

THE EFFECT OF TECHNOLOGICAL CHANGES ON UNEMPLOYMENT IN THE BEVERAGE SECTOR OF THE SOUTH AFRICAN ECONOMY

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ABSTRACT

The ability of the South African economy to absorb labour has been declining since the 1960's, with the manufacturing sector employment declining since 1990. The decline in manufacturing jobs flies in the face of increased output of the sector. This trend is attributed to the application of technology and sophisticated equipments in the manufacturing process leading to a loss of jobs, particularly for unskilled labour.

Unemployment in South Africa has become one of the biggest challenges facing the present government. The government in its bid to overcome this major problem is doing everything to get to the crust of the matter, including information on major causes of unemployment in the country. Reduction of unemployment is hugely regarded as a prerequisite for poverty alleviation, a policy that is very close to the heart of the present government. For this singular reason, information on major causes of unemployment in South Africa is becoming increasingly important to policy makers.

The objective of this study is to compare the effect of labour and capital on the revenue of the beverage industry in South Africa from 1985 to 2005 using translog production function. The study showed that new technology, due to spending on new capital did not play a significant role in achieving an increase in revenue in the beverage sector. The increase in revenue was rather attributed to an increase in spending on labour. Increasing expenditure on labour by 1% raised revenue by 0, 62% while 1% change in capital expenditure increased revenue by 0, 43%. This, in some ways, indicates that the beverage sector of the South African economy is labour-intensive. One could therefore conclude that the beverage industry relies more on labour and does not contribute significantly to unemployment in South Africa.

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This dissertation is dedicated to my wife Elizabeth, and children Jacqueline and Keith, who understood my dire and busy circumstances and pretended not to have seen the books and study materials strewn around the house and prevailed when they temporary lost my affections and love. To my friends, Kwabena Antwi, Isaac Koranteng, Oliver Adjei-Twum and Charles Addai, I say thank you for your invaluable assistance, encouragement and support. To Dr Christoff Botha, your calmness and suggestive inputs provided me with the impetus to work harder to complete this work.

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LIST OF ABBREVIATIONS

ANC	African National Congress
CES	Constant Elasticity of Substitution
COSATU	Congress Of South African Trade Union
CV	Coefficient of Variation
FM	Financial Mail
GATT	General Agreements on Trade and Tariffs
GDP	Gross Domestic Products
R&D	Research and Development
SETA	Skills and Educational Training Authority
StatsSA	Statistics South Africa
WTO	World Trade Organization

CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

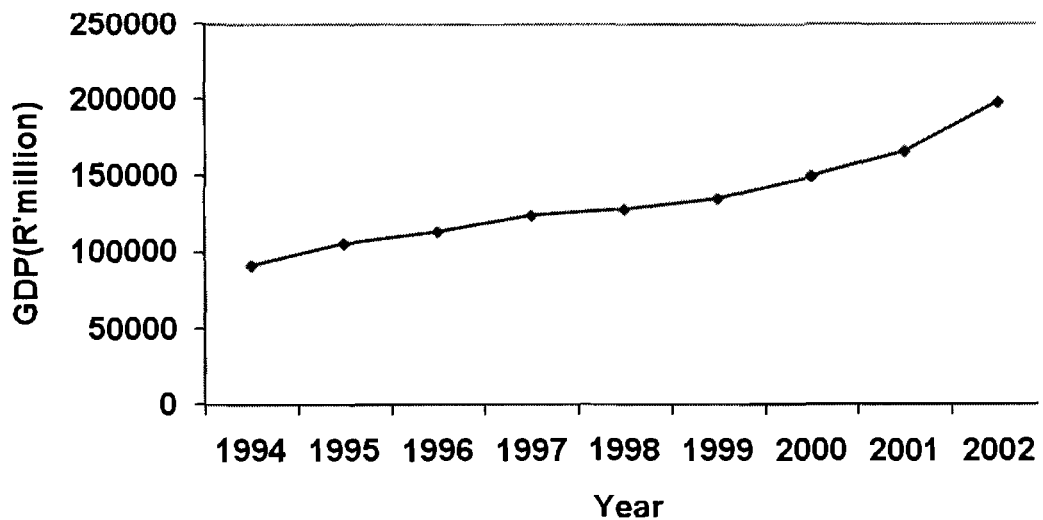
1.1. INTRODUCTION

According to the World Bank Report (1994), the capacity of the economy to absorb labour has been declining since the 1960's and growth in total employment since the 1970's has also deteriorated. The formal sector employment is now estimated to be less than half the labour force. The same report, estimated black unemployment in the formal sector at 53%. In an opinion poll conducted by Markinor, Ideas and the South African Broadcasting Corporation (SABC) in 1999, 75% of respondents cited unemployment and lack of job creation as South Africa's main problem, compared with 61% who assigned crime as the main problem (Pirterse, 2001: 39). Employment in the public sector, however, increased during 1992 but the manufacturing sector employment declined from 1990. The unemployment in the country is estimated by SA Trade Unions at 7 million since 1995 and workers' share of the national income has declined from 58% in 1992 to 51% in 2002 (Daily Dispatch, 9 May, 2003). Statistics South Africa (2004) estimated unemployment in 2003 at 30, 5% and indicated that there was only 0, 02% increase in employment in 2003. The contribution to GDP by the manufacturing sector has been rising steadily from 1994 (see Table 1.1 and Figure 1.1 below)

TABLE 1.1: Gross Domestic Product (GDP) by manufacturing industry at current prices, 1994-2002 (R millions)

1994	1995	1996	1997	1998	1999	2000	2001	2002
92 068	106 180	114 126	124 603	129 017	136 016	150 198	166 331	198 094

Source: Statistics SA (2004)



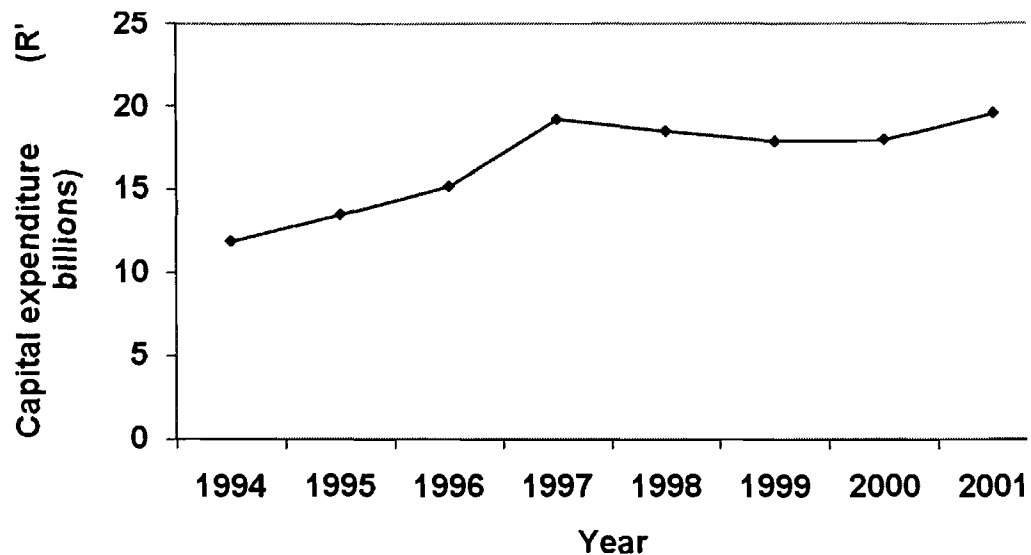
Source: Statistics SA (2004)

Figure 1.1: GDP (1994-2002) (R'million)

The figure above shows consistent increase in the contribution of the manufacturing sector to the country's GDP over the period 1994 to 2002.

The increase in output by the manufacturing sector could have been achieved through improved technology rather than through an increase in the number of people employed. Information made available by Statistics South Africa (2004) shows the number of people employed in the manufacturing industry decreased from 1.5 million in 2000 to 1.2 million in 2002. Within the same period, there were increases in capital expenditure on installations of new machinery and other equipment in the manufacturing sector.

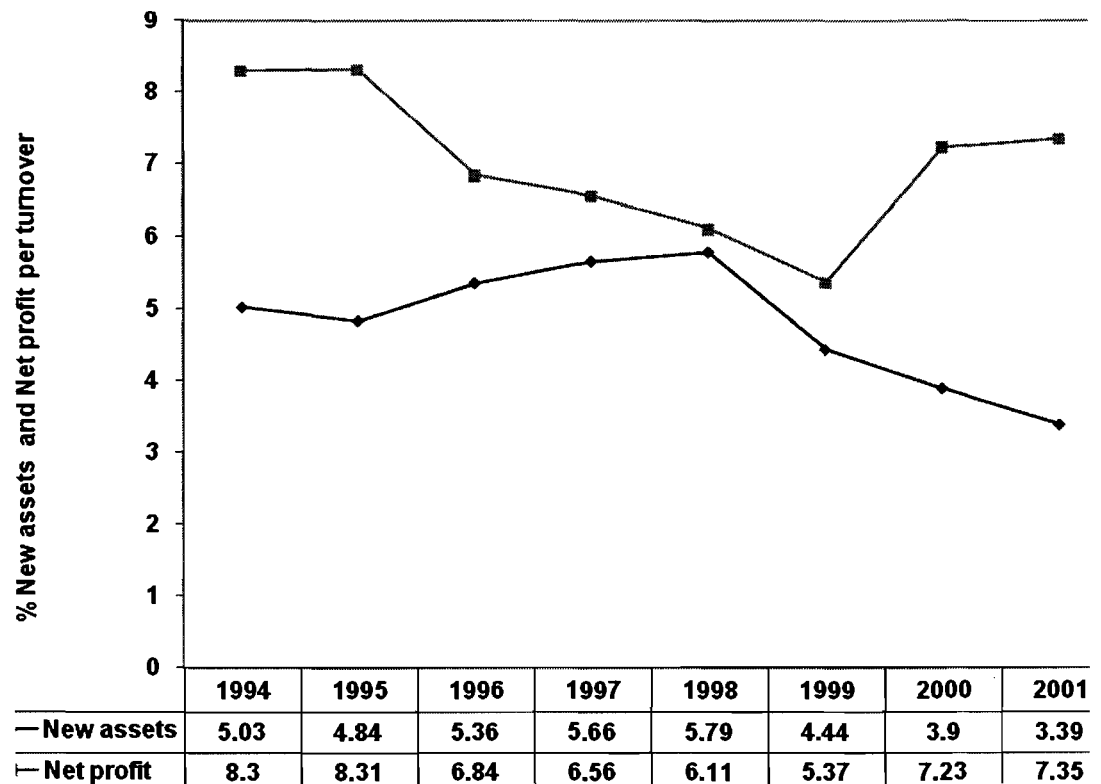
Figure 1.2 shows capital expenditure on new machinery which rose steadily from 1994 to a peak in 1997 and thereafter climbed to a new peak in 2001.



Source: Statistics SA (2004)

Figure 1.2: Capital expenditure on new machinery and equipment (1994-2001)

Investment in new machinery and equipment by the manufacturing sector increased from R11 billion in 1994 to about R20 billion in 2001. This is an indication of advancement in technology in that sector. It should be noted that this was the period in which the majority black ANC government came into power and the workers were insistently agitating for redress of the injustices of the past, including better remunerations for services rendered. The situation suggests a shift from labour-dependency to capital-dependency in production by the manufacturing sector within the same period. The increase in percentage turnover spend on acquisition of new capital from 1995 to 1998 is further confirmed by Figure 1.3. The capital expenditures on new assets as a percentage of turnovers in the manufacturing industry increased from 4.84% in 1995 to a peak of 5.79% in 1998. Within the same period the net profit of the industry declined from 8.31% to 6.11%.

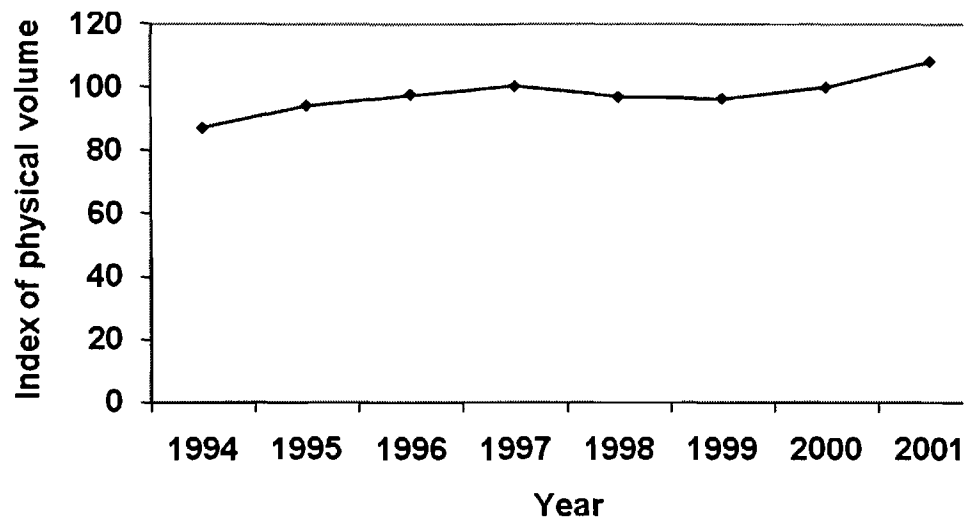


Source: Statistics SA (2004)

Figure 1.3: Values of capital expenditure and Net Profits as percentage turnover for the manufacturing sector (1994-2001)

After 1998, investment in new capital by the manufacturing sector started to decline and net profit started to rise (Figure 1.3). The increase in net profit after 1998 could be due also to improved efficiency brought about by the new technology and skilled labour.

Figure 1.4 presents the index of physical volume of manufacturing production from 1994 to 2001.

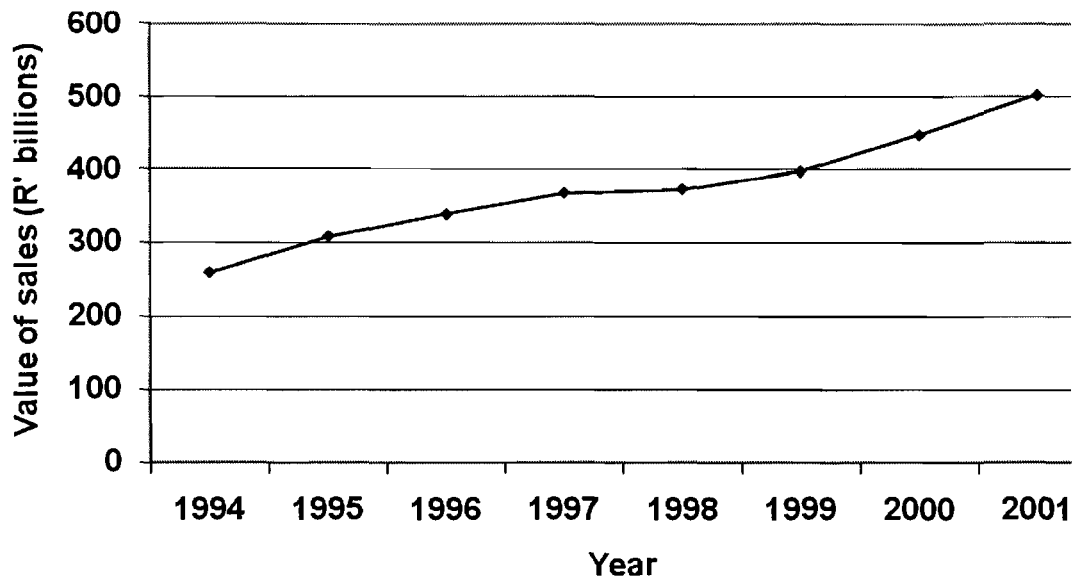


Source: Statistics SA (2004)

**Figure 1.4: Index of physical volume of manufacturing production, 1994-2001
(Base year 2000=100)**

The index of output increased from 1994 to a peak in 1997, then declined briefly before rising to a new peak in 2001. It should be noted that investment in new capital increased to a peak and started declining after 1997 (Figure 1.4). One could argue that after 1997 the attention of the manufacturing sector was on skilled workers to operate the technology put in place. The increased in output from 1997 could be seen as the outcome of more skilled workers using the technology in place efficiently. The decline in the number of people employed (Statistics South Africa, 2004) indicates that manufacturers were able to produce around full capacity with new machinery and more skilled but few unskilled labour.

The value of sales of manufactured goods rose from R373.6 billion in 1998 to a staggering R502.5 billion in 2001 (Figure.1. 5).



Sources: Statistics SA (2004)

Figure 1.5: Value of sales of manufactured products (actual values), 1994-2001.

The increase in the value of manufactured goods cannot be attributed only to inflation but also to increase in volume of production as depicted in Figure 1.5. The foregoing analyses clearly support the assumption that the manufacturing sector has gone through technological advancement. The increase in turnover, especially from 1998, has been achieved through the use of more capital. It is possible that the manufacturing industry used little unskilled labour but increased the number of skilled workers. Many countries have been struggling with economic growth without subsequent creation of new jobs. Anthuvan (2005:62) in his work reported that in spite of rapid growth of output in the industrial sector, there was smaller growth in employment. This supports the view that increase in production through technology does increase unemployment in some cases. The increase in unemployment, according to Chetty (2002), due to technological advancement could be a temporary displacement because the displaced workers could gain employment in areas that may require their skills in the long term.

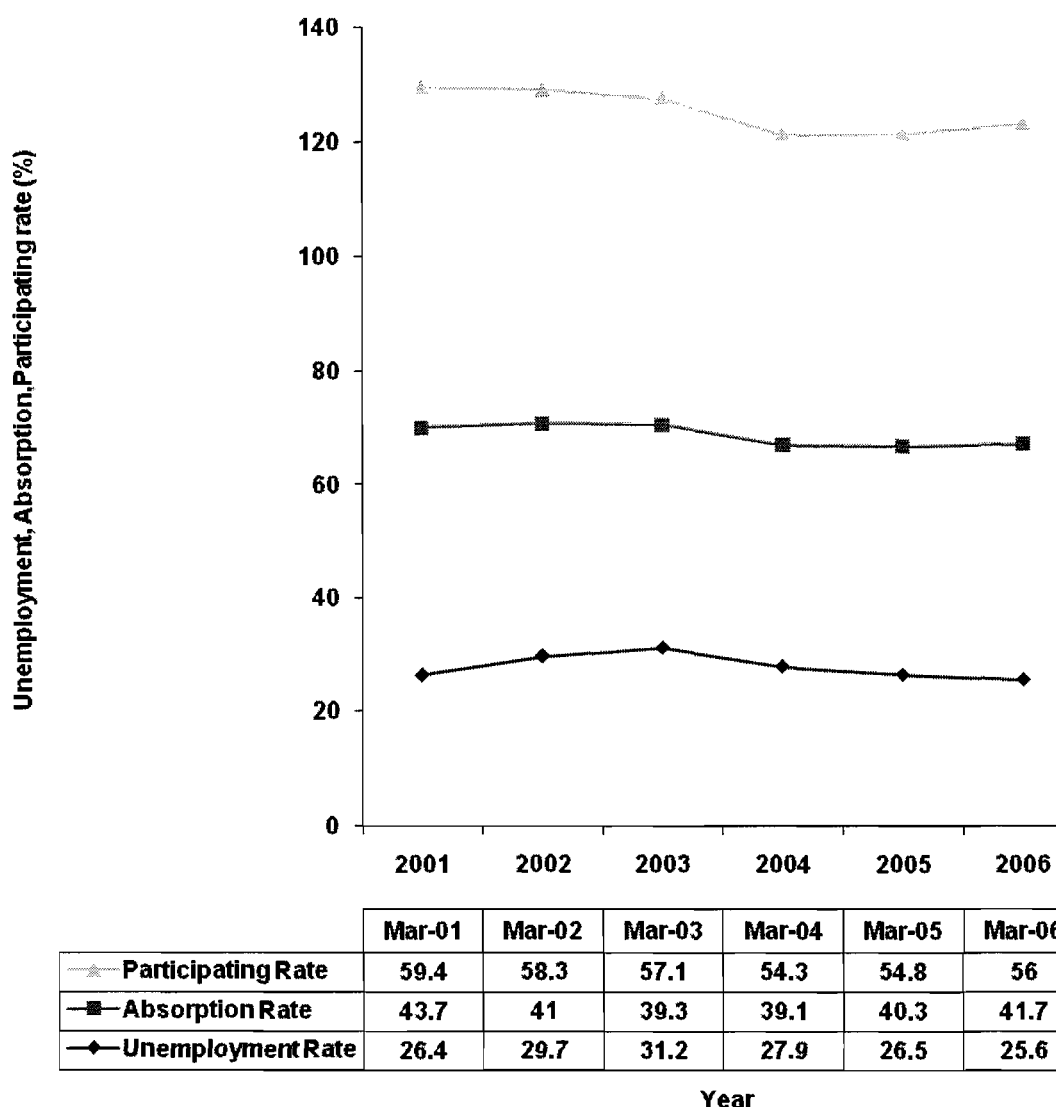
Advances in technology in the manufacturing sector and their effect on unemployment have been of much concern to the trade unions. The trade unions

view technology as a major contributory factor to retrenchments in the manufacturing sector in South Africa. The 2006 report of South Africa Management, Development and Productivity Institute (MDPI) indicated that the increase in productivity of the manufacturing sector in the South African economy in 2005 has not been accompanied by an increase in employment (MDPI, 2007). Employment by industry shows that the manufacturing sector is the third largest employer of labour after wholesale and retail trade and personal services (Figure 1.6)

However, the manufacturing industry is recognized as the second largest contributor to South Africa's GDP and has occupied this position over so many years (Gilmore, 2006:98-102). Within this industry, the Food and Beverage sector contributed 16, 4% to the value of the total manufacturing output in 2006. This is the third highest output after Petroleum and Steel and Iron sectors in the manufacturing industries.

According to Statistics South Africa, little over 1, 2 million jobs were created in the formal sector, excluding agriculture, over the period from March 2001 to March 2006 (Statistics South Africa, 2006). The source indicates that the rate of unemployment in South Africa increased from 26,4% in March 2001 to a peak of 31,2% in March 2003 and decreased thereafter to 25,6% in March 2006.

Labour Force Survey (Statistics South Africa, 2006), gives a broad picture of the participating rate of labour and the absorption rate between 2001 and 2006 (Figure 1.6).



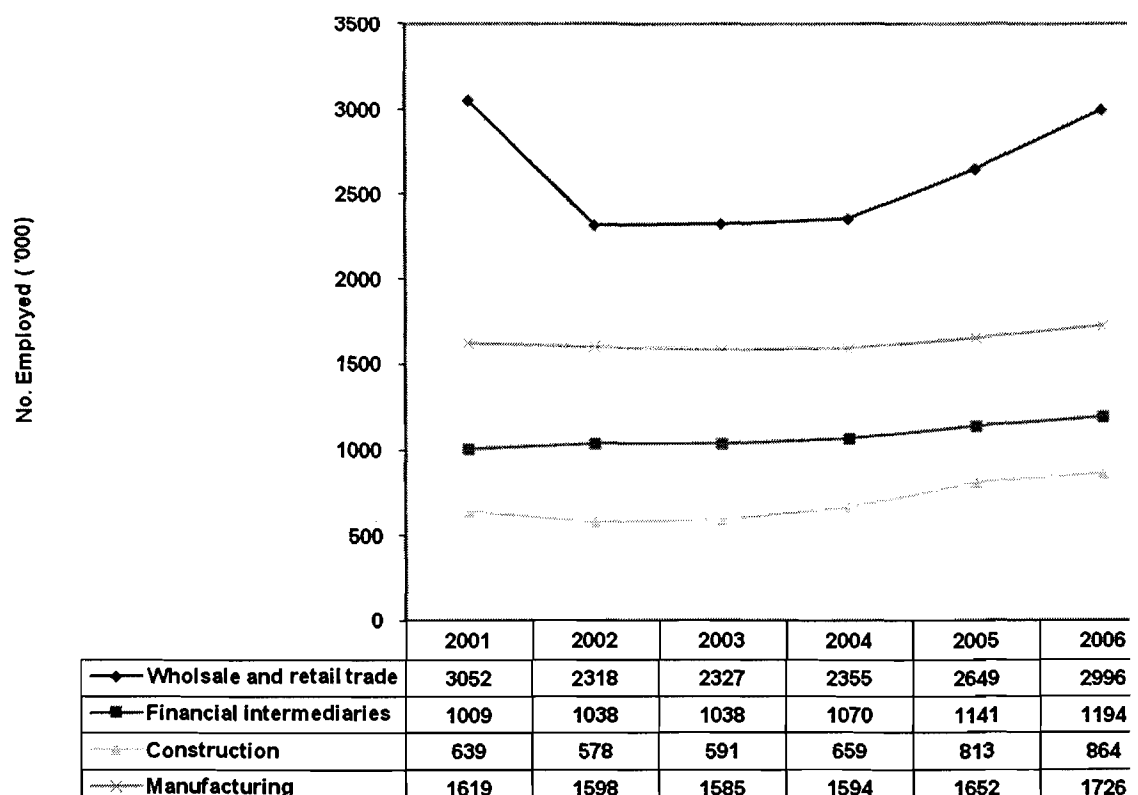
Source: Statistics SA (2006)

Figure 1.6: Unemployment, absorption and participating rates of labour (March, 2001 to March, 2006)

This trend was followed in the same manner by the absorption rate of labour into the economy from March 2001 to March 2006. The absorption rate of labour decreased from 43,7% in 2001 to the lowest of 39,1% in 2004 before reaching a high of 41,7% in March 2006 (Figure 1.6). The Absorption rate of labour by provinces indicates that the Western Cape had the highest (55-57%) followed by Gauteng (47-51%). The province with the lowest labour absorption rate between 2001 and 2006 was the Eastern Cape (28-40%). The 2006 Labour Force Survey by

Statistics South Africa showed that the unemployment rate among Black Africans was the highest (30,7%) followed by Coloureds (18,9%) and Whites (4,2%), (Statistics South Africa, 2006). During the same periods, unemployment among the female sectors was higher than the male counterpart. In 2001, 59,4% of the employable members of population entered the labour market but the economy could absorb only 43,7% of 56% of the employable members of the population entering the labour market in 2006.

The earlier assertion that employment by industry shows that the manufacturing sector is the third largest employer of labour after wholesale and retail trade and personal services is confirmed by the diagram below:



Source: Statistics SA Labour force survey, March 2006

Figure 1.7: Industries with the largest employment gains, March 2001 to March 2006 (Thousand)

This should be viewed in the context that the manufacturing sector, which includes the beverage industry, is the second largest contributor to South Africa's GDP.

The high unemployment rate among Black Africans could be attributed to a lack of relevant skills. According to the Food and Beverages Survey (Statistics South Africa, 2006), the FoodBev SETA is charged with the responsibility of solving the scarce and critical skills shortages in the food and beverage sector. The idea is to raise the level of human capital in the industry. FoodBev SETA created in the late 1990's is still in its infancy stage and it is far from fulfilling its mandate of providing scarce and critical skill labour for the industry (Kraak, 2005:57-83). According to the SETA, there were about 1851 absolute scarce labour, more than 7000 relative scarce workers and about 4000 equity candidates needed in the food and beverage sector by the end of 2006 (Statistics South Africa, 2006).

1.2. PROBLEM STATEMENT

The purpose of this study is to determine how the technological changes in the beverage sector of the South African economy between 1985 and 2005 have impacted on unemployment in the country.

1.3. SPECIFIC OBJECTIVES

- a. To determine the rate of technological advancement in capital in the South African beverage industry.
- b. To determine the sizes of the elasticity of capital and labour in the beverage sector.
- c. Compare the influence of both capital and labour on the output of the beverage industry in South Africa over the period of the study.

1.4. RESEARCH METHODEPARTMENT OF LABOUROGY

The main sources of data for the analyses were the documents of Statistics South Africa and the 2006 South African annual Statistical Handbook. The data of the revenue and the values of total capital and labour used by the beverage sector of the South African economy between 1995 and 2005 are analyzed. Further information on labour in the manufacturing industry was sourced from the Department of Labour in South Africa and the Management, Development and Productivity Institute of South Africa.

The analyses employed in the study include Ordinary Least Square regression of translog production function to show the effects of technological advancements in capital on unemployment in South Africa. In addition, descriptive analyses were also done to show the reliability of the variables used. Lastly, analysis of variance (ANOVA) was performed to share light on the combined strength of the independent variables in the regression. All the analyses were done using the Computer package SPSS for Windows version 11.

CHAPTER 2

LITERATURE RESEARCH

2.1 INTRODUCTION

Many news outlets have been running stories on the increase in unemployment in spite of the growth of the economy. That is most economic indicators are rising but the economy is not adding jobs and unemployment is still high. Increased productivity is supposed to be a sign of economic growth but unfortunately this is not producing jobs. According to Klasen and Willard (1999:4), unemployment is expected to increase because the number of new entrants into the labour market far outweighs the employment opportunities that can be created in the formal sector, looking at the current economic situation. Technological advancements around the world in the early part of the nineteenth century has been reported by Reineke (1980) There have been rapid increases in technology in the manufacturing and other sectors of the economy and this has transformed our society into a new level industrial and information-based society. These have brought about improved living standard and productivity. According to Minehann (2003), technology lies at the heart of all economic growth and that “the spur of new technology is a vital element in changing” our living standards. Vinassa (2002) described the way technology is reshaping the face of the world economy as phenomenal.

South Africa is by no means an exception when it comes to the quest for technological advancement in the manufacturing industry. Piquito and Pretorious (2000:73) highlight the correlation between technology and economic development and further investigated whether South Africa, is positioned to take advantage of such knowledge. They found that economic success is to a large extent dependent on the ability of government and other relevant bodies to establish and sustain a comprehensive, coherent and practical program of technologically driven economic development. The role of the state with regard to technology has been discussed in the work by Smith (1989:15) when he argued that technology policy should focus on the infrastructure required, the climate of innovation, and the buying power of

the state, technology programmers and initiatives. Marais (2000:4) identifies the challenges the new science and technology policy poses to researchers and research institutions, and Kaplan (1999:473) explored how technological innovations has influenced the reformulation of South Africa's science and technology policy. Rajoo (1990:16) contends that knowledge will become outdated and unusable at a faster pace than ever before due to rapid technological changes through scientific advances. This means technological advances are imperative for improvements in living standards of human kind and survival. The need to adapt to technological changes and stay in course is supported by Coetzee (1986:49). Smith and Jafta (1995:17) examined the experiences of some developed Asian countries and identified the factors in their choice of technology and discussed the appropriate technology policy for South Africa on the basis of the cost involved. The work by Scerri (1995:49) explored some considerations that should be taken into account in the formulation of a coherent science and technology policy for South Africa, especially for attaining international competitiveness. Amuah and Makgoba (1995:63) argued that South Africa must invest in science and technology if it is to meet the challenges of development, global industrial competition and a rising standard of living.

The need for technological advancements in South Africa has been recognized by the previous National Party regime and the present ANC government. The draft report on technology policy released by Trade Minister Kent Durr in the 1990,s suggested reduction of import tariffs on the purchase of technology and stimulation of industries (Cashmore, 1990:63). The policy, it was argued, was in response to the poor state of technology in South Africa and on development relative to the world (Smith & Garbers, 1992:60). The ANC government has a fully functional science and technology policy team which has been in place since early 1990's (Gottschalk, 1993:9).

2.2 THE SOUTH AFRICAN BEVERAGE INDUSTRY

The South African beverage industry is made up of companies that produce alcoholic and non-alcoholic beverages, including fruit juices. According to Gilmore (2006:98-102) the industry is dominated by multinationals that operate in other countries. These include Coca-Cola and SABMiller. At present, SABMiller is the world's second-largest brewer and the largest Coca-Cola bottler, by volume, outside the United States of America. SABMiller controls 95% of the South African beer market. Another important player in the beverage industry is Ceres which produces fresh juice for the local and export markets. The South African wine industry is the 6th largest in the world. A total of almost 250 cellars, producing wines of various kinds, operate in the industry.

In general, the beverage industry's supply chain environment includes, amongst others, bottling, storage and distribution of the products to consumers in various corners of the world. This has multiplier effects that create lots of opportunities for other sectors of the economy, including packaging, transportation, wholesalers, retailers and tourism. According to the new monthly Food and Beverages survey for the months of August 2005 to March 2006 (Statistics South Africa, 2006), restaurants have the lion's share of the food and beverages industry with 49,3%, followed by take-away outlets with 28,4%, catering services 17,9% and other catering at 4,4%. The average monthly income for the eight months survey is just below R2 billion (Statistics South Africa, 2006). Clearly, the survival of these supply chain sectors is inextricably linked with the survival, efficiency and sustainable productivity of the beverage industry. At present, over 80% of SABMiller's products' distribution in South Africa is carried out via independent owner-drivers (Gilmore, 2006:98-102).

2.3 THE NEED FOR TECHNOLOGICAL INNOVATIONS IN THE BEVERAGE INDUSTRY

The world has become a global village in which the strongest survive and the weaker competitors are overtaken by stronger players through acquisitions

(Thompson, Strickland & Gamble, 2007:255). To ride the wave and stay in the competition requires continuous investment in new technologies, especially those that strive to achieve economy of scale reduce unit cost of production and eventually produce high profit margins. A company in such an enviable position is able to create value for shareholders. Most large companies with large number of shareholders have, among others, the following as their mission statement:

- Creation of value for shareholder
- Striving to become leaders in the sectors they operate in.

The mission statement of a company, to a large extent, is a form of contract agreed upon with the shareholders that must be fulfilled in a sustainable way. Most invariably, the company's means of achieving the goals set upon itself in the mission statements are embodied in the business strategies it adopts (Thompson *et al*, 2007:24). According to Fry and Killing (2004), a company's competitive strategies basically involve its product market strategy, price strategy, features and execution strategies. Thompson *et. al* (2007:134) state that a company's competitive advantage depends upon five distinct strategies of a low cost provider, a broad differentiation appeal, a best cost provider, a market niche based on low costs and a market niche based on differentiation. New technologies are required in order to achieve these functions as well.

Many South African companies have formed partnerships of different types with overseas ones. This is a typical product market strategy. The move has given the companies access to the latest technologies and expertise in their respective industries and much larger range of products. An example of these is the association between Natal Cooperative of Diaries (NCD) and Clover with Danone of France in dairy products. SABMiller, the second largest brewer in the world, recently announced US\$8 billion purchase of South America's second-largest brewer, Bavaria of Colombia (Gilmore, 2006:98-102). These partnerships provide a springboard into other markets in the world and create demand for new products. In some cases, the market demand for a particular product changes according to the season. For example, there is increased demand for alcoholic beverages around the globe in areas that experience prolonged period of cold weather. The companies are

therefore bound to go through technological innovations and increased production dictated by the new markets (Gilmore, 2006:98-102).

Due to the short shelf-life of most of their products, the Beverage industry is in a unique position such that it must integrate forward in order to improve their product visibility. It is for this reason that the dominant companies in the beverage industries have integrated forward, as a means of gaining better access to consumers and achieve a better visibility for their products. Others try to improve their competitiveness by undertaking a broad range of activities in-house (Thompson *et. al* 2007:171). The foregoing therefore requires investment in technological innovations in their production facilities as well as in their supply chain sector in order to get the products to the consumers in the right conditions at the right time. This situation calls for investment in sustainable and cost-effective transportation, storage and logistics management, sales and marketing, product innovation and packaging. The aims of which are, to satisfy consumers, increase sales and profits and satisfy shareholders with reasonable compensations for their investments and patience.

Investors are always on the lookout for quality stocks. To investors, companies with quality stocks are those that are innovative, develop new products widely accepted by consumers and manage their operations efficiently. One criterion investors' use in judging the quality of a company's stock is the Price/Equity ratio (P/E ratio). A higher P/E ratio indicates higher growth prospects, other things held constant (Brigham & Ehrhardt 2005:455). This puts much pressure on the industry to achieve good results through technological innovations that reduce cost of production and increase profit through increase in product outputs.

Changes in the political dispensation that came into being after 1994 also brought new challenges in the beverage industry. South Africa, as many industrialized countries, have been achieving economic growth without creating the matching increase in job creation (Anthuvan, 2005).

It is abundantly clear that the beverage industry in South Africa is not competing only in this country but also with the rest of the world for positions in the industry. This means the playing ground is widened and the goal posts shifted. It is therefore imperative upon the multinational companies operating in the international arena to adapt their strategies to suit the changing environment. Currently, the rules of trade between nations are controlled by the international body, World Trade Organization (WTO). WTO is the only international body dealing with the rules of trade between nations. Since 1948, the General Agreement on Tariffs and Trade (GATT) had provided the rules for the system. After the Uruguay Round on December 15, 1993 the GATT organisation was transformed into the WTO. Whereas the GATT dealt mainly with trade in goods, WTO and its agreements now cover trade in services, and in traded inventions, creations and designs (intellectual property). The WTO agreements provide the legal ground-rules for international commerce including fighting protectionisms imposed by governments. Even subsidies to farmers by governments are being opposed by WTO in their agreements. South Africa was a member of the GATT and participated in the Uruguay Round of negotiations. The country also ratified the Marrakesh Agreement in December 1994 and thus became a founding member of the WTO when it was established. This then means that there is little that the South African government can do to help in terms of interventions to offer protection to the local industries. The beverage industry should therefore strive to attain comparative advantage over its competitors in the global village through innovative ideas. By January 2002 there were 141 members of WTO and 31 observer governments from the largest overseas markets (Greenfield 1999).

Another reason for need for improvement in technology in the beverage industry is the growing awareness, partly brought about by the exposure of South African industry to the rest of the world following the removal of sanctions, of the need to improve quality in order to be more competitive. Quality check is being done through newly created agencies like HACCP (Hazard Analysis of Critical Control Points), ISO 9000 series and SPC (Statistical process Control) to replace the outdated concept of Quality Control with its emphasis on end-product checking (Chase, Jacobs & Aquilano 2004:286). A major benefit of these methods for South African companies is the international recognition of quality of their products. It

however takes much effort to meet the stringent requirements of the quality control agencies.

The United Nations Industrial Development Organization (UNIDO, 2007) programme on technological advances and innovations sums up the role and impact of technology to enhance productivity of industry as follows:

i. Increasing globalization

- ✓ Worldwide economic growth offers many new opportunities for selling products and services in countries previously inaccessible because of geography
- ✓ To compete effectively in foreign markets, local manufacturing is important and will increase the potential markets for local industry.
- ✓ Technological innovations will provide many new market opportunities
- ✓ Success in capturing new emerging markets will depend on the industry's ability to compete in different environments.

ii. Sustainability

- ✓ Technological advancement meets economic and environmental needs of present and future generations.
- ✓ As the world population increases, the industry can serve more customers with higher quality, higher performing products and services, while protecting the planet.
- ✓ Use materials and energy more efficiently.
- ✓ Create products and processes that are environmentally friendly so as to reduce global warming.

iii. Financial performance

- ✓ Achievement of targeted short-term returns while at the same time attracting the capital needed for investment in the longer term projects and facilities.
- ✓ Strategically driven investment in R&D and new technologies will continue to drive the industry towards unprecedented levels of productivity and returns on capital.
- ✓ R&D, new technologies and innovations are the greatest drivers of productivity increases.

- ✓ Investment in advanced manufacturing technologies, logistics and management of supply chain, information technology, and new engineering technologies are vital for achieving the country's goal of leading the manufacturing sector in profitability.

iv. Customer expectations

- ✓ To meet expanding customer expectations, the industry needs to apply innovative technology throughout all phases of R&D, production and distribution.
- ✓ Improvements in logistics and supply chain management will enable manufacturers to deliver products to costumers more efficiently and at lower costs.
- ✓ New operations and manufacturing technology will ensure higher product quality and more sophisticated information systems will link companies to their customers.
- ✓ New engineering technologies will provide products that add value to customers.
- ✓ Technological advances will reduce product development response times and help industry meet customers' rising expectations.

The foregoing clearly calls for continuous investments in new technologies and research and developments (R&D) in the beverage industry to meet the growing demand around the globe. Industries try to reduce cost and increase profit for shareholders through restructuring. The restructuring process, most invariably, results in reduction of labour, which is assumed to account for the largest slice of a company's production cost. This is usually followed by increased acquisition of more machinery and equipment. The expectation with such an exercise is that labour productivity would go up in the long-run. In South Africa, the manufacturing sector, which includes the beverage industry, increased spending on new machinery and equipment from R11 billion in 1994 to about R20 billion in 2001 (Statistics South Africa, 2004). Productivity also increased quite significantly within the same period (Figure 1. 4)

2.4 TECHNOLOGICAL ADVANCEMENTS AND UNEMPLOYMENT

According to Reinecke (1980), Ned Ludd first raised the concern for loss in employment due to technological advancements in the early part of the nineteenth century in England. He led riots, specifically, to prevent the use of machinery to

process weaving and spinning, arguing that it would lead to mass unemployment. According to Miklovic (2003), “the productivity gains spurned by factory automation are driving a worldwide decline in manufacturing jobs, even in developing countries”. In his research study, he states that the U.S. has, over the past decades, lost manufacturing jobs by more than 10%. He cites China as one of the largest losers of manufacturing jobs, but still gets the blame for the job losses in the U.S when evidence suggests that it is also losing jobs in the manufacturing sector as well. One of the proxies for technological advancements in a sector is increased in investments in machinery and equipment. The long run effect of investments in new machinery and equipment is increased in productivity with reduced labour. Thus automation and improved productivity have been driving jobs down on a global basis (Miklovic, 2003). Technological advancement could therefore be measured in terms of increased productivity per labour or increased investment in machinery and equipment in the sector.

The work carried out by some researchers indicates that technological advances reduce employment. Rand Corporation (Concannon, 1983) estimated that, due to advances in technology, only 2% of the work force in USA would be employed in the manufacturing sector by the year 2000. Blum (1991) highlighted the impact of technological changes on employment and discusses the instruments the trade unions could use to soften the problem.

According to Mohr and Fourie (2004: 87), the increase in unemployment as a result of increased use of technology is not unique to South Africa and that in most industrialized countries people are increasingly being replaced by machines to boost manufacturing production. This phenomenon is supported by Garrison, Noreen and Brewer (2006: 316) who argued that “many tasks previously done by hand are now done with automated equipment”.

2.5 INCREASES IN EMPLOYMENT THROUGH TECHNOLOGICAL ADVANCEMENTS

Contrary to the foregoing, the work by others, however, indicates that advancement in technology creates more jobs for skilled workforce and also through multiplier effects. According to the literature, although the introduction of machinery in the spinning industry led to some job losses, new jobs were created for those who acquired new skills to use the new technology (Reinecke, 1980). Ulrich (1983) and Cyert and Mowery (1987) also showed that some jobs are displaced by technology but new ones are always created. The studies by Ginsburg (1982) also showed that unskilled mining, factory and farming jobs were decreasing but more white-color jobs in those fields were being created. Goldsworthy (1983) argued that high technology industries generate far more new jobs than the traditional or established industries. The argument is that, direct loss of jobs through technological progress is only a temporary process of 'displacement'. New jobs are created for displaced workers who acquire new skills to use the new technology. For instance, computer-integrated manufacturing is likely to be associated with structural changes in employment. Such a situation would need less shop-floor workers but new posts such as programmers; system analysts computerized machine operators would be created. It can be argued that advances in technology would not create employment if workers are not trained to acquire the relevant skills to use them. The extent of loss of employment depends very much on the advancement of the technology. Hirshowitz (1987) did not find significant loss of employment in the factories when robots were introduced to do spot welding.

In most technologically advanced countries, large volumes of products are usually made by few people (Jones, 1982) The direct effect of new technology is temporary job displacement and not increased in unemployment in the long run. People who lose their jobs might move into small-scale industries or other sectors of the economy such as leisure and entertainment. Peichinis (1983) reported that more employment was created in non-productive industries. It is believed that introduction of new technology results in reduced labour and other costs leading to lower cost per output and lower price per produce. The lower unit price will then

have a multiplier effect by the increases demand and hence a need to expand and employ more labour (Cyret & Mowery, 1987). This, of course, would depend on elasticity of demand and competitiveness of the local and overseas markets for the products. Studies by Hirshowitz (1990) found that increases in production due to new technology, are constrained by lack of new markets for the extra production to create more employment. Technological advancement has led to an increase in productivity and real income. Increase in income results in increased spending. Such situations motivate the industry to expand and create new jobs.

The empirical evidences reviewed by Suchard (1984) clearly shows how extremely difficult it is to separate the effect of technology on unemployment. This is because unemployment results out of so many extenuating factors. Wallich (1978) lists these factors to include swings in trade cycles, general depressions in trade and search activities of individuals trying a better march for the skills they hold. Workers trying to show the effect of technology on employment have adopted different approaches. For instance, Goldsworthy (1983) uses turnover and argued that car manufacturing and steel making in the United States create some five additional job for each million Department of Labour turnover while high-technology firms such as computers and micro-electronics create over forty new jobs for each million turnover.

Suchard (1985) warns of difficulties involved in comparing observations based on two different periods of time on statistical studies involved with technology. This is because the quality of technology changes over time. He cites, for example, that “mini-computers and micro-processors may produce fundamentally different effects upon employment levels when compared with the changes produced by mainframe.”

In case of unemployment studies in South Africa, it should be noted that there are a few published or accessible studies done about its linkages with technological advancement. Most of the work done in these areas, by research workers, agrees that technological progress in manufacturing increases unemployment if the workers are not skilled to match the new technology. This could explain the reason

why there is a great number of unemployment in the country and yet advertisements for so many vacant posts appear in the media regularly. Motala (1995) discussed science and technology policy in relation to development of a manufacturing economy and human resources and labour market policies that softens the gravity of unemployment. A research report of Business Leadership South Africa (2006) concludes that the pressure on the country to become more technologically advanced coupled with the effects of increased globalisation has further increased the demand for highly skilled workers.

2.6 SUMMARY

The literature review shows there is a need for technological advancement in all sectors of the South African economy, including the beverage industry, to bring about better life for its people. This view has fully been supported by the previous and present South African governments with tailor-made policies for the various sectors.

The effect of technological advancement on unemployment is mixed. Where technological advancement impacts positively on employment, there a lag period of unemployment occurs. This period of displacement depends on how long the displaced workers acquire the new skills to move to new jobs and the magnitude of the multiplier effect. This means there is a period of unemployment due to technological advancement in the economy.

CHAPTER 3

THE RESEARCH PROCEDURES, METHOD DEPARTMENT OF LABOUR AND TECHNIQUES

3.1 DATA NEEDS AND SOURCES

The data employed for the research are secondary data of total revenue and the values of capital and labour employed in the beverage sector between 1985 and 2005 in South Africa. This produced a sample of twenty-two time series data. The period 1985 to 2005 was purposefully chosen because of the availability of appropriate and sufficient data. The data were collected and compiled from Statistics South Africa (Stats SA), and the South African annual Statistical Handbooks. The Department of Labour provided help in identifying the data on labour that are specifically related to the beverage industry among those of the manufacturing sector. The Management Development and Productivity Institute of South Africa (MDPISA) contributed to the mining of data on revenue of the beverage over the period of the study as well as those on capital employed in the production. Statistics SA is the largest compiler of authentic data on all aspects of economic, health and social developments in South Africa. Their data are widely used by important researchers in the country and other parts of the world. The data are published quarterly on their website, which is easily accessible to all. The data are also published in their annual Statistical Handbooks that are distributed free-of-charge around the country.

The Department of Labour keeps information on the total number, the age and gender distribution of employees in all sectors in the country. The Department also has data on the number of active members in the country that are unemployed. It is hoped that information obtained from Department of Labour would be used to paint a reliable picture on the nature of unemployment in the country.

MDPISA is concerned, among others, with the sectors that contribute to the Gross Domestic Product (GDP), which includes the manufacturing industries. The annual

reports of MDPIISA include the productivity of the manufacturing sector and the major inputs that contributed to such productivity. These annual reports are freely available in the libraries and on their website (MDPD, 2006).

3.2 THE ANALYTICAL FRAMEWORK

The analytical techniques used in the study include descriptive statistics, and advanced analysis including multiple regression and one-way analysis of variance (ANOVA).

3.2.1 Methods and purpose of descriptive analyses

The descriptive analyses are used to summarize the data collected. Numerical descriptive measures include the mean and standard deviations of the selected variables. These are used to determine the efficiencies of the variables and compare their levels of influence. Charts are drawn to show the kinds of trends that exist within the numerical data and also the kind of correlation between the variables.

3.2.2 Method and purpose of regression analysis

Regression analysis of the data is conducted to obtain the elasticity of capital and labour on the revenue in the manufacturing. The major problem in the estimation of elasticity of capital and labour lies with the type of production function employed in the study. For example, the Cobb-Douglas type of production function, which is popular among economists, imposes total elasticity between input pairs of exactly one (Fleisher & Knienert, 1980), (Debertin, 1986). In an effort to overcome this problem, Arrow et al. (1961) introduced constant elasticity of substitution production function, CES, in their work. CES production functions also had flaws because they impose only one elasticity of substitution value to all input pairs in the variables (Debertin, 1986). The production function that has recently become popular to overcome this problem is the translog production function. Most economists estimated elasticity of substitution for major inputs categories in US agriculture using the translog production functions as bases (Debertin, 1986). The

parameters of the production function are estimated indirectly from the cost function data.

For technological changes over time, Muzondo (1978) the used time/trend variable. This study uses **transcendental function** as discussed by Debertin (1986) to incorporate technological changes that has taken place over the years of the study.

The function is given as:

$$Y = ax_1^{\alpha_1} x_2^{\alpha_2} e^{\gamma_1 T x_1 + \gamma_2 T x_2} + \epsilon \quad (2.1)$$

Where T is technology measure and the values for γ_1 and γ_2 indicate the extent to which the new technology favours input x_1 or x_2 .

The function, if transformed into its natural logarithms, gives the model to which OLS can be applied.

3.2.2.1 Model specification

The econometric model using all the explanatory variables is given as:

$$\ln y = \ln a + \alpha_1 \ln x_1 + \alpha_2 \ln x_2 + \phi_1 x_1 + \phi_2 x_2 + \epsilon \quad (2.2)$$

Where;

$\ln Y$ = Natural log of total revenue (lnREV)

$\ln X_1$ = Natural log of Wages/Salaries of labour employed in the sector for the year (lnWagSal)

$\ln x_2$ = Natural log of new capital expenditure for the year (lnCapex)

X_1 = Wages/Salaries of labour employed (WAGESAL)

X_2 = Capital expenditure (CAPEX)

α_1 and α_2 = coefficients of elasticity of labour and capital respectively

ϵ = the error term with zero mean and a fixed variance

The technological changes in labour and capital are explained by the values of the coefficients of ϕ_1 and ϕ_2 respectively.

3.2.2.2 A priori expectations regarding the signs of the coefficients

i) **LnWagSal**: = the sign of this independent variable is expected to be negative, thus indicating that reduction in labour is bound to increase revenue in the beverage sector. This is due to high cost of labour in production. Also, as the incomes of the firms increase they tend to invest more in machinery and less in labour to achieve economy of scale.

ii) **LnCapex**: = More capital is expected to increase output. The unit profits of the products of the beverage industry are very low, so mass production is necessary to realize substantial income. High production is made through investment in automation processes. Therefore the sign of the coefficient of capital should be positive.

iii) **Technological changes in labour (WAGESAL)**: = The SETA programme for the beverage industry is in its infancy. Large parts of the labour force in the South African beverage industry do not have the necessary skills to man new technologies needed in modern production. Skilled workers are necessary for production of beverages but the lack of it should result in a positive sign but less significant.

iv) **Technological changes in capital (CAPEX)**: = the coefficient of this should be positive and significant. Automation is very common in the beverage sector when it comes to production. Acquisition of new machines should increase output and revenue.

TABLE 3.1 “A priori” signs of the coefficients

	Ln(WagSal)	Ln(Capex)	WAGESAL	CAPEX
Signs of coefficients	–	+	+	+

3.2.3 Method and purpose of analysis of variance (ANOVA)

ANOVA is used to estimate and test a hypothesis about both the population variances and population means. The analysis is used to confirm whether the differences in the revenue in the beverage industry are due to the independence variables in the model or from other unexplained sources as represented by the residuals (μ_1). One-way analysis of variance is used to test the significant effect of the independent variables on the revenue.

3.3 RESEARCH RESULTS

The regression analysis of **model 2.2** on page 31 was done using the SPSS computer package. The output of the computer programme included descriptive analysis of the data as well.

3.4 DESCRIPTIVE ANALYSES

The numerical descriptive analyses of the data using the SPSS computer programme are presented in Table 3.2. It shows the mean, standard deviation and coefficient of variation of each variable used in the model.

TABLE 3.2 Descriptive statistics of the dependent variables

Variable	Mean (N = 21)	Std. Deviation	C.V (%)
LnREV	16.35	0.77	4.70
WAGESAL	2969821.52	7976995.61	268.60
CAPEX	867898.67	665342.85	76.70
Ln(WagSal)	14.07	0.94	6.69
Ln(Capex)	13.29	0.99	7.49

The mean measures the central tendency of the variables and it may be distorted by extreme values in the data. The standard deviation measures the scatter around the mean. High standard deviation value indicates that most of the data are scattered far away from the mean, which means it is a good representative of the data. The

coefficient of variation (C.V) measures the percentage of the data that are scattered far away from the mean. A low value means that the data are deviating less from the mean value.

3.4.1 LnREV

The mean is 16.35 with a low standard deviation of 0.77. This indicates that the values are much closer to the mean. The coefficient of variation (CV) of 4.7% confirms the Natural log of revenue data to be less variable from the mean. It suggests that there is not much difference between the values of this variable.

3.4.2 WAGESAL

The high standard deviation and very high coefficient of variation (CV) of 268.8% is indicative of great scatter of individual data of this variable around the mean. This suggests that the mean of R2 969 821, 00 spent on labour within the study period is not a good representative of the amounts spent yearly. According to the standard deviation of WAGESAL, the typical 21-year annual labour cost of the beverage industry deviates from the mean by approximately R7 976 995,00. This suggests that the cost of labour in the industry differ greatly from year to year. Inflation cannot be blamed for this anomaly because the values were deflated with a base year 2000 (2000=100).

3.4.3 CAPEX

CAPEX is the second most scattered data around the mean with Standard deviation of R665 342,45 around a mean of R867 898,67 and coefficient of variation of 76.7%. This suggests that only 25% of the data are distributed around the mean. In other words, there is great variation in the amount spent on capital and equipment yearly.

3.4.4 Ln (WagSal)

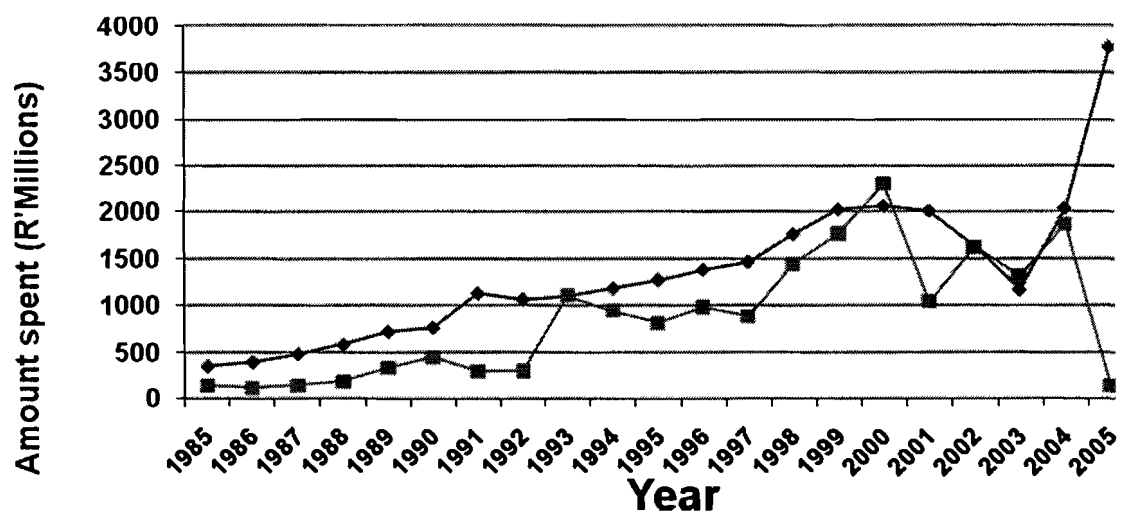
This variable has low spread. The standard deviation (SD) is quite low. The mean value of 13,3 is quite representative of the sample.

3.4.5 Ln(Capex)

The coefficient of variation of 7.49% and SD of 0.99 shows a well behaved data just like ln(WagSal).

3.4.6 Charts for the categorical data

The graph clearly displays associated trends between capital and labour.



Source: Statistics South Africa (2006)

Figure 3.1 Graph of Labour and Capital vs. Year

The beverage industry has been investing increasing amount of money on both labour and capital before and after the new democracy in South Africa in 1994. This trend changed drastically after 2004 when more money was spent on labour (WAGESAL) than on new capital (Capex). This is quite understandable from the point of view of the new labour regulations and the influential role played by the powerful trade unions in South Africa in wage negotiations.

3.4.7 Correlations between the variables

Table 3.3 is the SPSS computer programme output of Pearson correlation matrix of model 2.2 on page 30. The table displays the degree of association between both dependant and independent variables employed in the model. Correlation between the dependent and the independent variables is good and very well accepted.

Pearson correlation tests of the variables show that WAGESAL has the least influence on revenue (correlation, 0.396). Correlation within the data used shows that increases in all the variables are associated with increases in revenue. The single item that influenced revenue most is Ln(WagSal). Technological advances in capital (CAPEX) have a weak impact on labour Ln (WagSal) ((0.259). Correlation of 0.229 between Ln(Capex) and Ln(WageSal) means a small increase in capital assets is associated with a small labour increase.

TABLE 3.3 Pearson correlation matrix

		LNREV	WAGESAL	CAPEX	Ln(WagSal)	Ln(Capex)
Pearson Correlation	LNREV	1.00	.			
	WAGESAL	0.40	1.00			
	CAPEX	0.70	-0.19	1.00		
	Ln(WagSal)	0.78	0.86	0.26	1.00	
	Ln(Capex)	0.72	-0.27	0.94	0.22	1.00
Sig. (1-tailed)	LNREV	.	0.04	0.00	0.00	0.00
	WAGESAL	0.04	.	0.20	0.00	0.12
	CAPEX	0.00	0.21	.	0.13	0.00
	Ln(WagSal)	0.00	0.00	0.13	.	0.16
	Ln(Capex)	0.00	0.12	0.00	0.16	.
N	LNREV	21	21	21	21	21
	WAGESAL	21	21	21	21	21
	CAPEX	21	21	21	21	21
	Ln(WagSal)	21	21	21	21	21
	Ln(Capex)	21	21	21	21	21

The negative relationship between WAGESAL and CAPEX, to Ln (Capex) in Table 3.3, indicates that advances in new capital assets are associated with reduction in investment in labour training. Surprisingly, WAGESAL and CAPEX are positively related to Ln (WagSal) and Ln (Capex) respectively. That translates into the assumption that advances in technologies in capital and labour is connected with an increase in the two inputs. Such a situation is possible if the new advanced capital acquired require more people with technical know-how to increase production.

3.5 MULTIPLE REGRESSION ANALYSES

Most time series data encounter problems of multi-collinearity and autocorrelation among the variables which render the use of OLS in a regression biased and inefficient. Stepwise regression of model 2.2 on page 30 was ran to determine the irrelevant variables and either eliminate them to improve the goodness of fit or retain them on the basis of theoretical considerations. The stepwise multiple regressions using the SPSS computer package for the transcendental regression model 2.2 is presented in Table 3.4.

TABLE 3.4 Coefficients of the stepwise multiple regression

Model		Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.	VIF
		B	Std. Error	Beta			
1	(Constant)	1.741	2.763		.630	.537	
	WAGESAL	-1.240E-08	.000	-.128	-.330	.746	29.231
	CAPEX	-6.304E-08	.000	-.054	-.246	.809	9.454
	Ln(WagSal)	0.63	.313	.773	2.026	.060	28.175
	Ln(Capex)	0.44	.252	.561	1.725*	.104	20.502
2	(Constant)	2.08	2.336		.889	.386	
	WAGESAL	-1.503E-08	.000	-.155	-.429	.673	26.870
	Ln(WagSal)	0.65	.294	.797	2.222**	.040	26.351
	Ln(Capex)	0.39	.148	.497	2.604**	.019	7.481
3	(Constant)	2.99	.954		3.131*	.006	
	Ln(WagSal)	0.53	.057	.646	9.213*	.000	1.056
	Ln(Capex)	0.45	.054	.573	8.178*	.000	1.056
4	(Constant)	16.346	.168		97.077*	.000	

Dependent Variable: LNREV

* = Significant at 10%; ** = Significant at 5%; * = Significant at 1%

The summary of the regression models with regards to the Goodness of Fit is presented in Table 3.5. The table displays the strength of each model.

TABLE 3.5 Model Summary of Stepwise regressions

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.96(a)	0.92	0.90	0.25
2	0.96(b)	0.92	0.90	0.24
3	0.96(c)	0.92	0.91	0.24
4	0.00(d)	0.00	0.00	0.77

a Predictors: (Constant), Ln (Capex), Ln (WagSal), CAPEX, WAGESAL

b Predictors: (Constant), Ln (Capex), Ln (WagSal), WAGESAL

c Predictors: (Constant), Ln (Capex), Ln (WagSal)

d Predictor: (constant)

Model 1 with all the variables included had the lowest Goodness of Fit as indicated by the Adjusted R-squared (0.90). The signs of the coefficients of some of the explanatory variables did not agree with the prior intuition. Contrary to expectations, the rates of technological change in labour (WAGESAL) and capital (CAPEX) parameters are negative, low and insignificant even at 10% level.

The adjusted R-squared improved to (0.902) in model 2 but WAGESAL still had the wrong sign and remained insignificant even at 10% level. Elimination of WAGESAL and CAPEX in model 3 did not change much the effect of Ln (WagSal) and Ln (Capex) on revenue, but did improve their significance and Goodness of Fit (R^2 -Adj= 0.907). Model 3 proved to be the best, but the study is about the influence of capital and labour on the revenue of the beverage industry. There is therefore a need to include the technological changes that have taken place in these variables as well. In light of the foregoing model 1 is selected for the analysis despite the poor performance of WAGESAL and CAPEX in the model. Technological changes in capital and labour have much influence on their input mix. The literature supports

the inclusion of variables with low coefficients in regression models on the basis of theoretical considerations. Also the “Principle of Parsimony” suggested by Levine, Stephan, Krehbiel & Berenson (2005, 634) allow the selection of model 1 because it includes technological advances in capital and labour which influences their rate of substitution. The low coefficient values and the wrong signs of some of the variables could be due to problems of multicollinearity or serial correlation, among others. It was therefore found prudent to use the appropriate tests to examine the data for such problems.

3.5.1 Test of multicollinearity among the independent variables

Collinearity between the dependent and the independent variables is very good and quite accepted. The matrix pair wise correlation coefficients are presented in Table 3.6 below. There is a strong negative correlation coefficient between WAGESAL and Ln (WagSal) (-0.981). CAPEX also has strong negative value with Ln (Capex) (-0.797). Collinearity is negative and high between Ln (WagSal) and Ln (Capex) at -0.743.

TABLE 3.6 Correlation coefficients of the explanatory variables in the regression

	Ln(Capex)	Ln(WagSal)	CAPEX	WAGESAL	
Ln(Capex)	1.00				
Ln(WagSal)	-0.74	1.00			
CAPEX	-0.79	0.25	1.00		
WAGESAL	0.76	-0.98	-0.28	1.00	

a Dependent Variable: LnREV

Tests, including “Condition Index” and “Variance Inflationary factor (VIF)” were used to determine the severity of collinearity among the individual variables. The variables with serious collinearity problems were indicated by “condition numbers” of over 30 and low Eigenvalues.

TABLE 3.7 Collinearity Diagnostics (a)

Model	Dimension	Eigenvalue	Condition Index
1	Const	3.87	1.00
	Ln(WagSal)	0.89	2.09
	Ln(Capex)	0.24	4.01
	CAPEX	0.00	110.00
	WAGSAL	9.96E-05	197.14

A Dependent Variable: LNREV

Table 3.7 shows that CAPEX and WAGESAL with very high “condition numbers” 110 and 197 and very low Eigenvalues have serious collinearity problems. According to Ramanathan (2002), no single solution exist that will eliminate multi-collinearity altogether. On the other hand, OLS estimators are still regarded BLUE and hence are unbiased, efficient, and consistent in the face of collinearity among the independent variables. It does not affect the forecasting powers of the model as well. Multi-collinearity, however, makes it difficult to interpret individual coefficients in the model, and may reduce the power of the t-test or change the signs of some variables (Ramanathan, 2002). Fortunately, the two variables with serious collinearity have the same signs and almost similar coefficient values. Ln (WagSal) and Ln (Capex) on the other hand have low “condition numbers” of 2 and 4 respectively, which are far below the cut-off level of 30. Principles of Parsimony allows the selection of a model that gets the job done adequately (Levine *et al.*, 2005)

3.5.2 Serial correlation tests

A major problem with time series data is serial correlation among the variables. One of the assumptions for using the ordinary least squares is independence of the error term. Serial correlation exists where the residuals of the regression are related. According to the literature, OLS estimates are no longer BLUE and will be inefficient where there is serial correlation among the variables. Also the computed

R^2 will be an overestimate, indicating a better fit than actually exists. The t-statistic in such a case will tend to appear more significant than they actually are (Ramanathan, 2002). The error terms in this time series data used are not too far apart and therefore may be related. Durbin-Watson and ACF Tests were run to test for First- and Higher-Order serial correlations in the data.

The Durbin-Watson test is used to test the overall serial correlation in the model. Autocorrelation factors (ACF) of the variables however show which of them contributed most to the overall serial correlation. The presence of serial correlation has been attributed to:

- a) omitted variables;
- b) measurement errors; and
- c) ignoring nonlinearities.

According to Ramanathan (2002), ignoring nonlinearities or model misspecifications is the factor that contributes to serious serial correlations. Since the model did not show any serious serial correlation, one could assume that the contribution of the variables to serial correlation could be due to measurement errors.

Figure 3.2 below shows that the variable LNREV did not contribute significantly to autocorrelation in the model. Almost all the lagged values lie within the confidence limits. Therefore an influence of error measurement of revenue in only one year is not significant.

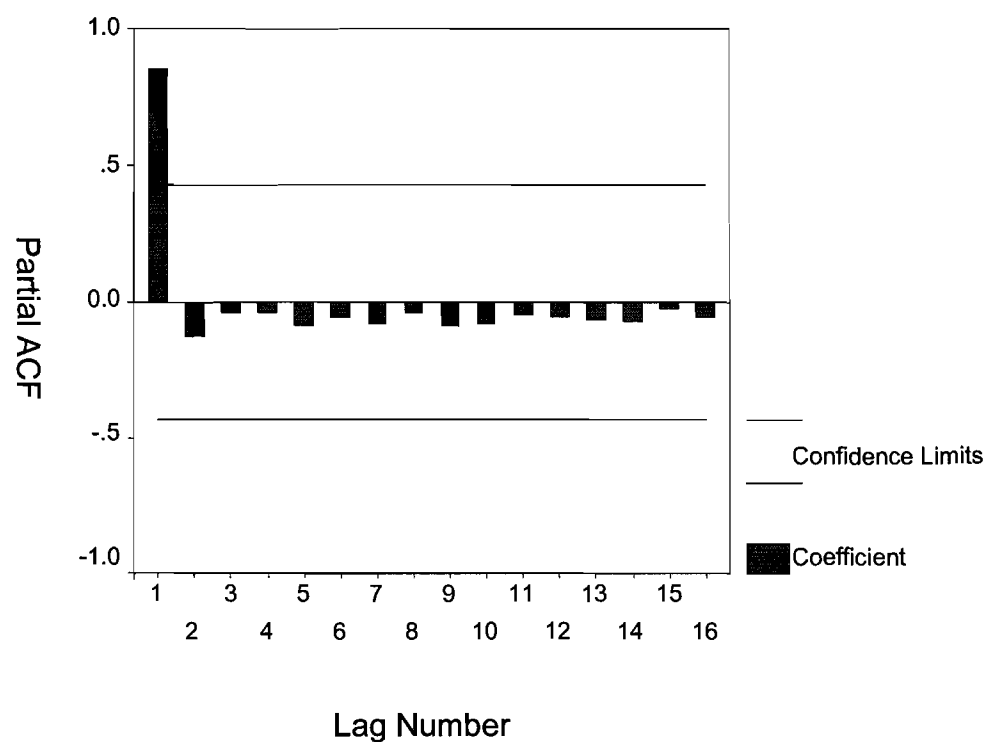


Figure 3.2 Partial Autocorrelation for LNREV

Figures 3.3 and 3.4 display some contributions of Ln Capex to serial correlation. These could be due to errors caused by the firms in the beverage industry updating their inventory stocks in the periods 2003 and 2004. The accumulated measurement errors could have shown up as serial correlation. However, the overall effect is not significant since the majority of the measured capital values are within the confidence limits.

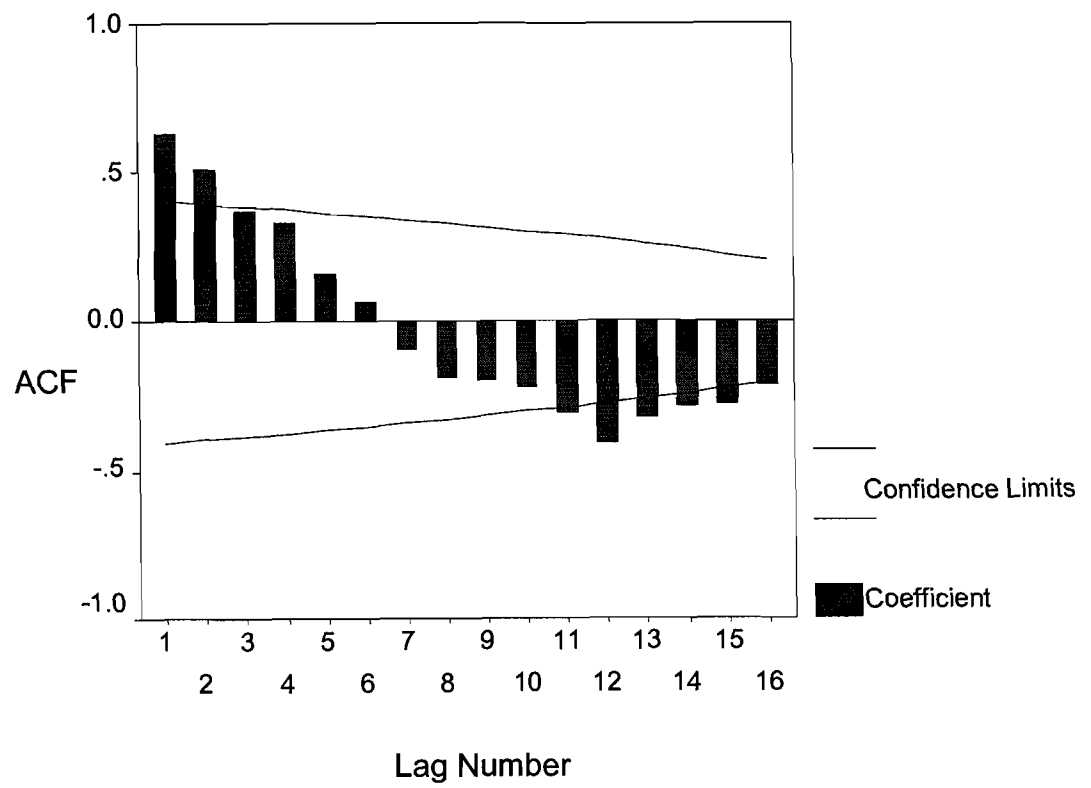


Figure 3.3 Autocorrelation for Ln (Capex)

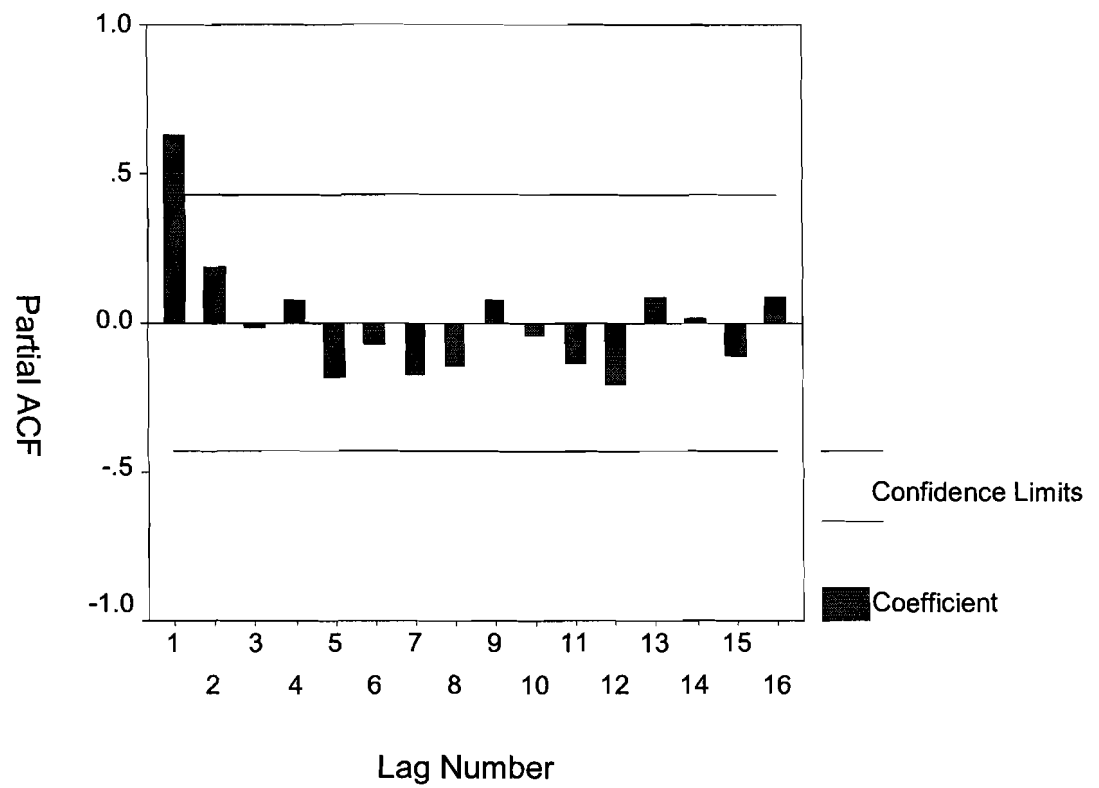


Figure 3.4 Partial Autocorrelation for Ln (Capex)

Figures 3.5 and 3.6 also show that Ln (Wagsal) values did not contribute to serial correlation significantly.

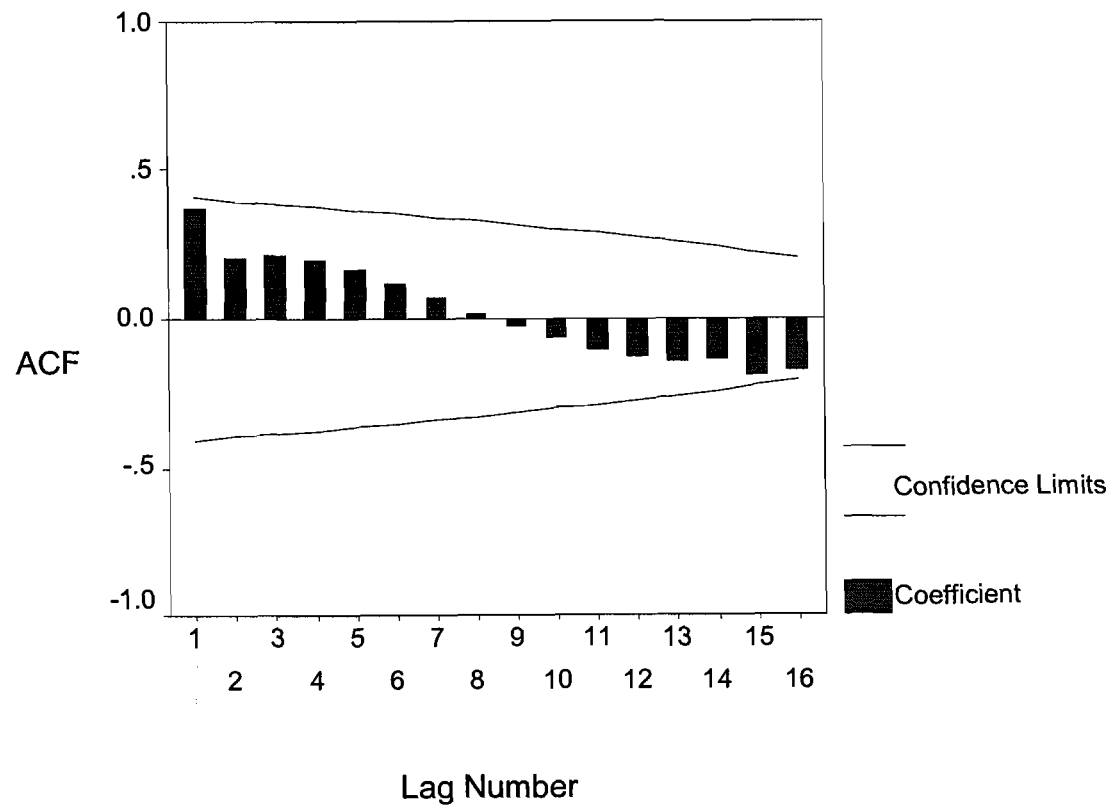


Figure 3.5 Autocorrelation for Ln (Wagsal)

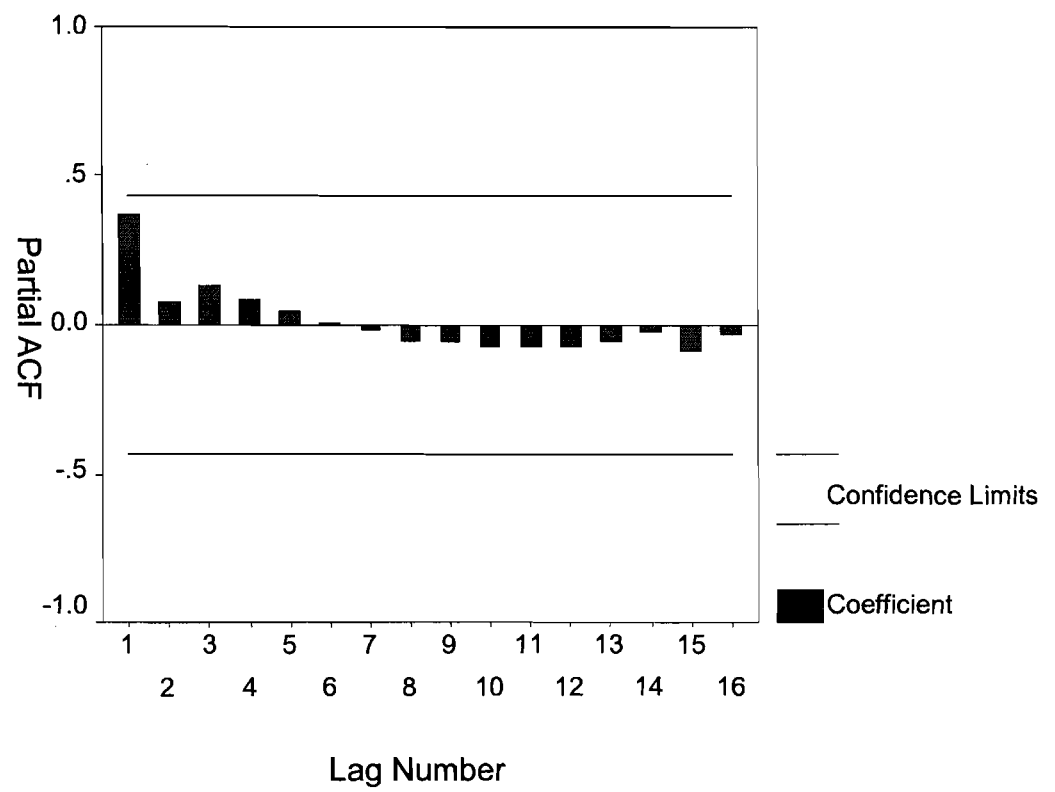


Figure 3.6 Partial Autocorrelation for Ln (Wagsal)

Figures 3.7 and 3.8 confirm that Capex values did not contribute to the serial correlation as well.

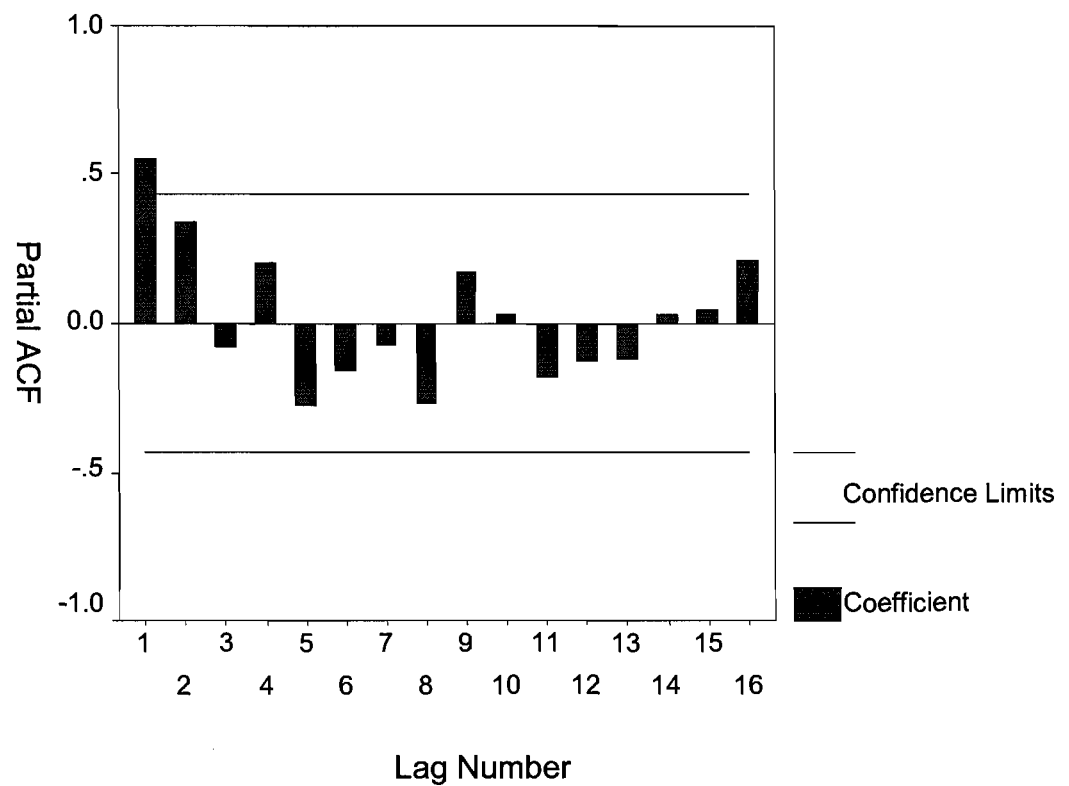


Figure 3.7 Partial Autocorrelation for Capex

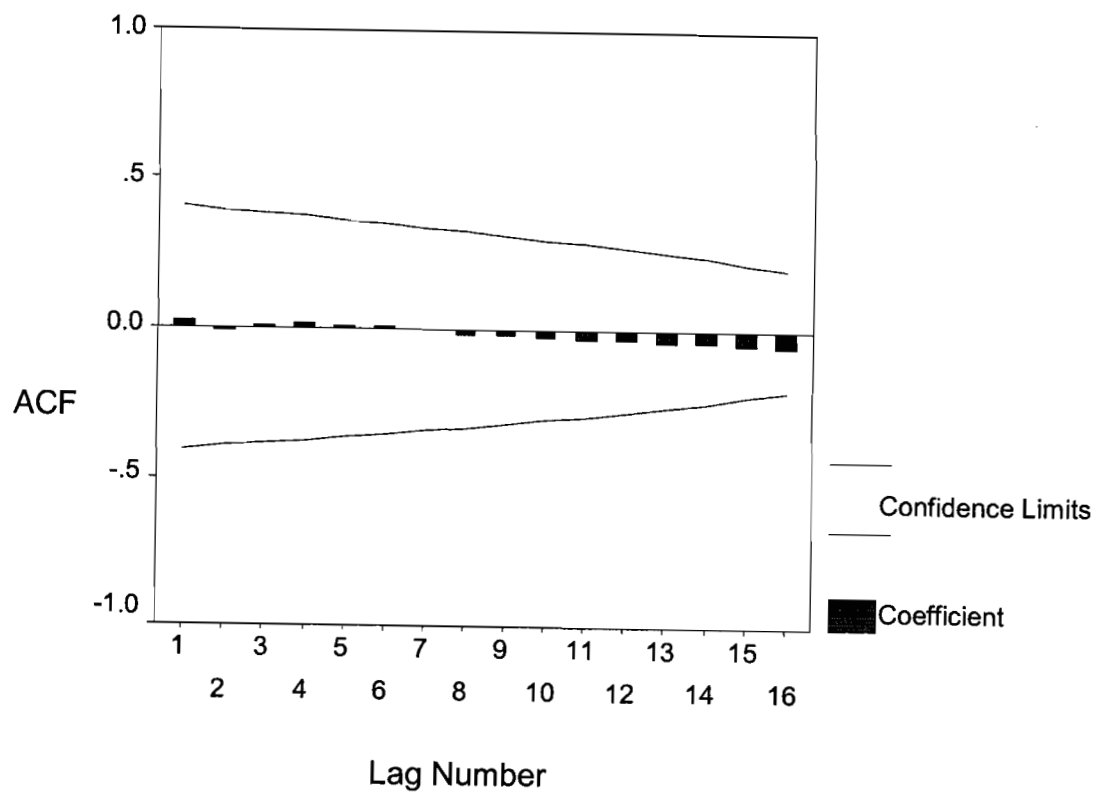


Figure 3.8 Autocorrelation for Capex

According to figure 3.9, Wagsal values over the period of the study did not contribute to the serial errors in the model

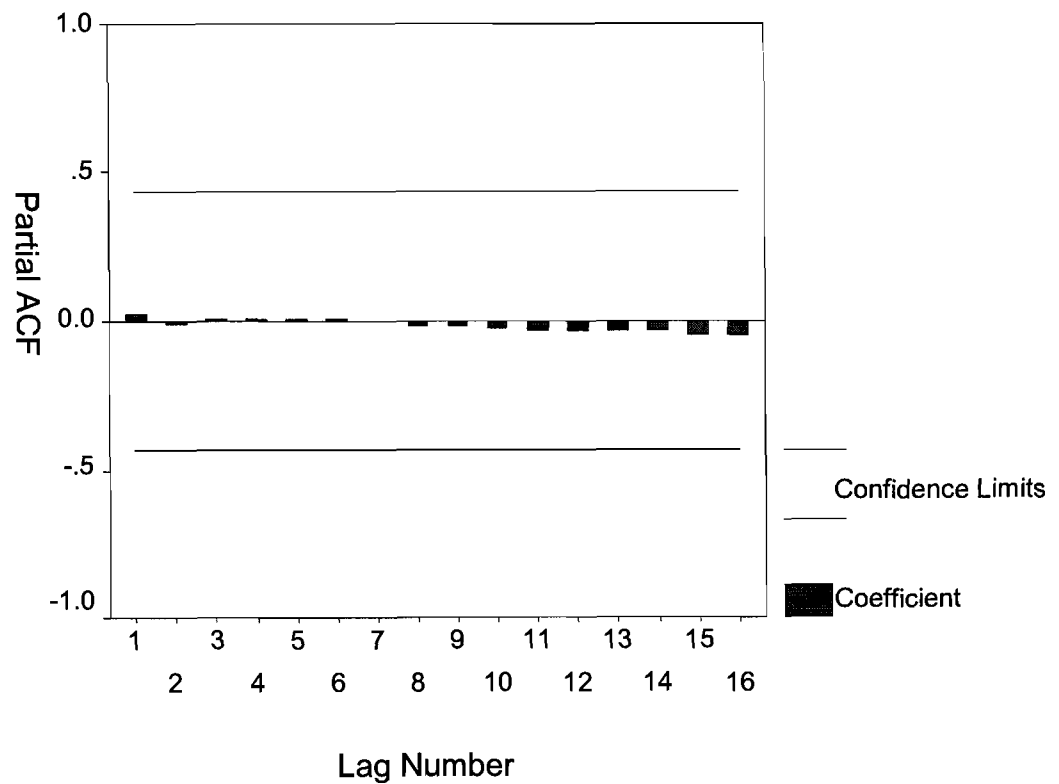


Figure 3.9 Partial Autocorrelation for Wagsal

3.5.3 The selected econometric model estimations

The model with all the independent variables is analysed for the study.

$$\ln \text{REV} = \ln \text{Constant} + \alpha_1 \ln \text{WagSal} + \alpha_2 \ln \text{Capex} + \phi_1 \text{WAGESAL} + \phi_2 \text{CAPEX} + \epsilon$$

The estimations of the regression are summarised and presented in table 3.8 below.

Table 3.8 Summary of multiple regression selected for the analysis

Variable	Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
	B	Std. Error	Beta		
(Constant)	1.74	2.76		0.63	0.54
WAGESAL	-1.2E-08	0.00	-0.13	-0.33	0.75
CAPEX	-6.3E-08	0.00	-0.05	-0.25	0.81
Ln(WagSal)	0.63	0.31	0.77	2.026*	0.06
Ln(Capex)	0.44	.252	0.56	1.725*	0.10
R ²	0.917				
R ² -Adjusted	0.897				
F	44.41				
DW	2.197				

Dependent Variable: LNREV $t_{20}^*(0.05) = 1.724$; $t_{20}^{**}(0.025) = 2.086$;
 $t_{20}^{***}(0.005) = 2.845$

* = significant at 10%; ** = significant at 5%; *** = significant at 1%

The Adjusted R² value (0.897) means the independent items in the model accounts for almost 90% of the changes in the revenue that accrued in the beverage industry. The goodness of fit is therefore quite within an acceptable range. The Durbin-Watson (DW) value of 2.197 indicates no serious autocorrelation among the variables in the model. The β -coefficients of Ln (WagSal) and Ln (Capex) represent elasticities.

As pointed out in Table 2.8, the coefficients of CAPEX and WAGESAL variables are insignificant at 10% level. This means their effects on the revenue of the beverage industry are not quite irrelevant at 90% confidence level. The negative signs of their coefficients tell us that on increase in investment to improve the skills

in labour and capital assets reduce revenue in the industry but the reduction is insignificant at 90% confidence. This is contrary to expectations and this anomaly could be due to the serious multi-collinearity among those independent variables or sources of data. The two have very high “condition indices”.

As mentioned above, the effect of technological changes in labour (WAGESAL) on the revenue in the beverage industry is weak and insignificant at 10% level. The relationship between WAGESAL and LnREV is log-linear. The negative relationship means, increase in a rand spent on improving the technological know-how in the labour force in the beverage industry will decrease revenue by infinitesimal -0.00012%. This effect is, however, not significant, suggesting that the rate of technological changes in labour in the beverage industry is negligible. The beverage industry is made up of manufacturers who bottle alcoholic and non-alcoholic beverages and drinks. The leaders of the sector are large conglomerates and are able to adopt highly automated process in the manufacturing their products. However, a greater number of workers involved in distribution do not require high technological know-how.

CAPEX represents the rate of change of technological advancements in capital assets on revenue. The relationship is also log-linear. According to the estimated model, one rand increase in money spent on new technology decreases revenue by 0000063%. This effect is found to be insignificant as well. It means money spent on new technology do not contribute any significant amount to the sector’s rate of change in revenue. The reasons for such a situation could be due to:

1. Acquisition of wrong technology in the manufacturing of the products. This is most unlikely because the South African beverage industry is world class, with some affiliated with world class leaders in the sector.
2. The new technologies do not have the right caliber of workers to man and utilise them most profitably. Technology in South Africa used to be in the hands of a selected few. Most of these people have either passed on or retired or moved to overseas. There is shortage of capacity in the economy as a whole. For a technological innovation to work, it requires manpower with the necessary know-how. One can rightly say that technological advances in

labour needs to complement advances in capital technology to make their effect felt in a positive way.

The coefficient of Ln (WagSal) variable came out positive (0.63) and significant at 10% level. This has a log-log relationship. The coefficient is positive and it is contrary to prior intuitions. The coefficient, 0.63, is the same as the elasticity of labour on revenue in the beverage industry, which means 1% increase in money spent on labour increases revenue by 0.63%. The beverage industry consists of a group of manufacturers who produce fruit juices for the local market. These sectors of the beverage industry employ more people to distribute their produce through the retailers and directly to consumers. There are many street vendors who sell fruit juices and cold drinks of various kinds. They do not have the sophisticated manufacturing processes and distribution systems like their big brothers.

The variable Ln (Capex) has log-log relationships with revenue in the model. The effect is weak but significant at 10%. The positive coefficient of 0.43 indicates that if all the manufacturers in the sector have the same endowments with regards to the other inputs, increasing capital by 1% will raise revenue by 0.43%. It should be noted that the coefficient is the same as the elasticity of revenue with respect to capital.

3.6 RETURNS TO SCALE

The return to scale is given by: coefficient of Ln (Capex) + coefficient of Ln (WagSal). That is: $0,63 + 0,43 = 1,06 \geq 1$. Since the value is greater than one it indicates **increasing returns to scale**. This means if the beverage industry increases labour and capital by 1%, **revenue** will increase.

3.7 ONE-WAY ANALYSIS OF VARIANCE (ANOVA) ESTIMATES

One way analysis of variance was done to further test the effect of labour and capital in the model. This is summarized in table 3.9.

TABLE 3.9 One-Way Analysis of Variance (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	10.93	4	2.73	44.41	0.00(a)
Residual	0.98	16	0.06		
Total	11.91	20			

a Predictors: (Constant), Ln (Capex), Ln (WagSal), CAPEX, WAGESAL

b Dependent Variable: LNREV

From F-statistical tables, $F_{4, 16}^*(0.05) = 3.01$ compared to the calculated value, $F(\text{calculated}) = 44.41$. Since $F(\text{calculated}) \geq F^*$ H_0 is rejected and conclude that the source of variation of the revenue of the beverage industry is accounted for by the independent terms in the model. The calculated F-value is high and significant even at 1% (4.77) indicating that the effect of new capital expenditure and labour on the revenue of the beverage industry in South Africa is real and cannot be ignored.

3.8 SUMMARY AND CONCLUSIONS

The results of the analysis have given a different picture of what was expected in terms of the effect of technological changes on unemployment in the beverage industry. What has been realized is that the rates of technological advances in labour and capital on revenue in the beverage industry of South Africa are quite insignificant. This supports the general lack of capacity in the economy. So far, the resources spent in the SETA sector has not reached a stage that could contribute to growth in the beverage industry. The SETA sector of the beverage industry was established in the late 1990 and it is still in its infancy. It seems to have a lag effect, so it would take some time for the effect of the training to be felt in the industry. The success of the SETA program is inextricably linked with the positive attitude of the learners to the training in place. Considering the historical background of the majority of unskilled workers in the country it will take some time for the BevSETA effect to be felt in the industry. At the present level of technological know-how of labour, increasing acquisition of new technology is not contributing much to growth

in the sector. This means any new technology brought into the sector to achieve growth requires importation of skilled manpower to man them.

The study has also shown that technology did not play a stronger role in achieving revenue accumulation by the sector. The increase in revenue from 1985 to 2005 was rather achieved mainly through increased spending on labour. This is in contrast with the hypothesis expounded for this study. It is possible that the sector absorbed more labour for production, due in part to the Employment Equity Act legislation which came into practice after 2000. This is also not surprising, if one considers that the beverage industry has numerous small to medium sized enterprises involved in the manufacturing of different kinds of fruit juices and drinks that employ more labour for production and distribution of their products. Since the elasticity of revenue with respect to labour is stronger than with respect to capital one can assume that the production in the sector is not capital intensive. According to the outcome of the study, the beverage industry achieved increasing economy of scale through a labour-intensive production process.

Statistics South Africa (March, 2006) Labour Force Survey report (Figure 1.6) clearly shows that the Manufacturing sector, which includes the beverage industry, was the second employer of labour after Wholesale and retail trade.

In conclusion, the study shows that the beverage industry did not contribute much to increased unemployment in the country. It is an industry consisting of numerous small and medium enterprises and may have rather absorbed more labour probably retrenched from other sectors that have probably gone through technological advancement.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

4.1 INTRODUCTION

This study determined the effect of capital and labour on the revenue of the beverage industry. It was established that the industry is labour intensive and therefore concluded that technological changes in the industry did not create unemployment. The results of the study are contrary to expectations which could be due to the quality of the data used, or the method of analysis employed, among others. The study also did not show the extent of substitution of capital for labour in the beverage industry.

4.2 CONCLUSIONS AND RECOMMENDATIONS

There is, therefore, a need to study the coefficient of substitution between capital and labour to find out the rate of replacement of one input by the other. This will show the rate at which new employment are created for skilled workers in the beverage industry as a result of new technology.

Due to the lack of the appropriate data, the large multinational members of the industry were grouped together with the small and medium enterprises. It is possible that the multinationals achieve economy of scale through capital intensity but their effects were masked by the action of the numerous small and medium sized enterprises (SME) in the industry. The South African government, of late, has given much encouragement and support to the growth of SMME. The SMME's are regarded as vehicles for creating employments in the country. There is, therefore, a need for further studies in this area whereby the effect of the variables are determined separately among the small, medium and large enterprises in the beverage industry.

The multiplier effects of the beverage industry were not considered in the study. In other words, employments created by sectors such as packaging, transportation, wholesalers, retailers and tourism as a results of the activities of the beverage industry were not taken into account in the study. According to Statistics South Africa (2006), the average monthly income of the distributors of food and beverages amounted to R2 million for a period of eight months. This suggests that future studies should also include data from the supply chain environment.

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APPENDIX: SPSS COMPUTER OUTPUT OF THE TRANSLOG MODEL

Regression

Notes

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	No of Rows in Working Data File	21
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /DESCRIPTIVES MEAN STDDEV CORR SIG N /MISSING LISTWISE /STATISTICS COEFF OUTS CI BCOV R ANOVA COLLIN TOL CHANGE ZPP /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT lnrev /METHOD=ENTER wagesal capex lnwages lncapex /METHOD=STEPWISE wagesal capex lnwages lncapex /METHOD=REMOVE wagesal capex lnwages lncapex /METHOD=BACKWARD wagesal capex lnwages lncapex /PARTIALPLOT ALL /RESIDUALS HIST(ZRESID) NORM(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3) .
Resources	Elapsed Time	0:00:00.06
	Memory Required	3084 bytes
	Additional Memory Required for Residual Plots	2256 bytes

Descriptive Statistics

	Mean	Std. Deviation	N
LNREV	16.3464	.77164	21
WAGESAL	2969821.52	7976995.609	21
CAPEX	867898.67	665342.846	21
Ln(WagSal)	14.06853471696095	.941439871140797	21
Ln(Capex)	13.2858976472069	.99470533429709	21

Correlations

		LNREV	WAGESAL	CAPEX	Ln(WagSal)	Ln(Capex)
Pearson Correlation	LNREV	1.000	.396	.697	.778	.722
	WAGESAL	.396	1.000	-.190	.858	-.266
	CAPEX	.697	-.190	1.000	.259	.940
	Ln(WagSal)	.778	.858	.259	1.000	.229
	Ln(Capex)	.722	-.266	.940	.229	1.000
Sig. (1-tailed)	LNREV	.	.038	.000	.000	.000
	WAGESAL	.038	.	.205	.000	.122
	CAPEX	.000	.205	.	.129	.000
	Ln(WagSal)	.000	.000	.129	.	.159
	Ln(Capex)	.000	.122	.000	.159	.
N	LNREV	21	21	21	21	21
	WAGESAL	21	21	21	21	21
	CAPEX	21	21	21	21	21
	Ln(WagSal)	21	21	21	21	21
	Ln(Capex)	21	21	21	21	21

Tables Entered/Removed(c)

Model	Variables Entered	Variables Removed	Method
1	Ln(Capex), Ln(WagSal), CAPEX, WAGESAL(a)		Enter
2		CAPEX	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3		WAGESAL	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	(a)	Ln(Capex), Ln(WagSal)(b))	Remove

a All requested variables entered.

b All requested variables removed.

c Dependent Variable: LNREV

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.958(a)	.917	.897	.24799	.917	44.411	4	16	.000
2	.958(b)	.917	.902	.24104	.000	.061	1	16	.809
3	.957(c)	.916	.907	.23551	-.001	.184	1	17	.673
4	.000(d)	.000	.000	.77164	-.916	98.351	2	18	.000

a Predictors: (Constant), Ln(Capex), Ln(WagSal), CAPEX, WAGESAL

b Predictors: (Constant), Ln(Capex), Ln(WagSal), WAGESAL

c Predictors: (Constant), Ln(Capex), Ln(WagSal)

d Predictor: (constant)

ANOVA(e)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.925	4	2.731	44.411	.000(a)
	Residual	.984	16	.061		
	Total	11.908	20			
2	Regression	10.921	3	3.640	62.657	.000(b)
	Residual	.988	17	.058		
	Total	11.908	20			
3	Regression	10.910	2	5.455	98.351	.000(c)
	Residual	.998	18	.055		
	Total	11.908	20			
4	Regression	.000	0	.000	.	(d)
	Residual	11.908	20	.595		
	Total	11.908	20			

a Predictors: (Constant), Ln(Capex), Ln(WagSal), CAPEX, WAGESAL

b Predictors: (Constant), Ln(Capex), Ln(WagSal), WAGESAL

c Predictors: (Constant), Ln(Capex), Ln(WagSal)

d Predictor: (constant)

e Dependent Variable: LNREV

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error				Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.741	2.763		.630	.537	-4.115	7.598					
	WAGESAL	-1.240E-08	.000	-.128	-.330	.746	.000	.000	.396	-.082	-.024	.034	29.231
	CAPEX	-6.304E-08	.000	-.054	-.246	.809	.000	.000	.697	-.061	-.018	.106	9.454
	Ln(WagSal)	.633	.313	.773	2.026	.060	-.029	1.296	.778	.452	.146	.035	28.175
	Ln(Capex)	.435	.252	.561	1.725	.104	-.100	.971	.722	.396	.124	.049	20.502
2	(Constant)	2.077	2.336		.889	.386	-2.852	7.005					
	WAGESAL	-1.503E-08	.000	-.155	-.429	.673	.000	.000	.396	-.103	-.030	.037	26.870
	Ln(WagSal)	.653	.294	.797	2.222	.040	.033	1.273	.778	.474	.155	.038	26.351
	Ln(Capex)	.386	.148	.497	2.604	.019	.073	.699	.722	.534	.182	.134	7.481
3	(Constant)	2.987	.954		3.131	.006	.983	4.992					
	Ln(WagSal)	.529	.057	.646	9.213	.000	.409	.650	.778	.908	.629	.947	1.056
	Ln(Capex)	.445	.054	.573	8.178	.000	.331	.559	.722	.888	.558	.947	1.056
4	(Constant)	16.346	.168		97.077	.000	15.995	16.698					

a. Dependent Variable: LNREV

Coefficient Correlations(a)

Model			Ln(Capex)	Ln(WagSal)	CAPEX	WAGESAL
1	Correlations	Ln(Capex)	1.000	-.743	-.797	.763
		Ln(WagSal)	-.743	1.000	.254	-.981
		CAPEX	-.797	.254	1.000	-.284
		WAGESAL	.763	-.981	-.284	1.000
	Covariances	Ln(Capex)	.064	-.059	-5.155E-08	7.241E-09
		Ln(WagSal)	-.059	.098	2.038E-08	-1.152E-08
		CAPEX	-5.155E-08	2.038E-08	6.567E-14	-2.737E-15
		WAGESAL	7.241E-09	-1.152E-08	-2.737E-15	1.413E-15
2	Correlations	Ln(Capex)	1.000	-.925		.927
		Ln(WagSal)	-.925	1.000		-.980
		WAGESAL	.927	-.980		1.000
	Covariances	Ln(Capex)	.022	-.040		4.811E-09
		Ln(WagSal)	-.040	.086		-1.008E-08
		WAGESAL	4.811E-09	-1.008E-08		1.227E-15
3	Correlations	Ln(Capex)	1.000	-.229		
		Ln(WagSal)	-.229	1.000		
	Covariances	Ln(Capex)	.003	-.001		
		Ln(WagSal)	-.001	.003		

a Dependent Variable: LNREV

Collinearity Diagnostics(a)

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	WAGESAL	CAPEX	Ln(WagSal)	Ln (Capex)
1	1	3.874	1.000	.00	.00	.00	.00	.00
	2	.885	2.092	.00	.03	.00	.00	.00
	3	.241	4.011	.00	.01	.11	.00	.00
	4	.000	110.002	.64	.00	.77	.01	.36
	5	9.968E-05	197.136	.36	.96	.11	.99	.64
2	1	3.180	1.000	.00	.00		.00	.00
	2	.817	1.972	.00	.04		.00	.00
	3	.002	35.963	.10	.00		.00	.15
	4	.000	171.127	.90	.96		1.00	.85
3	1	2.994	1.000	.00			.00	.00
	2	.004	28.288	.01			.42	.79
	3	.002	39.630	.98			.58	.21
4	1	1.000	1.000	1.00				

a Dependent Variable: LNREV

Excluded Variables(d)

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
2	CAPEX	-.054(a)	-.246	.809	-.061	.106	9.454	.034
3	CAPEX	-.075(b)	-.364	.720	-.088	.115	8.691	.115
	WAGESAL	-.155(b)	-.429	.673	-.103	.037	26.870	.037
4	CAPEX	.697(c)	4.242	.000	.697	1.000	1.000	1.000
	WAGESAL	.396(c)	1.878	.076	.396	1.000	1.000	1.000
	Ln(WagSal)	.778(c)	5.390	.000	.778	1.000	1.000	1.000
	Ln(Capex)	.722(c)	4.544	.000	.722	1.000	1.000	1.000

a Predictors in the Model: (Constant), Ln(Capex), Ln(WagSal), WAGESAL

b Predictors in the Model: (Constant), Ln(Capex), Ln(WagSal)

c Predictor: (constant)

d Dependent Variable: LNREV