UNIVERSITY OF KWA-ZULU NATAL

The effect of Chinese rubber imports on the South African rubber manufacturing industry

by

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DECLARATION

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ABSTRACT

In recent years, the South African rubber industry has experienced a decline in output value and has faced increased pressure from imported rubber products. Chinese imports are frequently blamed as being the primary source of such imports but there have been limited academic studies which have shown that this is indeed the case. Furthermore, previous studies have not attempted to separate the industry into its two sectors – non-tyre and tyre.

The present study addressed this gap and carried out a detailed and focussed analysis of the effects of importing of rubber products on each sector of the South African rubber industry between 1999 and 2014, with a particular focus on imports originating from China. The effect of imports on employment in the rubber industry was also examined. The study involved collection of secondary data from various sources such as Statistics South Africa, the South African Revenue Service and the Department of Trade and Industry and several rubber industry sources. These data were analysed using the well-documented Chenery modelling approach and the output the non-tyre and tyre sectors of the industry was decomposed to determine the sources of the changes in domestic output in each sector. A survey of the rubber manufacturing industry was also carried out using a questionnaire in order to ascertain the effect of imports, and the current economic climate, on rubber companies in South Africa.

It was found that Chinese imports have had a significant and negative effect on domestic production in the rubber industry between 1999 and 2014 – especially in the non-tyre sector. The output of the tyre sector has also been negatively affected – but not to the same extent. Chinese imports of rubber products were also shown to have had a direct and negative effect on employment in the rubber industry. The questionnaire results showed that there was an overall perception within rubber manufacturing companies that the rubber industry was in decline and that imports – mostly from China and India – were the primary cause for this decline. There was a strong sentiment amongst companies that the government should be doing more to protect the industry in terms of tariffs, tax incentives and training support.

Suggestions were put forward by the researcher on how the industry can take action to initiate a recovery. These included addressing the shortcomings with the tariff system, strategic collaboration between companies and a focussing on training, research and development.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

At the beginning of the 21st Century, South Africa amended its foreign trade policy and since then the doors have been opened for bilateral trade with many foreign countries. Imports, primarily of manufactured goods, have raised many concerns about possible effects on the South African economy. The primary aim of this study is to examine the effects of imports on one particular sector within the manufacturing industry in South Africa – namely, the rubber industry.

This chapter provides an introduction to the rubber industry and lead into the rationale and reasoning for carrying out the research study. An outline of the problems facing the rubber industry which assisted in the formation of the specific objectives of the study. The chapter concludes with an outline of the delimitations and a summary of the chapter structure of the dissertation.

1.1.1 South African Rubber Manufacturing Industry

Before introducing the rubber industry, it is worthwhile to first highlight a significant trend regarding the manufacturing industry as a whole in the past 10 to 15 years: between 2000 and 2015 the percentage contribution of the domestic manufacturing industry to the Gross Domestic Product (GDP) of South Africa dropped from 17.2% to 11.7%. Although in this same period the actual Rand figure for GDP for manufacturing has increased by 33%, this is quite a way off the 54% increase seen for total GDP in that period (Stats SA, 2015a). These statistics signify that the prominence of manufacturing in South Africa's economy is on the decline.

Commercial rubber manufacturing first began in South Africa in the early 1900s, and by 2000, it had developed to become a R7 Billion industry that was employing approximately 15000 people in South Africa (Stats SA, 2015b).

Historically, the rubber industry has been divided into two sectors: tyre and non-tyre (the non-tyre sector is also known as the *industrial rubber* sector). The tyre sector is the largest

by volume by a considerable margin, using up approximately 70% of the world's rubber (The Rubber Economist, 2008).

There are four tyre manufacturers within South Africa and they dominate the rubber industry in this country in terms of volume output; but there are also many smaller rubber companies servicing the non-tyre sector. The non-tyre sector focusses on other markets for rubber such as conveyor belting, rubber-lining of pipes and equipment, and automotive seals and gaskets. The non-tyre/tyre division in the industry means that the two sectors operate quite independently of each other and trends experienced in one sector may not necessarily be experienced in the other. Another key point to note is that the tyre companies in South Africa are all part of multinational tyre companies whereas the non-tyre companies are typically South African-owned, smaller businesses. This means that there are very different strategic approaches to business management in the two sectors. It therefore makes sense that any analysis of the rubber industry should separate the two sectors rather than looking at the industry as a whole.

1.2 RATIONALE

In recent years, the South African rubber industry has come under pressure. The seasonally adjusted index for physical volume of manufacturing of rubber products was 139.4 in December 2000 but had reduced to 103.3 by December 2014 (Stats SA, 2015b). This indicates a significant drop in value of the output of manufactured rubber products in this period.

A skills demand profile of the South African tyre industry found that even though total employment in the tyre companies increased, on average, by 14.1% between 2009 and 2012, the rate of growth in the tyre industry was in decline – the growth observed in 2009 was 9.3%, reducing to only 0.7% in 2012 (Barnes, Terreblanche and Kirby, 2012).

The decline in the rubber industry appears to be quite widely accepted and there have been numerous media reports in recent years that point towards Chinese imports as being one of the main causes of this decline (Cokayne, 2014; Motlanthe, 2013; Payne, 2011). However, there have been limited studies that have attempted to prove that Chinese imports, or imports from any country for that matter, are indeed having a negative effect on the rubber industry. In fact, recent studies that have presented data pertaining to the effects of Chinese imports

on the rubber industry have not actually been specifically focussed on the rubber industry – but rather they have been studies on the general manufacturing industry (Edwards and Jenkins, 2015; Tregenna, 2012). Furthermore, these studies did not separate the rubber industry into non-tyre and tyre in order to analyse the effects of imports on each sector individually. Without this separation it is difficult to be certain of the effects of imports on either one of the sectors individually.

Almost ten years ago an investigation was carried out into the possible dumping of Chinese-manufactured tyres into the South African market (International Trade Administration Commission of South Africa, 2007). The investigation found that, in contravention of anti-dumping regulations, dumping was taking place and that the South African tyre manufacturing industry was experiencing reduced employment, reduced market share, a lack of growth and a decrease in output as a result. However, dumping duties were not imposed by the South African government and the investigation was terminated. Another complaint has recently been launched to ITAC regarding dumping of tyres from China – an investigation is currently underway (Peters, 2015).

It is quite clear, from this brief discussion, that there are problems within the rubber industry and it is possible that imports are at least partly contributing to the problem. However, without an academic study focussed on the effects of imports on the rubber industry, it is impossible to be certain. And without certainty, it is difficult for South African rubber manufacturing companies to implement strategic measures to counteract the problems. The present study sought to fill the gaps addressed here by carrying out a study that focussed on the rubber industry, separated the industry into the non-tyre and tyre sectors and analysed the effects of imports on each sector individually.

1.3 PROBLEM STATEMENT

Since 2000 imports of general manufactured goods from China have risen significantly and there have been claims that this increase been the primary cause of an overall decline in the South African manufacturing industry (Edwards and Jenkins, 2015; Tregenna, 2012). There has been a decline in the output of the South African rubber manufacturing industry in the same period (Stats SA, 2015b) and Chinese imports have frequently been blamed for this decline (Cokayne, 2014; International Trade Administration Commission of South Africa, 2007; Payne, 2011). Academic studies to analyse the effects of imports on the South African

rubber industry have been limited. Furthermore, no evidence of studies that have separated the rubber industry into non-tyre and tyre could be found by the researcher. Without an academic study focussed on the effects of Chinese imports on the rubber industry, it is impossible to be certain if the industry is indeed affected by such imports. And without certainty, it is difficult for South African rubber manufacturing companies to implement strategic measures to counteract the problems. The present study sought to gain a firm understanding of the link between Chinese imports and the output of the non-tyre and tyre sectors of the rubber industry and to examine the effects, if any, that these imports have had on employment in the industry.

1.4 PURPOSE

The purpose of this study was to determine if the South African rubber manufacturing industry has been affected by imports of rubber goods from China between 1999 and 2014. The effect of Chinese imports on the South African rubber manufacturing industry was measured by the effect on the volume of domestic output of rubber products (in tonnes) and employment in the industry. The imported rubber goods from China was measured by the volume (in tonnes). The rubber manufacturing industry has historically been divided into two sectors – tyre and non-tyre. The study was split in accordance with this and both sectors were explored separately, where possible.

1.5 OBJECTIVES

The objectives of this study were as follows:

- To determine the effect of Chinese rubber imports on the output of the South African non-tyre rubber manufacturing industry.
- To determine the effect of Chinese rubber imports on the output of the South African tyre manufacturing industry.
- To determine the effect of Chinese rubber imports on employment in the South African rubber manufacturing industry.
- To determine if South African rubber manufacturing companies have been affected by the current economic climate and to ascertain if imports of rubber products have had an effect on their business.

1.6 RESEARCH QUESTIONS\

The research questions to be answered were as follows:

1. What is the effect of Chinese rubber imports on the output of the South African non-tyre rubber manufacturing industry?
2. What is the effect of Chinese rubber imports on the output of the South African tyre manufacturing industry?
3. What is the effect of Chinese rubber imports on employment in the South African rubber manufacturing industry?
4. Have South African rubber manufacturing companies been affected by the current economic climate and have they been affected by imports of rubber products?

1.7 JUSTIFICATION FOR THE STUDY

The rubber industry worldwide is split into the tyre and non-tyre sectors. These two sectors are largely independent of each other. While there have been limited academic studies that have quantified the general effect of Chinese imports on the overall South African rubber industry (Edwards and Jenkins, 2015; Tregenna, 2012), no such studies have been found by the researcher that divide the rubber industry into the two component sectors to allow a detailed analysis of the effect of imports on each sector individually. Without definite answers in this regard, it is difficult for South African rubber companies in each sector to devise strategies to curb the deterioration and revitalise the sector. The findings of the present study may assist industry players in identifying possible strategies to revitalise this once-thriving sector of the manufacturing industry.

1.8 DELIMITATIONS

- This study involved an analysis of the effects of Chinese imports on the non-tyre and tyre sectors of the South African rubber manufacturing industry. In general, a comprehensive analysis of trade flow is carried out using mathematical methods to model data and ascertain cause and effect relationships. To carry out such analysis, a researcher is reliant on obtaining secondary data for imports and exports. The boundaries set by these secondary data will therefore, to a large extent, dictate the

boundaries for the overall study. For example, there were instances in the present study where trade data could not be separated between the tyre and non-tyre sector and this, therefore, meant that that particular portion of the analysis could not be separated between the sectors.

- One mathematical model was selected by the researcher to analyse the data in this study; the conclusions of the study were based on this model. There are many mathematical models which could have been used but the researcher, after an extensive literature review, selected the one that was thought to be most suited. It would have been preferable to apply the data to at least two models to allow a comparison – but time constraints did not allow this.
- In order to complete the mathematical modelling, data for domestic output of the two sectors of the rubber industry were required. These data were not readily available from any source so the researcher used the secondary data available to estimate the domestic output. The ideal scenario would have been to source primary output data from rubber companies in order to validate the estimated output – but time and budget constraints did not allow this. It is also highly unlikely that rubber companies would share such information due to the competitive nature of the industry.
- The present study focussed on imports from one country only – namely China. The reason for the selection of China was that previous studies on similar topics, reports in the media and general sentiment in the industry in recent years have all pointed to Chinese imports having a negative effect on the industry. It would have been beneficial to also examine the effects of imports from other countries on the rubber industry but time constraints did not allow this.
- A questionnaire of South African rubber manufacturing companies was carried out to investigate the fourth research question. It was decided by the researcher to limit the population to members of the only rubber industry association in South Africa, namely the Institute of Materials, Minerals and Mining (IOM3). This association comprised 26 rubber manufacturing companies. Limiting the questionnaire to this association meant that one single gatekeeper's letter could be obtained for ethical clearance. To survey companies outside of the association would have required a gatekeeper's letter from each and every company. Since the questionnaire was only required for one out of the four research questions, the time required to seek gatekeeper's letters would have been

grossly disproportionate to the relative importance of the questionnaire to the study's objectives.

1.9 STRUCTURE OF THE DISSERTATION

Chapter 1 Introduction

This chapter provided an introduction to the rubber industry and outlined the rationale and reasoning for carrying out the research study. An outline of the problems facing the rubber industry was presented which assisted in the formation of the specific objectives of the study. The chapter concluded with an outline of the study delimitations.

Chapter 2 Literature Review

This chapter provides a comprehensive review of the literature surrounding the subject matter of the present study. The chapter starts with an overview of the South African manufacturing industry before proceeding into a discussion on international trade and the theories behind modelling of trade flows. The review then focusses on empirical studies relating to South African trade and then, more specifically, South African trade with China. The chapter concludes with a review of empirical literature on employment, and the effect of trade on employment within the manufacturing sector in South Africa.

Chapter 3 Conceptual Framework

This chapter provides an introduction to the rubber industry and the tariff sustem used for international trading of rubber. The conceptual framework that was developed by the researcher is then presented. This framework provides the foundational knowledge for the application of the analytical framework in Chapter 4.

Chapter 4 Research Approach & Frameworks

This chapter outlines the research methodology and analytical frameworks that were used in achieving the objectives of the study. The chapter provides a general overview of research methodology and design before proceeding into the rationale used for the choice of research approach for the present study. This is followed by a presentation of the analytical frameworks that were adapted and developed specifically for this study on the rubber industry. The sources for secondary data and the data collection methods is also outlined.

Chapter 5 Analysis & Presentation of Results

This chapter presents the results obtained from the empirical analysis carried out as part of the present research study. Initially, the results for the estimation of domestic output are presented, followed by application of these data to the analytical model for the non-tyre and tyre sectors. The chapter concludes with a brief overview of the questionnaire results that were obtained.

Chapter 6 Discussion of Results

This chapter revisits the initial objectives of the study and seeks to answer the research questions through further discussion of the collected data and the resultant analysis. This chapter also seeks to validate the data analysis methods used. The discussion follows the flow of the research objectives and associated questions which were presented in Chapter 1 – with a section dedicated to each objective.

Chapter 7 Conclusion & Recommendations

This chapter draws conclusions on the data and the analysis carried out in the study and also offers the researcher's recommendations on what this means for the rubber manufacturing industry in South Africa. The limitations of the study and recommendations for further research are also presented.

1.10 CONCLUDING REMARKS

This chapter commenced with a brief background on the rubber manufacturing industry in South Africa. An overview of the research project undertaken was then provided which included the rationale for the study, the objectives and the delimitations. The chapter concluded with an overview of the structure of the dissertation which included a summary of the content of each chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter commences with an overview of the recent trends in the South African manufacturing industry highlighting the overall decline that has been experienced in recent years. The potential that importing of manufactured goods being a contributor to the decline is raised, which leads into an overview of how international trade has evolved globally, in South Africa and, more specifically, between South Africa and China. The use of theoretical modelling of trade flow is also introduced and leading into a general outline of the various theories that are commonly used. A literature review of empirical studies that have been carried out both internationally and domestically is then presented.

The chapter aims to provide the reader with the background knowledge required to gain an understanding of the research approach, theories and methods utilised in the current study.

2.2 RECENT PERFORMANCE OF THE SOUTH AFRICAN MANUFACTURING INDUSTRY

"Manufacturing is a process involving tools and labour to produce goods for use or sale as intermediaries, or as final products, either domestically or internationally" (SEDA, 2012, p.19). The South African manufacturing industry has long been an important part of the country's economy – in 1990 it was contributing approximately 20% in Rand value to the total South African GDP (South African Reserve Bank, 2016). Between 1990 and 2010 South African manufacturing increased from $30 billion to $44 billion, using constant 2005 prices (SEDA, 2012). However, as illustrated in Figure 2.1, the percentage contribution of the manufacturing industry to the country's GDP has dropped at a steady rate in this same period. Not only this, but the share of South African manufacturing on the world market has dropped also from 0.61% to 0.50% in the same period highlighting the urgent need for an improvement in the domestic output of the manufacturing industry. Employment has also reduced in all of the major manufacturing sectors between 2000 and 2010 – in total formal manufacturing job loss in this period is estimated at 11.3% of the labour force (SEDA, 2012).

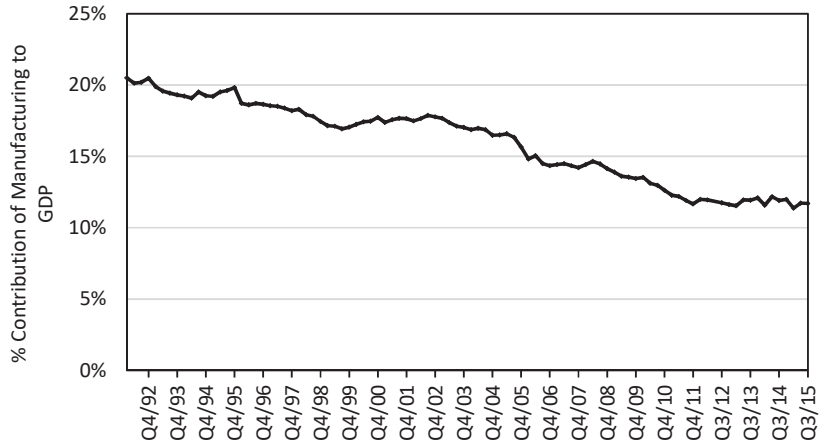


Figure 2.1 % Contribution of manufacturing to South Africa's GDP since 1992

Source: Researcher's compilation of data from South African Reserve Bank (2016)

The South African public can be forgiven for feeling somewhat aggrieved with the government given that the country's GDP has risen markedly since 1990 but unemployment has not increased in the same period and currently sits above 25% (see Figure 2.2). A growing economy should be creating jobs but this does not appear to be the case in South Africa. Whilst domestic demand has increased strongly over the past 20 years, cheaper imports have also been in high demand and consequently domestic supply has not increased in the same proportions as domestic demand. There has been immense potential for South Africa to capitalise on the global marketplace through export, but progress on this front has been disappointing. Operational costs, infrastructural issues, labour disputes and government policies have made it difficult for South African exporters to compete on the competitive global market (Industrial Development Corporation, 2013).

It is no wonder that there has been a flood of media reports in recent years claiming that imports into South Africa are damaging the economy and leading to job losses (Cokayne, 2014; Maswanganyi, 2012; Payne, 2011). In fact, such claims formed the idea to conduct the current study on the rubber manufacturing industry. But in order to thoroughly investigate the claims, it is first pertinent to carry out a review of international trade and trade theories to establish a knowledge base on this complex topic.

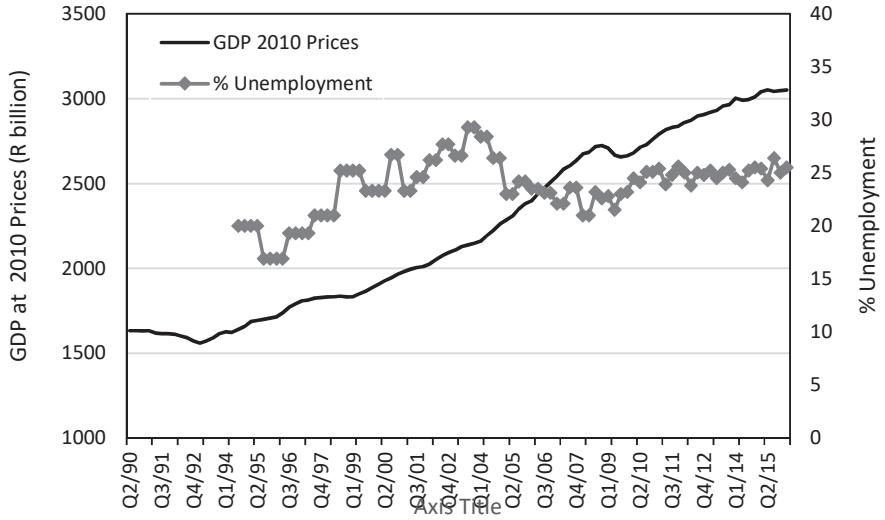


Figure 2.2 GDP at constant 2010 prices and % unemployment between 1990 and 2015

Source: Researcher's compilation of data from South African Reserve Bank (2016)

2.3 A BRIEF HISTORY OF INTERNATIONAL TRADE

Long-distance trade has been in existence since ancient times when civilisations used river and sea transport to trade goods between settlements. Although, strictly speaking, this cannot be classified as *international trade* since nations did not actually exist in these times, it nonetheless shows that the concept of exchange of goods, resources and raw materials between civilisations for mutual gain has been in existence for a very long time. Since the 16th century the importance that international trade would play in modern civilisation truly began to unfold when a nation's ability to trade became a measure of its wealth and as such it became the foundation of imperial colonialism (Amaya, 2015). In the following centuries, as nations developed, governments recognised that international trade increased power and wealth. Economic theories began to emerge such as Adam Smith's *theory of absolute advantage* (Smith, 1776) which refers to the ability of a nation to produce a good or service more efficiently, and with the same amount of resources, than another nation therefore giving it an absolute advantage in this field of expertise. Smith believed that it therefore makes sense for a nation to focus on this expertise and to export these goods or services internationally and import other goods or services from other nations.

However, there has always been a dual view of trade – does it do more harm than good to a domestic economy? Is it always desirable to have *free trade* with other nations? Many

economists believe that, like with most technological advances, some people's interests are harmed, but overall the benefits to society make it worthwhile and that trade makes a "significant contribution to economic growth" in a nation (Sun and Heshmati, 2010, p.5). But others believe that it is more important to promote local industry and job promotion by restricting international trade as this will have a more positive effect on the people of the nation.

But, regardless of views, with the proliferation of international trade over the centuries, the need arose for trade regulations and laws to be implemented. In the early years of such directives, individual countries implemented tariff and trade policies which were often extremely restrictive to import and export flow and unfair on one or more of the nations involved. But after World War II the major powers of the world recognised that multilateral trade was essential and the *General Agreement of Trade and Tariffs (GATT)* was formed in 1947. GATT was "designed to encourage the reduction of tariffs among member nations to provide for the expansion of multilateral trade" (Johnston, 2016, p.1).

However, over the next few decades, many additional regional trade agreements arose to address the shortfalls of the GATT and eventually this led to the formation of the more comprehensive World Trade Organisation (WTO) in 1995. The WTO is currently the only global international organisation governing trade between nations and today consists of 162 member states. The main function of the organisation is to assist in the flow of trade as freely as possible, notwithstanding trade that has undesirable side effects. The WTO's guiding principle is that the opening of borders to international trade will help to combat poverty, assist in sustainable economic development and increase people's welfare (World Trade Organisation, 2016a).

2.3.1 A History of South African International Trade

"Prior to the 1980s, South Africa's trade and industrial policies were aimed primarily at encouraging import substitution industrialisation" (Edwards, 2006, p.2). Import substitution refers to the intentional replacement of imported products with domestically produced products. South Africa had implemented this policy during the 1920s and initially it served the country well and promoted the growth of domestic manufacturers. South Africa became the tenth member of the GATT when it joined on 13th June 1948 (World Trade Organisation, 2016b). However, by the 1970s South Africa found itself to be highly dependent on gold as

a source of foreign exchange. During the following years, efforts were made to stimulate growth in non-gold exports which led to a shift in trade policy that focussed more on openness and trade liberalisation.

In 1990 a policy shift towards export promotion was implemented in South Africa through the *General Export Incentive Scheme* (GEIS) (Tregenna, 2012). Quantitative restrictions were gradually reduced in an effort to stimulate exports and by the beginning of 1994 most of these restrictions had been removed (Mabugu and Mabugu, 2014). With the formation of the new government in April 1994, international trade sanctions imposed during the apartheid era were lifted and this, together with South Africa's more relaxed trade policies led to a rapid increase in imports and exports. In this same year the GATT Uruguay Round was signed off and South Africa committed to, among other things, bind 98% of its tariffs to the *Harmonised System* (HS), reduce the number of tariff rates, rationalise tariff lines and adopt anti-dumping legislation (Edwards, 2006). By the time GATT became the WTO on 1st January 1995 South Africa was enjoying increased political and economic stability leading to a surge in foreign investment and a reverse of the stagnation that was observed during the 1980s (Thurlow, 2006).

2.3.2 South African Trade with China

"One of the most significant transformations of the global economy over the past quarter of a century has been the re-emergence of China as a major economic power" (Jenkins and Edwards, 2012, p.1). With China's joining the WTO in 2001, the door was opened for China to trade worldwide leading to a surge in Chinese exports as illustrated in Figure 2.3. This boom in outgoing trade has contributed to China rising from being the world's 11th largest economy in 1990 to the 2nd largest, after the U.S., in 2014 in terms of GDP (The World Bank, 2016).

International relations between South Africa and China go back as far as the late 19th century. Up until the late 1970s these relations were primarily due to British imperial ties and were mostly dealt with through their foreign office. It was only when PW Botha went to China on an official state visit in 1980 that stronger economic ties between the Republics of South Africa and China started to form. Bi-lateral trade began to grow and when formal diplomatic ties between the two were opened in January 1998 the foundation for the current relationship was laid. In April 2000 the Pretoria Declaration was signed which affirmed a commitment

by both countries to expand trade and investment. In June 2004 the nature of the relationship was elevated to a 'strategic partnership' and in August 2010, at the signing of the Beijing Declaration, it advanced again to become a 'comprehensive strategic partnership' (Alden and Yu-Shan, 2014). In December 2010 South Africa became part of BRICS – an association for five developing nations; namely Brazil, Russia, China, India and South Africa – further cementing the strong political between the China and South Africa.

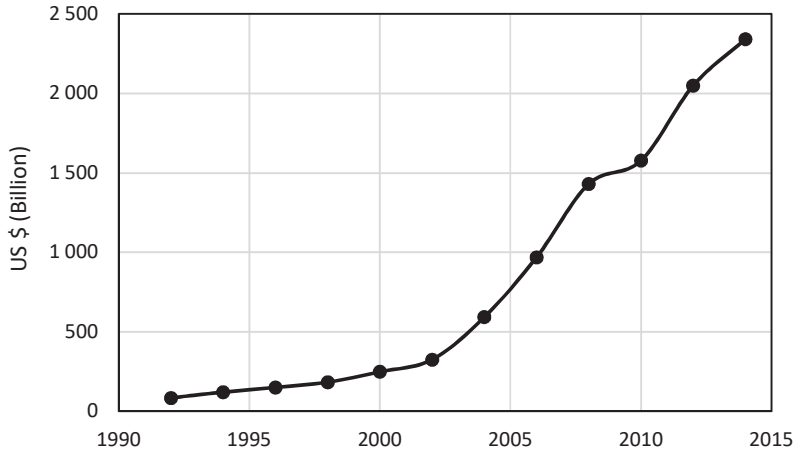


Figure 2.3 Annual value of China's total exports from 1992 to 2014

Source: Researcher's compilation of data from UN Comtrade website (comtrade.un.org)

Since China joined the WTO, bilateral trade with South Africa has increased dramatically as illustrated in Figure 2.4. China is now South Africa's highest supplier of imports ahead of Germany and the highest receiver of South Africa's exports ahead of the U.S. (SARS, 2016a). While the sharp rise in exports to China since 2000 may be viewed as positive, it is concerning that there is a constant and significant trade deficit. It is also concerning that the top five exports to China, comprising 76% of total exports, are mineral products (Alden and Yu-Shan, 2014). This means that value-added products, which would be far more beneficial to the South African economy, are not exported in high volumes to China.

Imports from China are overwhelmingly manufactured products. As a low cost labour economy, imports of manufactured products from China have put a downward pressure on the pricing of manufactured goods in South Africa (Edwards and Jenkins, 2014). Furthermore, this massive influx of cheap manufactured products from China may actually be causing a reduction in domestic demand and, consequently, lower domestic sale (Yang, 2014).

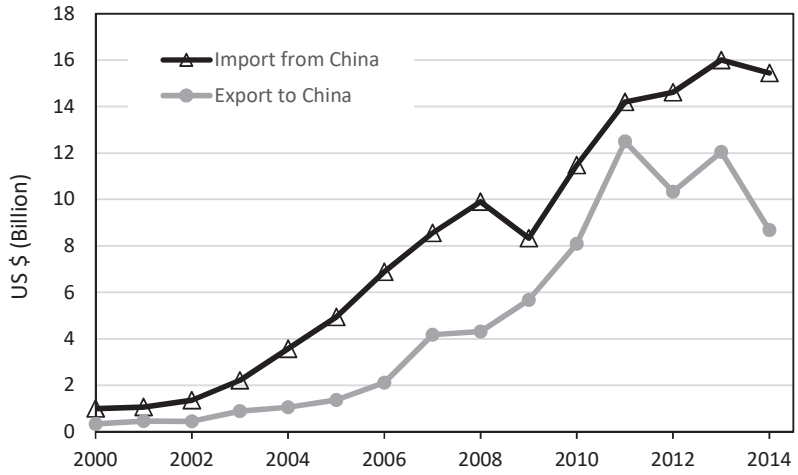


Figure 2.4 Annual value of Chinese bi-lateral trade with South Africa from 2000 to 2014

Source: Researcher's compilation of data from UN Comtrade website (comtrade.un.org)

With the exponential increase in trade flow experienced globally in the twentieth century came the need to analyse such flow in order to determine the effect of trade on the world economy and the economic health of the nations involved.

2.4 THEORIES ON TRADE FLOW MODELLING

There are many theoretical economic models available that can be utilised as a tool for international trade analysis. At its most basic, supply and demand analysis shows "how equilibrium quantities of imports and exports are determined" and if the world price falls below the domestic price, then there will be a surplus of domestic supply and imports will increase (Janse van Rensburg, McConnell and Brue, 2011, p.494).

In order to carry out a more detailed study on the effects of international trade on an economy, theories that are more complex must be utilised. Prior to 1960, there was limited research carried out on the effect of trade (Sun and Heshmati, 2010). However, the years that followed saw the development of various econometrics models.

2.4.1 An Overview of Econometrics Modelling

Econometrics involves the development of basic economic relationships utilising mathematical models and statistics. For example, a common and widely publicised application of econometrics is the forecasting of macroeconomic indicators. Econometrics has evolved over the past fifty years to become a separate discipline of mathematics and its methods are now used in virtually all branches of economics (Wooldridge, 2013).

Econometrics methods often utilise a mathematical model to which "quantitative analysis is performed under the assumption that the economic model is correctly specified" (Hansen, 2016, p.2). In general, a model is used to provide a representation of a *real-life* phenomenon in order to explain, predict or control it (Intriligator, 1983). The data for such models are generally non-experimental or observational which means that they are not collected through controlled experiments but rather collected passively by the researcher (Wooldridge, 2013).

Many different econometric models have been developed over the years. At their most basic, a model treats a situation as an isolated system and monitors the input(s) and output(s) without developing a relationship between them. As models become more complex, they can be used to track inputs and outputs and measure the interdependency of the inputs and outputs on each other and on the outside world. Models can also be used to analyse interconnections with other phenomena and/or to disaggregate outputs for further analysis (Intriligator, 1983).

Where studies on international trade flow are concerned, as is the case with the present study, *input-output models* are extensively utilised to gain a better understanding of trade effects. Input-output economic theories started to emerge in the 1950s and since then they have expanded in their usage and complexity. The basic theory underlying the model has, however, remained unchanged – "the amount of a good or service produced by a given sector in the economy is determined by the amount of that product that is purchased by all the users of the product" (Fatemi, n.d., p.1). Input-output models, in other words, can be used to model the output of an industry or a sector based on the consumption of input factors.

What makes input-output models appealing is the fact that data for such models are generally widely available and they are quite simple to implement. There are three approaches used in input-output models – multiplier analysis, scenario analysis and decomposition analysis. Multiplier analysis is generally used to analyse shifts in demand on output. Scenario analysis analyses the impact of hypothetical scenarios on the output. Decomposition analysis is used

to determine reasons for the change in one variable that arise due to changes in other variables (Duchin and Steenge, 2009).

In the present study, the overall objective is to analyse the effect of imports on the South African rubber manufacturing industry – imports being an input to the industry and manufacturing being the output. Such studies are ideally suited to a modelling approach based on input-output theories and, more specifically, a decomposition approach.

In the researcher's review of literature, many models were identified which have been used in the analysis of international trade flows such as the *gravity model* (Anderson, 2011) and the *Lewis model* (Kirkpatrick and Barrientos, 2004). However, it is beyond the scope of the present study to provide a detailed overview of the different types and varieties of trade flow models that exist.

The model which was identified by the researcher as being most suited to the present study was the Chenery decomposition model. Justification for this selection is provided in section 3.3.2.

2.4.2 The Chenery Decomposition Model

The Chenery (1960) model was originally developed with the aim of explaining the patterns of industrial growth in 51 countries between 1950 and 1955. The model incorporated changes in both demand and supply conditions to give a measure of the growth of individual sectors by decomposing the gross domestic production into four components as follows:

$$X_i = D_i + W_i + E_i - M_i \qquad (2.1)$$

where X_i is the domestic production of commodity i

D_i is the domestic consumption of i

W_i is the use of i by other producers

E_i is the export of i

M_i is the import of i

Chenery proposed that there were three factors that led to industrial growth: (i) substitution of imports by domestic production, (ii) growth in demand for a product and (iii) growth in intermediate demand (W_i) due to (i) and (ii). Import substitution was defined as "the increased share of domestic production in total supply" (Chenery, 1960, p.641) and, from

equation 1, an expression was developed which gave a measure of import substitution of a particular product as:

$$(\mu^0 - \mu^1) X^1 \qquad (2.2)$$

where μ is the fraction of total supply that comes from imports or the *import ratio* (M_i/X_i)

μ^0 is the import ratio at level 0

μ^1 is the import ratio at level 1

X^1 is the domestic production of the product at level 1

Chenery found that contribution of import substitution to domestic production was significantly more important than pure demand growth effects in the time period studied. Further breakdown into product categories showed that the substitution of domestic production for imports was the cause of high growth rate in non-consumer goods. But in consumer goods import substitution was only found to be a minor factor.

2.5 EMPIRICAL LITERATURE ON MODELLING OF TRADE FLOW

In order to gain a better understanding of the application and benefits of trade flow modelling a review of empirical literature on such studies is presented, initially, for international studies and followed by South African studies.

2.5.1 International Studies

Morley and Smith (1970) used Chenery decomposition to analyse the import substitution taking place in Brazil between 1949 and 1964. It was noted by the researchers that, where intermediate goods are concerned, the Chenery estimation of import substitution can fall short since it ignores the linkages between intermediate and final products. However, in an industry where few intermediates are produced, then the Chenery calculation is accurate.

Zaidan (1998) used Chenery's model when studying the effect of import substitution policy on manufacturing industries in Iraq over a 10-year period starting from 1978. He analysed import substitution effects using Chenery's theory that "positive import substitution occurs when the ratio of domestic production to total supply increases between two periods, or when the ratio of imports to total supply declines between two periods" (Zaidan, 1998, p.45). In other words, import substitution of a product occurs between time, t=0 and t=1 if:

$$M_1/S_1 < M_0/S_0 \quad (2.3)$$

where M_0 and M_1 are the imports of the product in period 0 and 1 respectively
S_0 and S_1 are the total domestic consumption of the product in period 0 and 1 respectively

Note that M_t/S_t, designated as m_t, is the same as the *import ratio*, μ, previously defined by Chenery and referred to in equation 2.2. Zaidan presented the following equation which decomposes M into its component parts:

$$\Delta M = M_1 - M_0 = S_1(m_1 - m_0) + m_0(S_1 - S_0) \quad (2.4)$$

where ΔM is the change in imports between time periods 0 and 1 ($M_1 - M_0$)

The first term of the equation, $S_1(m_1 - m_0)$, is an absolute measure of import substitution and the second term, $m_0(S_1 - S_0)$, is the change in the supply of the product. To obtain a comparison of the extent of import substitution relative to domestic production, Zaidan used the following expression, which divides absolute import substitution by the change in domestic production:

$$S_1(m_1 - m_0) / (Q_1 - Q_0) \quad (2.5)$$

where Q_0 and Q_1 are the domestic production quantities in periods 0 and 1 respectively

Zaidan's analysis of the food industry in Iraq showed that negative import substitution (i.e. import penetration) occurred during the period from 1978 to 1988. He further split this period into three and analysis showed that the food industry actually achieved success in replacing imports between 1982 and 1988 – in this period an import substitution level of 20% was calculated. Calculations using equation 2.5 showed that this import substitution induced 108% of the growth in the total production in the food industry in that period. Over the entire manufacturing industry, the highest level of import substitution was found to be in the manufacture of construction materials, textiles, petroleum products, electrical machinery and tobacco products.

Giovannetti and Sanfilippo (2009) carried out an analysis on the effect of China on exports from African countries between 1995 and 2005. They utilised a modified version of a model that had been previously developed for the analysis of China and India on developing countries. Secondary trade data were acquired and used to estimate the effect of China on

African manufacturing exports and it was found that, in areas where China and Africa compete, the effect was generally a negative one.

Afzal (2012) carried out a study to determine if trade liberalisation can stimulate economic growth in Pakistan. Two models were utilised including the Chenery model. Both models were showed that liberalisation of trade would not necessarily promote economic development in Pakistan.

Habiyaremye (2013) used Bardhan and Lewis's imported input growth model from 1970 to investigate the effect of capital goods import on the productivity growth in Botswana's manufacturing sector. The rationale behind the study was to investigate if Botswana, being a resource dependent country, was successfully using capital generated primarily through sale of diamonds to import the technology required to boost its manufacturing sector. It was found that labour productivity benefitted from the import of foreign capital goods. Further analysis of firm-level data showed that imported capital goods improved the manufacturing productivity.

Dai (2013) utilised a model previously developed by Blosch and McDonald in 2001 to analyse the effects of import competition on the productivity of the Swedish manufacturing industry in the period between 1998-2008. It was found that productivity at an industrial level was positively affected by import competition in sectors with a low price-cost margin.

Akkus (2015) used a theoretical framework previously developed by Revenga in 1992 to investigate the effect of import competition on employment and wages in the Turkish manufacturing industry. It was found that there was a positive and significant relationship between import competition and employment in the manufacturing industry. However, no significant correlation was found between import competition and industrial wages.

Sekakela (2016) used the Chenery model to determine whether trading with China has had an impact on the economy of Botswana during two periods from 2001-06 and 2007-12. It was found that Botswana's manufacturing output increased in the two periods and that while China's import penetration has increased, it has been at the expense of imports from the rest of the world rather than domestic manufacturing. The growth in the manufacturing output was attributed to export expansion.

2.5.2 South Africa-China Trade Flow Modelling

Because of the importance of South Africa's trade with China, many studies have been conducted which analyse this flow of trade utilising various theoretical models. For example, Yang (2014) utilised a computable general equilibrium (CGE) model to explore the ways in which China's economic development has affected South Africa. CGE models were used to estimate how an economy reacts to changes in external factors. The study focussed on five channels including the effect of increased domestic competition from Chinese imports and increased competition from Chinese products on South Africa's export market. Simulations were carried out in which the world price of Chinese imports were reduced by 10%. It was found that a growth in Chinese imports leads to a drop in the demand for domestic products.

Bothma and Cant (2010) also used the gravity model analyse the trade between South Africa and China. It was concluded that from 2004 to 2008 the relationship between the two countries was a *pull relationship* in that China was simply sourcing the raw materials it needed from South Africa rather than South Africa building sustainable markets in China. However, evidence was found of value-added exports, such as nickel and aluminium plates and rolled stainless steel sheets, which showed that there is potential for South Africa to develop in the export of high-end products to China.

Wood and Mayer (2011) used Heckscher and Ohlin's model to analyse how China's entry into world markets has affected developing economies, with a special focus on labour-intensive manufacturing. Application of this model, based on neoclassical trade theory, used relative factor endowment as a measure of how China effects the sectoral structure of other countries –factor endowment being the resources, labour and capital that a country has available for manufacturing. It was found that China's emergence onto the world trade market altered the comparative advantage of other countries and on average lowered the share of manufacturing in the primary output of these countries. The changes in both output and export of manufactured products for South Africa were found to be negative, which was consistent with the expected impact of China.

Adekunle and Gitau (2013) used the gravity model to examine the trade flow between China and Sub-Saharan Africa (SSA). The gravity model postulates that the "trade flow between two regions is directly related to the GDP and inversely related to the distance between them" (Adekunle and Gitau, 2013, p.121). They studied the impact of various economic indicators on the trade flow between the regions. It was found that China's trade with SSA had

increased almost 100-fold since 1990 and that South Africa was SSA's second Chinese largest trading partner in 2009 – Angola being the largest. It was found that GDP, exchange rate and foreign direct investment were the best predictors of import volumes to the SSA region.

There have been several recent studies that have utilised the Chenery approach to analyse the trade flow between South Africa and China.

2.5.3 Chenery Decomposition Applied to South Africa-China Trade Flow

Lewis (2001) examined the changing role of trade in South Africa and used the Chenery decomposition model to analyse trade flow for various periods between 1984 and 1997. It was found that despite a rise in gross output, South African firms could not retain domestic market share and rising import penetration was seen throughout the period analysed. This led to an overall decline in domestic demand during the 1984 to 1997 period. This is interesting since at this point China was not part of the WTO so the level of import penetration due to China was relatively low. However, it was highlighted by Lewis (2001) that in the late 1990s China's manufacturing exports were dominated by unskilled labour intensive products which account for 40.5% of its total exports. South Africa's share, on the other hand was only 6.8% suggesting that, unlike China, South Africa was not utilising its abundant labour supply effectively. So it seems that the foundation was already being laid by China and trends were forming in the 1990s which would continue into the 21st century and subsequently have enormous effects of the South African trade profile.

Tregenna (2012) also utilised Chenery's methodology in an analysis of sources of subsectoral growth in South Africa. Growth in selected sectors was decomposed into four components for a given period – domestic demand expansion, export expansion, import substitution and technological change. It was found that subsectors that relied heavily on the domestic market performed poorly during the period from 2000 to 2007, primarily due to import penetration, and had not experienced a high growth rate in export expansion. This presents a problem in that the manufacturing sector will eventually reach the limits of domestic expansion and, more importantly, it leaves this sector more vulnerable to import penetration (Tregenna, 2012).

Edwards and Jenkins (2015) recognised the growing change that China was having on the South African economy and carried out a study which attempted to analyse the impact of trade with China on the manufacturing sector in South Africa. A Chenery-type decomposition was used which separated South African imports from China from the rest of the world and then calculated the impact of growth in Chinese imports on domestic manufacturing and the volume of imports from other countries between 1992 and 2010. A minor modification of the standard Chenery decomposition was used which started with the basic equation:

$$Q_{it} = D_{it} + X_{it} - M_{it} \quad (2.6)$$

where Q_{it} is the domestic production of industry i at time t

D_{it} is the domestic absorption of industry i at time t

X_{it} is exports of industry i at time t

M_{it} is imports of industry i at time t

Import penetration was defined as:

$$m_{it} = M_{it} / D_{it} \quad (2.7)$$

Note that this is the same as the import ratio, μ, previously referred to in equation 2.2. The authors then decomposed the change in production in industry i between a base year, 0, and a later year, 1, as:

$$\Delta Q_i = (1 - m_0)\,\Delta D_i + \Delta X_i + (m_{i0} - mi_1)D_{i1} \quad (2.8)$$

But since the focus of the study was to determine the effects of Chinese imports on domestic production it was necessary to disaggregate the trade data between China and the rest of the world:

$$\Delta Q_i = (1 - m_0)\,\Delta D_i + \Delta X_i + (m_{Ci0} - m_{Ci1} + m_{Ri0} - m_{Ri1})D_{i1} \quad (2.9)$$

where m_{Ci} is the share of Chinese imports in total domestic absorption

m_{Ri} is the share of imports from the rest of the world in total domestic absorption

Their study (Edwards and Jenkins, 2015) found that in the 15-year period from 1995 to 2010, China moved from being South Africa's tenth largest source of imports, with a share of 2%, to being the number one source of imports, with a share of 19%. China's import penetration increased from 0.4% to 5.9% in this same period. Furthermore, it was found that in 2010 China was the number one source of imports in 27 out of the 45 manufacturing industries

studied. Chenery decomposition of the domestic demand showed that this increase in Chinese import penetration had a significant effect on South African domestic manufacturing since 2001. In other words, the increased volume of Chinese imports was found to be displacing domestic production as opposed to displacing imports from other countries. For example, South Africa's knitted and crocheted fabrics industry lost out on 60.5% of the 2001 production volume between 2001 and 2010 and experienced a 23.5% decline in sales.

Both Edwards and Jenkins utilised Chenery's decomposition in other studies on the effect of trade on the Southern African economy (Edwards, Flowerday, Rankin, Roberts and Schoer, 2015; Edwards and Jenkins, 2014; Jenkins and Sen, 2006; South African Reserve Bank, 2016).

In addition to the effect of trade on manufacturing output, it is also critical to consider the effect on employment within South Africa.

2.6 THE EFFECT OF TRADE WITH CHINA ON EMPLOYMENT IN SOUTH AFRICA

In September 2012, at the Congress of South African Trade Unions, the General Secretary of the National Union of Mineworkers (NUM) announced that they wanted the government to initiate an investigation into the effect of Chinese companies on job losses, factory closures and unfair competition in South Africa (Motlanthe, 2013). This viewpoint is somewhat typical of the general sentiment among unions, employees and, surprisingly often, companies not only South Africa, but around the world. For example, in his study on the relationship between China-U.S. trade flow and employment, Scott (2012, p.1) stated that "the extraordinary growth of trade between China and the United States has had a dramatic effect on U.S. workers and the domestic economy, though in neither case has this effect been beneficial". Scott's analysis found that a staggering 2.7 million jobs in the U.S. had been displaced due to its ongoing trade deficit with China between 2001 and 2011 – and 77% of these were in the manufacturing sector.

It is evident, therefore, that claims of Chinese trade having a negative influence on a country's employment levels are not unique to South Africa. Statistics South Africa figures for the fourth quarter of 2015 show unemployment in South Africa is at 24.5% (Stats SA,

2016a); it is no wonder that people are seeking something or someone to blame for the employment crisis. The manufacturing sector is one of the most affected in recent years. The latest figures specific to the South African manufacturing sector indicates there were 1.21 million people employed in the sector in 2014. This figure has reduced 2.4% per annum since 2011 when there were 1.30 million people employed in the sector (Stats SA, 2015c).

Thurlow (2006) used a dynamic equilibrium and microsimulation model to analyse the effect of the liberalisation of trade on growth and employment in South Africa between 1993 and 2003. He found that although, in general, during the 1990s trade liberalisation fostered growth and employment, an increase in import competition contributed to a fall in employment in the manufacturing sector in the same period. Dunne and Edwards (2006) also studied the relationship between trade and employment in South Africa in a similar time period (1994 to 2002). They used Chenery decomposition analysis and showed that domestic demand and technology have been the dominant factors in determining the demand for labour in the manufacturing sector. It was found that, in general, employment directly lost through import growth was matched by import gained through export growth. However, it was found that trade, in particular from China and India, had indirectly affected employment in a negative way especially in the manufacture of labour-intensive products.

Edwards (2006) carried out a study to see if South Africa had indeed liberalised its trade. In this study he analysed the change in employment in the manufacturing sector with changing trade between 1993 and 2002. However, in this period, no significant relationships between the two factors emerged. However, it was conceded that the analysis of employment had not been rigorous and that further work would be carried out in this area.

In the years that followed Edwards indeed continued his studies in this field and in 2015 he co-authored a paper, focussed on the manufacturing sector, in which data from many of his preceding studies were amalgamated (Edwards and Jenkins, 2015). In this work the researchers used Chenery decomposition to determine the effects of trade on unemployment levels in South Africa. Their study was specifically focussed on trade with China and utilised the theory that "changes in employment are a result of changes in output and changes in labour productivity" (Edwards and Jenkins, 2015, p.455). They decomposed the change in employment, L_i, per unit of output (Q_i) in industry i between a base year, 0, and a later year, 1, as:

$$\Delta L_i = l_{i1}\Delta Q_i + (\Delta l_i)Q_{i0} \qquad (2.10)$$

Substitution of equation 2.10 into equation 2.8 gives:

$$\Delta L_i = l_{i1}(1 - m_0)\,\Delta D_i + l_{i1}\Delta X_i + l_{i1}\,(m_{i0} - mi_1)D_{i1} + (\Delta l_i)Q_{i0} \qquad (2.11)$$

The first term on the right hand side of equation 2.11 represents the effect of changes in domestic demand on employment, the second term represents the effect of changes in exports, the third represents the effect of changes in imports and the fourth term represents the effect of changes in labour productivity. The researchers used employment coefficients from Statistics South Africa over two periods, 1992-2001 and 2001-2010. Analysis showed that in the period before 2001, the loss of jobs caused by increased imports from non-China regions was approximately five times higher than the impact of Chinese imports. However, during 2001-2010 more than 110,000 jobs were lost due to imports in total, almost 78,000 of which were attributed specifically to Chinese imports. These effects "caused employment in South African manufacturing in 2010 to be 8.2% lower than it otherwise would have been" (Edwards and Jenkins, 2015, p.459). The effect of exports to China on employment was minimal in both periods.

Edoun and Netshiozwi (2015) used a statistical regression approach to analyse the impact of Chinese imports on employment in the textile industry. Trade data were obtained from the Department of Trade and Industry and employment data from the Textile Federation. Analysis showed that there was a strong correlation between increasing level of cheap imported textile from China contributed and falling employment in the sector. It was found that for every R1 million increase in Chinese imports, employment in the textile sector fell by 2.1 people – which is significant when one considers that the value of imports from China increased from R0.3 billion in 1996 to R11 billion in 2011 (Edoun and Netshiozwi, 2015).

2.7 CONCLUDING REMARKS

This chapter presented an introduction to international trade flow and trade flow modelling methods. The modelling method to be utilised in the present study, namely the Chenery decomposition model, was introduced and empirical literature, both international and domestic, that have utilised the Chenery and other models were reviewed. These reviews have illustrated the effectiveness of Chenery decomposition s an analytical tool and set the foundation for proceeding to Chapter 3, where more details on this modelling method are presented.

CHAPTER 3

CONCEPTUAL FRAMEWORK

3.1 INTRODUCTION

The present study is concerned with an analysis of the South African rubber industry. This analysis included the use of mathematical modelling methods to determine the causes of changes in output of the rubber industry. Before proceeding with the modelling methods the researcher developed a conceptual framework which provided the foundation for the application of the analytical framework, which is presented in Chapter 4.

A conceptual framework serves as a basis for "the measurement of your concepts in the data collection stage of the research process" (Sekaran and Bougie, 2013, p.78). This framework can provide a conceptual model to assist in providing an understanding of the relationship between the variables in the study.

In the present study, there was a requirement for conceptual frameworks to be developed by the researcher for the following reasons:

- To provide a background to the structure of the rubber industry and provide an understanding of the interconnection between various inputs and outputs to the manufacturing process.
- To disaggregate trade flow data in order to provide absolute input data for the Chenery model.
- To provide a framework to enable the estimation of the domestic output of the rubber industry.

This chapter outlines the framework in three sections – one dedicated to each of the three points above.

3.2 AN INTRODUCTION TO THE RUBBER INDUSTRY

In order to proceed with the presentation of an analytical framework relating to the rubber industry, it is pertinent to first provide a background on the rubber industry, the technology involved in the industry and the system used for international trade flow of rubber.

3.2.1 Brief Overview of Rubber Technology and Terminology

Rubber technology, as we know it today, began in the late 1700s. In these early stages, the only source of rubber was from the latex from *hevea brasiliensis* trees. Extraction of latex from trees was slow and laborious and required complex treatment processes to convert it into useable natural rubber. Synthetic versions of rubber, derived from oil and its by-products, started to emerge in the late 1800s and now make up a large portion of the volume of rubber utilised worldwide. Latex harvesting has, however, advanced significantly since the 1700s and natural rubber still remains a hugely important part of the rubber industry (Verheye, 2010).

Nowadays rubber products are directly utilised by the majority of people on this planet on a daily basis. What most people call "rubber" is in fact a material which comprises natural and/or synthetic rubber mixed together with often ten to twenty inorganic and organic materials and chemicals. The actual rubber component typically constitutes only 40-60%, and occasionally as little as 10-15%, by weight of the final rubber material (this is based on the researcher's extensive experience in the rubber industry). One can therefore comprehend that the rubber products that we are so used to seeing and using go through a complex series of steps before they reach their end use.

On their own, natural or synthetic rubbers are virtually useless. They generally need reinforcement through the addition of inorganic 'fillers', and require chemical or physical modification through the addition of organic chemicals. Incorporation of these additives into the rubber creates what is known as a *rubber compound* and provides the rubber with the properties required for its end use. The rubber compound is then heated, pressurised and converted to the shape desired for the end product and *vulcanised* or *cured* in order to set this shape.

The process of mixing of the raw rubber with the fillers and chemicals is known as *rubber compounding*. Subsequent *conversion* of the rubber compound to a vulcanised rubber product of a specific shape is generally achieved using moulding, calendering or extrusion.

3.2.2 Structure of the Rubber Manufacturing Industry

Due to the complexity of the rubber manufacturing process, the general tendency in the industry worldwide has been for a company to either focus on rubber compounding or on

rubber conversion. However, there are also some companies that do both. The input raw materials for the compounding companies are the raw rubber (natural or synthetic) and fillers and chemicals. The input raw material for the conversion companies is the rubber compound. An understanding of this is necessary in order to successfully analyse the trade flow.

Furthermore, the rubber industry worldwide has historically been divided into two sectors – the tyre sector and the non-tyre sector. The non-tyre rubber sector is commonly known as the *industrial rubber* sector. The tyre sector is by far the largest sector by volume, consuming approximately 70% of the world's rubber (The Rubber Economist, 2008). Almost all tyre companies in the world carry out the entire rubber manufacturing process themselves – i.e. they produce the rubber compound and convert it into the final tyre. The schematic in Figure 3.1 gives an overview of how the rubber industry worldwide is structured.

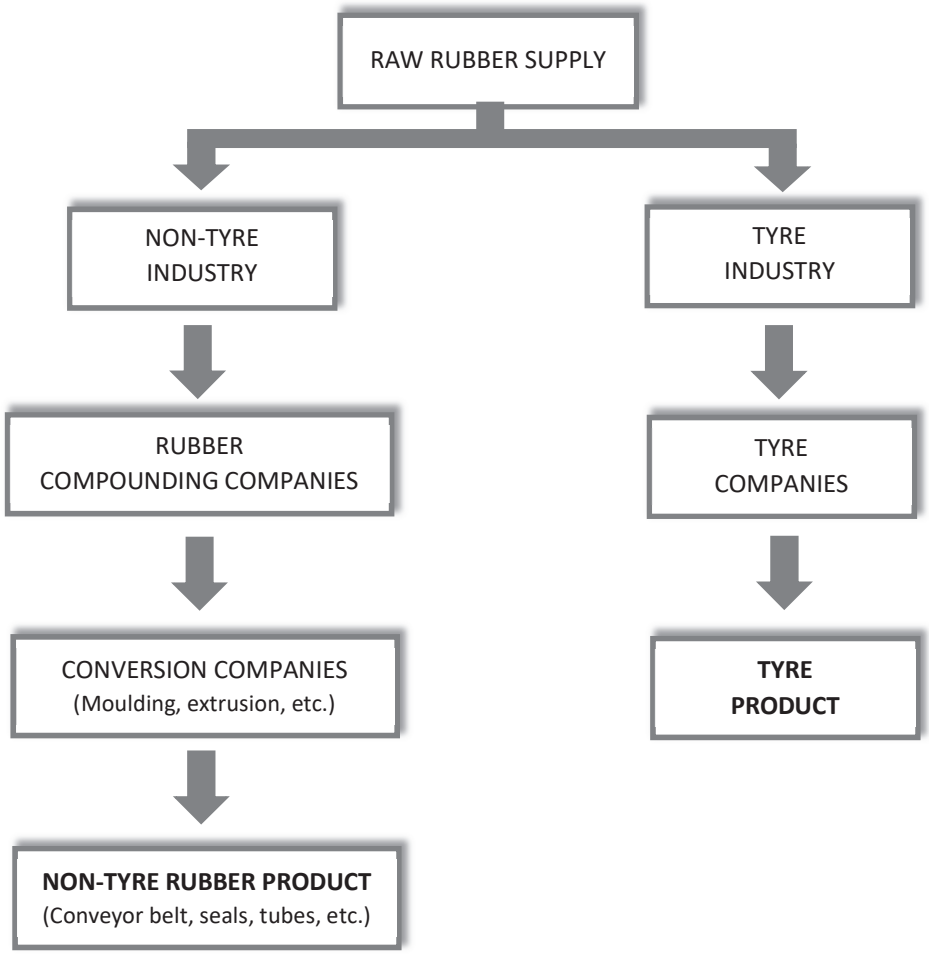


Figure 3.1 Generalised structure of the worldwide rubber manufacturing industry

Schematic based on the researcher's knowledge of the rubber industry

3.2.3 Overview of the System used for International Trade Flow of Rubber

According to the international Harmonised System (HS) of tariff nomenclature, the trade flow of all rubber materials and products is grouped into one chapter – namely Chapter 40 – *Rubber and articles thereof* (World Customs Organisation, 2016). Therefore, raw rubber, unvulcanised rubber compound and vulcanised rubber products (both tyre and non-tyre) are all grouped into this one Chapter. Analysis of the trade flow of rubber is therefore not a simple matter of analysing the change over time of a single figure for *Rubber and articles thereof*. A comprehensive analysis requires one to delve deeper into the tariff headings and sub-headings within Chapter 40 and allocate the various tariffs into the appropriate categories within the rubber industry.

There are seventeen *headings* within Chapter 40 which are listed in Table 3.1. Within each heading, there are many more sub-headings which provide further description of the rubber. The full breakdown of Chapter 40 headings and sub-headings are available on various online sources such as on the World Customs Organisation website (World Customs Organisation, 2016).

Table 3.1 Tariff headings within Chapter 40 of the harmonised system of tariffs

Heading	Description
40.01	Natural rubber, balata, gutta-percha, guayule, chicle and similar natural gums, in primary forms or in plates, sheets or strip.
40.02	Synthetic rubber and factice derived from oils, in primary forms or in plates, sheets or strip; mixtures of any product of heading 40.01 with any product of this heading, in primary forms or in plates, sheets or strip.
40.03	Reclaimed rubber in primary forms or in plates, sheets or strip.
40.04	Waste, parings and scrap of rubber (other than hard rubber) and powders and granules obtained therefrom
40.05	Compounded rubber, unvulcanised, in primary forms or in plates, sheets or strip.
40.06	Other forms (for example, rods, tubes and profile shapes) and articles (for example, discs and rings), of unvulcanised rubber.
40.07	Vulcanised rubber thread and cord.
40.08	Plates, sheets, strip, rods and profile shapes, of vulcanised rubber other than hard rubber.
40.09	Tubes, pipes and hoses, of vulcanised rubber other than hard rubber, with or without their fittings (for example, joints, elbows, flanges).
40.10	Conveyor or transmission belts or belting, of vulcanised rubber.
40.11	New pneumatic tyres, of rubber.
40.12	Retreaded or used pneumatic tyres of rubber; solid or cushion tyres, tyre treads and tyre flaps, of rubber.
40.13	Inner tubes, of rubber.
40.14	Hygienic or pharmaceutical articles (including teats), of vulcanised rubber other than hard rubber, with or without fittings of hard rubber.
40.15	Articles of apparel and clothing accessories (including gloves, mittens and mitts), for all purposes, of vulcanised rubber other than hard rubber.
40.16	Other articles of vulcanised rubber other than hard rubber.
40.17	Hard rubber (for example, ebonite) in all forms, including waste and scrap; articles of hard rubber.

Researcher's own compilation using information from the World Customs Organisation website ((World Customs Organisation, 2016))

3.3 DISAGGREGATION OF TRADE FLOW DATA

The first two objectives of this study related directly to trade flow data:

- To determine the effect of Chinese rubber imports on the output of the South African non-tyre rubber manufacturing industry.
- To determine the effect of Chinese rubber imports on the output of the South African tyre manufacturing industry.

Chapter 40 trade data for the 1999-2015 period were obtained from the DTI website in the form of import and export quantities. Further details on data collection are be provided in Chapter 4. The key task in achieving the above objectives was to correctly recognise which data to analyse and, more specifically, which data could be grouped together to make the analysis valid. It was here that the background knowledge of the rubber industry that was presented in section 3.2 was critical. Using this knowledge, the seventeen headings that were outlined in Table 3.1 can be grouped as follows which gives an initial disaggregation of the trade flow of rubber:

1. Rubber Raw Materials: Tariff Headings 40.01 to 40.04

These headings can be grouped together as *rubber raw materials*. Importing of raw materials into South Africa allows South African rubber compounding companies to produce rubber compound for supply to conversion companies. But this trade flow does not directly affect rubber conversion companies.

2. Rubber Compound: Tariff Heading 40.05

This heading refers to *rubber compound* which is ready for use by conversion companies to produce rubber products. Importing of rubber compound into South Africa potentially reduces the demand on South African rubber compounding companies.

3. Rubber Products: Tariff Headings 40.06 to 40.17

These headings can be grouped together as finished *rubber products*. Importing of rubber products into South Africa possibly potentially reduces the demand on South African rubber conversion companies and rubber compounding companies.

In order to determine if the output of the South African rubber manufacturing sector has been affected by imports, the focus of the data analysis must therefore be on Groups 2 and 3, the trade flow of rubber compound and finished rubber products. In order to fulfil the first two objectives, however, these data must be further disaggregated in order to split between the non-tyre and tyre industries and determine which data are specific to the non-tyre industry and which are specific to the tyre industry.

Group 2 refers to a single tariff heading, namely 40.05. Within this heading there are four sub-headings relating to the form of rubber compound. However, the sub-headings do not

distinguish as to whether the rubber compound is for tyre product or non-tyre product. It is therefore impossible to disaggregate Group 2 trade flow data any further. Because of this, further analysis of non-tyre and tyre sectors was limited to finished product only – i.e. Group 3.

On scrutinising the headings and sub-headings within Group 3, it was possible to allocate each heading to either the tyre or non-tyre sector as outlined in Table 3.2.

Table 3.2 Disaggregation of finished rubber product tariff headings into non-tyre or tyre

Heading	Brief description	Non-tyre	Tyre
40.06	Prepared shapes of unvulcanised rubber	✓	
40.07	Vulcanised tyre tread and cord		✓
40.08	Prepared shapes of vulcanised rubber	✓	
40.09	Tubes, pipes and hoses	✓	
40.10	Conveyor Belts	✓	
40.11	New pneumatic tyres		✓
40.12	Retreaded or used pneumatic tyres		✓
40.13	Inner tubes for tyres		✓
40.14	Pharmaceutical products	✓	
40.15	Apparel and clothing products	✓	
40.16	Other articles	✓	
40.17	Hard rubber products	✓	

3.4 DOMESTIC OUTPUT OF RUBBER PRODUCTS

The annual domestic output of the rubber industry in South Africa is the total quantity of rubber products that is produced by South African conversion companies annually. Acquiring these output data was essential for the application of analytical framework to be presented in Chapter 4. But in order for such data to be publically available it would require each of the approximately one hundred rubber manufacturing companies in South Africa to divulge their annual output. It can be appreciated that in such a competitive industry that it

would not be realistic to expect companies to do this and such information is hence not available in the public domain.

However, by use of other data that are available, the researcher devised a method that enabled the estimation of the output of the non-tyre and tyre sectors of the rubber industry. The method devised was a five-step calculation process and is presented in Chapter 4. The foundation for the development of this process was a detailed understanding of the inputs and stages required to produce a rubber product the rubber manufacturing industry. A simple schematic depicting the stages of rubber product manufacturing is presented in Figure 3.2. The basic process flow for rubber product manufacturing is that raw rubber is used to make rubber compound, and then rubber compound is converted into rubber product.

The theory behind the five-step calculation process to be presented in Chapter 4 is as follows:

- Raw rubber is used to make rubber compound. Therefore, knowledge of the amount of raw rubber consumed in South Africa each year can be used to estimate the annual quantity of rubber compound produced. Furthermore, knowledge of the proportional split in raw rubber supply into the non-tyre and tyre sectors can be used to estimate the annual quantity of rubber compound produced by each sector.
- Rubber compound is used to make rubber product. Therefore, knowledge of the annual quantity of compound consumed in South Africa by each sector can be used to estimate the annual quantity of rubber products produced by each sector – i.e. the annual domestic output of rubber products for each sector.

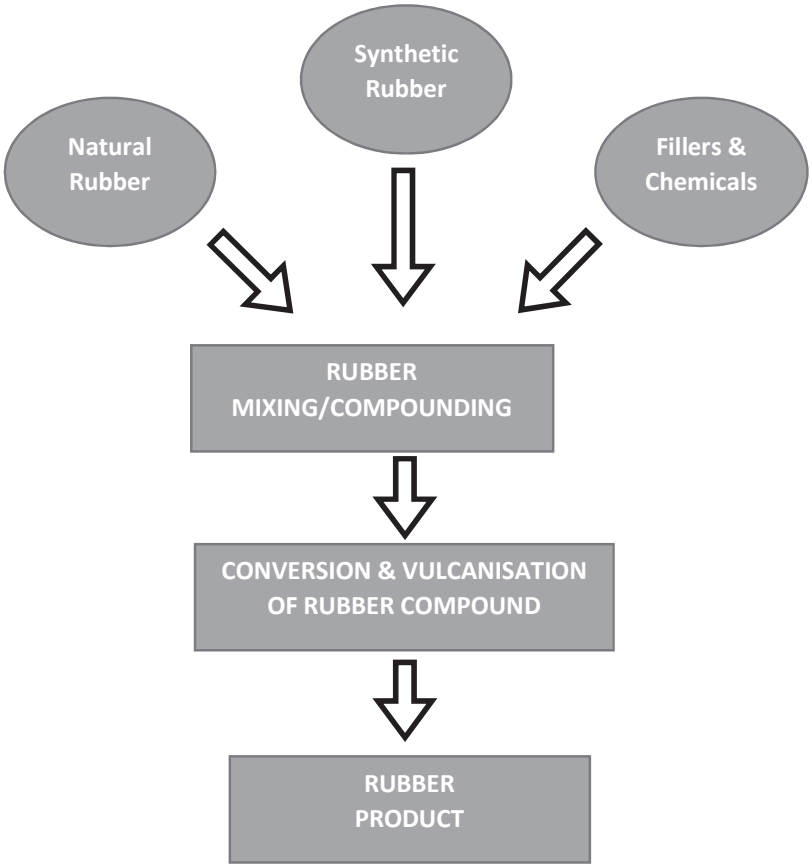


Figure 3.2 Simplistic schematic of the rubber product manufacturing process

Schematic based on the researcher's knowledge of the rubber industry

3.5 CONCLUDING REMARKS

This chapter commenced with an introduction to the rubber industry and the tariff system used for the trade flow of rubber. The conceptual frameworks were then presented which provided an overview of the foundational aspects required for the analytical frameworks to be presented in Chapter 4.

CHAPTER 4

RESEARCH APPROACH & FRAMEWORKS

4.1 INTRODUCTION

This chapter outlines the research methodology and analytical frameworks that were used in achieving the objectives of the study. The chapter commences with a general overview of research methodology and design before proceeding into the rationale used for the choice of research approach for the present study. This is followed by a presentation of the analytical framework that was adapted and developed specifically for this study on the rubber industry. The sources for secondary data and the data collection methods are also outlined.

The purpose of this study is to determine if the rubber manufacturing industry in South Africa has been affected by the importing of rubber from China over the past fifteen years (2000 to 2015).

The objectives of the study are as follows:

- To determine the effect of Chinese rubber imports on the output of the South African non-tyre rubber manufacturing industry.
- To determine the effect of Chinese rubber imports on the output of the South African tyre manufacturing industry.
- To determine the effect of Chinese rubber imports on employment in the South African rubber manufacturing industry
- To determine if South African rubber manufacturing companies have been affected by the current economic climate and to ascertain if imports of rubber products have had an effect on their business.

4.2 RESEARCH APPROACH

At the outset of any research study it is critical to outline the research approach that will be taken. Before presenting details on the approach taken for the present study, it is important to first provide a general overview of research methodology and design.

4.2.1 Overview of Research Methodology and Design

The choice of research methodology and design is a key foundation of any research study and shapes the overall approach, philosophy, strategy and interpretation that will be utilised in the collection and analysis of data.

4.2.1.1 What is Research Methodology?

Research methodology is the systematic way in which a study is carried out in order to solve a research problem. The research methodology, or the approach taken to a research study, is the strategy that connects the objectives to the data collection. At its most basic, the approach can either be qualitative or quantitative. The former involves organisation of data into quantitative form that is then subjected to rigorous and rigid analysis. The latter involves subjective assessment of opinions, beliefs and behaviour (Kothari, 2004). There is also a third approach called mixed methods which is a combination of quantitative and qualitative.

(i) Quantitative Research

In short, quantitative research involves measurement of the quantities or amount of a variable. The measurements can be expressed in numerical format which can then be applied to statistical or theoretical analytical procedures.

(ii) Qualitative Research

Qualitative research focusses on determining the feelings, thoughts and perspectives of the participants. These types of data often allow the researcher to construct theories and explanations based on the responses of the participants (Conrad and Serlin, 2011).

(iii) Mixed Methods

"Mixed methods research is an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks" (Creswell, 2014, p.4). The researcher is not restricted by the limitation of purely quantitative or purely qualitative.

Although these three approaches are often viewed as being discrete, this is in fact not always the case. Quantitative and qualitative should not be viewed as distinct categories. Instead they are situated at opposite ends of a continuum. Mixed methods research is situated

between the two and incorporates both quantitative and qualitative elements (Creswell, 2014).

It is commonplace for researchers to oversimplify their choice of research approach by simply using the viewpoint that quantitative research deals with numbers and qualitative research deals with words. But a more complete way to view the decision is to take a holistic view of the study in terms of the philosophy of the researcher, the strategic approach to be taken and the methods to be utilised (Creswell, 2014).

4.2.1.2 What is Research Design?

Research design is commonly referred to as "the blueprint for the collection, measurement and analysis of data" (Kothari, 2004, p.31). The design therefore arranges the conditions for collection and analysis of the data in a way that is relevant to the overall objectives of the study. More specifically, it outlines the source and types of information to be collected and the strategy to be used to collect the data. A well thought out research design is essential to the successful completion of any scientific research study and it assists the researcher in achieving the research objectives in a timely and efficient manner.

The design of a research study is largely determined by the type of study being conducted and, often more importantly, the type of data available to the researcher (Ellis and Levy, 2009). A research design can be exploratory, descriptive, causal-comparative or experimental.

An e***xploratory*** study is generally undertaken when little or nothing is known about the topic being researched. In these situations extensive preliminary research is required in order to gain an understanding of the topic after which a decision can be made whether or not to proceed with further research (Sekaran and Bougie, 2013).

Descriptive research searches for explanations and seeks to determine why things are like they are (Rajasekar, Philominathan and Chinnathambi, 2013). This type of study seeks to describe the characteristics of the topic being researched and often determines whether certain factors are influencing the behaviour or frequency of occurrence.

Causal-comparative research focusses on determining if a cause and effect relationship exists between one factor and another factor or set of factors. The researcher does not

manipulate the variables in any way but rather observes and collects to determine if the independent variable affects the dependent variable or variables (Ellis and Levy, 2009).

An ***experimental*** study also seeks to determine if there is a cause and effect relationship between variables but the researcher takes control of and manipulates the independent variable in order to measure or observe the performance of the dependent variable (Ellis and Levy, 2009).

In the choice of the research design, a factor which becomes important is the philosophical stance of the researcher. The *ontology*, or the "study of what can be said to exist", deals with the researcher's views of the world around us. The *epistemology*, or the "nature of knowledge or how we come to know", deals with the researcher's understandings of how we interact and relate with the world around us (Sekaran and Bougie, 2013, p.29). Together, the ontological and epistemological views of the researcher form the *paradigm* or philosophical perspective of a research study. There are three main perspectives that can be adopted (Sekaran and Bougie, 2013; Wilson, 2013):

a) ***Positivism***

   Positivists take an objective view of the research study in the belief that the truth exists independent of the researcher's interaction or interference. A positivist research approach will be rigorous, scientific and reliable and analysis generally involves quantitative observations as opposed to qualitative. Testing of cause-and effect to describe a phenomenon is often utilised.

b) ***Interpretivism***

   Interpretivists believe that the world is too complex to be measured in the rigid, scientific manner adopted by positivists. Their view is rather that the world is made up of people's thoughts and cultural surrounds. An interpretivist's approach will therefore seek an understanding of the social side of a phenomenon and will often mean that the researcher interacts with the participants leading to the collection of qualitative data which is analysed in a truly subjective manner.

c) ***Pragmatism***

   Pragmatists neither take a positivist nor an interpretivist view – they recognise that both the physical and social world are important and they believe that the truth is changing over time. A pragmatist will therefore focus on practical research and take

an objective or subjective approach depending on the research questions of the study. The research goal is therefore at the centre of the study and the researcher will take whatever steps are appropriate in order to gain the maximum insight into the phenomenon.

Using the research methodology and design background outlined in this section, a choice of approach to the current research study is now be presented.

4.2.2 Research Approach for the Present Study

There are four objectives in this study, as outlined in section 4.1, which are concerned with determining if rubber imports from China are affecting the South African rubber manufacturing industry. The approach taken to this study is determined by the nature of these objectives.

4.2.2.1 Research Methodology

The first three objectives were concerned with the rubber industry as a whole and required a rigorous analysis of data relating to domestic rubber manufacturing and international trade flow. The domestic data in question were manufacturing output data and employment data. The trade flow data were import and export data. These data are all based on *secondary data* in that the data "already exist and do not have to be collected by the researcher" (Sekaran and Bougie, 2013, p.36). Furthermore, such data "have already been passed through the statistical process" (Kothari, 2004, p.95), in that they have already been processed and analysed by someone else.

The secondary data used are in the following format:

- Weight quantities of rubber material or product measured in either kilograms (kg) or tonnes
- Monetary value of rubber material or product measured in South African Rand (ZAR)
- Quantities of employees measured in numerical format

The fourth objective was concerned with individual South African rubber manufacturing companies and sought to determine if their businesses have been affected by the recent economic climate or, more specifically, imports of rubber products. This phase of the study

involved collection of primary data using a questionnaire completed by a selection South African rubber manufacturing companies. Primary data "refers to information that the researcher gathers first hand" (Sekaran and Bougie, 2013, p.36).

The questionnaire consisted of eight questions the details of which is outlined in section 4.4.2. The first seven questions were closed, multiple choice questions – these data were therefore quantitative. The eight question was open-ended and requested the opinion of the participant, meaning that these data were qualitative in nature. However, for analysis of these data the responses were categorised and treated as quantitative. Bazeley (2012) asserted that quantising of qualitative data is a widely used approach and that this can assist in merging and comparative analysis of different data types. Indeed, Srnka and Koeszegi (2007) put forward a generalisation method for conversion of qualitative data into meaningful quantitative results.

Since the output data for this study were entirely quantitative in nature it can therefore be said that this study took a quantitative approach.

4.2.2.2 Research Philosophy and Design

The use of a quantitative approach was in line with the researcher's positivist view and belief that scientific research is the best route to determining truth and that everything can be identified and measured. Indeed, this philosophy played a role in the decision to convert the qualitative data from question eight of the questionnaire into quantitative data. It is felt by the researcher that this decision was justifiable based on the fact that the majority of the study was in fact scientific, objective and quantitative and, hence, in line with the researcher's core philosophy.

The analysis of the data focussed on quantifying the effect of Chinese imports on the output of the rubber manufacturing industry. This type of research is classified as a causal-comparative research design since it relied on the collection of data in order to determine if a cause-and-effect relationship exists between factors. The data analysis in this study therefore followed a rigorous and well-defined strategy and was scientific in nature.

The first three objectives involved collection of secondary trade data between 1999 and 2015. Such a study is called a *longitudinal study* since it analyses the change in data over time as opposed to. The analysis of these data involved application to an analytical framework which is discussed in more detail in sections 4.3. The questionnaire used for the

fourth objective was a *cross-sectional study*, which analyses data from a specific point in time.

4.3 ANALYTICAL FRAMEWORK

An analytical framework is the foundation on which the analysis in the research study is based. The framework should be identified in the literature review and should be based on previous research findings and "logical connections that can be conceptualised" between these previous studies and the present research problem (Sekaran and Bougie, 2013, p.77). A good analytical framework will establish relationships between variables and explain the reason for the relationships.

Before outlining an analytical framework for the present study, it is first important to clearly identify the variables involved.

4.3.1 Definitions of Variables

The variables that must be applied to the analytical framework in order to address the research objectives of the present study are as follows:

(i) **Domestic output** of the South African rubber industry measured in weight and monetary value
(ii) **Imports** of rubber goods measured in weight and monetary value
(iii) **Employment** in the South African rubber industry measured in number of people

For the first two objectives in the present study, the aim is to determine the effect of imports on the domestic output of the sectors of the rubber industry. By analysing the domestic output of the industry an understanding of the variability and the reasons for such variability can be obtained. The domestic output is therefore the variable of primary interest in the first two objectives of the study and is hence the *dependent variable* (Sekaran and Bougie, 2013). The level of imports of rubber goods can be classified as an *independent variable* since it influences the dependent variable and variances of dependent variable can be explained by variances in the independent variable (Sekaran and Bougie, 2013).

The third objective is concerned with analysing the effect of imports on employment in the rubber industry. In this case, employment is the dependent variable and the level of imports, again, is the independent variable.

4.3.2 Choice of Analytical Modelling Method

A brief overview of econometric modelling was presented earlier in section 2.4.1. In this discussion it was highlighted that input-output type models are ideally suited to the analysis of international trade flow data. It was also pointed out there are many variations of such models that can be applied to trade flow analysis, but only one was selected for use in the present study – namely Chenery modelling. The justification for selecting the Chenery modelling approach was as follows:

- As discussed in section 2.5, Chenery modelling has been used extensively and successfully for similar types of analysis both internationally and domestically.
- The input requirements for the Chenery model were accessible to the researcher within the time and budget constraints of the study.
- The Chenery modelling approach, unlike many modelling approaches, is not highly complex which enabled the analysis to be completed within the time constraints of the study.
- Ideally, other modelling methods should have been applied to the trade flow data in the present study in order to obtain comparisons between different methods. However, time constraints did not allow this.

4.3.3 Chenery Modelling Applied to the Rubber Industry

Analysis of the secondary data collected in this study was carried out using the well-documented Chenery Decomposition model, which was selected after the extensive review of existing literature as presented in Chapter 2. Through consideration of the conceptual framework outlined in Chapter 3, the basic Chenery equation was adapted by the researcher to the South African rubber industry as follows:

$$Q_R = D_R + X_R - M_R \qquad (4.1)$$

where Q_R is the domestic production of the rubber industry

D_R is the domestic demand of the South African rubber market

X_R is the exports of the rubber industry

M_R is the imports of the rubber industry

An overview of the inputs and outputs of the Chenery model adapted to the present study is illustrated graphically in Figure 4.1.

To determine if import penetration has occurred one must determine if the proportion of total supply that is obtained through imports increases between two periods. In other words, import penetration has occurred between time 0 and 1 if:

$$M_{R1}/D_{R1} > M_{R0}/D_{R0} \quad (4.2)$$

Note that the ratio M_{Rt}/D_{Rt} is known simply as *import penetration* and, for the rubber industry can be denoted as m_{Rt}.

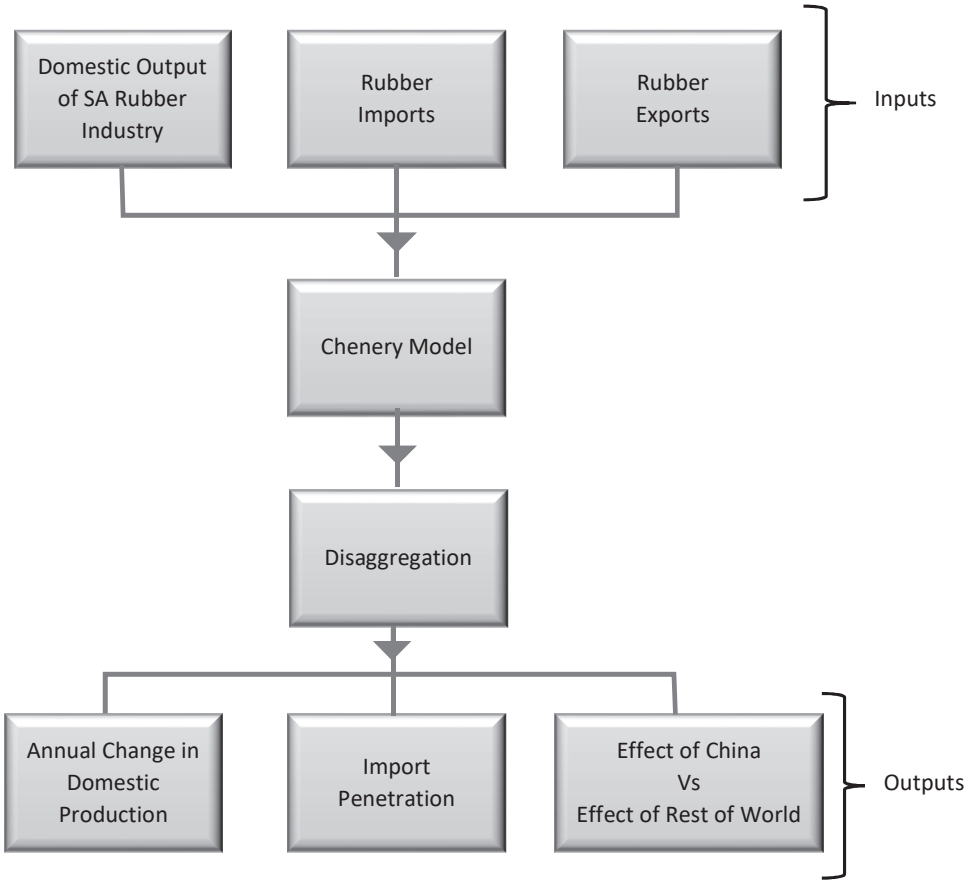


Figure 4.1 Overview of inputs and outputs of Chenery model

Schematic based on the researcher's interpretation of the Chenery model applied to the rubber industry

The Chenery model can be decomposed to give further measures which are extremely useful for data analysis. Such measures have been used previously by Zaidan (1998) and Edwards and Jenkins (2015) and were discussed previously in section 2.5. In the context of the rubber

industry between time 0 and 1, and for the present study, these measures can be adapted as follows (see Appendix 1 for derivations and further details):

Absolute Change in Annual Domestic Demand, ΔD_R:

$$D_{R1} - D_{R0} \tag{4.3}$$

Absolute Change in Annual Domestic Production, ΔQ_R:

$$Q_{R1} - Q_{R0} \tag{4.4}$$

Absolute Change in Import Penetration Level:

$$(m_1 - m_0) \tag{4.5}$$

Absolute contribution of changing domestic demand to the domestic production:

$$\Delta D_R(1 - m_{R0}) \tag{4.6}$$

Absolute contribution of changing exports to the domestic production, ΔX_R:

$$X_{R1} - X_{R1} \tag{4.7}$$

Absolute change in domestic production due to import penetration:

$$(m_{R1} - m_{R0})D_{R1} \tag{4.8}$$

Change in Import Penetration specifically due to China, Δm_c:

$$m_{Rc1} - m_{Rc0} = (M_{Rc1}/D_{R1}) - (M_{Rc0}/D_0) \tag{4.9}$$

where m_{Rct} is the Chinese import penetration at time t

M_{Rct} is the Chinese imports for the rubber industry at time t

Change in Import Penetration due to imports from the rest of the world, Δm_w:

$$m_{Rw1} - m_{Rw0} = (M_{Rw1}/D_{R1}) - (M_{Rw0}/D_0) \tag{4.10}$$

where m_{Rwt} is the import penetration from the rest of the world at time t

M_{Rwt} is the imports from the rest of the world for the rubber industry at time t

Total Loss in Domestic Production due to imports from China:

$$\Delta m_{Rc} D_1 \tag{4.11}$$

Total Loss in Domestic Production due to imports from the rest of the world:

$$\Delta m_{Rw} D_1 \qquad (4.12)$$

The Chenery modelling approach can also be utilised to analyse the effect of imports on employment as was discussed in section 2.6 of the literature review. In the context of the rubber industry between time 0 and 1, and for the present study, these measures can be adapted as follows (see Appendix 1 for derivations and further details):

Absolute Change in Employment, ΔL_R:

$$L_{R1} - L_{R0} \qquad (4.13)$$

Absolute contribution of changing domestic demand to the employment:

$$l_{R1}(1 - m_{R0})\Delta D_R \qquad (4.14)$$

where l_{Rt} is the labour productivity of the rubber industry at time t

Absolute contribution of changing exports to the employment:

$$l_{R1}\Delta X_R \qquad (4.15)$$

Absolute contribution of changing import penetration to the employment:

$$l_{R1}(m_{R1} - m_{R0})D_{R1} \qquad (4.16)$$

Absolute contribution of changing labour productivity to the employment:

$$\Delta l_R Q_{R0} \qquad (4.17)$$

Total Loss in employment due to imports from China:

$$l_{R1}\Delta m_{Rc} D_{R1} \qquad (4.18)$$

Total Loss in employment due to imports from the rest of the world:

$$l_{R1}\Delta m_{Rw} D_{R1} \qquad (4.19)$$

In order to apply equation 4.1, and subsequently equations 4.3 to 4.19 to the rubber industry, data were required for the annual domestic output of the South African rubber industry. As discussed in Chapter 3, such information was not available from any secondary sources and it was therefore required that the researcher develop a method to estimate the output using various data that were available.

4.3.4 Estimation of Domestic Output of Rubber Products

With the conceptual framework presented in section 3.4 as a foundation, the following five steps were devised to provide an estimate of the annual domestic output of the rubber products manufacturing industry.

Step 1:

It is possible to calculate the quantity of raw rubber (natural and synthetic) consumed in South Africa each year through the following:

- No natural rubber is produced in South Africa. Therefore, all natural rubber used in the country is imported and the total quantity supplied into and out of South Africa each year appears under heading 40.01 of Chapter 40 trade flow data (as outlined in section 3.2.3).
- Synthetic rubber used in South Africa has either been manufactured by Karbochem (Pty) Ltd or imported from an overseas supplier. The researcher made contact with Karbochem and they provided their annual volumes supplied to the South African market between 1999 and 2014. The imported volumes are available under heading 40.02 of Chapter 40 trade flow data (as outlined in section 3.2.3). The total synthetic rubber supplied into and out of South Africa each year can therefore be determined.

The model devised by the researcher for calculation of the annual quantity of raw rubber consumed by the South African market each year, R, was as follows:

$$R = (NR_i + SR_i + SR_{sa}) - (NR_e + SR_e - SR_{sae}) \quad (4.20)$$

where NR_i is the annual quantity of Natural Rubber imported in South Africa
SR_i is the annual quantity of Synthetic Rubber imported in South Africa
SR_{sa} is the annual quantity of Synthetic Rubber produced in South Africa
NR_e is the annual quantity of Natural Rubber exported out of South Africa
SR_e is the annual quantity of Synthetic Rubber exported out of South Africa
SR_{sae} is the annual quantity of Synthetic Rubber produced in South Africa that is exported

Absolute data for each of the variables on the right hand side of equation 4.20 were acquired from secondary sources outlined in Table 4.1 and the annual R values for the total South African market were calculated.

Table 4.1 Data source for each of the variables from equation 4.20

Variable	Data Source
NR_i	40.01 from Imported Trade Flow Data
SR_i	40.02 from Imported Trade Flow Data
SR_{sa}	South African sales volume from Karbochem (Pty) Ltd
NR_e	40.01 from Exported Trade Flow Data
SR_e	40.02 from Exported Trade Flow Data
SR_{sae}	Export sales volume from Karbochem (Pty) Ltd

Step 2:

The total annual quantity of raw rubber consumed in South Africa each year, R, can now be split to provide the annual quantity of rubber used by the non-tyre sector, R_n, and the tyre sector, R_t using the following:

$$R = R_n + R_t \qquad (4.21)$$

In order to devise the proportion of the split between non-tyre and tyre, the researcher made contact with Karbochem (Pty) Ltd, South Africa's only manufacturer of synthetic rubber, and acquired the annualised proportion of synthetic rubber that they supplied to the two sectors from 1999 to 2014. These proportions are presented in Table 4.2.

According to Karbochem's figures, an average of 72% of raw rubber was consumed by the South African tyre sector between 1999 and 2014. This is in good agreement with worldwide trends in the rubber industry for other raw materials. Brentin and Sarnacke (2011), for example, reported that in 2010 the world tyre sector accounted for 73% of world consumption of carbon black (a critical raw material in the production of rubber compound) suggesting a similar split in the industry to that experienced by Karbochem.

Table 4.2 Proportions of rubber supplied to the two sectors of the South African rubber industry by Karbochem (Pty) Ltd

	% of Rubber Supplied to Non-Tyre Sector	% of Rubber Supplied to Tyre Sector
1999	28%	72%
2000	28%	72%
2001	24%	76%
2002	23%	77%
2003	21%	79%
2004	22%	78%
2005	21%	79%
2008	29%	71%
2009	27%	73%
2010	29%	71%
2011	31%	69%
2012	33%	67%
2013	36%	64%
2014	35%	65%
Average	**28%**	**72%**

Step 3:

Knowledge of the quantity of rubber used by each sector can be used to calculate the quantity of rubber compound produced within South Africa in each sector each year using the following equation:

$$Q_{Ci} = (R_i / P_{Ci}) \times (1 - S_C) \quad (4.22)$$

where Q_{Ci} is the annual domestic output of rubber compound for sector i

R_i is annual quantity of raw rubber consumed by sector i

P_{Ci} is the average raw rubber proportion in a typical rubber compound in sector i

S_C is the nominal scrap rate for rubber compounding = 1% for both sectors

Note that the 1% scrap figure for the rubber compounding process is based on the researcher's own extensive experience in the rubber compounding industry.

Calculation of P_{Ci} also requires an extensive knowledge of the rubber compounding industry since the proportion of rubber in a compound varies widely depending on the application for which the compound is manufactured. The raw rubber component can often comprise as little as 10% to as high as 80% by weight of the final rubber compound depending on the end application. Table 4.3 presents the average data for the proportion of raw rubber within

typical tyre and non-tyre compounds. These data were based on calculations by the researcher from a range of rubber compound formulations for each sector. It is not possible to provide detailed breakdowns of these formulations due to the highly proprietary nature of the formulations. The non-tyre applications shown in Table 4.3 are deemed to be the largest segments, by volume, of the non-tyre segment in South Africa.

Table 4.3 The average proportion of raw rubber in rubber compounds in the tyre and non-tyre sectors

Non-Tyre*:	
Steel-Reinforced Conveyor	53.2%
Textile-Reinforced Conveyor	31.1%
Mill Liner	52.9%
Pipe Liner	45.7%
Average for Non-Tyre, P_{Cn}	**45.7%**
Average for Tyre, P_{Ct}	**56.5 %**

* These values were based on data for typical rubber compounds for each application which were devised using the researcher's knowledge and experience within the rubber compounding industry.

Step 4:

Knowledge of the annual domestic output of rubber compound for both sectors of the rubber industry, Q_{Ci}, can now be used to calculate the overall annual domestic output of compound for the rubber industry, Q_C, as follows:

$$Q_C = Q_{Cn} + Q_{Ct} \quad (4.23)$$

This allows the Chenery equation to be applied to the rubber compounding industry as follows:

$$D_C = Q_C + M_C - X_C \quad (4.24)$$

where D_C is the annual domestic demand for rubber compound by both sectors combined
M_C is the annual imports of rubber compound for both sectors combined
X_C is the annual exports of rubber compound for both sectors combined

Import and export data for unvulcanised rubber compound appear under one tariff heading, namely 40.05. Note that equation 4.24 could not have been applied to the non-tyre and tyre sectors separately due to the fact that the rubber compound trade flow data are not separated into the two sectors – i.e. X_{Ci} and M_{Ci} data are not known for the individual sectors.

Step 5:

The annual domestic demand for rubber compound, D_C, is the quantity of rubber compound used by South African manufacturing companies to manufacture rubber products each year. These data can now be split into tyre and non-tyre, using the annual proportions from Table 4.2, to provide the annual domestic demand of rubber compound for the non-tyre sector, D_{Cn}, and for the tyre sector, D_{Ct}.

Knowledge of these compound usage data can be used to calculate the annual quantity of rubber products manufactured by each sector each year – i.e. the annual domestic output of each sector of the rubber industry. This can be calculated using:

$$Q_{Ri} = (D_{Ci} / Y_P) \times (1 - S_R) \qquad (4.25)$$

where Q_{Ri} is the annual domestic output of rubber products for sector i of the rubber industry
D_{Ci} is the annual domestic demand for rubber compound by sector i
Y_{Pi} is the average % weight of rubber compound in a typical rubber product
S_R is the nominal scrap rate for the rubber product manufacturing

The nominal scrap rate, S_R, for the rubber conversion industry is widely accepted as being in the region of 5%. This figure is based on both the researcher's own extensive experience within the rubber industry.

The average % weight of rubber compound in non-tyre products, Y_{pn}, was found to be 76.9%. This was determined though detailed analysis of the types of products imported and exported between 1999 and 2014 as presented in Appendix 2.

The weight proportion of rubber compound in a tyre is generally accepted as 75% for passenger tyres and in the region of 75 to 78.5% for truck tyres (British Standards Institution, 2012; Ramos, Alguacil and Lopez, 2011; Williams, 2013). For the present study, Y_{pt}, was taken as the average of these figures – 77.2%.

Using equation 4.25, Q_{Rn} and Q_{Rt} could now be calculated for the non-tyre and tyre sectors respectively thus completing the framework and allowing the study to progress to the modelling of the data for the individual sectors of the rubber industry using the analytical method outlined in section 4.3.3.

4.4 DATA COLLECTION

As outlined in section 4.2, there were two types of data collected for this study, namely primary and secondary. The secondary data comprised the majority of the data collected and is discussed first.

4.4.1 Secondary Data Collection

The process of collection of secondary data requires one to firstly identify the potential data sources. Until recent times, the selection of such sources was limited and often restrictive. But nowadays there is a vast pool of data resources readily available online. The nature of the data required will largely determine the institutions that will prove to be the most useful and appropriate sources. Data gathering of large amounts of data over an extended time period is expensive to conduct and therefore government institutions are usually the best place to start. Brewer (2012) affirmed that researchers have found broad applications for secondary data analysis using the vast amounts of data available in government data banks.

The chief drawback with using government sources is the question of accuracy and reliability of the data. In some countries, government data is notorious for being unreliable and flawed. It is therefore highly recommended to, wherever possible, verify the data through a second source. Furthermore, it is vital to scrutinise data for irregularities or unjustifiable outliers and, if necessary, query any anomalies with the responsible individuals in the institution. Often the dependability of a government source can be determined by the frequency at which the institution of origin is cited in published research studies.

In his overview of secondary data analysis, Brewer (2012) suggested that the process of a secondary data research study is quite similar to that of a primary data research study – the main difference being in the process of data collection and analysis.

In the present study, the purpose of secondary data collection was to determine if rubber imports from China have affected the South African rubber manufacturing industry over the past fifteen years. The analytical framework outlined in section 4.3 was used to model the secondary data. This framework allowed the data to be in the form of either value (in South African Rand) or weight (in kilograms) and could be used to disaggregate annual changes in domestic production between annual changes in domestic demand, imports and exports and subsequently estimate the effect of international trade on the industry. Application of this framework led to the computation of key indicators which were further analysed in order to isolate the effects of trade with China on the various segments of the rubber industry.

4.4.1.1 Sources used for Secondary Data

As can be seen from Figure 4.1 presented earlier, the input data required for the Chenery model were annual trade flow data and annual domestic output data.

Trade Flow Data Source:

Trade flow data are periodically monitored and recorded by various government institutions within South Africa for the purpose of tax calculations and statistical analysis. These data are collated by the Department of Trade and Industry (DTI) on a monthly basis and are readily available online on their website (www.thedti.gov.za) in the form of both monetary value, in South African Rand, and weight in kilograms. For verification purposes, trade flow data were also obtained from the South African Revenue Service (SARS) through direct correspondence with individuals within the organisation. It was also possible to obtain a more detailed breakdown of the data from SARS which assisted in the separation of data between the non-tyre and tyre sectors of the industry.

Compilations of the Chapter 40 weight and value trade flow data obtained from secondary sources are presented in Appendix 3. In order to apply these data to the analysis in the present study, however, these data were disaggregated into the non-tyre and tyre sectors as outlined earlier in section 3.3. A summary of the disaggregated weight (tonnage) and value (Rand) data are presented in Appendix 4 for trade between South Africa and the world.

On review of these data, it was noted by the researcher that the weight data for non-tyre imports for 2006 and 2007 were extreme outliers. According to the data in Table I of Appendix 4, in 2006 the non-tyre imports increased by over 660% compared to 2005 and in 2007 it increased by 29700% compared to 2005. In 2006 the increase was due to data outliers

in two sub-headings. For example, sub-heading 40.09.41 claimed that 84000 tonnes of tubes, pipes and hoses without fittings were imported in that year, whereas the norm in this sub-heading for other years was in the region of only 1000 tonnes. In 2007 the figure was due to data outliers in four sub-headings. For example, sub-heading 40.10.31 claimed that 3.3 million tonnes of endless transmission belts were imported in that year, whereas the norm in this sub-heading for other years was in the region of 500 tonnes. These erroneous readings were queried with SARS by email on 26th February 2016 – a Senior Data Analyst confirmed that the data were unusual and instigated a detailed investigation to uncover the source of the error. However, at time of the present study going to print, this investigation had not been completed by SARS. The data for 2006 and 2007 were therefore removed from all subsequent analysis.

Since this study was concerned with the effect of Chinese imports on the rubber industry, it was necessary to also analyse the trade flow between South African and China and carry out a similar disaggregation as was done for the total trade flow. The annual weights and Rand values of product imported and exported from and to China from 1999 to 2015 for the non-tyre and tyre sectors are also presented in Appendix 4.

Domestic Data Source:

Various domestic data for the South African rubber industry were obtained from Statistics South Africa (Stats SA) both from their website (www.statssa.gov.za) and through direct contact with individuals within the organisation.

Domestic output data are available from Stats SA for both monetary value and volume output of manufacturing production. However, the volume output is in the form of an index which is merely "a statistical measure of the change in volume of production…based on the value of sales of products and articles manufactured and change in monthly stocks of manufactured products" (Stats SA, 2016b, p.18). This index is therefore not directly comparable with the absolute weight of product obtained for the trade flow data. Furthermore, the Stats SA data does not distinguish between the non-tyre and tyre sectors. An alternative means of obtaining domestic output data was therefore required.

Annual domestic weight output data for the tyre industry were obtained from the South African Tyre Manufacturers Conference (SATMC); but only from 2011 to 2015. Prior to 2011 no source for such data could be found.

Annual domestic weight output data for the non-tyre industry were not available directly from any source. For such data to be available it would be required that every non-tyre rubber company within South Africa divulge their annual manufacturing output – data which are often highly confidential due to the competitive nature of the industry. The best alternative was to estimate the domestic output using an analytical framework designed by the researcher as presented in section 4.3.4. The input data for this model were partly available through the three aforementioned public sources – namely Stats SA, SARS and the DTI. But additional data were also required which were obtained through direct correspondence with Karbochem (Pty) Ltd, a South African supplier of raw synthetic rubber. The exact sources of the secondary data obtained was indicated earlier in Table 4.1 and the collected data are presented in Table I of Appendix 5.

Employment Data Source:

Employment data for the rubber industry were also acquired for application to the Chenery model. These data were obtained from Stats SA and comprised annual employment data for Standard Industrial Classification Code (SIC) 337 which is for the *Manufacture of Rubber Products*. These data were therefore for the rubber products industry as a whole were not separated into the non-tyre and tyre sub-sectors within the rubber industry. Stats SA were only in a position to provide data from 1999 to 2014 inclusive. These data are presented in Table II of Appendix 5.

4.4.2 Primary Data Collection

In general, the collection of primary data allows a researcher to tailor the collection process to best suit the research problem at hand and to use procedures that best fit the research questions being explored. Once primary data is collected it becomes part of the existing store of knowledge and can then be utilised by others as secondary data. Primary data collection is carried out mainly through experiment or survey (Hox and Boeije, 2005).

An *experiment* refers to a study where a variable under interest is purposefully isolated and manipulated in a controlled environment and its effect on other variables is then measured and analysed. A *survey* refers to the collection of information that already exists in the field – without interference by the researcher – through the capture of data from a population or a representative sample of a population. There are three main survey methods of collecting

data – interview, observation and questionnaire. An *interview* is often used in the exploratory phase of a study and requires the researcher to present oral questions or statements to the subject(s) and record their oral response. Interviews can be unstructured or structured and can be conducted face-to-face or telephonically. *Observation* is most commonly used in behavioural science and involves the researcher watching the research subject(s) and subjectively recording what one has seen. A *questionnaire* consists of a series of written questions which is delivered to the respondents who are tasked with writing their replies in the space provided and returning the completed questionnaire to the researcher. Questionnaires are versatile in that they can be delivered to the respondents personally, by post or electronically (Kothari, 2004; Sekaran and Bougie, 2013)

In the present study the fourth objective sought to ascertain if South African rubber manufacturing companies have been affected by the recent economic climate or, more specifically, imports of rubber products over the past fifteen years. Such an objective required survey research because the data is in the past and therefore already exists. For the same reasons, survey research through observation was not a viable data collection tool meaning that the remaining options for collection were either interview or questionnaire. The latter was selected for the following reasons:

- South Africa's rubber manufacturing companies are geographically dispersed and therefore face-to-face interviews would have been an expensive and time-consuming method. Telephonic interviews were an option but due to the number of companies involved the time taken for such interviews would have been prohibitive.
- It was felt by the researcher that the nature of the questions to be asked were better suited to being presented in written format with a closed list of possible answers.
- The researcher's aim was that, wherever possible, the owners or managing directors of companies would complete the questionnaires. It was felt by the researcher that, given the time constraints for such respondents, it would be better to allow them to complete the questionnaire in their own time rather than attempting to pre-arrange an interview.

Once a questionnaire had been selected as the method of data collection, the next step was to design the questionnaire by constructing the questions.

4.4.2.1 Questionnaire Content

The purpose of the questionnaire was to probe the opinions of the respondents regarding the condition of the South African rubber industry and to seek certain facts regarding the respondents' companies. The questionnaire consisted of eight questions and is presented in Appendix 6. The overall flow of the questionnaire was designed to commence with somewhat general questions before becoming more specific and then finishing off with a general open-ended question.

The first two questions sought the respondent's opinion about the overall condition of the rubber industry in South Africa. The third and fourth questions sought specific information relating to the respondent's company. The fifth and sixth questions sought the respondent's opinion on the importing of rubber products. The seventh and eight sought the respondent's opinion on the prospects for improvement of the industry.

Before finalising the questionnaire and distributing to the respondents, a pilot test questionnaire was carried out with a selection of the researcher's work colleagues. This assisted in the finalising of the wording, the questionnaire flow and the lists of possible answers to the closed-ended questions. No participants in the pilot questionnaire were used in the final questionnaire.

After the final questionnaire had been constructed, it was necessary to devise the list of rubber companies to which the questionnaire would be sent.

4.4.2.2 Population and Survey Approach

The rubber manufacturing industry in South Africa is quite vast and widespread. The size of rubber companies in existence range from the large tyre manufacturers to the small, family-run business. In fact, there is no certainty as to the exact number of such companies in existence in South Africa today. A DTI-sanctioned report on the South African rubber industry (Chemical Marketing and Consulting Services, 2003, p.17) stated that "there are four tyre and conveyor belting manufacturers and in the order of 90 other rubber convertors in South Africa". A Department of Labour-sanctioned research report on the chemical sector (Van Zyl, 2008, p.25) stated that there were "around 130 identified other rubber manufacturing sites in SA".

To carry out a survey of the entire population of the rubber manufacturing companies would therefore be an extremely difficult task and one which would not have been possible for the present study due to budget and time constraints. In such cases a sample, that is a sub-group of the population, must be selected. By gathering and analysing information within this sample the researcher can postulate as to the behaviour of the entire population of interest (Sekaran and Bougie, 2013).

Due to the nature of the South Africa Rubber Industry and the lack of certainty and sources of information regarding the individual rubber companies, it was decided to approach an association within the rubber industry for assistance. The Institute of Materials, Mineral & Mining (IOM3) is the only such association of rubber companies that exists within South Africa and they agreed to assist in providing a list of their members and contact details for individuals within these member companies (presented in Appendix 7). They also gave written approval for the researcher to survey these members which assisted greatly in the granting of ethical clearance by the Ethical Clearance Committee at the University of KwaZulu-Natal (see Appendix 8).

According to Sekaran and Bougie (2013, p.240), in the context of surveys, a "population refers to the entire group of people, events or things of interest that the researcher wishes to investigate".

In the present study, the population therefore refers to the rubber manufacturing companies that are members of IOM3. The number of companies in the population was 26, which was deemed to be a manageable size for the questionnaire. It was therefore decided to use a census survey approach whereby all of the population members were surveyed.

4.4.2.3 Administration of Questionnaire

The questionnaires were sent via electronic mail and respondents required to complete and return. The questionnaire was therefore self-administered questionnaire in that the participants completed the questionnaire in their own time and without any interaction with the researcher. Self-administration was chosen so that there would be no time or travel boundaries in the participation. Email was chosen primarily due to the fact that it is the quickest and most direct form of delivery.

The questionnaires were sent out to participants on 4th April 2016. A reminder was sent out after 2 weeks to those participants that had not already responded. Thereafter two more reminders were sent before the shut-off date of the 13th May 2016 was reached.

4.4.3 Data Validity and Reliability

In the data collection phase of any research study it is vital to ascertain the validity and reliability of the data. Validity is the relevance, appropriateness and overall suitability of the data to the research study being carried out. In other words, validity "indicates the degree to which an instrument measures what it is supposed to measure" (Kothari, 2004, p.73). Reliability is "the extent to which we can rely on the source of the data and, therefore, the data itself" (Pierce, 2008, p.83).

There are three types of validity that must be considered when assessing data (Kothari, 2004):

(i) *Content validity* which relates to the coverage of the data in terms of the population. Does the data represent the population?
(ii) *Criterion-related validity* which relates to the success of the data in empirical predictions. Expressed as the coefficients of correlation between the data and some measure of future performance or against other measures of validity.
(iii) *Construct validity* which relates to the degree to which predictions using the data conform to other theoretical predictions.

For secondary data, it is generally considered that a range of validity and reliability criteria should be used for evaluation of potential data, which can be incorporated into a three-step process (Saunders, Lewis and Thornhill, 2012):

1. **Assess the overall suitability of the data to the research objectives**
   To do this one must assess the validity of the data in terms of its ability to provide the information that is required. It is also important to consider the population coverage of the data – in other words, do the data represent the population and time period that is required for the study. Data which are not relevant to the study must be omitted.

2. **Evaluate the precise suitability of the data for analysis**

   Here one must pay particular attention to the validity and reliability of the data in terms of the method used in data collection and the source of the data. In general, data from large organisations that have a proven history of providing credible data are more likely to be reliable. Data from government organisations are generally thought to be reliable. The possibility of measurement bias must also be considered at this stage. Measurement bias can be caused by deliberate recording of inaccurate data or by changing the data collection method. While bias may be difficult to detect, the potential for bias should be considered by examining the source with an open mind and considering the possibility that pressures on the source may have biased the data. A cross-check with other published data sources can also improve the confidence that secondary data are not distorted.

3. **Assessment of costs and benefits in comparison to alternative sources**

   This step involves an assessment of the costs that would be incurred in acquiring the secondary data and considered against to the benefits they will bring to the study. Costs may include institutional access fees, travel expenses, etc. The benefits can be assessed in terms of the extent to which the data will assist in answering of the research questions.

In the present study, the above three-step method was used to assess the validity and reliability of the secondary sources and is discussed in Chapter 5.

4.5 CONCLUDING REMARKS

This chapter commenced with a general overview of research approaches that can be taken to a research study. The selection of the approach used for the present study was indicated and explained. Due to the nature of the objectives in the study, an analytical framework was presented that was used to model the input and output data relating to trade flow and domestic production of the rubber manufacturing industry. Due to the limitations of data availability for the rubber industry, it was necessary to develop a model which assisted in the analysis of the variables. Finally, the data collection methods used for the secondary and primary data were presented. Any secondary data that were collected during the data collection phase were also presented in this chapter.

CHAPTER 5
EMPIRICAL ANALYSIS & RESULTS

5.1 INTRODUCTION

The previous chapter presented the research approach and the analytical and conceptual frameworks that were used in the study, which included a review of the Chenery modelling method that was utilised. The present chapter augments the analysis methods used by applying the Chenery framework and the analytical techniques on trade flow and output data that were obtained for the 1999 to 2015 period. Note that other secondary data such as the Karbochem (Pty) Ltd data and employment data could only be obtained for the 1999 to 2014 period. Therefore, the empirical analysis in this chapter does not include 2015 but rather focusses on the 15-year period from 1999 to 2014. Furthermore, it was found that secondary trade flow data obtained for 2006 and 2007 were erroneous and these years were therefore removed from the analysis.

Initially, in this chapter, a section is dedicated to the assessment of the validity and reliability of the secondary data used in this study. This is followed by a section that outlines the analysis and results for the estimation of domestic output, which is structured in the same step sequence as the framework steps presented previously in section 4.3.4. Thereafter, a section is dedicated to each of the four objectives of the study within which the appropriate analysis and results are presented.

All calculations and data modelling were completed in Microsoft Excel using spreadsheets and Excel formulae developed by the researcher for this study. All tables and graphs presented in this chapter are the researcher's own compilations based on data generated for this study.

5.2 ASSESSING THE VALIDITY AND RELIABILITY OF THE SECONDARY DATA

As outlined in section 4.4, this study involved the collection of secondary data from various sources in order to carry out an analysis of the effects of imports on the South African rubber industry. Before proceeding with the analysis phase of the study it is important to examine the secondary data in terms of their validity and reliability for this research study. The types

of secondary data acquired for this study, alongside their sources, are presented in Table 5.1. Each source was assessed using the three-step process that was outlined in section 4.4.3. A summary of this assessment is presented here under the same three-step headings.

Table 5.1 Data sources for secondary data used in the present study

Data Source	Data Acquired
The Department of Trade & Industry (DTI) from their website (www.thedti.gov.za)	Import Export Data
The South African Revenue Service (SARS) by direct contact with individuals in the organisation	Import Export Data
Statistics South Africa (Stats SA) by direct contact with individuals in the organisation	Employment data
Karbochem (Pty) Ltd by direct contact with their Accounts Manager	Sales volumes of synthetic rubber
South African Tyre Manufacturer's Conference (SATMC) by direct contact with their Managing Executive	Output of Tyre Sector

1. Assess the overall suitability of the data to the research objectives

The import and export data required in order to complete the analyses for this study were figures for annual tonnage of rubber products that were imported and exported for the various chapter 40 tariff headings and sub-headings. These data were available in this exact format from the DTI and SARS and were therefore suitable for this study. The coverage of the data from the DTI and SARS was 100% – in other words, their data recorded all import and export transactions that were carried out through South African customs channels. The issue of population sampling is therefore not applicable to these data.

The employment data required were the annual figures of the number of people employed in the rubber industry. These data were available from Stats SA in the form of quarterly updates on the number of people employed in the industry as per Standard Industry Classification (SIC) 337 which applies to the rubber products industry. The employment

statistics collected by Stats SA therefore covered the entire rubber industry and were therefore suitable for this study.

The data on sales volume of synthetic rubber required were annual tonnages supplied into the tyre and non-tyre sectors in South Africa by Karbochem (Pty) Ltd. These data were compiled by Karbochem specifically for the purpose of this study and therefore were provided in such a way that they suited the researcher's needs.

The data required for output of the tyre sector were the annual tonnages of tyres produced by the entire South African tyre sector. The SATMC were in a position to provide these data, but only from 2011 onwards. These data were therefore not suitable for the entire 1999-2014 period of study, but they were suitable in terms of providing validity to the analytical framework utilised by the researcher (see Chapter 6).

2. Evaluate the precise suitability of the data for analysis

The DTI, SARS and Stats SA are all government organisations and, in general, "survey data from government organisations are likely to be reliable" (Saunders et al., 2012, p.274). Furthermore, data from the DTI and Stats SA have been used in similar studies that have analysed the effects of imports on the manufacturing industry (Edwards and Jenkins, 2015; Tregenna, 2012). There are no reasons to suspect that there may have been measurement bias in any of the data provided by these organisations.

Data obtained from Karbochem and SATMC were data provided specifically for this study and were obtained from individuals at the upper level of the organisations. There are no known reasons why the data acquired would be incorrect or biased in any way.

It was difficult to directly cross-check the acquired secondary data with any other sources since, as far as the researcher is aware, there were no alternative sources for the data that were acquired. The best alternative was to cross-check analysis results from the study with analysis results from previously published studies. This cross-check is be presented in the form of an assessment of the frameworks which is presented in Chapter 6.

3. Assessment of costs and benefits in comparison to alternative sources

There were no monetary costs involved in acquiring any of the secondary data in this study. There were, however, considerable amounts of time involved in making contact with

organisations, requesting specific information and then waiting for feedback. However, the data required were essential to the study and the time required in their acquisition was deemed to be worthwhile.

5.3 ESTIMATION OF DOMESTIC OUTPUT

A framework was devised by the researcher that enabled the estimation of the domestic output of rubber products in South Africa. This framework was outlined previously in section 4.3.4 and involved a 5-step process. The analysis results are presented here for these steps.

Step 1: **Calculation of R, the annual quantity of raw rubber consumed in South Africa**

Equation 4.20, presented earlier, was devised by the researcher for calculation of R. Using the data sources indicated in Table 4.1 and the secondary data presented in Table I of Appendix 5, the annual values for R were obtained for the 1999 to 2014 period. These results are presented in Table 5.2.

Table 5.2 Values for R, the total quantity of raw rubber consumed by the South African rubber industry, from 1999 to 2014 ($x10^3$ tonnes)

	Quantity of rubber consumed by the overall rubber industry, R
1999	**103.16**
2000	**117.38**
2001	**105.29**
2002	**129.03**
2003	**132.87**
2004	**133.41**
2005	**119.06**
2008	**128.43**
2009	**111.37**
2010	**113.31**
2011	**121.45**
2012	**115.38**
2013	**112.02**
2014	**109.79**

Step 2: **Calculation of R_n and R_t, the annual quantities of rubber consumed by both the non-tyre and tyre-sectors respectively**

Using Karbochem (Pty) Ltd's annual proportional split data presented earlier in Table 4.2, the annual quantity of raw rubber consumed by each sector can be calculated by applying these proportions to the R-values from Table 5.2. The resultant data are presented in Table 5.3.

Table 5.3 Estimate of raw rubber consumed by both the non-tyre and tyre sectors of the South African rubber industry from 1999 to 2014 ($x10^3$ tonnes)

	Quantity of rubber supplied to non-tyre sector, R_n	**Quantity of rubber supplied to tyre sector, R_t**
1999	28.89	74.28
2000	32.87	84.51
2001	25.27	80.02
2002	29.68	99.35
2003	27.90	104.97
2004	29.35	104.06
2005	25.00	94.06
2008	37.25	91.19
2009	30.07	81.30
2010	32.86	80.45
2011	37.65	83.80
2012	38.07	77.30
2013	40.33	71.69
2014	38.43	71.36

Step 3: **Calculation of Q_{Cn} and Q_{Ct}, the annual domestic output of rubber compound for both the non-tyre and tyre sectors respectively**

Equation 4.22, presented earlier, was devised by the researcher for estimation of Q_{Cn} and Q_{Ct}. Using the R-values presented in Table 5.3, the annual values for Q_{Cn} and Q_{Ct} were calculated for the 1999 to 2014 period and are presented in Table 5.4.

Table 5.4 Annual domestic output of rubber compound for the non-tyre and tyre sectors from 1999 to 2014 (x10^3 tonnes)

	Quantity of Compound produced by the non-tyre sector, Q_{Cn}	**Quantity of Compound produced by the tyre sector, Q_{Ct}**
1999	61.26	120.08
2000	69.70	136.63
2001	53.59	129.37
2002	62.93	160.62
2003	59.17	169.70
2004	62.24	168.23
2005	53.02	152.06
2008	78.99	147.42
2009	63.77	131.43
2010	69.68	130.06
2011	79.84	135.48
2012	80.74	124.97
2013	85.52	115.91
2014	81.49	115.37

Step 4: **Application of the Chenery model to the rubber compounding industry**

Equation 4.23, presented earlier, was used to calculate Q_C, the total annual quantity of rubber compound produced in South Africa. These data were then applied to the adapted Chenery equation 4.24 to complete the modelling of the South African rubber compound industry. The model data are presented in Table 5.5. Note that the M_C and X_C data presented here correspond to the secondary import and export data for heading 40.05 (unvulcanised compounded rubber) presented in Tables I and II of Appendix 3.

Table 5.5 Compilation of Chenery model data for South African rubber compounding industry from 1999 to 2014 ($x10^3$ tonnes)

	M_C	X_C	Q_C	D_C
1999	0.50	1.68	181.34	180.16
2000	0.74	1.51	206.33	205.56
2001	0.61	2.59	182.96	180.97
2002	1.27	3.93	223.55	220.89
2003	0.80	3.96	228.87	225.72
2004	0.99	3.00	230.47	228.45
2005	0.96	3.42	205.08	202.62
2008	1.82	3.77	226.41	224.45
2009	3.46	3.13	195.20	195.53
2010	2.03	2.92	199.74	198.86
2011	2.27	4.92	215.32	212.66
2012	2.63	5.09	205.71	203.25
2013	2.24	4.13	201.43	199.54
2014	2.24	3.77	196.86	195.33

Step 5: **Calculation of Q_{Rn} and Q_{Rt}, the annual domestic output of rubber products from both the non-tyre and tyre-sectors respectively**

Initially, D_{Cn} and D_{Ct}, the annual quantities of rubber compound consumed by the non-tyre and tyre-sectors respectively were calculated by applying the Karbochem annual proportional split data (Table 4.2) to the D_C data from Table 5.4. The resultant data for these calculations are presented in Table 5.6.

The D_{Cn} and D_{Ct} values from Table 5.6 were then applied to equation 4.25, presented earlier, to calculate the annual domestic output of rubber products for each sector of the rubber industry. This completed the calculations in this section and all of the data were now available to be applied to the Chenery model for the rubber products industry in order to fulfil the objectives of the study.

Table 5.6 Domestic demand of rubber compound for both the non-tyre and tyre sectors of the South African rubber industry from 1999 to 2014 ($x10^3$ tonnes)

	Rubber compound consumed by the non-tyre sector D_{Cn}	Rubber compound consumed by the tyre sector D_{Ct}
1999	50.44	129.71
2000	57.56	148.01
2001	43.43	137.54
2002	50.80	170.08
2003	47.40	178.32
2004	50.26	178.19
2005	42.55	160.07
2008	65.09	159.36
2009	52.79	142.73
2010	57.67	141.19
2011	65.93	146.74
2012	67.07	136.18
2013	71.84	127.71
2014	68.37	126.97

5.4 ANALYSIS OF THE NON-TYRE MANUFACTURING SECTOR

The first objective of this study was to determine the effect of Chinese rubber imports on the output of the South African non-tyre rubber manufacturing industry.

To address this objective, secondary data were collected and modelled using the Chenery method and then decomposed to provide further insight into the reasons for the changes in domestic production. An overview of the analytical framework used for this study was presented earlier in section 4.3.

The first phase in the analysis was to apply the secondary data and output (production) data pertaining to the non-tyre sector to the Chenery model. Equation 4.1, presented earlier, can be adapted for the non-tyre sector as follows:

$$Q_{Rn} = D_{Rn} + X_{Rn} - M_{Rn} \quad (5.1)$$

where D_{Rn} is the domestic demand for non-tyre rubber products by the South African market
Q_{Rn} is the annual domestic production of non-tyre rubber products

M_{Rn} is the imports of non-tyre rubber products

X_{Rn} is the exports of non-tyre rubber products

X_{Rn} and M_{Rn} for this equation were obtained from the export and import data presented in Table I of Appendix 4. Q_{Rn} data were obtained through the calculations detailed in section 5.3. D_{Rn} could therefore be calculated using equation 5.1 thus completing the Chenery modelling. The resultant model data for the non-tyre sector are presented in Table 5.7.

Table 5.7 Compilation of Chenery model data for South African non-tyre sector from 1999 to 2014 ($x10^3$ tonnes)

	M_{Rn}	**X_{Rn}**	**Q_{Rn}**	**D_{Rn}**
1999	16.79	10.00	60.71	67.49
2000	16.91	9.28	69.46	77.10
2001	18.08	8.16	53.04	62.96
2002	23.28	9.66	62.35	75.98
2003	27.18	10.89	58.41	74.70
2004	36.99	11.95	61.20	86.24
2005	42.48	12.40	51.89	81.97
2008	46.80	13.04	81.07	114.83
2009	45.23	18.11	64.78	91.90
2010	51.78	17.24	72.29	106.83
2011	53.92	20.17	82.90	116.66
2012	54.58	19.90	84.44	119.12
2013	62.16	29.50	91.48	124.14
2014	58.46	28.61	85.25	115.09

The second phase was to decompose the domestic production, Q_{Rn}, using the Chenery method in order to measure how various input variables to the modelling have affected domestic production in the non-tyre sector of the South African rubber industry. Decomposition was carried out by applying equations 4.3 to 4.8 to the data in Table 5.7. The resultant decomposition results are presented in Table 5.8 for the overall 1999 to 2014 period and also separately for two 6-year sub-periods within this time – namely 1999 to 2005 and 2008 to 2014 (2006 and 2007 were omitted, as noted earlier). The purpose of dividing into sub-sectors assisted in determining the effect of changing circumstances on growth.

The first three rows in Table 5.8 give an overall view of the non-tyre rubber sector. Between 1999 and 2014 the domestic demand of non-tyre products increased significantly by over 47000 tonnes. Notably, there was a large increase in demand during the first sub-period of 1999 to 2005 and only a small increase in the second sub-period of 2008-2014. However, despite this high increase in demand during 1999 to 2005, the domestic production actually reduced markedly in this same period by almost 9000 tonnes. The domestic production recovered somewhat during the latter 2008 to 2014 period and overall, during the entire 1999 to 2014 period, the domestic production in the non-tyre sector grew by over 24000 tonnes.

Table 5.8 Chenery decomposition of domestic production of non-tyre rubber products

	1999-2005	**2008-2014**	**1999-2014**
Change in Domestic Demand (tonnes)	+14 477	+261	**+47 601**
Change in Domestic Production (tonnes)	-8 819	+4 177	**+24 539**
Absolute Change in Import Penetration (%)	+27 %	+10 %	**+26 %**
Factor Decomposition:			
Contribution of changing domestic demand to the domestic production (tonnes)	+10 876	+155	**+35 673**
Contribution of changing exports to domestic production (tonnes)	+2 397	+15 578	**+18 611**
Change in domestic production due to import penetration (tonnes)	-22 092	-11 556	**-29 835**

The factor decomposition data in Table 5.8 (bottom three rows) show the contribution of three factors to the domestic production in the non-tyre sector – namely domestic demand, exports and import penetration. It was found that for the 1999-2014 period a rise in domestic demand contributed almost 36000 tonnes to the growth in domestic production and a rise in exports contributed almost 19000 tonnes. However, a significant level of import penetration effectively reduced the demand on the South African non-tyre sector by almost 30000 tonnes in the same period. This represents an average of almost 2000 tonnes per year in domestic production lost due to imports. This is a substantial quantity of rubber products especially

when one considers that a sizeable proportion of the rubber manufacturing companies in South Africa are likely to have an output of less than 100 tonnes per annum.

The third phase in the analysis was to assess the direct effect of Chinese imports on the non-tyre sector. An initial overview of the effect of Chinese imports can be obtained by examining the change in annual Chinese import penetration between 1999 and 2014. For comparison, it is also useful to examine the import penetration from the rest of the world (ROW). Import penetration is simply calculated as the proportion of imports to domestic demand (as outlined in section 4.3.3). Chinese import data for these calculations were obtained from Table III of Appendix 4. The import data for the ROW were taken as the total imports (presented in Table I of Appendix 4) less the Chinese imports (presented in Table III of Appendix 4). The resultant annual import penetration data are presented in Table 5.9.

Table 5.9 Import penetration for the South African non-tyre sector from 1999 to 2014

	Import Penetration from China	**Import Penetration from the ROW**
1999	0.8%	24.0%
2000	1.4%	20.6%
2001	3.6%	25.1%
2002	7.7%	23.0%
2003	7.5%	28.8%
2004	8.3%	34.6%
2005	11.2%	40.7%
2008	13.2%	27.6%
2009	16.0%	33.2%
2010	19.7%	28.8%
2011	19.5%	26.7%
2012	17.9%	27.9%
2013	23.8%	26.2%
2014	23.6%	27.2%

It can be clearly seen from Table 5.9 that that import penetration from China in the non-tyre sector has increased significantly since China joined the World Trade Organisation (WTO) in 2001. Between 1999 and 2014 import penetration from the ROW has only seen a minor increase. The 2014 Chinese import penetration figure of 23.6% means that in this year Chinese imports accounted for almost a quarter of the total demand for non-tyre rubber

products in South Africa, almost matching the import penetration from all other parts of the world (27.2%). However, while this illustrates that Chinese imports have certainly been on the rise, it is not to say for certain that these Chinese imports have displaced domestic production – they may simply be at the expense of imports from other parts of the world.

Further decomposition by applying equations 4.9 to 4.12 to the Chenery model data and import data provides a more detailed analysis of the effect of Chinese imports on domestic production. The resultant data are presented in Table 5.10. It is evident from these data that Chinese imports are indeed having a substantial effect on the domestic production of non-tyre rubber products. The overall import penetration figures for China and the ROW for the 1999 to 2014 period are both positive which infers that the entire increase in Chinese import penetration has come at the expense of domestic production (Edwards and Jenkins, 2015).

Table 5.10 Decomposition of domestic production showing the effect of Chinese imports on the non-tyre sector

	1999-2005	***2008-2014***	**1999-2014**
Absolute change in Chinese Import Penetration (%)	*+10 %*	*+10 %*	**+23 %**
Absolute Change in Import Penetration from the rest of the world (%)	*+17%*	*-0.4%*	**+3%**
Change in domestic production due to the change in Chinese import penetration (tonnes)	*-8 465*	*-12 014*	**-26 028**
Change in domestic production due to the increase in import penetration from the rest of the world (tonnes	*-13 627*	*+459*	**-3 627**

Looking at the two sub-periods in Table 5.10, one can see a distinct changeover from the ROW imports to Chinese imports in the transition from the first sub-period to the second. Between 1999 and 2005 the ROW change in import penetration was dominant at 17% compared to 10% for China leading to losses in domestic production of 13627 tonnes and 8465 tonnes respectively. These first 6 years were in the early stages of China's membership of the WTO and, while import penetration due to China was increasing steadily, the ROW was still importing higher quantities. However, between 2008 and 2014 this changed

dramatically. The change in import penetration due to China remained at 10% but the ROW plummeted to -0.4%. Note that this marginally negative value means that it is possible that a small portion of the 12014 tonnes of domestic production lost to China in this period may have actually replaced imports from the rest of the world. But it is still an immensely significant figure.

5.5 ANALYSIS OF THE TYRE MANUFACTURING SECTOR

The second objective of this study was to determine the effect of Chinese rubber imports on the output of the South African tyre rubber manufacturing industry.

To address this objective, using the same method as with the non-tyre sector, secondary data were collected and modelled using the Chenery method and then decomposed to provide further insight into the reasons for the changes in domestic production. An overview of the analytical framework used for this study was presented earlier in section 4.3.

The first phase in the analysis was to apply the secondary data and output (production) data pertaining to the non-tyre sector to the Chenery model. Equation 4.1, presented earlier, can be adapted for the tyre sector as follows:

$$Q_{Rt} = D_{Rt} + X_{Rt} - M_{Rt} \quad (5.2)$$

where D_{Rt} is the domestic demand for tyres by the South African market
Q_{Rt} is the annual domestic production of tyre products
M_{Rt} is the imports of tyres
X_{Rt} is the exports of tyres

X_{Rt} and M_{Rt} for this equation were obtained from the export and import data presented in Table I of Appendix 4. Q_{Rt} data were obtained through the calculations detailed in section 5.3. D_{Rt} could therefore be calculated using equation 5.2 thus completing the Chenery modelling. The resultant model data for the non-tyre sector are presented in Table 5.11.

Table 5.11 Compilation of Chenery model data for South African tyre sector from 1999 to 2014 (x10^3 tonnes)

	M_{Rt}	X_{Rt}	Q_{Rt}	D_{Rt}
1999	9.49	7.55	144.97	146.90
2000	9.81	5.23	165.42	169.99
2001	9.81	5.58	153.72	157.94
2002	10.04	5.60	190.09	194.53
2003	12.36	5.41	199.29	206.24
2004	12.29	6.35	199.16	205.09
2005	15.81	6.99	178.90	187.72
2008	15.04	8.79	178.11	184.36
2009	13.67	50.65	159.53	122.55
2010	16.84	9.46	157.80	165.18
2011	16.08	11.77	164.00	168.31
2012	17.15	10.67	152.20	158.68
2013	17.05	6.68	142.73	153.10
2014	16.42	6.54	141.90	151.79

The second phase was to decompose the domestic production, Q_{Rt}, using the Chenery method in order to measure how various input variables to the modelling have affected domestic production in the tyre sector of the South African rubber industry. Decomposition was carried out by applying equations 4.3 to 4.8 to the data in Table 5.11. The resultant decomposition results are presented in Table 5.12.

The first three rows in Table 5.12 give an overall view of the tyre sector. Between 1999 and 2014 the domestic demand of tyre products increased significantly by almost 5000 tonnes. However, in the two sub-periods a distressing trend is evident – between 1999 and 2005 the demand increased by almost 41000 tonnes but between 2008 and 2014 it dropped by over 32000 tonnes. A similar pattern is evident with domestic production for the sub-periods. The negative effect of change in import penetration were not to the same level as that experienced in the non-tyre industry. But there was still a gradual increase overall as is evident by the 4% absolute increase in import penetration between 1999 and 2014.

The factor decomposition data in Table 5.12 (bottom three rows) show the contribution of domestic demand, exports and import penetration to domestic production in the tyre sector. Domestic demand contributed over 38000 tonnes to the domestic production of tyres between 1999 and 2005 but it effectively reduced domestic production by almost 30000

tonnes between 2008 and 2014. Exports of tyres similarly detracted more from domestic production in the second sub-period compared to the first and, for the overall 15-year period, exports reduced domestic production by just over 1000 tonnes. This was due to the drop in quantities of tyres being exported (as seen in Table I of Appendix 4). The increase in import penetration led to an increasing drop in domestic production as is evident from the 3688 tonne reduction in the first sub-period and 4033 tonnes in the second sub-period. Over the entire 15-year period 6619 tonnes tyres were imported at the expense of domestic production.

Table 5.12 Chenery decomposition of domestic production of tyre products

	1999-2005	**2008-2014**	**1999-2014**
Change in Domestic Demand (tonnes)	+40 821	-32 578	**+4 811**
Change in Domestic Production (tonnes)	+33 928	-36 205	**- 3069**
Absolute Change in Import Penetration (%)	+2 %	+3 %	**+4 %**
Factor Decomposition:			
Contribution of changing domestic demand to the domestic production (tonnes)	+38 185	-29 920	**+4 566**
Contribution of changing exports to domestic production (tonnes)	-568	-2 252	**-1 016**
Change in domestic production due to import penetration (tonnes)	-3 688	-4 033	**-6 619**

The third phase in the analysis was to assess the direct effect of Chinese imports on the tyre sector. An initial overview of the effect of Chinese imports can be obtained by examining the change in the annual Chinese and the ROW import penetrations between 1999 and 2014. The resultant annual import penetration data are presented in Table 5.13. As with the non-tyre sector, import penetration from China has increased steadily since China joined the WTO in 2001. However, the level of penetration was significantly lower than for the tyre sector than the non-tyre sector, peaking at only 4.0% in 2014. The import penetration for the ROW did not vary significantly in the 1999 to 2014 period.

Table 5.13 Import penetration for the South African tyre sector from 1999 to 2014

	Import Penetration from China	Import Penetration from the ROW
1999	0.2%	6.3%
2000	0.3%	5.4%
2001	0.6%	5.6%
2002	0.4%	4.8%
2003	0.5%	5.5%
2004	0.9%	5.1%
2005	1.7%	6.7%
2008	2.1%	6.0%
2009	2.8%	8.4%
2010	3.2%	6.9%
2011	3.0%	6.6%
2012	3.8%	7.0%
2013	3.8%	7.4%
2014	4.0%	6.9%

Further decomposition by applying equations 4.9 to 4.12 to the Chenery model data and import data provides a more detailed analysis of the effect of Chinese imports on domestic production in the tyre sector. The resultant data are presented in Table 5.14. From these data it is evident that Chinese imports have had a significant effect on the domestic production of tyre products. Furthermore, all import penetration percentage figures for China and ROW are positive inferring that the entire increase in Chinese import penetration has come at the expense of domestic production (Edwards and Jenkins, 2015). Therefore, almost 6000 tonnes of domestic production has been lost solely due to Chinese imports – which is 87% of the total amount of production lost due to imports from the entire world. Incidentally, this the exact same proportion that was seen with the non-tyre sector.

Table 5.14 Decomposition of domestic production showing the effect of Chinese imports on the tyre sector

	1999-2005	2008-2014	1999-2014
Absolute Change in Chinese Import Penetration (%)	+1.5 %	+1.8 %	**+3.8 %**
Absolute Change in Import Penetration from the rest of the world (%)	+0.4 %	+0.8 %	**+0.6 %**
Change in domestic production due to the increase in Chinese import penetration	-2 856	-2 760	**-5 732**
Change in domestic production due to the increase in import penetration from the rest of the world	-833	-1273	**-886**

5.6 ANALYSIS OF EMPLOYMENT IN THE RUBBER INDUSTRY

The third objective of this study was to determine the effect of Chinese rubber imports on employment in the South African rubber manufacturing industry.

To address this objective, secondary data were collected and modelled using the Chenery method and then decomposed to provide further insight into the reasons for the changes in employment (the decomposition method was detailed earlier in section 4.3.3).

Because separate data were not available for the two sectors of the rubber industry, data for modelling involved combining the tyre and non-tyre domestic production data and trade flow data to compile a single Chenery model for the overall rubber manufacturing industry. Therefore, initially, the Chenery model was applied to the rubber industry as a whole in order to obtain the required data for the analysis of the effects on employment. Equation 3.1 was utilised:

$$Q_R = D_R + X_R - M_R \qquad (5.3)$$

where Q_R is the domestic production of the rubber industry

D_R is the domestic demand of the South African rubber market

X_R is the exports of the rubber industry

M_R is the imports of the rubber industry

X_R and M_R data for this model were obtained directly from the export and import data presented earlier in Table I of Appendix 4 and the calculation of Q_R was detailed in section 5.3. The resultant Chenery model data for the rubber manufacturing industry are presented in Table 5.15.

Table 5.15 Compilation of Chenery model data for the overall South African rubber industry from 1999 to 2014 ($x10^3$ tonnes)

	M_R	X_R	Q_R	D_R
1999	26.27	17.56	205.68	214.39
2000	26.71	14.51	234.88	247.09
2001	27.89	13.74	206.76	220.90
2002	33.32	15.25	252.44	270.51
2003	39.54	16.31	257.70	280.94
2004	49.28	18.30	260.36	291.33
2005	58.29	19.38	230.79	269.69
2008	61.84	21.83	259.18	299.19
2009	58.90	68.76	224.30	214.45
2010	68.62	26.70	230.09	272.01
2011	70.00	31.94	246.90	284.96
2012	71.73	30.58	236.64	277.80
2013	79.20	36.18	234.21	277.24
2014	74.88	81.38	227.15	220.65

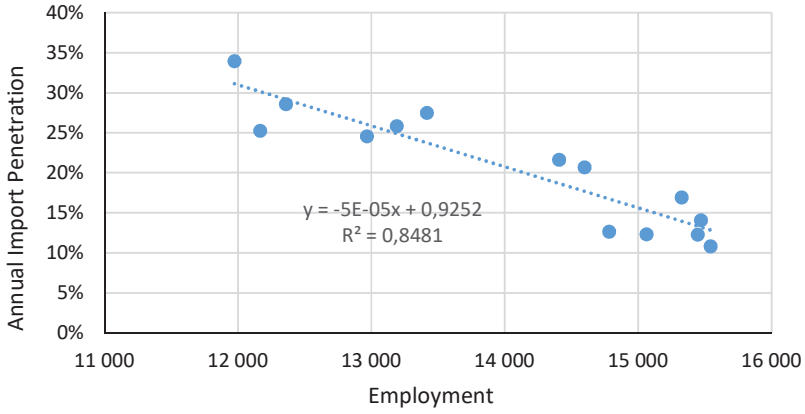
An initial overview of the effect of import penetration on employment in the rubber industry can be obtained by first examining the change in annual import penetration for the rubber industry alongside employment data. The employment data, presented earlier in Table II of Appendix 5, are presented again in Table 5.16 alongside the import penetration data for the overall industry, for Chinese imports and for the ROW imports. Import penetration is the proportion of imports to domestic demand. Correlation plots of these data are illustrated in Figure 5.1.

Table 5.16 Import penetration for the South African rubber industry from 1999 to 2014

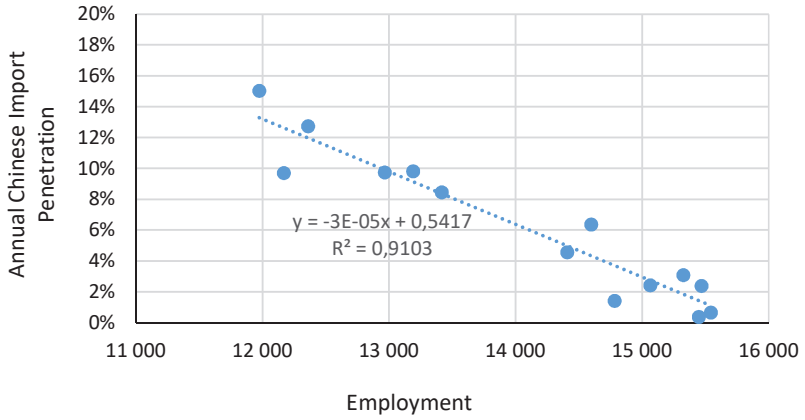
	Employment in the Rubber Industry	Overall Import Penetration	Chinese Import Penetration	ROW Import Penetration
1999	15 448	12.3%	0.4%	11.9%
2000	15 544	10.8%	0.7%	10.2%
2001	14 782	12.6%	1.4%	11.2%
2002	15 064	12.3%	2.4%	9.9%
2003	15 470	14.1%	2.4%	11.7%
2004	15 327	16.9%	3.1%	13.8%
2005	14 408	21.6%	4.6%	17.0%
2008	14 193	20.7%	6.4%	14.3%
2009	14 492	27.5%	8.4%	19.0%
2010	14 599	25.2%	9.7%	15.5%
2011	13 417	24.6%	9.8%	14.8%
2012	12 169	25.8%	9.8%	16.0%
2013	12 968	28.6%	12.7%	15.8%
2014	13 191	33.9%	15.0%	18.9%

In Figure 5.1(a) a negative linear correlation is evident between overall import penetration and employment with a statistically significant r^2 of 0.85. When the import penetration is disaggregated into Chinese and the rest of the world – as illustrated in plots (b) and (c) – it is evident that these is also a significant negative linear correlation, with an r^2 of 0.91, between Chinese import penetration and employment. This broadly suggests that importing of rubber products from China has reduced employment within the rubber manufacturing industry.

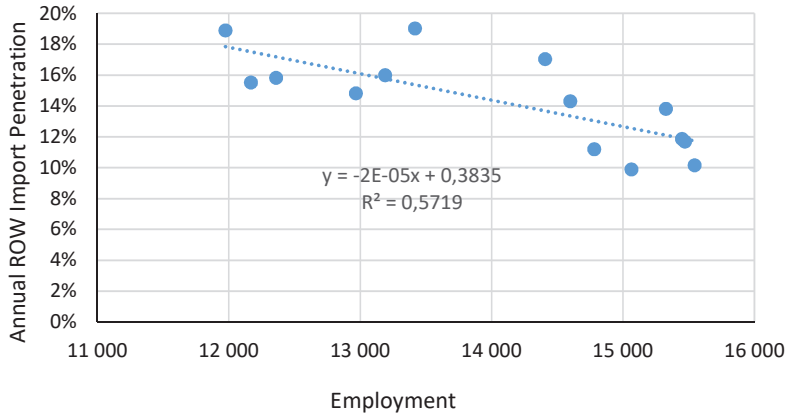
The linear correlation between employment and import penetration from the ROW, however, only had an r^2 value of 0.57 suggesting that the correlation between these variables is less significant. Furthermore, the negative slope for the ROW was less than for China indicating that the effect of the ROW import penetration on employment was probably not as detrimental to employment as the import penetration from China.



(a)



(b)



(c)

Figure 5.1 Employment as a function of import penetration for (a) overall rubber imports, (b) Chinese imports and (c) rest of the world (ROW) imports from 1999-2014

The second phase was to decompose the employment data from Table 5.15 using the Chenery method in order to measure how various input variables to the modelling have affected employment in the South African rubber industry. Decomposition was carried out by applying equations 4.13 to 4.19 to these data. The resultant decomposition results are presented in Table 5.17.

Changes in employment can be due to changes in domestic production and/or due to changes in labour productivity where labour productivity is a measure of the level of employment per unit of output (Edwards and Jenkins, 2015), as discussed earlier in section 2.6.

Firstly, it is evident that the overall change in employment in the rubber industry in the last fifteen years has been the loss of 3473 jobs. Factor decomposition of employment data for the industry showed that the growth in domestic demand has led to the creation of 289 jobs in this period. Exports of rubber products have also benefitted employment in that it led to the creation of 3365 jobs in the 15-year period. However, import penetration has had a negative effect and has led to the loss of 2522 jobs since 1999. Furthermore, growth in labour productivity has been found to have led to the loss of 4605 jobs – which is almost twice that of the losses due to import penetration.

Table 5.17 Chenery decomposition of employment in the rubber industry

	1999-2005	**2008-2014**	**1999-2014**
Overall change in employment	-1 040	-2 624	-3 473
Contribution of changing domestic demand to employment	+3 029	-3 285	+289
Contribution of changing exports to employment	+114	+3 140	+3 365
Contribution of changing import penetration to employment	-1 576	-1 543	-2 522
Contribution of changing productivity to employment	-2 608	-935	-4 605
Employment change directly due to the changes in Chinese import penetration	-706	-1 008	-1 704

The third phase in the analysis was to assess the direct effect of Chinese imports on the employment in the rubber industry. The last row of Table 5.17 illustrates the direct effect of Chinese imports on employment in the rubber industry. These data showed that 1704 of the 2522 jobs lost in the rubber industry due to imports can be attributed directly to Chinese imports. Therefore, the effect of Chinese import penetration on employment comprised 68% of the total import penetration effect.

5.7 ANALYSIS OF SURVEY RESULTS

The fourth, and final, objective of this study was to determine if South African rubber manufacturing companies have been affected by the current economic climate and to ascertain if imports of rubber products have had an effect on their businesses.

To address this objective, primary data were collected using a survey approach. Questionnaires were sent out to all rubber manufacturing companies that were members of the Institute of Materials, Mineral & Mining (IOM3) as at February 2016. In total there were 26 such companies as listed in Appendix 7. The questionnaire is presented in Appendix 6 and the ethical approval for carrying out the survey is presented in Appendix 8. A summary of the response rate of the questionnaires is presented in Figure 5.2.

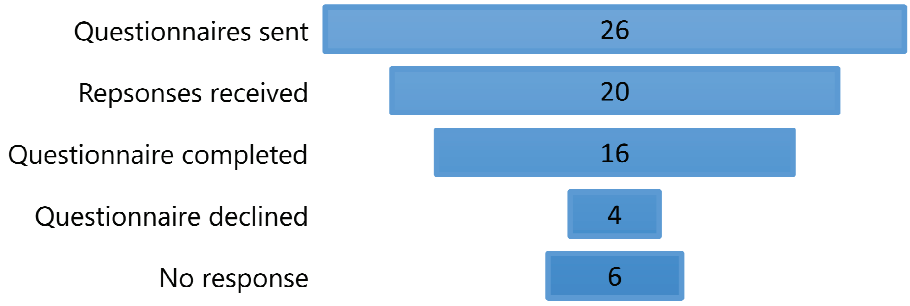


Figure 5.2 Overview of response details received from the questionnaire survey

Overall the level of responses received, 77%, could be considered quite successful. Unfortunately, four of these responses were not positive in the respect that the questionnaire was declined, giving a 62% completion rate for the questionnaire. This is still a successful

survey completion rate. The 16 companies that participated in the questionnaire represents in the region of 14-18% of the entire rubber industry in South Africa.

The following provides more details on the respondents:

- Out of the 16 respondents, 15 were from the non-tyre sector and 1 from the tyre sector
- The 15 non-tyre companies can be further segregated as:
    - 4 rubber compounders
    - 3 conveyor belt manufacturers
    - 8 manufacturers of other general rubber products
- The respondents held the following positions within their company:
    - 6 managing directors
    - 7 senior managers in technical and/or manufacturing
    - 3 senior managers in procurement and/or business development

The questionnaire responses are now be presented in the form of pie charts and bar charts in order to provide a visual representation of the results that were obtained for each question.

Question 1: **In your opinion, has the rubber manufacturing industry in South Africa declined in recent years?**

All 16 respondents answered "yes" to this question suggesting that there is a negative overall perception of the recent state of the rubber industry in South Africa. This is in line with various media reports in recent years that have voiced the concerns of rubber industry experts regarding a decline in the industry (Buthelezi, 2012a; Cokayne, 2014; Payne, 2011; Peters, 2015).

Question 2: **If yes, what do you think has caused this decline of the rubber manufacturing industry in SA?**

Question 2 asked the respondent's whom had chosen 'yes' for question 1 to select what they thought has been the cause(s) of the decline. Multiple options were provided for the respondent to tick along with an "other" option which gave the respondent the opportunity to list any other reason(s) not included in the list. The responses received are illustrated in Figure 5.3.

In total, 76 selections were made by the 16 respondents. Every respondent selected more than one option suggesting that the general sentiment in the rubber industry is that there is not one single reason for the decline.

100% of respondents cited *imports of rubber products* as being a reason for the rubber industry decline, which again, echoes the sentiment published in the various aforementioned media articles. Among the next highest responses selected were *poor production efficiencies* (69% of respondents), *failure of government to promote the industry* (67% of respondents) and *labour unrest* (63% of respondents). Almost half of the respondents (44%) indicated that *global trends* were playing a part suggesting that there is also an opinion in the industry that a portion of the blame for the decline is beyond the control of South Africa.

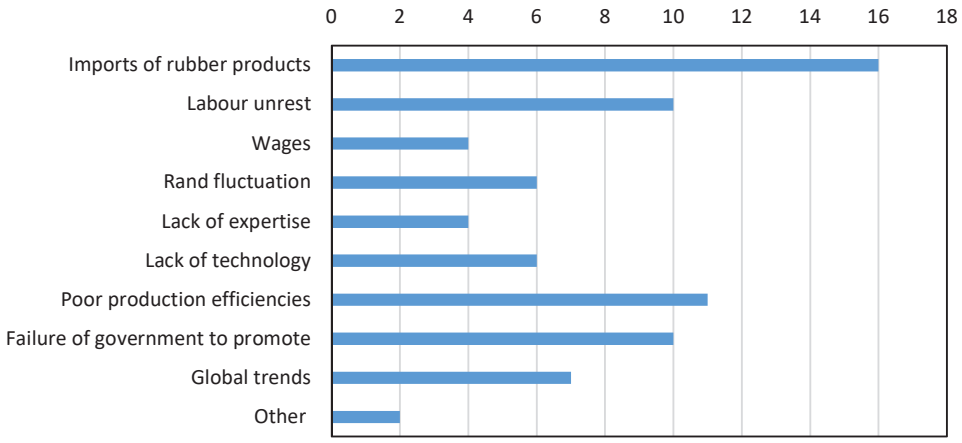


Figure 5.3 Opinions on the causes of the decline in the rubber industry

<u>Question 3</u>: Has your annual volume output increased, decreased or stayed the same over the past 15 years?

Question 3 gave an insight into the actual performance of the respondents' companies in terms of their annual output over the past 15 years. The results are illustrated graphically in Figure 5.4. Interestingly, despite the 100% negative view of the overall rubber industry in question 1, 38% of respondents confirmed that the output of their companies has increased. The average level of increase in output was 153%. This high average value was due to two

exceptionally high figures of 600 and 250% which were experienced by two companies. The remaining companies experienced between 10 and 30% increase in annual volume output.

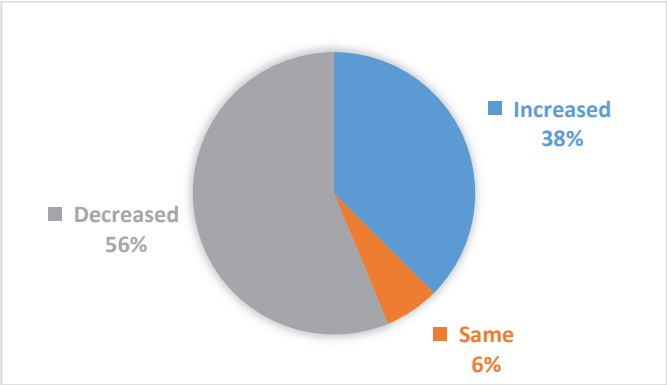


Figure 5.4 Change in annual volume output over the past 15 years

The respondents were provided the option of citing the reasons for their increase in output. As illustrated in Figure 5.5, various reasons were selected which mostly related to in-company strategy rather than external forces. Only one respondent stated that their increased output was due to an improvement in the South African market.

As illustrated in Figure 5.4, 56% of companies have experienced a decline in output over the past 15 years. The average level of decline was 34% and the highest level declared was 75%. The reasons for the declines are shown in Figure 5.6 and shows all 100% of companies that experience a decline cited import competition as a reason for their decline.

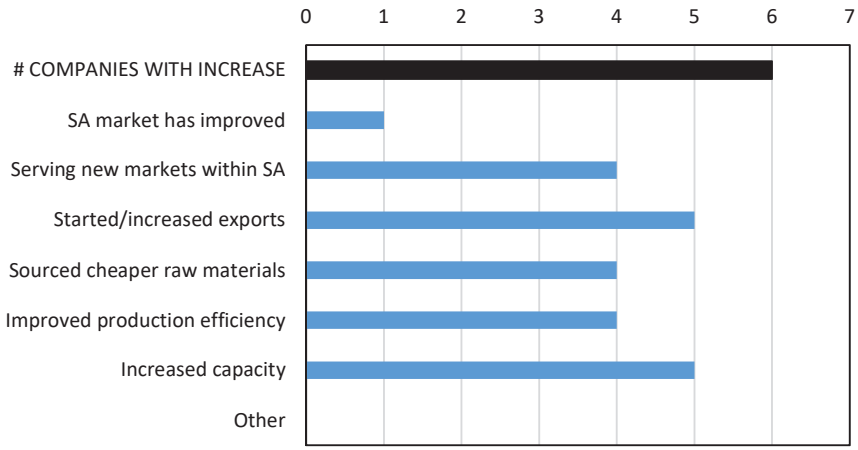


Figure 5.5 Reason for increase in annual volume output

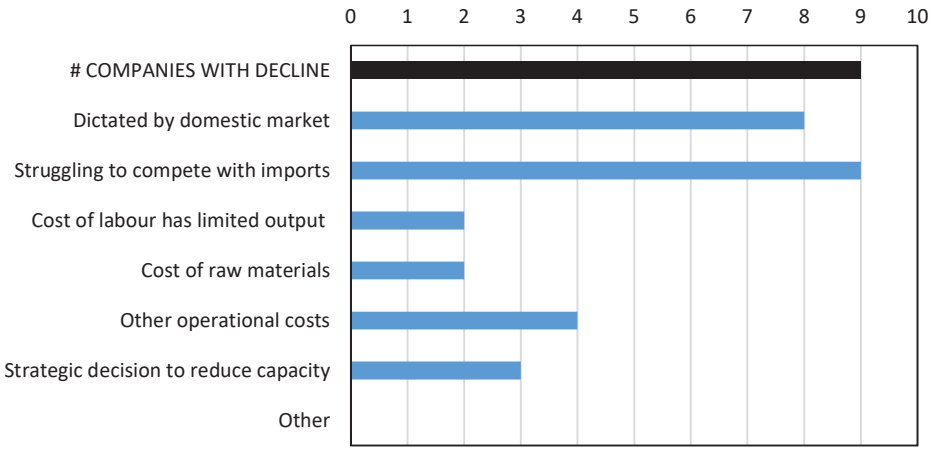


Figure 5.6 Reason for decrease in annual volume output

<u>Question 4:</u> Has your workforce size increased, decreased or stayed the same over the past 15 years?

Question 4 was used to determine if the employment level has changed within companies in the rubber industry over the past 15 years. As illustrated in Figure 5.7, 50% of companies have increased employment, which again, is quite surprising considering the negative view of the industry. The average increase in employment level was 27% with the highest increase declared as 50%. The reasons for the increase are shown in Figure 5.8 where it is evident that a range of causes of the increase in employment – the main one being an increase in capacity of the manufacturing plant. Note that 5 out of the 6 companies that increased annual volume output have had an increase in employment also. Among the "other" reasons cited were introduction of an extra shift and the use of introduction of learnership programmes.

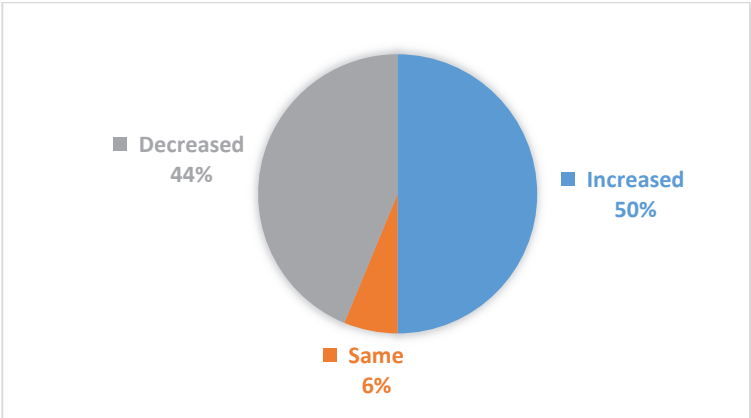


Figure 5.7 Change in workforce size over the past 15 years

The reasons for the decrease in employment are shown in Figure 5.9 where it is evident 44% of companies stated that their level of employment has declined with the average level being declared at 41%. The highest drop in employment in any one firm was 50% and alarmingly this occurred in 4 of the 7 companies that have reduced employment. The primary reason for lay-offs was declared as a reduction in volume output. Among the "other" reasons cited were voluntary retrenchments and new product range.

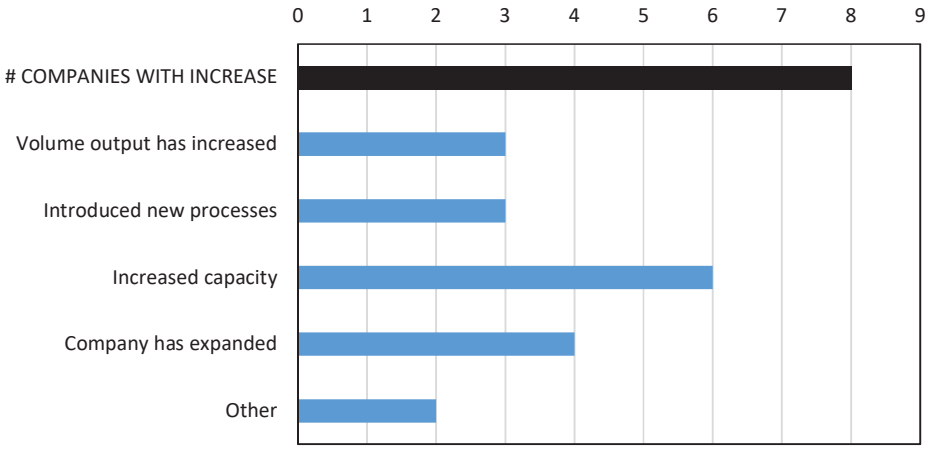


Figure 5.8 Reason for increase in employment

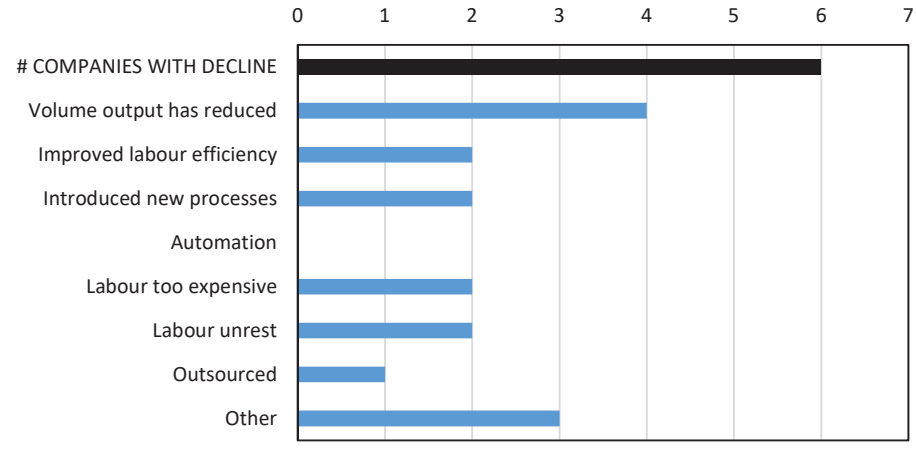


Figure 5.9 Reason for decrease in employment

Question 5: **Which of the following countries/regions do you think threatens the South African rubber market the most through import penetration?**

This question sought to determine the opinion in the industry as to what country was a threat to South Africa in terms of imported rubber products. There were six options listed and respondents were asked to tick as many as they felt appropriate. Figure 5.10 illustrates that every respondent selected China as being a threat to the South African rubber industry and 81% also selected India.

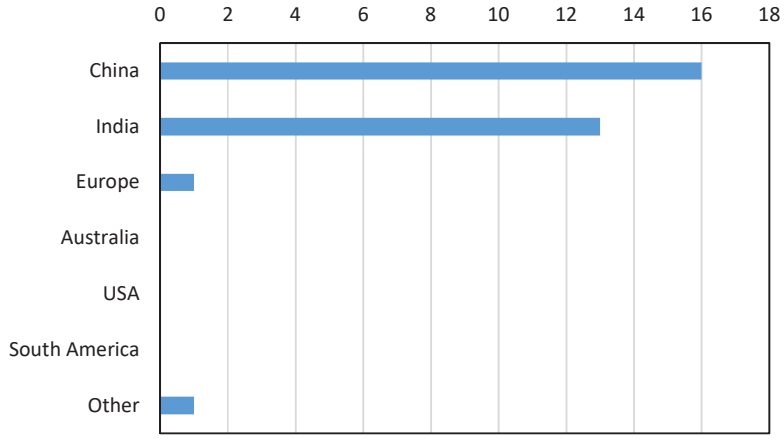


Figure 5.10 Opinions on what regions threatens the rubber industry

Question 6: **Do you think that the South African government should be doing more to protect the country's rubber manufacturing industry from imported rubber products?**

The purpose of question 6 was to ascertain whether the sentiment in rubber companies was in line with media reports – i.e. that the government should be doing more to protect the rubber industry from imports. The result was clear cut in that all 16 respondents affirmed that the government should be doing more.

Question 7: **Do you think that the recent weakening of the Rand will assist the South African rubber manufacturing industry?**

This question sought to determine if South African rubber companies viewed the recent weakening of the Rand as a potential opportunity for their companies to benefit – most likely

in terms of exports. However, only 37% viewed the weak currency as a potential benefit as shown in Figure 5.11. There are various possible reasons for this. It is possible, for instance, that exporting products is simply not an option for some South African companies. Perhaps international competition has already flooded the export market. Or there may be regulatory or logistical barriers to export. Another possible factor is that rubber companies in South Africa may be importing raw materials or product components and the weakening of the Rand is actually increasing their cost of sales. So even if they have benefitted from export this extra margin may be consumed by the rise in costs.

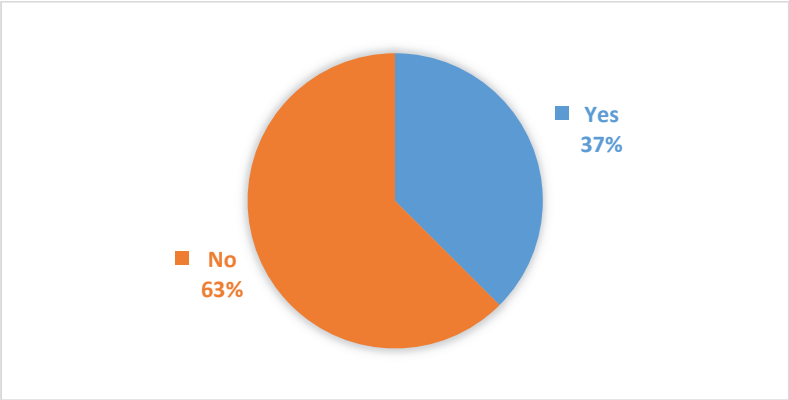


Figure 5.11 Opinions on whether the weakening Rand can assist the rubber industry

Question 8: **What do you think can be done to assist the South African rubber manufacturing industry?**

Question 8 was an open ended question which, in contrast to the first seven questions, was qualitative in nature. However, by thorough analysis, it was possible to categorise responses into common groups thereby allowing conversion of the responses to quantitative data. This method of data conversion has been widely used (Bazeley, 2012; Srnka and Koeszegi, 2007) and was discussed earlier in section 4.4.1.

In total, 15 out of the 16 questionnaire respondents answered question 8. The categories of responses and corresponding frequency of occurrence are illustrated in Figure 5.12. Based on the earlier responses in the questionnaire, it is not surprising that 87% of respondents suggested some form of action that needed to be taken by the government. This again highlights the sentiment in the rubber industry that the government should be doing more.

In addition, four categories of responses were related to efforts that should be made by the companies within the rubber industry. For example, 47% of respondents suggested that the level of skill of the workforce should be improved as a means of boosting the industry. A third of respondents also suggested that the industry needs to improve the technology in manufacturing plants.

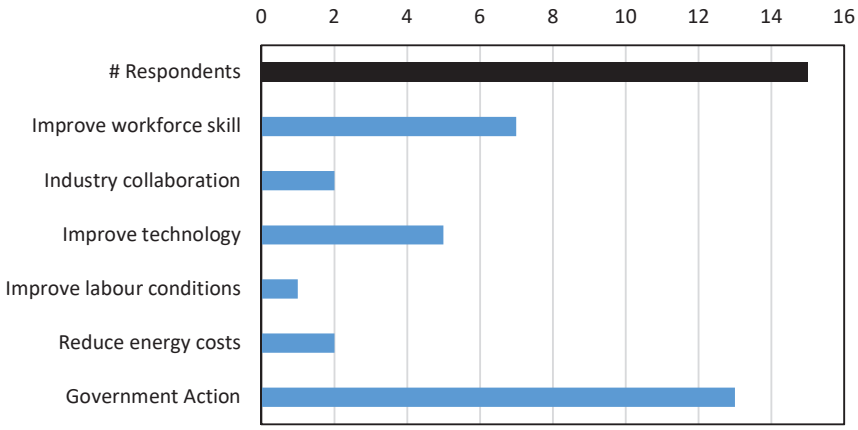


Figure 5.12 Opinions on what can be done to assist the rubber industry

Because of the variety of suggestions put forward relating to government action, a separate chart in Figure 5.13 has been compiled to provide a further breakdown of the responses received for this category. As expected, the most common response received was relating to the need to increase or apply import duties – 73% of respondents made this suggestion. A third of respondents also suggested that the government should be promoting or offering incentives for the purchase of locally manufactured rubber products.

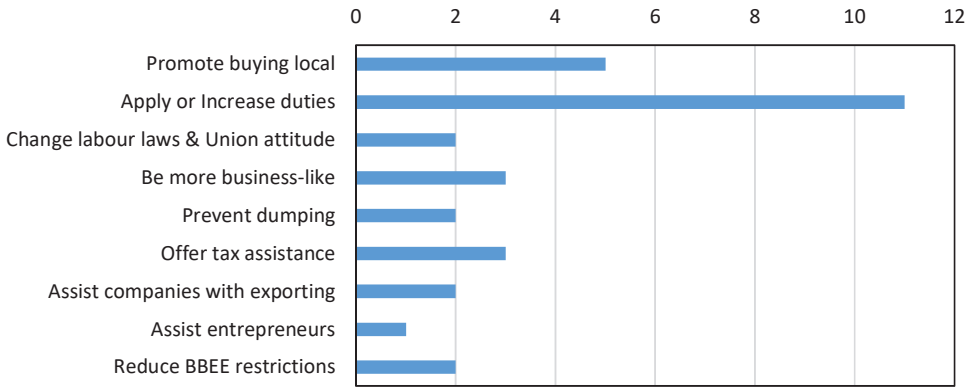


Figure 5.13 Breakdown of responses relating to government action required for the rubber industry

5.8 CONCLUDING REMARKS

This chapter presented the tabular results for the empirical analysis carried out as part of the research study and also gave an overview of the questionnaire responses that were obtained from the survey. The interpretation of these results are now be discussed in detail in the following chapter in order to address the objectives of the study.

CHAPTER 6

DISCUSSION OF RESULTS

6.1 INTRODUCTION

The data collected for this study included secondary data in the form manufacturing and trade flow data and primary data in the form of questionnaire results. Secondary and Primary data were presented in Chapter 4 and analysed in Chapter 5. The present chapter revisits the initial objectives of the study and seeks to answer the research questions through discussion and interpretation of the collected data and the resultant analysis data. This chapter also seeks to validate the data analysis methods used by relating, where possible, to similar studies uncovered in the literature review.

In the next section of this chapter, a general synopsis of the trade flow data collected for the rubber industry is presented. Then following section comprises an assessment of the empirical analysis methods used in Chapter 5. Following this, a synopsis of the South African rubber manufacturing industry taking the empirical data generated from this study into consideration is presented. Thereafter the discussion follows the flow of the research objectives and associated questions which were presented in Chapter 1 – a section is dedicated to each question.

All graphs presented in this chapter are the researcher's own compilations based on data generated for this study.

6.2 A SYNOPSIS OF TRADE FLOW IN THE RUBBER INDUSTRY

The purpose of this section is to illustrate the extent of the issue of international trade flow of rubber products in South Africa. This section is concerned with secondary trade data that was disaggregated using the framework outlined previously in section 3.3.

The secondary trade flow data for the South African rubber industry were disaggregated into the non-tyre and tyre sectors from 1999 to 2015 and presented previously in section 4.4.1.2. Tabular data were presented, in both weight (tonnes) and monetary value (Rand), initially for the overall imports and exports and then specifically for Chinese imports and exports.

The overall import and export weight data for Group 3, presented in Table I of Appendix 4, are illustrated graphically in Figure 6.1 (Group 3 represents the total of all non-tyre and tyre

products as outlined earlier in section 3.3). Note that 2006 and 2007 were removed from this graph, and all further analyses, due to reasons stated earlier in section 4.4.1.2.

It is clear from Figure 6.1 that there has been a significant trade deficit in the weight of rubber products sector in all but one out of the last sixteen years. The year where exports exceeded imports was due to a sudden surge in export of pneumatic tyres in 2009 (sub-heading 40.11.99 – Other). But in general, the deficit has been steadily on the rise, growing from just under 9000 tonnes in 1999 to just over 40000 tonnes in 2015. In terms of Rand value, this trade deficit for the rubber manufacturing industry jumped from R 0.6 Billion in 1999 to R 6.9 Billion in 2015. This is a cause for concern for the South African rubber industry.

Figure 6.1 Total weight of South African imports and exports of all rubber product from 1999 to 2015

To illustrate the trend in flow of rubber products between South Africa and China, the import and export weight data for Group 3 between 1999 and 2015, presented in Table III of Appendix 4, are illustrated graphically in Figure 6.2. It is clear that the rubber industry's trade deficit with China has increased dramatically since 1999. In 1999 only 829 tonnes of rubber products were imported from China with a trade deficit of 806 tonnes. By 2015 this had risen to 28913 tonnes of rubber products imported with no corresponding increase in exports giving a massive trade deficit of 28846 tonnes. This means that the trade deficit has increased in magnitude by more than 35 times since 1999. In terms of Rand value this 2015 trade deficit with China amounted to a staggering R 2.9 Billion. The main reason for this

dramatic increase is most likely the fact that China joined the World Trade Organisation (WTO) in 2001 as was also suggested by Edwards and Jenkins (2015) in their study of the impact of Chinese import penetration on South Africa's manufacturing industry.

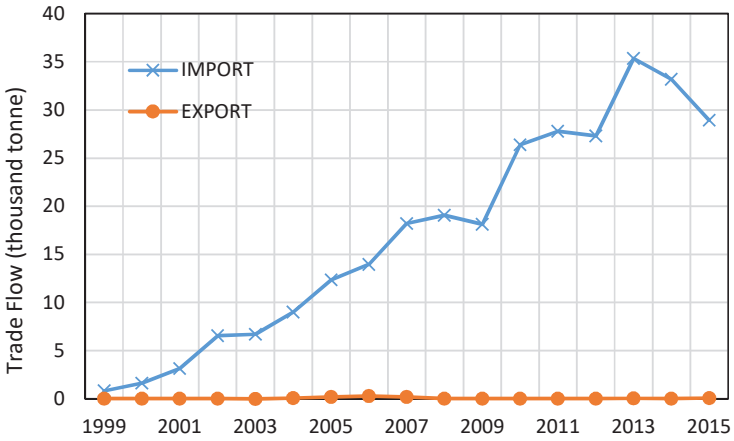


Figure 6.2 South Africa-China trade flow weight data for the rubber product sector from 1999-2015

A more detailed examination of the data presented in Table III of Appendix 4 reveals that both the non-tyre and tyre industries have seen a rise in Chinese imports – these data are illustrated graphically in Figure 6.3 which illustrates this trend more clearly. It can be seen that the non-tyre sector has seen a more significant rise in imports from China compared to the tyre sector.

It is evident from the data presented thus far, that imports of rubber products from China have risen significantly since 1999 and that both the non-tyre and tyre sectors have seen a rise in imports. The question remains, however, has this rise in Chinese imports displaced South African domestic production or has it displaced imports from other regions in the world? Perhaps imports from the rest of the world have dropped correspondingly and South African domestic production has not been affected at all? It was at this point that a more complex modelling of the data was carried out to answer these questions.

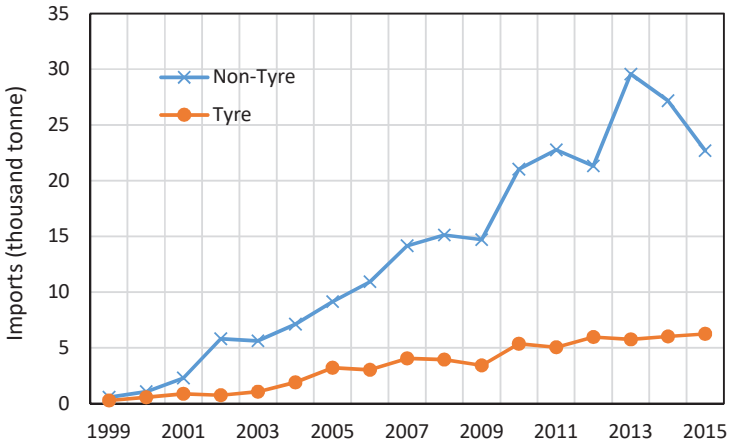


Figure 6.3 Chinese imports of finished rubber products from 1999-2015

6.3 ASSESSMENT OF THE FRAMEWORKS APPLIED TO THE RUBBER INDUSTRY

The purpose of this section is to carry out an assessment of the researcher's frameworks that was used in the present study to estimate this annual domestic output of the South African rubber industry. The best way to carry out such an assessment is to compare the framework analysis results, that were presented in Chapter 5, with previously published figures.

In order to carry out Chenery modelling of the rubber industry, it was first necessary to calculate the annual domestic output of the industry. An analytical framework was developed by the researcher in order to calculate these output data for the period from 1999 to 2014 since reliable data were not available from any source. This framework was presented earlier in section 4.3.4. Within the framework calculations it was unavoidable that certain estimations of variables were made. It is therefore critical to carry out an assessment of the results from this framework before attempting to answer the research questions.

An indirect comparison can be made between the calculated domestic output and Stats SA's monthly volume output figures, which are output indices related to sales (discussed previously in section 4.4.1). These figures are available on a monthly basis on Stats SA's Manufacturing Production and Sales Report (Stats SA, 2016c). While the magnitude of these output figures would not be directly comparable with the domestic output data calculated in

the present study, a comparison of trends is nonetheless useful – this comparison is presented in Figure 6.4.

The Stats SA line is a plot of the *Index of Physical Volume of Production of Rubber Products* and the *Model Output* line is a plot of the Q_R values from Table 5.12. On examination it can be seen that the year-to-year trends are quite similar for both sets of data. This provides some validation for the researcher's framework used.

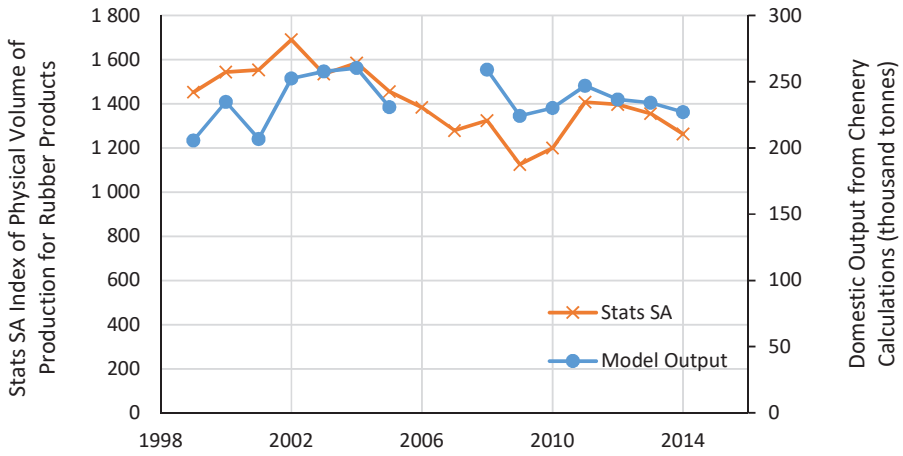


Figure 6.4 A comparison of Stats SA domestic output of rubber products with the domestic calculated output for the rubber industry

Further validation of the framework can be obtained by comparing calculated data against secondary output data for the tyre sector (in tonnes) obtained from the South African Tyre Manufacturer's Conference (SATMC). As pointed out in section 4.4.4.1, output data from the SATMC were only available for 2011 to 2014. The comparison, illustrated in Figure 6.5, illustrates that the calculated output data are in good agreement with the SATMC data suggesting that the framework used in this study was quite accurate.

For the non-tyre sector, and indeed for the total rubber manufacturing industry, the availability of such domestic output data in absolute weight format is rare. One report was found that estimated that the domestic output of the rubber industry in 2000 to be in the region of 200000 tonnes (Chemical Marketing and Consulting Services, 2003). The domestic production calculated in the present study for 2000 was 235000 tonnes (Table 5.12). This represents a difference of 15% which is not a dramatic difference considering that the Chemical Marketing report was a rough approximation with no documented theoretical

method. While this is not a validation, as such, of the calculations used in the current study, it does suggest that the annual domestic output figures calculated in the present study are in the right vicinity.

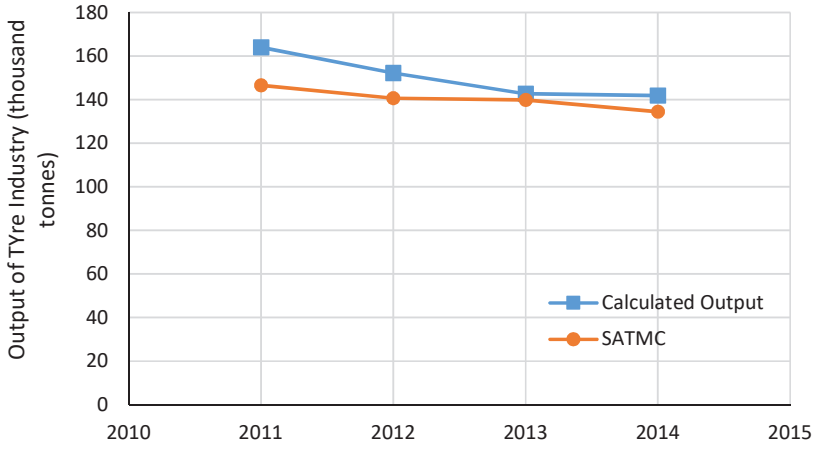


Figure 6.5 Comparison of the calculated annual output of the South African tyre industry and the figures quoted by SATMC

No further reliable sources of annual domestic volume output of the rubber industry could be located in literature.

In order to assess the analytical framework that was used, which was based on the Chenery modelling method, comparisons were made between analysis results from the present study with results from previous studies that utilised Chenery decomposition method to analyse the South African manufacturing industry.

Edwards and Jenkins (2015), for instance, analysed the effects of Chinese imports on various sectors of the South African manufacturing industry using secondary data obtained from UN Comtrade, the DTI and Stats SA from 1992 to 2010. They published Chinese import penetration data for various sectors of the manufacturing industry – but for two years only, namely 2000 and 2010. The figures were 0.6% and 9.6% respectively for the overall rubber manufacturing industry. To determine how these compare to the calculations in the present study, domestic demand, D_R, data from Table 5.12 can be recalled for these two years, together with Chinese imports figures for total rubber products from Table III of Appendix 4 (the figures are in thousand tonnes):

2000	$D_R = 247.09$	*Chinese Imports = 1.62*
2010	$D_R = 272.01$	*Chinese Imports = 26.39*

Chinese import penetration, which is the ratio of Chinese imports to domestic demand, for 2000 and 2010 is therefore 0.65% and 9.70% respectively, which are remarkably close to the figures published by Edwards and Jenkins.

This quite precise correlation with previously published research provides validity to the analytical framework used for secondary data analysis in the present study – and indeed to the framework used for estimation of domestic ouput.

Tregenna (2012) also used Chenery decomposition to study the effect of imports on various sectors of the South African manufacturing industry. It was found that, for the rubber products industry between 2000 and 2007, domestic demand expansion and export expansion contributed positively to growth and import penetration contributed negatively. These trends are identical to the trends observed for the overall rubber products industry for the 1999-2005 period in the present study.

It can be concluded from the discussion to this point that the conceptual and analytical frameworks used in the present study have provided output data for the rubber products industry which are in line with previously published statistics and data. This provides some validity, not only to the methodology, but also to the quality of the estimates that were made during these calculations.

6.4 SYNOPSIS OF THE SOUTH AFRICAN RUBBER MANUFACTURING INDUSTRY

The purpose of this section is to briefly discuss the trends evident in the two sectors of the South African rubber manufacturing industry using the empirical data generated in Chapter 5. This discussion serves to illustrate the difference in trends observed between the two sectors and to illustrate the extent of the import penetration problem for the sectors.

After the initial Chenery modelling was completed, the rubber products industry was sub-divided into the non-tyre and tyre sectors and Chenery decomposition analysis was carried out in order to address the objectives of this study (as detailed in section 5.4 and 5.5 respectively). The application of the Chenery model led to the calculation of the annual

domestic demand of each sector for the 1999 to 2014 period – in other words, the quantity of rubber products consumed by the South African market in these years.

For example, the domestic demand of South Africa's tyre market was found to be almost 152000 tonnes in 2014 (Table 5.11). The non-tyre market demand in the same year was just over 115000 tonnes (Table 5.7). This is an example of the dominance of the tyre sector of the rubber industry in terms of demand volume. The demand on South Africa's non-tyre market however, grew considerably between 1999 and 2014. It was found that the annual domestic demand for the non-tyre sector in 2014 was almost 48000 tonnes higher than it was in 1999. This was equivalent to a 170% increase. The increase in domestic demand in the tyre sector for this same period was only 3%.

The overall level of domestic production in the rubber industry increased from approximately 205 thousand tonnes in 1999 to 227 thousand tonnes in 2014 (data taken from Table 5.12). This represents just over 10% growth in output in the 15-year period. The non-tyre sector experienced just over 40% growth (using data from Table 5.7) and the tyre sector suffered a 2% decline in the same period (using data from Table 5.11).

Figures such as these show that the non-tyre and tyre sectors of the rubber industry are very distinct from each other and do not necessarily follow the same trends. It is at this point that decomposition of domestic output data using the Chenery method was extremely useful to determine the causes of changes in output from year to year.

As outlined in section 4.3.3, to determine if import penetration has occurred between two points in time, the proportion of the total supply that is obtained through imports will have increased in that time period. The annual import penetration for the industry, m, is therefore given by:

$$m = M/D \qquad (6.1)$$

The change in annual import penetration for the non-tyre and tyre sectors from 1999 to 2014 (calculated from the data presented previously in Table 5.7 and 5.11 respectively) is presented in Figure 6.6. It is clear that there has been a marked rise in import penetration in the non-tyre sector over the past fifteen years. Furthermore, the linear correlation coefficient, r^2, of 0.73 suggests that this upward trend can be considered statistically significant. The import penetration peaked at 51.8% in 2005 meaning that in this year the quantity of imports was over half that of the overall domestic demand. Imports in this year totalled over 42000

tonnes (Table III of Appendix 4) which was 82% of the tonnage of non-tyre rubber products that were manufactured locally in South Africa that year. This illustrates the relative volume that imports comprised in the non-tyre sector in that year.

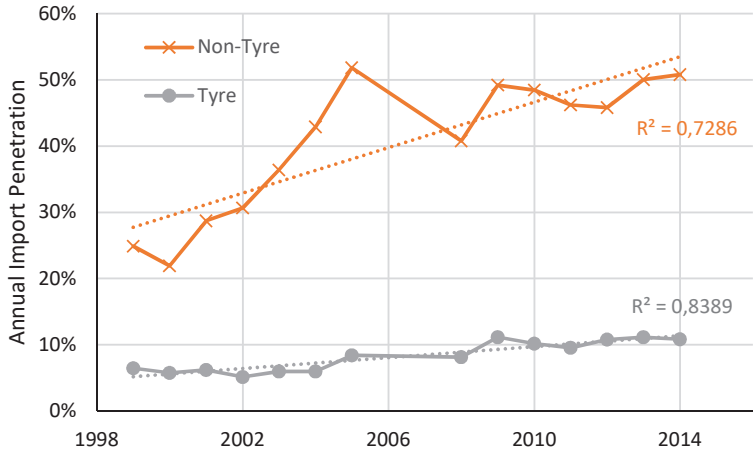


Figure 6.6 Annual import penetration in the non-tyre and tyre sectors of the rubber industry from 1999-2014

An upward trend in import penetration over the past fifteen years was also evident for the tyre sector, but the extent of increase was not as great for this sector. For example, in 1999 the import penetration for the two sectors were 24.9% and 6.5% for non-tyre and tyre respectively. By 2014 these had increased to 50.8 and 10.8% respectively. These represent increases in import penetration magnitude of 104% for the non-tyre sector and 66% for the tyre sector. Therefore, it is clear for these data that imports of rubber products has generally had a more significant penetration effect on the non-tyre sector.

The following four sections of this chapter directly address the four objectives of the study.

6.5 EFFECT OF CHINESE IMPORTS ON THE NON-TYRE MANUFACTURING SECTOR

The first research question posed for this study was as follows:

What is the effect of Chinese rubber imports on the output of the South African non-tyre rubber manufacturing industry?

To answer this question, secondary data were collected from the Department of Trade and Industry (DTI), the South African Revenue Service (SARS), Statistics South Africa (Stats SA) and Karbochem (Pty) Ltd. Data for the non-tyre sector were modelled using the Chenery method and then decomposed to provide further insight into the reasons for the change in domestic production. Further decomposition was then carried out to assess the effect of Chinese imports on the domestic production (as presented section 5.4). Similar methods of decomposition have been used extensively in the past for similar types of analysis (Edwards and Jenkins, 2015; Tregenna, 2012; Zaidan, 1998).

These factor decomposition data for the domestic production in the non-tyre sector were presented earlier in Table 5.8. These data are presented now in Figure 6.7 in the form of stacked columns, where the total of the three factors combined is 100%. This type of graphical representation assists in illustrating the relative importance of each factor to growth of domestic production for each period.

The following are the key findings that can be drawn from the factor decomposition analysis on domestic production in the non-tyre sector:

- Domestic demand had a positive contribution for the overall 1999 to 2014 period and within the two sub-periods. However, as shown in Figure 6.7, the demand expansion was relatively high in the first sub-period and almost negligible in the second-sub period suggesting that the majority of the contribution to the domestic demand expansion in the non-tyre sector for 1999 to 2014 occurred within the 1999 to 2005 period. This was most likely due to the high growth which was experienced in this period due to the commodity boom and also high consumption financed by credit (Tregenna, 2012).
- Export expansion contributed positively to domestic production for the overall 15-year period as illustrated in Figure 6.7. The majority of expansion came within the second sub-period. This suggests that South African manufacturers in the non-tyre sector are increasingly entering the export market which is definitely a positive for the industry. On investigation of trade data (presented in Appendix 3), it was found that the primary sources of the export expansion were primarily due to increases in exports of tariff sub-heading 40.10 (Conveyor belts) and, to a lesser extent, in 40.16 (Other articles).

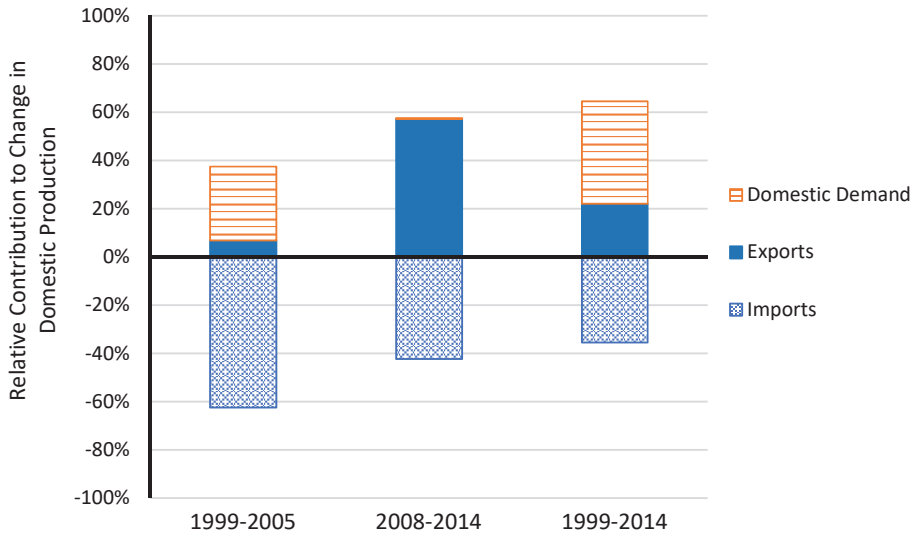


Figure 6.7 Relative contribution of input factors to domestic production in the non-tyre sector for the total 1999-2014 period and two sub-periods within

- It can be seen from Figure 6.7 that growth in domestic production was negatively impacted by import penetration in both sub-periods and, consequently, over the entire 15-year period. It is interesting to note that imports had a far more significant effect on domestic production in the 1999 to 2005 sub-period. This is due to the more marked rise in import penetration in this period (27%) as opposed to the 2008-2014 period (10%). In the first sub-period, the negative effect of imports was proportionately higher than the positive effects of demand and growth expansion combined. This was most likely due to the availability of cheaper rubber products through imports, despite the fact that the industry was experiencing a surge in growth during these boom years.

It is evident from the above findings that, out of the three factors, import penetration was the only factor that had a negative influence on domestic production in the non-tyre sector. This means that imports have detracted from (i.e. replaced) domestic production in the non-tyre sector between 1999 and 2014. In other words, the non-tyre sector has suffered as a direct result of increasing imports. The question remains, however, how much of this effect was directly due to Chinese imports?

Further decomposition analysis showed the effect of Chinese imports and imports from the rest of the world. The resultant data were presented earlier in Table 5.10. These data showed that Chinese imports detracted over 26000 tonnes from domestic production in the 1999 to

2014 period. In order to illustrate more clearly the influence of Chinese imports on the non-tyre sector, Figure 6.8 shows the actual growth experienced in the sector alongside the theoretical growth without the influence of Chinese imports. It can be seen that without Chinese imports the growth in domestic production in the non-tyre sector would have been 43% higher than it actually was in the 1999 to 2014 period. In terms of magnitude, the growth rate of the non-tyre sector between 1999 and 2014 has been more than halved due to Chinese imports. This is a significant finding as it clearly illustrates that Chinese imports are severely affecting the non-tyre rubber sector.

Edwards and Jenkins (2015) carried out similar calculations on sectors within the South African manufacturing industry between 2001 and 2010. They used sales value and trade value, rather than the weight volumes used in the present study, and found that Chinese imports had reduced domestic production of some sectors by up to 60% of the 2001 production. They estimated that this cost the country around R30 billion in local revenue in that decade. They also analysed the decade prior to China joining the WTO (2001) and found that import penetration was negligible in that period.

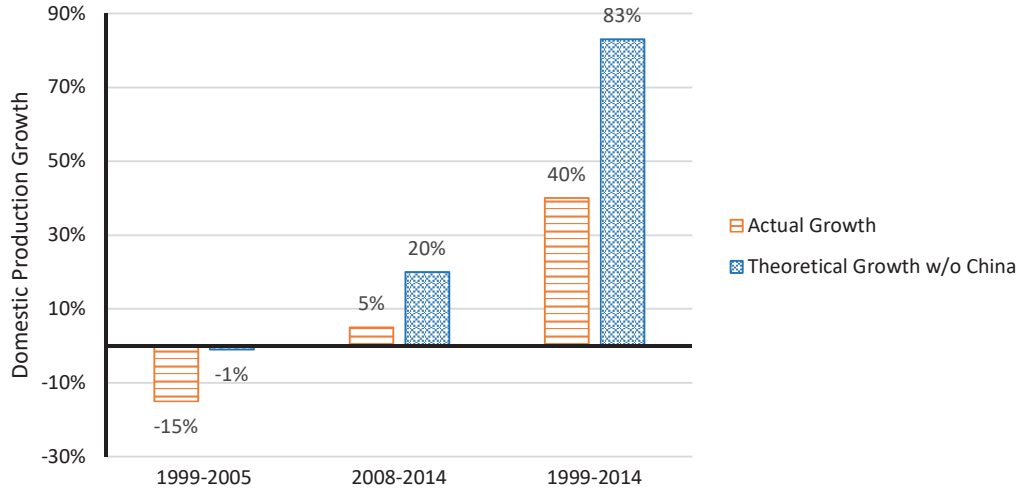


Figure 6.8 Comparison of growth in non-tyre domestic production – actual growth versus the theoretical growth if there were no Chinese imports

[Growth % calculated as the change in production in the final year of the period relative to the production in the base year of the period]

6.6 EFFECT OF CHINESE IMPORTS ON THE TYRE MANUFACTURING SECTOR

The research question posed regarding this objective in Chapter 1 was as follows:

What is the effect of Chinese rubber imports on the output of the South African tyre manufacturing industry?

To answer this question, a process similar to that of the non-tyre sector was followed. Therefore, secondary data were collected for the tyre sector, modelled using the Chenery method and then decomposed to provide further insight into the reasons for the change in domestic production. Further decomposition was then carried out to assess the effect of Chinese imports on the domestic production (as presented section 5.5).

These factor decomposition data for the domestic production in the tyre sector were presented earlier in Table 5.12. These data are presented now in Figure 6.9 in the form of stacked columns, where the total of the three factors combined is 100%. This type of graphical representation assists in illustrating the relative importance of each factor to growth of domestic production for each period.

The following are the key findings that can be drawn from the factor decomposition analysis on domestic production in the tyre sector:

- Domestic demand had a positive contribution on domestic production for the overall 1999-2014 period. Demand also had a positive effect in the first sub-period but had a major negative effect in the second sub-period as illustrated in Figure 6.9. This trend was somewhat similar to that observed in the non-tyre sector in that significant demand expansion in the 1999 to 2005 period led to an overall positive demand expansion for the entire 1999 to 2014 period. However, in the case of the tyre sector, the overall effect of demand expansion on domestic production was diminished due to the decline in demand in the 2008 to 2014 period. The reason for this decline in demand for tyres may have been largely due to the decline in new vehicle sales and new vehicle manufacture that occurred in South Africa between 2007 and 2010 (Pitot, 2011; Trading Economics, 2016).
- Change in exports did not contributed positively to domestic production between 1999 and 2014, nor in the two sub-periods analysed. In fact, as illustrated in Figure 6.9, the decline in exports observed between 1999 and 2014 effectively reduced domestic

production. As seen in Table I of Appendix 4, exports of tyre products in 1999 were just over 7500 tonnes and reduced to just over 6500 tonnes in 2014.

- Growth in domestic production was impacted heavily by the change in import penetration between 1999 and 2014. The increase in import penetration for the two sub-periods were quite similar in magnitude in terms of their negative effect on domestic production as illustrated in Figure 6.9. The overall weight volume that was detracted from domestic production by import penetration was significantly less than that seen for the non-tyre sector (6619 tonnes versus 29835 tonnes respectively). However, Figure 6.9 shows that for the 1999 to 2014 period the relative effect of imports on domestic production growth in the tyre sector was actually greater than was observed with the non-tyre sector (-54% versus -35% respectively).

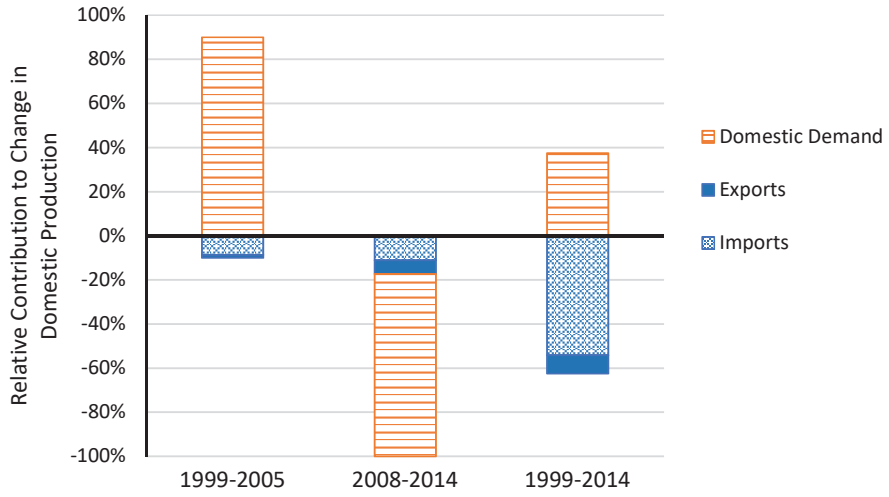


Figure 6.9 Relative contribution of input factors to domestic production in the tyre sector for the total 1999-2014 period and two sub-periods within

It is evident from the above findings that import penetration had a negative influence on domestic production in tyre sector throughout the 1999 to 2014 period. This means that imports have detracted from (i.e. replaced) domestic production in the tyre sector between 1999 and 2014. In other words, the tyre sector has suffered as a direct result of increasing imports. The question remains, however, how much of this effect was directly due to Chinese imports?

Further decomposition analysis showed the effect of Chinese imports and imports from the rest of the world. The resultant data were presented earlier in Table 5.14. These data showed that Chinese imports detracted almost 6000 tonnes from domestic production in the 1999 to 2014 period. In order to illustrate more clearly the influence of Chinese imports on the non-tyre sector, Figure 6.10 shows the actual growth experienced in the sector alongside the theoretical growth without the influence of Chinese imports. It can be seen that the effect of Chinese import penetration on growth in domestic production was not as severe as observed for the non-tyre sector. Increasing Chinese penetration in the tyre sector only stunted domestic production growth by 4 % between 1999 and 2014. Interestingly, this is quite close to the 5 % that Edwards and Jenkins (2015) measured for the entire manufacturing industry between 2001 and 2010.

Therefore, while Chinese tyre imports certainly have expanded since 1999 to the point that they now comprise by far the majority of total tyre imports, the effect of Chinese import penetration on the growth of domestic production is small relative to the non-tyre sector. It appears that the negative growth in the tyre sector in the 2008 to 2014 period was more due to a drastic drop in domestic demand than due to the effect of Chinese imports.

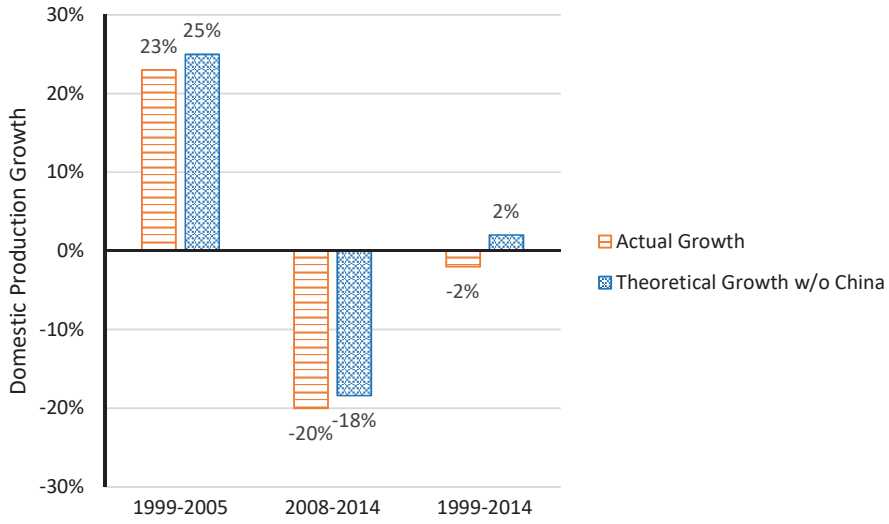


Figure 6.10 Comparison of growth in tyre domestic production – actual growth versus the theoretical growth if there were no Chinese imports

[Growth % calculated as the change in production in the final year of the period relative to the production in the base year of the period]

6.7 EFFECT OF CHINESE IMPORTS ON EMPLOYMENT IN THE RUBBER INDUSTRY

The research question posed regarding this objective in Chapter 1 was as follows:

What is the effect of Chinese rubber imports on employment in the South African rubber manufacturing industry?

To answer this question, a process somewhat similar to that of the non-tyre and tyre sectors was followed in that secondary data were collected for the rubber industry, modelled using the Chenery method and then decomposed to provide further insight into the reasons for the change in employment. Further decomposition was then carried out to assess the effect of Chinese imports on the domestic production (as presented section 5.6).

An initial overview of the effect of import penetration on employment in the rubber industry was obtained by analysing the correlation between these two variables as presented earlier in Figure 5.1. It was seen that import penetration had a negative linear effect on employment with a correlation coefficient of 0.85 which was deemed to illustrate that importing of rubber products has had a negative effect on employment. Edoun and Netshiozwi (2015) also used this correlation coefficient method to examine the effect of imports on employment in the textile industry South Africa. They found a negative correlation with a correlation coefficient of 0.89 and considered this as being a "good level of prediction" (Edoun and Netshiozwi, 2015, p.23).

Factor decomposition data for employment in the rubber industry were presented earlier in Table 5.17. These data are presented now in Figure 6.11 in the form of stacked columns, where the total of the three factors combined is 100%. This type of graphical representation assists in illustrating the relative importance of each factor to the change in employment for each period.

The following are the key findings that can be drawn from the factor decomposition analysis on employment in the rubber industry:

- Changing domestic demand contributed positively to employment between 1999 and 2005 and contributed negatively between 2008 and 2014 as illustrated in Figure 6.11. But over the entire 1999 to 2014 period, the net effect of changing domestic demand had a relatively negligible effect on employment compared to the other three factors.

- Figure 6.11 illustrates that export expansion between 2008 and 2014 had a significantly positive effect on employment resulting in over 3000 extra jobs (data presented earlier in Table 5.17). This was most likely due to the surge in exports in the non-tyre sector in this period (as discussed in section 6.5).
- Increasing import penetration had a negative effect on employment leading to the effective loss of over 2500 jobs between 1999 and 2014 (data presented earlier in Table 5.17).
- Improvements in labour productivity – i.e. a reduction in the labour required per unit of output for the industry – were evident for the 1999 to 2014 period and had a negative effect on employment as illustrated in Figure 6.11. Improving labour productivity can, unfortunately, lead to job losses most often due to technological advances and/or improvements in manufacturing efficiency (Edwards and Jenkins, 2015; Junankar, 2013; Klein, 2012). SEDA (2012) reported a decline in the *annual employment output ratio* in the South African rubber industry from 2001 to 2010, which also signifies improving labour productivity. Their findings are therefore consistent with the findings in the present study.

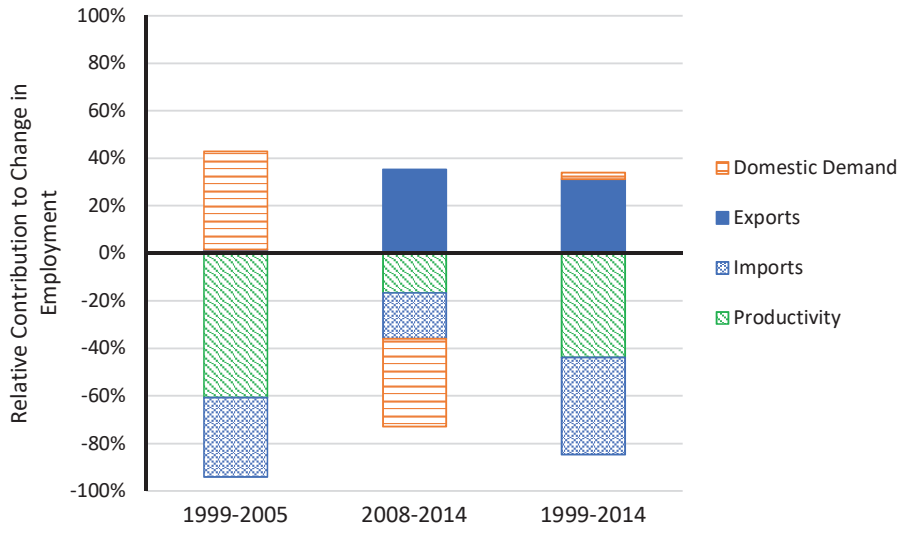


Figure 6.11 Relative contribution of input factors to employment in the rubber manufacturing industry for the total 1999-2014 period and two sub-periods within

It was therefore determined by the decomposition analysis that imports of rubber products, in addition to improvements in labour productivity, had a significant and negative effect on employment in the rubber industry throughout the 1999 to 2014 period. Similar trends were observed by Edwards and Jenkins (2015) for South Africa's overall manufacturing industry between 1992 and 2010. The question remains, however, have Chinese imports directly affected employment in the rubber industry?

Further decomposition analysis showed the effect of Chinese imports. The resultant data were presented earlier in Table 5.17. These data showed that Chinese imports detracted almost 1704 jobs from employment in the rubber industry in the 1999 to 2014 period. In order to illustrate more clearly the influence of Chinese imports on employment, Figure 6.12 shows the actual growth in employment in the rubber industry alongside the theoretical growth without the influence of Chinese imports.

Figure 6.12 shows that between 1999 and 2014 the increase in Chinese import penetration contributed 11% to the total 22.5% reduction in employment due to import penetration in the rubber industry in this period. Therefore, the loss of jobs in the rubber industry between 1999 and 2014 has been more than doubled due to Chinese imports. This is a significant finding as it illustrates that the effect of Chinese imports goes beyond that of company output and has had effects on the well-being of individual South African lives.

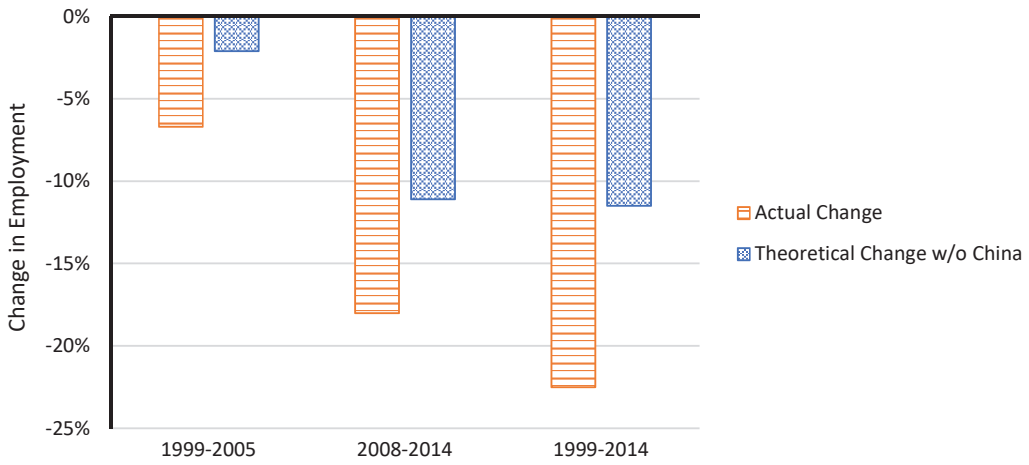


Figure 6.12 Comparison of change in employment in the rubber industry – actual change versus the theoretical change if there were no Chinese imports

[Growth % calculated as the change in employment in the final year of the period relative to the employment in the base year of the period]

6.8 EFFECT OF THE CURRENT ECONOMIC CLIMATE AND IMPORTS ON RUBBER MANUFACTURING COMPANIES

The research question posed regarding this objective in Chapter 1 was as follows:

Have South African rubber manufacturing companies been affected by the current economic climate and have they been affected by imports of rubber products?

The purpose of this objective was to attempt to determine the perception within the industry in terms of the current state of the rubber industry and the effect of imports that is being experienced *on the ground*. The methodology for answering this research question was a survey approach whereby 26 South African rubber manufacturing companies were sent an eight-question questionnaire by electronic mail. A 62% completion rate was achieved which can be considered quite successful. The results for the questionnaire were presented earlier in section 5.7. This section serves to summarise the key findings and outline the researcher's interpretations of these findings.

It was found in Question 1 that 100% of those surveyed felt that the rubber industry was in decline. Considering that all except one of the respondents were from the non-tyre sector, this is actually a little surprising since the modelling analysis in the present study has shown that the domestic production in the non-tyre sector has increased between 2008 and 2014. However, what is possibly being perceived in the industry is that the effect of domestic demand on growth in domestic production has been relatively negligible – growth has been dominated by exports. Therefore, unless a company is exporting, the growth benefits may not be experienced. This was actually reflected in Question 3 where only 38% of companies surveyed said that their output had increased and 83% of these cited exports as a contributory factor for this increase.

A dominant trend throughout the questionnaire responses was undoubtedly the blaming of imports for the decline in the industry. In question 2, 100% of respondents cited imports as a reason for the perceived overall decline in the industry. Again in question 3, 100% of respondents cited imports as being a reason for the reduction in their annual output. In question 8, a question which was open-ended and allowing suggestions for improving the industry, 73% of respondents said that import duties should be applied or increased. In terms of the perception in the industry as to the origins of imports – 100% of respondents cited China and 81% of these also cited India.

Therefore, there is undoubtedly a sentiment within the companies surveyed that imports, and more specifically, Chinese imports, are having a negative effect on the rubber industry – a sentiment that is fully justified given the analysis findings in the present study.

In terms of employment levels, it is interesting that 50% of companies stated that their employment level had increased over the past 15 years. This is despite the analysis findings in the present study that the overall level of employment has reduced in the rubber industry in that time period.

It is also interesting that out of the 44% of companies that stated their employment had declined, 67% of these cited a reduction in volume output as a reason and only 33% cited improved efficiency as a reason. This is not quite in line with the findings in the present study for the entire 15-year period – but it is more in line with the findings for the 2008 to 2014 period. This suggests that the answers provided by the respondents are indicative of more recent trends within their companies as opposed to trends over the past 15 years.

In terms of remedies for the rubber industry, in question 7, only 37% of respondents felt that the recent weakening of the Rand would assist the industry. This, again, suggests that only a small proportion of the companies surveyed are benefitting from exporting of products. However, it must be noted that even if an exporter of rubber products is benefiting in terms of international demand due to the weak Rand, they are also likely to be paying more for any raw materials which may be imported. This could effectively negate the export benefit of the weak Rand.

100% of respondents felt that the government should be doing more to assist the industry (question 6). Again, this is not surprising given the overall sentiment that imports are affecting the industry.

Question 8, which was open-ended and asked for opinions on how to improve the industry, provided some interesting responses. 47% of respondents suggested that workforce skill needed to be improved. It was noted in a rubber industry report a number of years ago, the industry has been "threatened by a shortage of skills" (Shirley, 2009, p.1). Mavuso (2013) investigated the shortage of rubber training in the rubber industry and her report highlighted the Institute of Minerals & Mining's (IOM3) efforts to revitalise the education programme for the industry. At that time, it was felt that this was causing a strain on the level of quality and productivity in the industry. However, the fact that almost half of respondents still feel that lack of training is an issue may suggest that more focus needs to be put in this area.

33% of respondents suggested that technology needs to be improved. The rubber industry is actually quite renowned for being slow to advance its technology. Buthelezi (2012b) previously reported on this problem in an article that suggested that the industry needs to advance and think of new ways and methods to combat the global downturn.

33% of respondents suggested that the government should be promoting the purchase of local goods – some of these suggested a tax incentive for doing so. Undoubtedly, the dominant feeling in responses to question 8 was that the government should be increasing import duties and/or preventing dumping of foreign goods. This sentiment has been present in the tyre sector for some time as signified by the SATMC's application to reduce tyre imports, which incidentally was recently rejected by the South African Revenue Service (Cokayne, 2016). But it is interesting to see that the sentiment is also prevalent in the non-tyre sector – to which the majority of this questionnaire's respondents belonged. However, it must be noted that there are potential drawbacks to increasing import duties in an attempt to block or reduce Chinese imports. Chinese direct investment is extremely important for South Africa. In fact, South Africa "receives the most Chinese investment on the African continent" and China has been the country's largest trading partner since 2011 (Fraser, 2016, p.1).

6.9 CONCLUDING REMARKS

This chapter has provided an overall discussion of the findings in the present study. It has been shown that the analytical and conceptual frameworks developed for this study have been successful in that results correlate well with previous published findings. Decomposition of domestic production and employment data has shown that Chinese imports have had a significant effect on the rubber industry. It was therefore not surprising that questionnaire results have shown that the overall sentiment in the industry is quite negative.

CHAPTER 7

CONCLUSIONS, RECCOMMENDATIONS & LIMITATIONS

7.1 SUMMARY OF THE STUDY AND CONCLUSIONS

The overall objective of this study was to investigate the effect that Chinese imports have had on the rubber industry in South Africa between 1999 and 2014. The industry was split into the two sectors – the non-tyre sector and the tyre sector.

In order to determine if Chinese imports have affected the domestic output of the rubber industry, a modification of the Chenery decomposition method was utilised which isolated the effect of three factors on the domestic output of the two sectors of the rubber industry – namely domestic demand, export expansion and import penetration. Further decomposition allowed the isolation of the effect of Chinese imports. A similar analysis was carried out on secondary employment data using the Chenery decomposition method in order to determine if employment in the rubber industry has been affected by Chinese imports in the 1999-2014 period. In order to complete these analyses, secondary trade flow data, relating to rubber materials and products, were acquired and combined with data obtained from sources within the rubber industry. A conceptual framework was generated by the researcher which enabled an estimation of the domestic output of the rubber industry. Primary survey data were also collected using a questionnaire in order to determine if South African rubber manufacturing companies have been affected by the current economic climate and imports and to get an overview of the perception *on the ground* regarding the state of the industry.

The first objective of the study sought to determine if the non-tyre sector has been affected by Chinese imports. Analysis showed that the domestic output of the non-tyre sector was reduced significantly due to Chinese imports in that the growth rate of domestic production between 1999 and 2014 had been more than halved due to Chinese imports. This is a significant finding as it clearly illustrates that Chinese imports were severely affecting the non-tyre rubber sector.

The second objective of the study sought to determine if the tyre sector has been affected by Chinese imports. Analysis showed that the domestic output of the non-tyre sector reduced in that growth in domestic production was reduced by 4% due to Chinese imports between 1999 and 2014. The effect of Chinese imports was therefore a lot less significant than that

measured for the non-tyre sector. However, when it is considered that the tyre sector experienced a 2% contraction in domestic production between 1999 and 2014, and theoretically, without Chinese imports, this would have been a growth of 2%; the relative effect of Chinese imports becomes far more significant.

The third objective sought to determine if employment in the rubber industry has been affected by Chinese imports. Analysis showed that over 2500 jobs were lost directly due to imports of rubber products from China between 1999 and 2014.

The fourth objective sought to determine if South African rubber manufacturing companies have been affected by the current economic climate and imports of rubber products. A survey of 26 rubber manufacturing companies was carried out and analysis of the results showed that there is an overall sentiment in rubber companies that the rubber industry is in decline and that imports from China and India are the primary cause for this decline. There is a strong perception in the industry that the government should be doing more to protect the industry in terms of tariffs, tax incentives and training support.

All four study objectives were therefore achieved. Chinese imports have had a significant and negative effect on the rubber industry in South Africa between 1999 and 2014 that has led to a reduction in domestic production, a loss of jobs and a negative sentiment amongst rubber manufacturing companies.

Modelling of rubber industry data also unveiled other noteworthy trends related to the non-tyre and tyre sectors. The domestic production of the non-tyre sector grew by just over 40% between 1999 and 2014 despite the high level of import penetration. Whereas the tyre sector experienced a decline of just over 2%. These data illustrate a distinct difference in the growth of the two sectors. In recent years the growth in the non-tyre sector was primarily driven by export expansion, most notably of conveyor belts. The decline in the tyre sector has primarily been caused by a drop in domestic demand.

Overall, this study has revealed significant findings that affect the non-tyre and tyre sectors of the South African rubber industry. The growth of both sectors is being restricted by Chinese imports and jobs are being lost as a direct result of this. As far as the researcher is aware, this is the first study in South Africa that has divided the non-tyre and tyre sectors of the rubber industry and analysed industry data in order to isolate the factors that have induced growth and caused decline within each sector. Knowledge of these findings can assist companies, and indeed the South African government, in devising strategies to promote

growth in the two sectors and ensure the survival of South African rubber manufacturing industry.

7.2 RECOMMENDATIONS FOR THE RUBBER INDUSTRY

As outlined in section 7.1, it is quite clear that there are problems within the rubber industry that are in urgent need of attention. Chinese imports have been having a serious effect on domestic production and employment over the past fifteen years. The overall perception within the rubber industry is that the industry is in decline and that the government are not doing enough to assist. Based on the findings of this study, the following sub-sections outline the researcher's recommendations based on the findings of the study.

7.2.1 Tariffs

The findings of this study indicated that imports of rubber products are restricting growth in the South African rubber industry and that domestic production and employment have been reduced as a result. One way to counteract this is for the policy-makers to review the current tariff system which evidently is not providing sufficient protection to the South African rubber industry.

Table 7.1 summarises the latest tariffs that are being imposed on importing of rubber products from China based on data from the latest SARS Customs & Excise Tariff Schedule issued on 10th June 2016 (SARS, 2016b). As can be seen from these tariffs, there is quite good protection already in place for the tyre industry. For example, an import tariff of 30% applies to new pneumatic tyres for cars. However, there have been repeated allegations that there is not adequate anti-dumping protection as discussed in section 6.8.

The non-tyre sector is not as well protected as tyres and this may be one of the reasons for this sector being affected more drastically by Chinese imports. For example, there is only 15% duty on conveyor belts, which comprise a large percentage of non-tyre imports from China. Is this adequate protection when there are numerous well-established domestic conveyor belt manufacturers who could manufacture these products within South Africa?

Table 7.1 Current tariffs for importing from China

Heading	Brief description	Non-tyre	Tyre
40.06	Prepared shapes of unvulcanised rubber	10%	
40.07	Vulcanised tyre tread and cord		10%
40.08	Prepared shapes of vulcanised rubber	0-15%	
40.09	Tubes, pipes and hoses	0-15%	
40.10	Conveyor Belts	15%*	
40.11	New pneumatic tyres		25-30%**
40.12	Retreaded or used pneumatic tyres		36-43%***
40.13	Inner tubes for tyres		Free
40.14	Pharmaceutical products	Free	
40.15	Apparel and clothing products	10-20%	
40.16	Other articles	0-20%	
40.17	Hard rubber products	Free	

[Researcher's own collaboration based on data from SARS Customs & Excise Tariff Schedule, June 2016]

* One out of the ten conveyor belt sub-headings is free
** All motorcar tyres are 30%. Truck tyres are 25%. Aircraft, bicycle and motorcycle tyres are free. Some types of agricultural and construction tyres are free.
*** Retreaded aircraft tyres are free. Used pneumatic tyres are free.

As discussed in section 6.8, there those within South Africa that are for tariffs and there are those that are against – and both sides have valid arguments to back their stance. Chinese direct investment is extremely important for South Africa. Will increasing tariffs, and therefore inhibiting trade, damage the China-South Africa relationship and reduce such investment?

Perhaps the way forward is to be more strategic about tariffs. South Africa could remain firm on tariffs for the import of finished rubber products from China. But reduce tariffs on raw materials and on semi-finished products or component parts that require conversion or finishing in South Africa. With this cheaper source of input materials, South African rubber companies may be able to manufacture new products and enter new markets that were previously not attainable. This could assist in boosting domestic production and employment in the South African rubber industry. Importing of semi-finished products or component parts would also encourage specialisation within rubber companies who may currently be

biting off more than they can chew in terms of manufacturing. If such companies focussed on specific stages of the manufacturing process and effectively outsourced parts of the process to China, then South Africa may become a more productive country.

7.2.2 Exports

The findings in this study indicated that increasing exports have boosted domestic production in the non-tyre sector, especially since 2008. But yet analysis of the survey results, which was predominantly carried out on non-tyre manufacturing companies, showed that only just over a third of companies had experienced a boost in production due to exports. This suggests that the majority of South African rubber manufacturing companies are not benefitting from the export market. This, therefore, means that the majority of manufacturers are reliant on domestic demand which can be risky especially given the economic uncertainty in South Africa in recent years.

If rubber companies put more focus on entering or expanding the export market then the industry's reliance on domestic demand will be lessened which should lead to a more sustainable level of growth. However, entering the export market is not a simple task and small companies may struggle due to lack of resources. This is where policy-makers in the government can play a role by incentivising exports through, for example, increased tax rebates. But the rubber industry cannot simply rely on government incentives and the industry as a whole must come together through collaborative efforts to make exports a more feasible option.

7.2.3 Collaboration

All stakeholders need to be involved in the building of a thriving and sustainable rubber industry in South Africa. Yes, as has been suggested earlier in this chapter, the government do have a role to play. But the drive must come from the collective rubber industry. A collaborative effort is required.

But the rubber industry is competitive and it would almost be counter-intuitive for a company start enter into cooperative endeavours with their competitors. So a change of mind-set may be required. This could be assisted by associations such as IOM3 who could be the guiding hand in the formation of such endeavours.

For example, as was illustrated in section 7.2.2, exports have been a major boost for the South African non-tyre rubber industry. But yet the majority of companies are not benefitting from this – most likely due to a lack of resources and experience. But if the rubber industry pooled their resources then it could be achievable; even for the smaller companies. By sharing knowledge, shipping costs and marketing costs, companies could find that exporting is far more viable than it would ever have been if they were to try to do it alone.

Collaboration could also be a major boost in the direct import of raw materials. Why import a part-container of materials and pay more expensive costs when you could combine loads with another company and import a full container at cheaper rates? Yes, this may mean sharing some information with competitors in terms of the types and costs of materials being imported. But such information is short-lived – the rubber industry and employment will ultimately benefit in the long run.

7.2.4 Training

As discussed in section 6.8, there have been reports for some years that the skill level in the rubber industry is insufficient. Based on the findings in the survey in the present study, the sentiment in the industry today is quite similar and there is most likely still a shortage of skilled rubber technologists and professionals in the country.

However, there are options which are available for companies to instigate the improvements required. The government's Skills Education Training Authority (SETA) provides funding to companies for in-service learnerships and training schemes for young South Africans seeking experience in the workplace. There are also training institutes such as Plastics SA that provide versatile training modules specific to the rubber industry. IOM3 hold regular, informative conferences and lecture events to share knowledge within the industry. And recently, the Nelson Mandela Metropolitan University (NMMU) launched the Centre for Rubber Science and Technology which is aimed at carrying out in-house research projects, providing support to industry and expanding the skills base of the industry (News 24, 2015).

South African Rubber companies need to utilise the resources available to advance the knowledge and skill-base in the industry. Companies should also seek to grasp young science graduates and tailor their knowledge and learning for the rubber industry. It is only through such advancement and learning that the South African rubber industry can remain versatile

and competitive on the world stage and enable them to compete with the inevitable import threat.

7.2.5 Research & Development

South Africa has the industrial experience necessary to become an R&D knowledge and innovation centre for the global rubber industry. However, in the fight for survival, firms may not have the resources to spare for R&D investment. This is where direct government assistance is desperately in need. The absurdity is that the funding is apparently available. The government has a target to spend 1.5% of GDP on R&D but they have failed to meet this target since 2010 (Kahn, 2016). According to Kahn's report, the government's annual R&D spend over the past three years has barely reached half of their target. But it seems that the government may have recognised that there are issues with their funding system. In their 2016 budget the formation of a task team was announced which will investigate the challenges that businesses were facing in accessing R&D tax incentives with a view to enhancing the incentive once the findings are considered (National Treasury, 2016).

If an accessible flow of R&D funds is established into the rubber industry there is no reason why South Africa cannot become a global industry leader in rubber technology. This will assist in employment, training, innovation, productivity improvements and sustaining the position of South African rubber companies as global players.

7.3 LIMITATIONS AND AREAS FOR FURTHER RESEARCH

The present research study was met with certain limitations, most notably relating to data collection. Time restraints and obstacles related to the competitive nature of the industry prevented the collection of primary or secondary data regarding the domestic output of the industry. It was therefore necessary to proceed with data analysis within which certain estimations were made. The following points have been highlighted by the researcher as being potential areas for further research:

- Acquisition of primary output data through direct contact with the major rubber companies with the aim of obtaining a more accurate estimate of the overall output of the industry

- A more detailed analysis of import data to determine a detailed profile of the specific types of rubber products being imported – especially from China. This would allow an extensive defragmentation of the effects of imports on specific products in the rubber industry.
- A greater focus on the tyre sector and especially on the analysis of imports to determine if tyres are being imported through *loopholes* that allow lower tariffs.
- Interviews with key players in the industry to obtain a more detailed view of the sentiment in the industry and possibly unveil potential areas for revival
- A more extensive questionnaire covering more companies in the rubber industry and including companies outside of the IOM3 membership.
- Broaden the expanse of the import effect analysis to include other countries such as India.

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APPENDIX 1

Derivation of Equations

These derivations are the researcher's own compilation based on the review of various literature on Chenery modelling cited in Chapter 2.

Starting with the basic Chenery equation:

$$Q_R = D_R + X_R - M_R$$

where Q_R is the domestic production of the rubber industry

D_R is the domestic demand of the South African rubber market

X_R is the exports of the rubber industry

M_R is the imports of the rubber industry

Import penetration, m_R, is given by:

$$m_R = M_R/D_R$$

Therefore,

$$M_R = m_R D_R$$

The absolute change in import between time 0 and 1, ΔM, is therefore:

$$\Delta M_R = M_{R1} - M_{R0} = m_{R1}D_{R1} - m_{R0}D_{R0}$$

By adding and subtracting $m_{R0}D_{R1}$

$$\Delta M_R = m_{R1}D_{R1} - m_{R0}D_{R1} + m_{R0}D_{R1} - m_{R0}D_{R0}$$

Thus,

$$\Delta M_R = (m_{R1} - m_{R0})\, D_{R1} + m_{R0}(D_{R1} - D_{R0})$$

or,

$$\Delta M_R = (m_{R1} - m_{R0})\, D_{R1} + m_{R0}\Delta D_R$$

Using the basic Chenery equation, the change in domestic production of the rubber industry, ΔQ is:

$$\Delta Q_R = \Delta D_R + \Delta X_R - \Delta M_R$$

Substituting for ΔM_R into the original Chenery equation gives:

$$\Delta Q_R = \Delta D_R + \Delta X_R - (m_{R1} - m_{R0})\, D_{R1} - m_{R0}\Delta D_R$$

Therefore,

$$\Delta Q_R = \Delta D_R(1 - m_{R0}) + \Delta X_R - (m_{R1} - m_{R0})D_{R1}$$

The change in domestic production has thus been decomposed into three component parts:

1. $\Delta D_R(1 - m_{R0})$ gives an absolute measure of the contribution of changes in domestic demand to the domestic production. This term calculates the actual change in domestic demand between time 0 and 1, but subtracts the expected change in imports assuming that imports in time 0 change in the same proportion as demand. In other words, it removes the expected import change from the change in domestic demand to give a more realistic view of change in demand.
2. ΔX_R which gives an absolute measure of the contribution of exports to the domestic production .
3. $(m_{R1} - m_{R0})D_{R1}$ which gives an absolute measure of the contribution of changing import penetration to the domestic production. In other words, it provides a measure of the difference between the actual and expected quantity of imports at time 1 if the import penetration remained the same as it was in time 0.

To determine if Chinese imports have impacted the domestic production it is necessary to disaggregate the contribution of imports into that due to China and that due to the rest of the world. The import penetration, m_{R1}, can be separated as follows:

$$m_R = m_{RC} + m_{RW}$$

where m_{Rc} is the contribution of Chinese imports and m_{Rw} is the contribution of the rest of the world. Therefore,

$$\Delta Q_R = \Delta D_R(1 - m_{R0}) + \Delta X_R - (m_{Rc1} + m_{Rw1} - m_{Rc0} - m_{Rw0})D_{R1}$$

Rearranging gives:

$$\Delta Q_R = \Delta D_R(1 - m_{R0}) + \Delta X_R - (m_{RC1} - m_{Rc0} + m_{Rw1} - m_{Rw0})D_{R1}$$

In other words,

$$\Delta Q_R = \Delta D_R(1 - m_{R0}) + \Delta X_R - (\Delta m_{Rc} + \Delta m_{Rw})D_{R1}$$

The contribution of changing import penetration to the domestic production has thus been disaggregated into the following:

1. $\Delta m_{Rc} D_{R1}$ which gives an absolute measure of the change in domestic production due to Chinese import penetration
2. $\Delta m_{Rw} D_{R1}$ which gives an absolute measure of the change in domestic production due to import penetration from the rest of the world

If Δm_{Rc} and Δm_{Rw} are either both positive or both negative then it is assumed that corresponding the increase or decrease in Chinese import penetration has come at the expense of domestic production. If, however, Δm_{Rc} and Δm_{Rw} have opposite signs then it is possible that some of the increase or decrease in Chinese import penetration has been substituted by the rest of the world.

To determine if employment has been affected by imports, let labour productivity, l_R, be the rubber industry employment, L_R, per unit output of the industry, Q_R:

$$l_R = L_R / Q_R$$

Therefore,

$$L_R = l_R Q_R$$

Change in employment between time=0 and time=1, ΔL_R, can be defined as:

$$\Delta L_R = l_{R1} Q_{R1} - l_{R0} Q_{R0}$$

By adding and subtracting $l_{R1} Q_{R0}$,

$$\Delta L_R = l_{R1} Q_{R1} - l_{R1} Q_{R0} + l_{R1} Q_{R0} - l_{R0} Q_{R0}$$

$$\Delta L_R = l_{R1}(Q_{R1} - Q_{R0}) + (l_{R1} - l_{R0}) Q_{R0}$$

Or,

$$\Delta L_R = l_{R1} \Delta Q_R + \Delta l_R Q_{R0}$$

Rearranging gives,

$$\Delta Q_R = (\Delta L_R - \Delta l_R Q_{R0}) / l_{R1}$$

Substituting into previous equation for ΔQ_R,

$$(\Delta L_R - \Delta l_R Q_{R0}) / l_{R1} = \Delta D_R(1 - m_{R0}) + \Delta X_R - (m_{R1} - m_{R0}) D_{R1}$$

Rearranging gives,

$$\Delta L_R = l_{R1}(1 - m_{R0}) \Delta D_R + l_{R1} \Delta X_R - l_{R1}(m_{R1} - m_{R0}) D_{R1} + \Delta l_R Q_{R0}$$

The change in employment has thus been decomposed into three component parts:

1. $l_{R1}(1 - m_{R0}) \Delta D_R$ gives an absolute measure of the contribution of changes in domestic demand to the employment
2. $l_{R1} \Delta X_R$ which gives an absolute measure of the contribution of exports to the employment
3. $l_{R1}(m_{R1} - m_{R0}) D_{R1}$ which gives an absolute measure of the change in employment due to import penetration.
4. $\Delta l_R Q_{R0}$ which gives a measure of productivity changes

To determine if Chinese imports have impacted the employment the earlier equation for ΔQ_R is recalled:

$$\Delta Q_R = \Delta D_R(1- m_{R0}) + \Delta X_R - (\Delta m_{Rc} + \Delta m_{Rw})D_{R1}$$

Substituting for ΔQ_R gives,

$$(\Delta L_R - \Delta l_R Q_{R0}) / l_{R1} = \Delta D_R(1- m_{R0}) + \Delta X_R - (\Delta m_{Rc} + \Delta m_{Rw})D_{R1}$$

Rearranging gives,

$$\Delta L_R = l_{R1} (1- m_{R0})\Delta D_R + l_{R1}\Delta X_R - l_{R1}(\Delta m_{Rc} + \Delta m_{Rw})D_{R1} + \Delta l_R Q_{R0}$$

The contribution of changing import penetration to the change in employment has thus been disaggregated into the following:

1. $l_{R1}\Delta m_{Rc}D_{R1}$ which gives an absolute measure of the change in employment due to Chinese import penetration
2. $l_{R1}\Delta m_{Rw}D_{R1}$ which gives an absolute measure of the change in domestic production due to import penetration from the rest of the world

APPENDIX 2

Calculation of average % weight of rubber compound in a typical rubber product

This is based on the researcher's own theory

The content of rubber compound in non-tyre products is, however, more complex due to the variety of products being produced. Estimation of Y_{Pn} requires an examination of the types of products being produced by South African manufacturers because the content of rubber compound in a rubber product varies widely from product to product. A conveyor belt reinforced with woven textile, for example, only comprises approximately 50% by weight rubber compound; whereas a rubber glove comprises 100% by weight rubber compound. Furthermore, the manufacture of conveyor belts is a major part of the South African rubber industry, whereas the manufacture of rubber gloves is not.

It is therefore necessary to find the weighted average of rubber compound in these non-tyre rubber products based on the proportions manufactured in South Africa each year. However, it was not possible to determine these proportions due to the lack of detailed statistical information on the industry. An alternative method is to use the weight proportions that were imported and exported since a detailed breakdown of volumes per product type is available for these trade flow data.

Table I presents a list of rubber products groupings by tariff heading and the corresponding estimate of the content of rubber compound in this product class. These estimates were based on the researchers own experience in the rubber industry and through conversations with key figures in the appropriate sectors of the industry.

Using these figures from Table I, it was possible to calculate the weighted average % rubber compound in non-tyre products each year, Y_{pn}, based on the proportions of each product type that was imported and exported. These weighted averages, along with an overall average are presented in Table II.

Table I Estimate of rubber compound content per rubber product tariff heading

Heading	Description	Estimated % of Rubber Compound
40.06	Unvulcanised Rods, tubes, discs, rings	90 %
40.08	Vulcanised Plates, sheets, rods	90 %
40.09	Vulcanised tubes, pipes, hoses with or without fittings	80 %
40.10	Conveyor or transmission belts or belting, of vulcanised rubber	70 %
40.14	Hygienic or pharmaceutical articles of vulcanised rubber with or without fittings of hard rubber.	80 %
40.15	Articles of apparel and clothing accessories of vulcanised rubber	80 %
40.16	Other articles of vulcanised rubber	80 %
40.17	Hard rubber (for example, ebonite) in all forms	90 %

Table II Weighted average % rubber compound in non-tyre products based, $Y_{pn,}$ on import and export data from the DTI

	Weighted Average
1999	78.9%
2000	78.7%
2001	77.8%
2002	77.4%
2003	77.1%
2004	78.0%
2005	77.9%
2008	76.3%
2009	77.4%
2010	75.8%
2011	75.5%
2012	75.5%
2013	74.6%
2014	76.2%
Total Average	**76.9 %**

APPENDIX 3

South African Trade Flow Data for Chapter 40

These tables are the researcher's own compilation using data obtained from the DTI

Table I Rubber Import weight data from 1999-2015 (x10^3 tonnes)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4001	49.26	61.29	53.78	68.41	66.82	69.04	67.59	64.08	67.73	62.77	54.49	55.15	51.70	52.66	47.74	48.29	45.60
4002	18.47	16.28	15.15	19.32	20.68	20.63	22.13	23.57	29.10	28.02	20.10	23.92	26.61	27.99	31.31	32.77	33.52
4003	0.00	0.01	0.04	0.04	0.41	0.58	0.09	0.24	0.37	0.44	1.03	1.46	3.03	2.86	4.33	3.53	3.86
4004	0.37	0.24	0.28	0.20	0.13	0.22	0.32	0.48	0.65	0.77	3.38	4.73	4.39	0.61	0.37	0.15	0.10
4005	0.50	0.74	0.61	1.27	0.80	0.99	0.96	1.48	1.32	1.82	3.46	2.03	2.27	2.63	2.24	2.24	2.72
4006	0.25	0.19	0.16	0.11	0.07	0.07	0.06	0.07	0.11	0.11	0.12	0.17	0.06	0.13	0.13	0.13	0.76
4007	0.48	0.48	0.46	0.47	0.60	0.68	0.57	0.42	0.43	0.40	0.37	0.37	0.26	0.10	0.08	0.09	0.10
4008	1.79	1.46	2.85	1.20	1.99	3.07	4.82	3.71	15.43	3.59	3.01	3.65	3.33	3.72	3.48	3.45	3.79
4009	3.05	3.84	2.80	3.18	4.69	5.26	7.94	90.99	726.81	9.58	6.08	8.61	10.12	10.64	10.38	10.81	10.91
4010	5.36	4.52	5.67	8.78	11.59	10.33	13.93	55.29	6819.54	16.17	14.09	20.72	21.41	18.75	26.63	20.90	19.64
4011	2.58	3.09	2.77	3.08	3.69	4.08	6.65	5.48	6.27	5.81	5.27	7.66	7.02	7.36	7.89	7.76	7.81
4012	2.82	2.85	2.62	2.73	4.21	3.14	4.14	3.98	3.98	3.95	3.91	4.64	5.31	5.49	5.35	4.50	3.87
4013	3.61	3.38	3.96	3.76	3.86	4.39	4.45	4.48	4.97	4.89	4.12	4.16	3.50	4.20	3.73	4.07	3.64
4014	0.73	1.10	1.16	3.16	1.31	1.84	1.67	1.31	1.75	1.65	9.15	2.52	1.84	2.88	2.36	3.58	2.31
4015	0.81	1.08	1.12	1.32	1.80	2.80	3.73	3.20	4.17	4.55	4.75	5.49	5.08	5.70	5.42	6.33	6.96
4016	4.77	4.65	4.25	5.34	5.60	13.51	10.16	125.95	5078.99	10.97	7.94	10.41	11.38	12.41	13.26	12.74	14.91
4017	0.03	0.06	0.06	0.19	0.13	0.12	0.18	0.18	0.14	0.17	0.10	0.21	0.71	0.36	0.48	0.52	0.18
TOTAL	94.86	105.28	97.75	122.55	128.38	140.74	149.38	384.90	12761.8	155.64	141.35	155.93	158.01	158.48	165.20	161.86	160.67

Table II Rubber Export weight data from 1999-2015 ($x10^3$ tonnes)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4001	1.06	0.65	0.61	0.28	0.92	1.77	2.10	1.59	1.62	0.80	1.13	0.86	1.06	1.35	1.43	0.76	0.70
4002	17.63	20.71	26.40	28.53	29.58	29.60	40.16	28.33	34.87	29.43	21.21	23.37	23.29	26.10	21.73	23.44	21.76
4003	1.13	0.66	0.66	0.26	0.02	0.16	0.11	0.24	0.28	0.17	0.05	0.28	0.06	0.13	0.05	0.28	0.23
4004	1.64	0.87	1.13	2.01	1.32	1.27	1.18	0.67	1.14	0.84	0.61	1.28	0.85	0.67	0.58	3.91	16.87
4005	1.68	1.51	2.59	3.93	3.96	3.00	3.42	3.42	5.13	3.77	3.13	2.92	4.92	5.09	4.13	3.77	2.53
4006	1.63	0.07	0.23	0.19	0.66	0.45	0.29	0.39	0.25	0.37	0.46	1.01	1.01	1.10	0.65	0.46	0.44
4007	0.10	0.06	0.20	0.14	0.05	0.30	0.94	0.85	1.68	2.44	0.52	0.62	0.50	0.50	0.55	0.56	0.32
4008	2.33	1.92	1.27	2.40	2.42	2.51	1.72	1.59	1.57	2.11	2.04	0.87	1.15	0.85	1.09	0.95	0.96
4009	0.67	1.31	1.48	0.94	1.49	2.36	3.71	1.58	2.06	1.94	3.28	2.12	3.22	3.54	4.15	3.87	3.47
4010	2.08	1.84	2.23	2.05	2.34	2.99	2.15	5.47	4.11	4.66	6.36	6.86	8.22	8.15	10.80	14.04	12.47
4011	6.88	4.77	4.72	4.81	4.95	5.25	4.76	4.23	3.61	3.44	47.96	6.62	8.11	7.37	3.22	2.83	2.73
4012	0.14	0.28	0.49	0.48	0.30	0.67	1.21	1.69	17.89	2.57	1.84	1.78	2.90	2.48	2.62	2.79	2.87
4013	0.43	0.13	0.18	0.18	0.12	0.13	0.07	0.13	0.20	0.35	0.33	0.44	0.26	0.32	0.30	0.35	0.29
4014	0.10	0.07	0.07	0.07	0.16	0.06	0.14	0.16	0.02	0.05	0.26	0.40	0.43	0.33	0.22	0.20	0.16
4015	0.71	0.33	0.20	0.41	0.20	0.20	0.20	0.19	0.12	0.26	1.48	0.66	1.04	0.91	0.67	0.76	0.56
4016	2.32	2.75	2.56	3.55	3.57	3.28	4.10	4.45	3.15	3.62	4.01	5.24	4.78	4.53	11.08	6.56	5.20
4017	0.16	1.00	0.12	0.05	0.05	0.10	0.09	0.03	0.10	0.03	0.20	0.08	0.32	0.48	0.84	1.78	5.33
TOTAL	40.70	38.91	45.14	50.26	52.11	54.10	66.35	55.00	77.80	56.84	94.89	55.41	62.13	63.91	64.09	67.32	76.90

Table III Rubber Import value data from 1999-2015 (ZAR Million)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4001	189.0	291.1	260.0	503.7	488.8	569.8	564.8	834.0	957.8	1342.0	810.5	1243.7	1799.8	1468.6	1256.6	1090.5	911.6
4002	156.5	175.1	209.8	315.9	271.8	243.0	285.1	345.5	472.0	600.8	396.7	460.5	710.0	826.9	845.8	928.1	846.6
4003	0.0	0.0	0.3	0.5	0.4	0.9	0.9	1.6	3.5	4.6	8.2	9.1	21.0	20.9	39.8	38.9	42.9
4004	1.1	1.3	1.5	1.2	0.6	0.8	0.9	1.7	3.0	3.8	8.0	11.4	9.8	2.7	2.6	1.0	0.9
4005	5.1	10.2	13.0	24.6	17.6	19.4	17.4	26.1	28.3	36.1	40.3	49.9	61.9	78.2	68.6	72.6	82.6
4006	3.6	5.8	12.4	16.8	11.3	8.9	4.8	2.8	4.4	7.9	9.6	9.4	6.9	6.9	9.5	13.2	40.1
4007	5.2	6.0	7.3	8.5	9.1	10.4	8.9	9.2	10.4	13.5	9.8	11.1	9.1	4.0	3.8	3.9	4.5
4008	46.8	53.4	62.3	67.1	67.4	73.0	92.5	92.1	116.3	132.9	110.1	106.6	134.1	166.7	206.6	204.3	240.5
4009	118.7	169.8	156.3	206.8	206.6	208.4	244.8	299.5	361.6	511.9	390.4	455.2	566.2	667.6	734.6	824.3	912.6
4010	142.1	144.7	180.9	273.6	282.2	241.6	273.3	385.5	421.0	575.9	536.9	643.8	788.5	805.7	1108.4	993.5	997.2
4011	687.7	833.6	876.3	1213.2	1316.5	1399.2	1684.2	2145.3	3521.9	3717.6	3090.2	4087.5	4979.2	6028.5	7380.1	7533.4	7607.7
4012	90.5	82.8	78.5	98.6	102.0	72.0	79.1	112.9	155.5	175.6	151.8	171.2	227.4	266.8	293.8	265.9	212.8
4013	36.3	41.1	66.8	70.7	58.8	55.6	56.7	71.8	90.8	126.2	122.0	113.0	108.8	127.7	141.0	158.7	155.5
4014	37.5	54.3	69.6	100.2	94.5	91.5	73.6	77.9	119.0	134.9	201.8	138.7	130.1	285.0	214.0	337.1	316.2
4015	31.3	32.2	42.8	58.9	56.0	49.1	77.8	103.8	125.3	170.0	174.3	221.6	267.0	297.1	326.5	396.9	489.0
4016	338.2	394.0	460.4	650.4	568.5	580.1	1013.4	718.0	877.0	1111.1	878.3	983.8	1086.3	1166.5	1399.5	1546.3	1640.6
4017	1.0	1.6	1.9	4.4	3.4	3.3	5.1	6.1	8.0	10.5	6.4	5.2	12.2	6.1	8.6	9.8	4.9
TOTAL	1890.8	2297.2	2500.2	3615.1	3555.5	3627.0	4483.5	5233.8	7275.7	8675.1	6945.2	8721.5	10918.2	12225.9	14039.6	14418.5	14506.4

Table IV Rubber Export value data from 1999-2015 (ZAR Million)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4001	6.7	3.9	5.7	5.0	16.4	17.7	22.7	31.8	31.4	21.0	20.8	23.8	31.8	44.7	60.6	37.3	35.3
4002	89.4	118.5	130.5	247.7	245.1	243.7	318.8	334.2	492.4	589.2	319.9	448.6	631.6	712.1	513.1	601.8	422.3
4003	2.2	2.0	1.8	1.6	0.2	1.1	0.4	0.8	1.2	1.3	1.0	1.9	1.7	1.9	0.9	2.2	2.8
4004	1.4	0.6	1.6	3.7	4.0	4.0	1.6	1.3	3.2	1.2	1.0	3.3	2.0	1.4	1.5	6.5	17.6
4005	11.9	13.1	22.1	39.3	32.1	18.9	21.4	24.4	23.9	27.9	92.3	39.5	81.8	149.4	117.0	97.6	52.9
4006	6.0	1.6	4.6	4.5	10.7	8.5	6.2	5.8	5.7	5.4	13.2	27.2	32.2	37.2	30.4	25.4	18.0
4007	1.1	0.9	2.2	2.2	1.2	5.3	5.9	3.5	4.2	3.1	14.3	16.8	13.7	15.7	18.3	18.6	12.3
4008	13.8	17.5	17.9	31.8	36.0	40.5	26.0	33.9	39.1	62.3	58.1	43.5	58.6	43.0	67.3	58.6	66.1
4009	33.4	51.5	79.4	106.8	111.1	110.1	124.5	95.1	119.5	142.4	161.2	182.8	279.5	312.4	399.0	387.2	370.2
4010	46.9	43.3	55.1	78.2	76.8	88.0	70.9	145.9	157.7	170.0	299.3	335.1	430.3	466.4	651.7	557.1	628.3
4011	705.3	827.0	925.9	1533.4	1389.7	1405.2	1300.5	1381.7	1423.4	2010.5	2270.7	2190.2	2954.4	3288.0	3430.3	3551.4	3823.0
4012	5.0	12.6	15.4	18.0	14.8	20.0	36.9	59.6	52.2	55.9	85.9	87.5	115.2	119.9	148.1	156.1	152.5
4013	9.4	8.9	9.2	12.0	6.7	6.1	5.3	6.6	10.2	11.5	23.7	28.9	20.7	21.3	23.2	27.2	24.7
4014	3.8	3.1	2.4	4.5	6.1	3.0	4.1	4.3	2.2	1.6	14.2	16.3	12.8	14.3	13.1	14.6	16.5
4015	6.1	6.8	6.3	10.5	6.9	6.3	5.9	9.5	7.0	15.1	42.0	35.9	43.0	54.5	52.7	66.4	66.7
4016	105.3	136.6	109.8	177.1	136.7	137.5	143.5	170.8	171.5	227.2	299.3	315.5	400.3	404.8	466.8	638.4	533.4
4017	1.0	2.1	0.9	1.9	1.1	1.0	1.5	0.9	3.0	0.9	9.6	7.5	8.7	12.4	8.2	8.1	8.1
TOTAL	1048.7	1250.0	1390.8	2278.1	2095.5	2116.9	2096.1	2310.2	2548.0	3346.3	3726.6	3804.2	5118.3	5699.6	6002.3	6254.6	6250.6

Table V Rubber Import weight data from **China** from 1999-2015 ($x10^3$ tonnes)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4001	0.0002	0.0000	0.0000	0.0000	0.0502	0.0000	0.0200	0.8909	0.3855	0.4484	0.3602	0.6840	0.6732	0.5909	0.6490	0.8016	0.7076
4002	0.0000	0.0000	0.0121	0.0330	0.0251	0.0277	0.0808	0.1966	0.2450	0.5308	0.5369	0.9047	0.9906	0.9412	0.6948	0.8614	1.4220
4003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0493	0.8280	1.1686	2.4310	2.2547	2.8841
4004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0781	0.5297	0.0162	0.0160	0.0167	0.0000	0.0000
4005	0.0000	0.0000	0.0076	0.0052	0.0072	0.0006	0.1528	0.2195	0.1780	0.2469	0.2864	0.2443	0.3785	0.5943	0.4603	0.4348	0.3376
4006	0.0000	0.0000	0.0007	0.0009	0.0033	0.0035	0.0029	0.0261	0.0352	0.0031	0.0111	0.0591	0.0057	0.0087	0.0465	0.0104	0.0122
4007	0.0068	0.0021	0.0015	0.0011	0.0014	0.0040	0.0033	0.0082	0.0150	0.0063	0.0145	0.0276	0.0055	0.0147	0.0078	0.0150	0.0010
4008	0.0069	0.0144	0.0531	0.0228	0.1748	0.4227	1.1264	1.1810	1.1877	1.7737	1.4325	1.8001	1.5174	1.3693	0.6791	0.7848	0.7852
4009	0.0514	0.0259	0.0286	0.0284	0.2595	0.5739	0.7482	1.3239	1.8351	2.0658	1.7190	2.0456	2.5424	2.4100	2.5124	2.6527	2.5394
4010	0.0258	0.1387	1.2728	2.4844	3.7711	3.5846	4.9912	6.0685	7.2164	7.5965	7.4323	11.5442	12.9646	11.5769	19.5326	15.8893	13.3031
4011	0.0947	0.2023	0.1447	0.1865	0.3213	0.6182	1.3439	1.0911	1.4239	1.3573	1.4309	3.2354	3.0421	3.1181	3.2899	3.4523	3.7207
4012	0.0583	0.0516	0.0640	0.0763	0.1313	0.3235	0.6090	0.3749	0.4634	0.4481	0.4264	0.4809	0.5873	0.7951	0.7340	0.5703	0.7303
4013	0.1073	0.3132	0.6737	0.4748	0.6039	0.9585	1.2411	1.5436	2.1497	2.1337	1.5480	1.6228	1.4003	2.0431	1.7332	1.9709	1.7943
4014	0.1586	0.4923	0.5627	2.6899	0.5836	1.1078	0.8640	0.5848	0.8626	0.8175	1.4438	1.5958	0.8968	1.0002	1.0144	1.4769	0.6726
4015	0.0836	0.0848	0.0922	0.1486	0.2586	0.4018	0.4629	0.4253	0.6585	0.6850	0.8230	0.9861	0.9625	0.9578	1.2405	1.6510	1.6165
4016	0.2314	0.2917	0.2648	0.4237	0.5794	1.0236	0.9470	1.3174	2.3605	2.1691	1.8277	2.9429	3.2791	3.7130	4.1324	4.2591	3.6448
4017	0.0044	0.0012	0.0012	0.0180	0.0033	0.0017	0.0050	0.0070	0.0088	0.0067	0.0038	0.0455	0.5872	0.2864	0.4152	0.4421	0.1107
TOTAL	0.8294	1.6183	3.1796	6.5937	6.7739	9.0521	12.5987	15.2590	19.0254	20.2888	19.3746	28.7977	30.6776	30.6043	39.5897	37.5274	34.2821

Table VI Rubber Export weight data to **China** from 1999-2015 ($x10^3$ tonnes)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0043
4002	0.0000	0.0000	0.0000	0.0860	1.1592	0.0672	0.0336	0.6742	1.4019	0.8099	0.9563	0.3538	0.0200	0.0441	0.4196	0.0502	0.0133
4003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0293	0.0000	0.0685	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4005	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000	0.1027	0.4847	0.0648	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0000	0.0000
4006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0944	0.1163	0.0000	0.0000	0.0001	0.0000	0.0000	0.0004	0.0001	0.0000	0.0000
4007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0505	0.0000	0.0334	0.0164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4008	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0186	0.0083	0.0000	0.0000	0.0000	0.0000	0.0005	0.0017	0.0445
4009	0.0000	0.0000	0.0000	0.0000	0.0001	0.0013	0.0002	0.0010	0.0005	0.0016	0.0040	0.0136	0.0000	0.0001	0.0002	0.0007	0.0003
4010	0.0000	0.0000	0.0003	0.0000	0.0000	0.0007	0.0002	0.0000	0.0560	0.0002	0.0000	0.0003	0.0000	0.0297	0.0001	0.0003	0.0032
4011	0.0000	0.0074	0.0000	0.0016	0.0001	0.0020	0.0007	0.0049	0.0003	0.0044	0.0000	0.0007	0.0000	0.0000	0.0000	0.0009	0.0009
4012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0338	0.0513	0.1031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4013	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4014	0.0020	0.0036	0.0070	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4015	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0011	0.0000	0.0000	0.0000	0.0361	0.0000	0.0000
4016	0.0206	0.0000	0.0022	0.0312	0.0038	0.0178	0.0643	0.0803	0.0050	0.0068	0.0058	0.0203	0.0088	0.0026	0.0037	0.0050	0.0185
4017	0.0000	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000	0.0000	0.0000	0.0080	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0.0227	0.0110	0.0096	0.1188	1.1642	0.1396	0.3594	1.4468	1.7350	0.8393	0.9675	0.3887	0.0290	0.0769	0.4623	0.0588	0.0851

APPENDIX 4

DISAGGREGATED SOUTH AFRICAN TRADE FLOW DATA

Table I Total annual South African trade flow weight data for the non-tyre and tyre rubber sectors from 1999-2015 ($x10^3$ tonnes)

	IMPORTS			EXPORTS		
	Group 3 Total	**Non-Tyre**	**Tyre**	**Group 3 Total**	**Non-Tyre**	**Tyre**
1999	26.27	16.79	9.49	17.56	10.00	7.55
2000	26.71	16.91	9.81	14.51	9.28	5.23
2001	27.89	18.08	9.81	13.74	8.16	5.58
2002	33.32	23.28	10.04	15.25	9.66	5.60
2003	39.54	27.18	12.36	16.31	10.89	5.41
2004	49.28	36.99	12.29	18.30	11.95	6.35
2005	58.29	42.48	15.81	19.38	12.40	6.99
2006	295.06	280.70	14.36	20.75	13.86	6.89
2007	12662.59	12646.94	15.65	34.75	11.38	23.38
2008	61.84	46.80	15.04	21.83	13.04	8.79
2009	58.90	45.23	13.67	68.76	18.11	50.65
2010	68.62	51.78	16.84	26.70	17.24	9.46
2011	70.00	53.92	16.08	31.94	20.17	11.77
2012	71.73	54.58	17.15	30.58	19.90	10.67
2013	79.20	62.16	17.05	36.18	29.50	6.68
2014	74.88	58.46	16.42	35.15	28.61	6.54
2015	74.86	59.45	15.41	34.80	28.59	6.21

Researcher's own compilation of data from the DTI that was disaggregated for the present study

Table II Total annual South African trade flow value data for the non-tyre and tyre rubber sectors from 1999-2015 (ZAR million)

	IMPORTS			EXPORTS		
	Group 3 Total	**Non-Tyre**	**Tyre**	**Group 3 Total**	**Non-Tyre**	**Tyre**
1999	1538.97	719.21	819.76	937.05	216.23	720.81
2000	1819.46	855.87	963.59	1111.91	262.42	849.50
2001	2015.60	986.72	1028.88	1229.16	276.35	952.80
2002	2769.17	1378.13	1391.04	1980.78	415.18	1565.60
2003	2776.37	1289.90	1486.47	1797.84	385.49	1412.35
2004	2793.03	1255.83	1537.19	1831.54	394.94	1436.60
2005	3614.26	1785.29	1828.97	1731.17	382.64	1348.53
2006	4024.87	1685.69	2339.17	1917.59	466.25	1451.34
2007	5811.23	2032.60	3778.63	1995.78	505.75	1490.04
2008	6687.94	2655.07	4032.87	2705.75	624.81	2080.95
2009	5681.48	2307.74	3373.74	3291.57	896.94	2394.63
2010	6946.92	2564.15	4382.77	3287.19	963.75	2323.44
2011	8315.71	2991.21	5324.51	4369.38	1265.45	3103.93
2012	9828.63	3401.68	6426.94	4789.98	1345.06	3444.92
2013	11826.32	4007.70	7818.61	5309.14	1689.21	3619.93
2014	12287.29	4325.37	7961.91	5509.15	1755.85	3753.30
2015	12621.65	4641.16	7980.49	5719.75	1707.29	4012.46

Researcher's own compilation of data from the DTI that was disaggregated for the present study

Table III Annual South Africa-China trade flow weight data for the non-tyre and tyre rubber sectors from 1999-2015 (x10^3 tonnes)

	IMPORTS			EXPORTS		
	Group C Total	**Non-Tyre**	**Tyre**	**Group C Total**	**Non-Tyre**	**Tyre**
1999	0.829	0.562	0.267	0.023	0.023	0.000
2000	1.618	1.049	0.569	0.011	0.004	0.007
2001	3.160	2.276	0.884	0.010	0.010	0.000
2002	6.555	5.817	0.739	0.033	0.031	0.002
2003	6.691	5.634	1.058	0.004	0.004	0.000
2004	9.024	7.120	1.904	0.072	0.020	0.053
2005	12.345	9.148	3.197	0.194	0.159	0.034
2006	13.952	10.934	3.018	0.287	0.198	0.090
2007	18.217	14.165	4.052	0.200	0.080	0.120
2008	19.063	15.118	3.945	0.029	0.025	0.004
2009	18.113	14.693	3.420	0.011	0.011	0.000
2010	26.386	21.019	5.367	0.035	0.034	0.001
2011	27.791	22.756	5.035	0.009	0.009	0.000
2012	27.293	21.322	5.971	0.033	0.033	0.000
2013	35.338	29.573	5.765	0.041	0.041	0.000
2014	33.175	27.166	6.009	0.009	0.008	0.001
2015	28.931	22.685	6.246	0.067	0.066	0.001

Researcher's own compilation of data from the DTI that was disaggregated for the present study

Table IV Annual South Africa-China trade flow value data for the non-tyre and tyre rubber sectors from 1999-2015 (ZAR million)

	IMPORTS			EXPORTS		
	Group C Total	**Non-Tyre**	**Tyre**	**Group C Total**	**Non-Tyre**	**Tyre**
1999	22.84	14.51	8.33	0.24	0.24	0.00
2000	45.48	30.63	14.85	0.47	0.02	0.45
2001	66.12	49.55	16.58	0.19	0.19	0.00
2002	135.96	114.04	21.92	0.61	0.31	0.30
2003	168.25	111.81	56.45	1.24	0.96	0.28
2004	240.15	126.40	113.75	2.66	1.38	1.28
2005	393.14	139.83	253.31	1.70	1.47	0.23
2006	532.22	181.44	350.78	1.50	0.31	1.19
2007	1068.45	257.51	810.94	2.10	0.99	1.11
2008	1133.20	373.09	760.11	3.21	1.50	1.71
2009	940.89	390.57	550.31	1.16	1.15	0.00
2010	1572.34	484.19	1088.15	2.84	2.16	0.68
2011	1968.34	606.79	1361.54	1.39	1.23	0.16
2012	2185.27	669.03	1516.24	1.44	1.44	0.00
2013	2707.12	983.64	1723.48	0.85	0.85	0.00
2014	2859.04	962.58	1896.46	7.12	2.02	5.10
2015	2921.91	892.77	2029.14	5.32	4.48	0.84

Researcher's own compilation of data from the DTI that was disaggregated for the present study

APPENDIX 5

SECONDARY DOMESTIC DATA COLLECTED

Table I Secondary data for the variables in equation 4.20 from 1999 to 2014 ($x10^3$ tonnes)

	NR_i	SR_i	SR_{sa}	NR_e	SR_e	SR_{sae}
1999	49.26	18.47	37.30	1.06	17.63	16.82
2000	61.29	16.28	39.83	0.65	20.71	21.33
2001	53.78	15.15	39.73	0.61	26.40	23.64
2002	68.41	19.32	42.50	0.28	28.53	27.62
2003	66.82	20.68	45.51	0.92	29.58	30.37
2004	69.04	20.63	45.48	1.77	29.60	29.63
2005	67.59	22.13	41.90	2.10	40.16	29.70
2008	62.77	28.02	40.25	0.80	29.43	27.63
2009	54.49	20.10	32.05	1.13	21.21	27.07
2010	55.15	23.92	37.04	0.86	23.37	21.43
2011	51.70	26.61	45.01	1.06	23.29	22.48
2012	52.66	27.99	38.06	1.35	26.10	24.11
2013	47.74	31.31	36.04	1.43	21.73	20.09
2014	48.29	32.77	31.54	0.76	23.44	21.40

Researcher's own compilation of secondary data obtained from various sources as indicated in Table 4.1

Table II Annual employment in the South African rubber industry from 1999 to 2014

	Employment in the Rubber Industry
1999	15 448
2000	15 544
2001	14 782
2002	15 064
2003	15 470
2004	15 327
2005	14 408
2008	14 193
2009	14 492
2010	14 599
2011	13 417
2012	12 169
2013	12 968
2014	13 191

Researcher's own compilation using data from the Stats SA

APPENDIX 6

QUESTIONNAIRE

Dear Sir/Madam,

RE: Self-completion of questionnaire

My name is Donal Ryan and I am studying part-time for a Masters in Business Administration (MBA) at the University of KwaZulu-Natal (UKZN). As part of my final year I am required to carry out a research study for my dissertation.

I have elected to do my study on **"The effect of Chinese rubber imports on the South African rubber manufacturing industry"**. There has been a lot of reports that Chinese imports are having a huge impact on the industry but to my knowledge nobody has done a formal scientific study on the topic on the rubber industry as a whole.

The objectives of my study are to determine the effect of Chinese rubber imports on the rubber manufacturing industry and to identify other factors that have affected the growth of the industry.

I would much appreciate if you could complete the following questionnaire which should take no more than **10 minutes** to complete. You can either print and complete by hand or complete electronically and save and return to me by email.

I assure you that this questionnaire will be treated in strictest confidence and no reference will be made to individual surveys or persons in the dissertation. I am also bound by the strict ethical standards of UKZN.

I feel that the completed dissertation will be of huge benefit to all in the South African rubber industry and assist rubber companies in drafting strategies to survive the downturn. Should you wish to receive a copy of the completed dissertation please let me know and I will email a copy to you once it has been assessed by the University.

Yours sincerely,

Donal Ryan
Email: donaloriain@gmail.com

QUESTIONNAIRE

NAME:	
COMPANY:	
POSITION:	

CONSENT:

Please put an 'X' in this box to confirm that you understand the contents of this document and the nature of the research project, and that you consent to participating in the research project.

I ☐ AGREE

1. In your opinion, has the rubber manufacturing industry in South Africa declined in recent years? *(Please put an 'X' in one box)*

Yes	
No	

2. If yes, what do you think has caused this decline of the rubber manufacturing industry in SA? *(Please put an 'X' in as many boxes as deemed appropriate)*

	Imports of rubber products	Lack of technology	
	Labour unrest	Poor production efficiencies within the industry	
	Wages	Failure of government to promote the industry	
	Rand fluctuation	Global trends	
	Lack of expertise	Other	

3. Please select one of the following regarding the approximate Annual Volume Output of **your company** over the past 15 years: *(Please put an 'X' in one box)*

Annual output has increased		(If possible, state approx. % _____)
Annual output has remained stable		
Annual output has decreased		(If possible, state approx. % _____)

If your annual output has changed, please indicate the possible reason(s) that contributed to this change:

(Please put an 'X' in as many boxes as deemed appropriate)

	Reason for increase	**Reason for decrease**	
	The SA market has improved	Dictated by domestic market	
	You are serving new markets within SA	You are struggling to compete with imports	
	You have started/increased exports	Cost of labour has limited output	
	You have sourced cheaper raw materials	Cost of raw materials has limited output	
	You have improved production efficiency	Other operational costs	
	You have increased capacity	Strategic decision to reduce capacity	
	Other (please state below if possible)	Other (please state below if possible)	

4. Please select one of the following regarding the approximate Workforce Size at **your company** over the past 15 years: *(Please put an 'X' in one box)*

Workforce has increased		(If possible, state approx. % _____)
Workforce has remained stable		
Workforce has decreased		(If possible, state approx. % _____)

If your workforce size has changed, please tick the possible reason(s) that contributed to this change:

(Please put an 'X' in as many boxes as deemed appropriate)

	Reason for increase	**Reason for decrease**	
	Your volume output has increased	Your volume output has reduced	
	You have introduced new processes	You have improved labour efficiency	
	You have increased capacity	You have automated	
	Your company has expanded	Labour has become too expensive	
	Other (please state below if possible)	Labour unrest has become excessive	
		You have outsourced	
		Other (please state below if possible)	

5. Which of the following countries/regions do you think threatens the South African rubber market the most through import penetration?

(Please put an 'X' in as many boxes as deemed appropriate)

China	
India	
Europe	
Australia	
USA	
South America	
Other	

6. Do you think that the South African government should be doing more to protect the country's rubber manufacturing industry from imported rubber products?

(Please put an 'X' in one box)

Yes	
No	

7. Do you think that the recent weakening of the Rand will assist the South African rubber manufacturing industry? *(Please put an 'X' in one box)*

Yes	
No	

8. What do you think can be done to assist the South African rubber manufacturing industry?

APPENDIX 7

List of Rubber Manufacturing Companies that are members of the Institute of Materials, Mineral & Mining (IOM3), South Africa

Area	Company Name
Northern (15)	Dunlop
	Bandag
	The Rubber Processors cc
	Trentyre (Pty) Ltd
	Elastool Products (Pty) Ltd
	National Rubber-Matmin (Pty) Ltd
	Dynamic Fluid Control
	ESCO
	Multotec Rubber (Pty) Ltd
	Silicone Extrusions (Pty) Ltd
	Delta Rubber cc
	Fenner SA (Pty) Ltd
	Hannover Engineering (Pty) Ltd
	Tega Industries South Africa (Pty) Ltd
	Transvaal Rubber Company (Pty) Ltd
KZN (4)	Nuvo Rubber Compounders (Pty) Ltd
	Aberdare Cables (Pty) Ltd
	H&M Rollers
	Dunlop Mixing & Technical Services (Pty) Ltd
Eastern Cape (6)	S & N Rubber (Pty) Ltd
	Bridgestone SA (Pty) Ltd
	ECL Industries
	Goodyear SA (Pty) Ltd
	ContiTech | Veyance Technologies Africa
	S R F Industex (Pty) Ltd
Western Cape (1)	Rubber Products & Mouldings (Pty) Ltd

APPENDIX 8

UKZN Ethics Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

29 March 2016

Dr Donal Ryan 214580262
Graduate School of Business and Leadership
Westville Campus

Dear Dr Ryan

Protocol reference number: HSS/0281/016M
Project Title: The effect of Chinese rubber imports on the South African rubber manufacturing industry

Full Approval – Expedited Application

In response to your application received 16 March 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

.....

Dr Shenuka Singh (Chair)
Humanitities & Social Scinces Research Ethics Committee

/pm

Cc Supervisor: Christopher Chikandiwa
Cc Academic Leader Research: Dr M Hoque
Cc School Administrator: Ms Zarina Bullyraj

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Website: www.ukzn.ac.za

1910 - 2010
100 YEARS OF ACADEMIC EXCELLENCE
Founding Campuses: Edgewood, Howard College, Medical School, Pietermaritzburg, Westville