
724000	5520000	110	152000
243000	10900000	257	120000

APPENDIX 6: METAL SECTOR DATA FOR 1995				
LABOUR units		CAPITAL (K'000)		OUTPUT (K'000)
3		800		900
5		26000		600
2		80150		10000
4		61800		84600
10		69000		44000
19		800		303000
16		150		1050
18		156000		29000
20		6206		50000
12		365		128000
11		800		860
13		800000		42000
13		150		850000
40		106000		102000
21		4000		150000
30		200000		11000
38		770000		246500
33		140000		451000
40		600000		480000
60		280000		250000
85		400000		550000
85		200000		800000
65		120000		500000
200		4950000		25000
517		6225000		480000
262		8000000		3200000
465		1000000		12700000
399		28000		86000

APPENDIX 7:DATA FOR TEXTILE:1993						
OUTPUT (K'000)		CAPITAL (K'000)		LABOUR UNITS		RAW MATERIAL (K'000)
26		250		4		44
137		80000		3		30
38		100000		5		28
324		72600		3		120
10500		108000		5		66
554		230000		1		4500
66		10000		2		65
1310		60000		4		600
191		22340		1		21
19000		50640		2		14500
16000		9000		4		1300
48000		75000		4		7500
2068		10500		8		4500
54600		3500		12		48200
36000		5800		10		21000
24150		1110		9		2700
60000		42000		7		2390
128000		60000		14		22200
18100		60000		6		77000
175000		300000		11		32880
2720000		55000		16		76000
180000		5000		14		7071
21000		250000		9		79600
4500		40000		15		70000
432		35300		15		20760
64600		100000		49		13924
81000		91800		49		70000
9120		300000		22		8000
12300		300000		27		29500
10000		250000		25		16100
1012		1001500		25		8000
3000		151000		45		84000
2690		180000		30		229000
9000		263000		50		342000
30000		345000		98		23000
44000		1540000		76		214000
9400		180000		70		12000
180000		320000		66		14800
80000		2000000		50		44100
110000		150000		67		195000
240000		707000		66		215000
180000		1900000		93		28000
76000		940000		500		18000
182000		4200		793		635000
3200000		173000		110		360000
1430000		299000		1100		557000

APPENDIX 8: DATA FOR TEXTILE :1994			
OUTPUT (K'000)	CAPITAL (K'000)	LABOUR UNITS	RAW MATERIAL (K'000)
439	200	2	1000
172	100	3	7
467	2200	1	68
216	18000	1	40
534	2000	2	60000
1173	1200	4	55
5343	8000	4	70
1068	30000	4	2800
1536	10000	4	120
2503	10000	4	750
577	3500	1	84
184	8000	4	150
1229	500	2	1
1730	2400	1	71
2644	700	1	13
1620	6000	4	100
6114	500	5	2200
5343	3200	4	585
13359	3000	5	93
16130	26000	15	400
4692	20000	15	800
879	11600	6	1500
1613	330000	20	38500
25922	10000	12	1500
4399	28000	7	1900
13062	12000	10	24000
29328	15000	20	9000
26328	500000	13	1262
26396	262000	27	49000
23463	80000	47	40000
30239	450000	21	50000
18149	300000	45	10500
62260	41895	34	85000
2229	205000	21	5850
64523	1200000	39	60000
85505	135000	21	140000
51856	110000	70	30680
87986	1000000	53	170000
115000	1417000	55	147000
201000	5600000	100	50000
64523	700000	148	137000
135000	6000000	103	173000
1090000	4500000	659	110000
195000	1880000	207	137000
1810000	9560000	659	214000
219000	1250000	105	20400

APPENDIX 9 TEXTILE SECTOR DATA FOR 1995

LABOUR (units)	CAPITAL (K'000)	OUTPUT (K'000)
2	505	438
2	6000	1200
4	1300	1100
1	1500	500
2	81400	1700
2	6000	400
3	700	5000
2	1270	1000
1	150000	3200
4	15500	4000
6	5000	117400
6	1200	6000
6	1100	90000
6	500	20000
8	25000	11400
14	20000	4900
15	1700000	80000
13	8028000	200000
38	49000	929801
35	24000	11500
27	510000	11000
30	320000	25000
22	2000000	190000
32	282500	500
32	100000	230000
75	178000	125000
97	333000	598659
65	130000	20000
120	7500000	480000
148	1752542	394000
130	4000000	900000
1700	600000	760000
672	90750	7787000
603	854000	2883
150	510000	3442000
197	*30000*	*982000*
720	2234000	917800

APPENDIX 10: DATA FOR WOOD: 1993			
OUTPUT (K'000)	CAPITAL (K'000)	LABOUR UNITS	RAW MATERIAL (K'000)
430	1000	4	142
500	6000	2	150
332	500	5	900
1300	360	4	900
915	2000	3	126
9400	495	5	300
3130	3000	4	101
5900	400	4	1388
1390	9385	2	2922
50600	1498	4	190
830000	720	3	126
245000	500	7	150
230	10000	8	550
500	34000	8	2500
246	700	7	1550
112	200	15	1960
4870	10960	6	890
340	15126	16	320
218	6100	9	5500
1100	511	7	1534
10000	90083	8	7300
2558	389000	7	2300
122000	142500	7	3000
5800	54600	45	31500
4500	40000	25	4000
69000	30000	24	8900
6500	75000	66	1980
5283	150000	61	22500
44000	700000	410	215000
677000	301360	250	177000
		516	

APPENDIX 11: DATA FOR WOOD SECTOR FOR 1995				
LABOUR **units**		CAPITAL (K'000)		OUTPUT (K'000)
4		10500		13600
3		10000		10422
4		3900		12200
3		500		3225
1		4000		15000
3		95000		14400
5		1250		150000
3		14000		1000
7		12500		34000
6		1000		5000
8		800		106000
13		50000		800
40		51500		350000
27		8600		86000
40		2250000		458000
49		530000		122300
58		40000		362000
52		1340000		246000
54		6027684		14220
64		180000		139000
336		100000		1335717
250		1000		56000
177		750000		1389000

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