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Disruptive Imports: The Impact of the Chinese Rubber Imports on the South African Rubber Manufacturing Industry

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Abstract: The main objective of this article is to shed some light on one of the burning questions in the African region on the effect of imports on economy and employment. As such, the article analysed the effect of the Chinese imports on employment in the South African rubber manufacturing industry using secondary data. The modified Chenery model was applied for the analysis. The findings of this study provide tentative evidence that the import penetration had a negative linear effect on employment. The results illustrate that importation of the rubber products has had a negative effect on domestic employment over the past 15 years. The study recommends that the rubber manufacturing companies should focus on collaboration, which should lead to a more sustainable level of growth. This article is valuable as it does not only conceptualise the rubber manufacturing industry and reveal the effect of Chinese imports on the industry, but it also suggests some strategic collaboration as a way to build resilience and sustainable growth.

Keywords: manufactured; rubber; Chinese imports; industry

JEL Classification: H20; H25

1 Introduction

A thriving and sustainable domestic manufacturing sector is the source of hope for many livelihoods living in the developing countries. However, in the past few years, the South African rubber industry has come under increasing 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, 2015). This indicates a significant drop in value of the output of manufactured rubber products during this period. However, Chinese imports have frequently been blamed

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for this decline (International Trade Administration Commission of South Africa, 2007). The decline in the rubber industry appears to be widely acknowledged yet, there have been limited studies on the effect of imports on the South African rubber manufacturing industry (Cokayne, 2014; Motlanthe, 2013; Payne, 2011).

The literature on the effect of Chinese imports on employment in the African context is scant (except for Bonga & Biyase, 2019, Peters, 2015, International Trade Administration Commission of South Africa, 2007) and little is known about the impact of Chinese imports on the South African rubber manufacturing industry. Most of the recent literature have pointed towards Chinese imports as being one of the main causes of the decline of output as well as a reduction of total employment in the manufacturing sector (Edwards & Jenkins 2015, Cokayne, 2014, Motlanthe, 2013, Payne, 2011) However, in view of the discussion above the indicators show that there are problems within the rubber industry. There is therefore a need for a study that explores the effect of imports on employment in the South African rubber manufacturing industry with a particular focus on the Chinese imports.

Thus, the aim of this article is to sheds light on of the burning question of whether the Chinese imports have directly affected employment in the SA rubber industry. To achieve the objective this article secondary data was collected from the Department of Trade and Industry (DTI), Statistics South Africa (SSA), the South African Revenue Service (SARs) and a number of rubber industry sources, over a period of 15 years, between 1999 and 2014. The rigorous analysis was carried out to analyse the employment data for the SA rubber industry using the Chenery (1960) analytical framework.

The remainder of the article is structured as follows. Next, the paper discusses the conceptual framework and an overview of the South African rubber industry. After that, the article is organised as follows: analytical framework, data analysis and results. Subsequently, a discussion of the findings and their implications is provided. Finally, the last section provides a conclusion, as well as future research guidelines. The following section focuses on the conceptual framework of the study.

2 Conceptual Framework and An Overview of the South African Rubber Industry

The terminology that is used in the rubber industry is often confusing to the uninformed. Further, there are conceptual difficulties in the measurement of, in particular, the output of the non-tyre and tyre sectors of the rubber industry. This section addresses this issue by defining and considering alternative measures of output of the rubber industry. A conceptual framework is proposed in Figure 1, which may assist in providing an understanding of the relationship between the variables in the study used by economists and market participants.

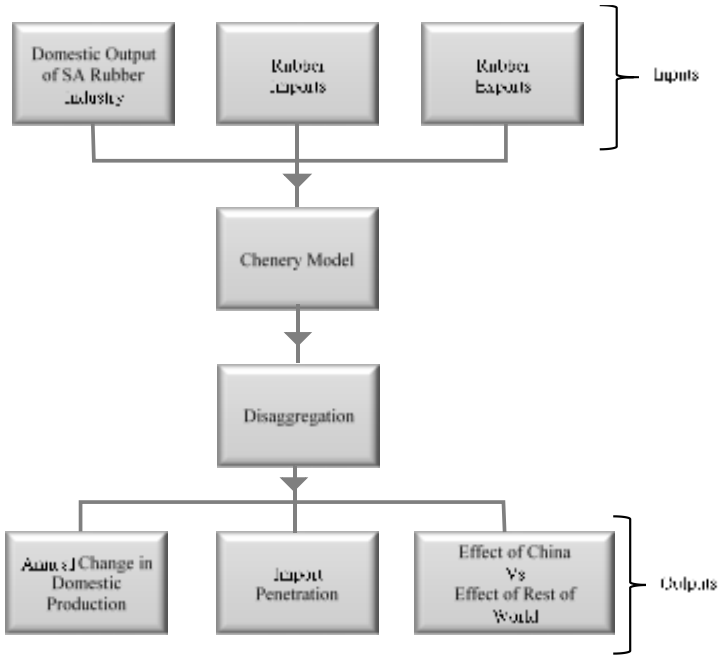


Figure 1. Overview of Inputs and Outputs of the Modified Chenery 1960 Model

2.1. Model Specification

Based on the theoretical underpinnings, data availability and applicability the modified Chenery (1960) analytical framework was adopted to determine the effect of the Chinese imports on the domestic output of the South African rubber industry. Analysis of the secondary data collected from SSA, SARs and DTI and a number of other industry sources between 1999 and 2014. In order isolate 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 decomposition method was utilised. Further, decomposition allowed the isolation of the effect of Chinese imports. The article estimates the following relationship:

$$Q_R = D_R + X_R - M_R \quad (1)$$

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 modified Chenery model is provided in 3. 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 occurs between time 0 and 1 if:

$$M_{R1}/D_{R1} > M_{R0}/D_{R0} \quad (2)$$

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}.

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 & Jenkins (2015). In the present article, these measures (between time 0 and 1), can be adapted as follows:

Absolute Change in Annual Domestic Demand, ΔD_R:

$$D_{R1} - D_{R0} \quad (3)$$

Absolute Change in Annual Domestic Production, ΔQ_R:

$$Q_{R1} - Q_{R0} \quad (4)$$

Absolute Change in Import Penetration Level:

$$(m_1 - m_0) \quad (5)$$

Absolute contribution of changing domestic demand to the domestic production:

$$\Delta D_R(1 - m_{R0}) \quad (6)$$

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

$$X_{R1} - X_{R1} \quad (7)$$

Absolute change in domestic production due to import penetration:

$$(m_{R1} - m_{R0})D_{R1} \quad (8)$$

Change in Import Penetration specifically due to China, Δm_c:

$$m_{Rc1} - m_{Rc0} = (M_{Rc1}/D_{R1}) - (M_{Rc0}/D_0) \quad (9)$$

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:

$$m_{Rw1} - m_{Rw0} = (M_{Rw1}/D_{R1}) - (M_{Rw0}/D_0) \quad (10)$$

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:

$$\Delta m_{Rc} D_1 \quad (11)$$

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

$$\Delta m_{Rw} D_1 \quad (12)$$

3. Analytical Framework

The preceding review of the literature on the conceptual framework and a background on the South African rubber manufacturing industry, have both shed some light on the linkage between the rubber imports and its effect on domestic rubber manufacturing output. This section builds on that background to set the analytical framework that is used in this study. It is divided into five steps.

3.1. Estimation domestic output of rubber products

With the conceptual framework presented in section 2 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 in Chapter 40 trade flow data.

- 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 in Chapter 40 trade flow data. 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:

$$R = (NR_i + SR_i + SR_{sa}) - (NR_e + SR_e - SR_{sae}) \quad (13)$$

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 13 were acquired from secondary sources outlined in Table 1 and the annual R values for the total South African market were calculated.

Table 1. Data Source for Each of the Variables from Equation 13

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:

$$R = R_n + R_t \quad (14)$$

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 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 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:

$$Q_{Ci} = (R_i / P_{Ci}) \times (1 - S_C) \quad (15)$$

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 researchers' 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 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 3 are deemed to be the largest segments, by volume, of the non-tyre segment in South Africa.

Table 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:

$$Q_C = Q_{Cn} + Q_{Ct} \quad (16)$$

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

$$D_C = Q_C + M_C - X_C \quad (17)$$

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 17 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 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:

$$Q_{Ri} = (D_{Ci} / Y_P) \times (1 - S_R) \quad (18)$$

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.

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, Williams, 2013 and Ramos et al., 2011). For the present study, Y_{pt}, was taken as the average of these figures – 77.2%.

Using equation 18, 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. The sources of data used in the analysis are provided in Table 5

Table 5. 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

4. Data Analysis and Results

4.1. The Effect of Chinese Imports on Employment in the SA Rubber Manufacturing Industry.

In order to measure how various input variables to the modelling have affected employment in the domestic rubber industry in SA, the Chenery decomposition method was applied. An initial overview of the effect of import penetration on employment in the rubber industry was obtained by first examining the change in annual import penetration for the rubber industry alongside employment data. The employment information is presented in Table 5 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 coefficient results of these two variables (i.e. import penetration and employment) are illustrated in Figure 2.

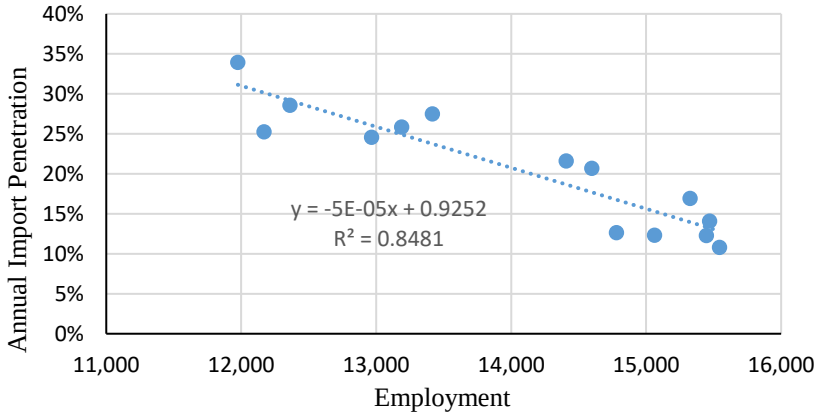
Table 5. Import Penetration for the South African Rubber Industry from 1999 to 2014

	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%

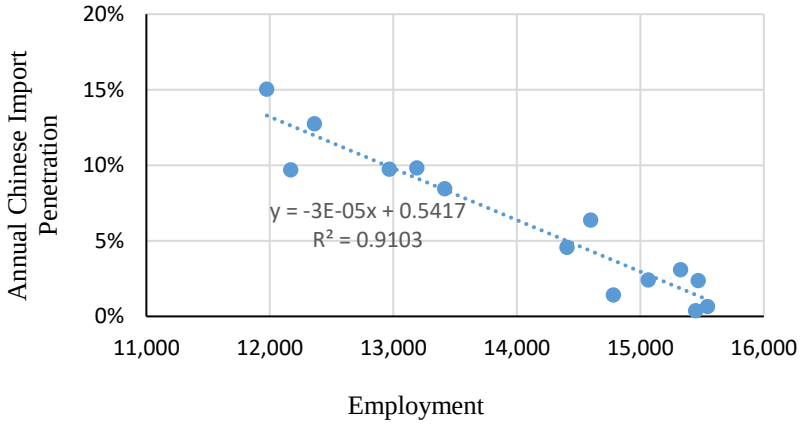
In Figure 2(a) a negative linear correlation is evident between overall import penetration and employment with a statistically significant r^2 of 0.85. When the import penetration is disaggregated into Chinese and the rest of the world – as illustrated in plots (b) and (c) – it is evident that these 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)



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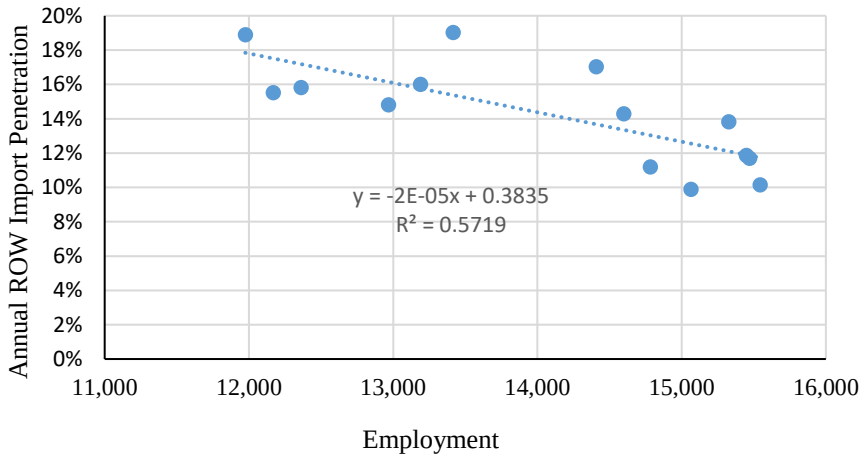

(c)

Figure 2. 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

However, changes in the employment levels can be due to changes in domestic production and/or changes in labour productivity (Edwards & Jenkins, 2015). In order to determine the factors that have affected employment levels in the South African rubber industry the modified Chenery model was used to decompose the employment data. The results of the decomposition analysis are presented in Table 6 and Figure 3. Figure 3 provide graphical representation with stacked columns to illustrate the relative importance of each factor to the change in employment for each period.

Table 6. Chenery Decomposition Change 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

Firstly, the results of the analysis provide evidence that the overall change in employment in the SA rubber industry (in the last fifteen years) has been a result of 3473 job losses. However, the factor decomposition analysis of the employment data for the whole industry showed that the growth in domestic demand has led to the creation of 289 jobs during the same 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.

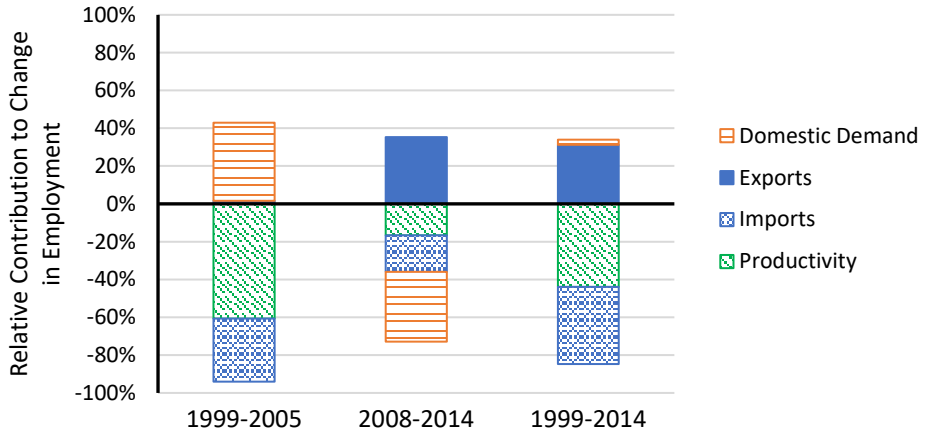

Figure 3. The Relative Contribution of Input Factors to Employment in the Rubber Manufacturing Industry for the Total 1999-2014 Period and Two Sub-Periods Within

Secondly, a further decomposition analysis to illustrate the direct effect of Chinese imports on employment in the SA rubber industry was conducted. As results indicated in the last row of Table 6, the results of the analysis show that 1704 out of the 2522 jobs lost (due to imports) in the rubber industry due can be attributed directly to Chinese imports. Therefore, the effect of Chinese import penetration on employment comprised 68% of the total import penetration effect.

The actual growth in employment in the rubber industry alongside the theoretical growth without the influence of Chinese imports is presented in Figure 4. The results presented in Figure 4 show that between 1999 and 2014 the increase in Chinese imports 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. These finding 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.

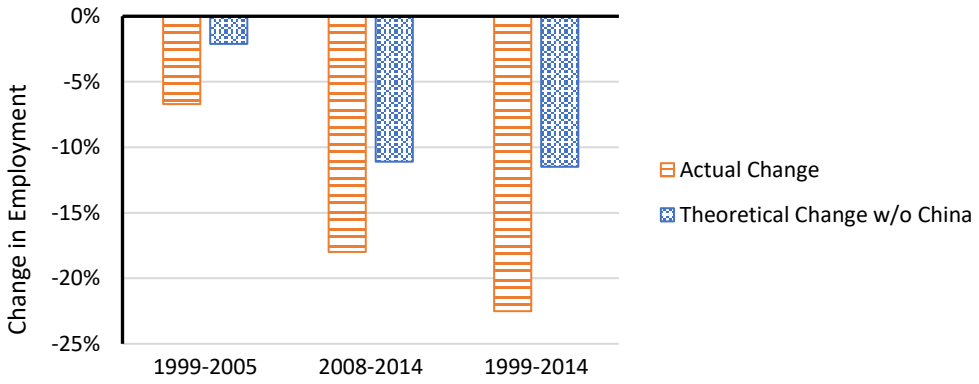

Figure 4. Comparison of Change in Employment in the Rubber Industry – Actual Change Versus the Theoretical Change if There Were no Chinese Imports
Source: [Growth % calculated as the change in employment in the final year of the period relative to the employment in the base year of the period]

5. Discussion of Findings

The study underlying this article addressed the gap in literature on the effect of imports of rubber products on the South African rubber industry using data between 1999 and 2014, with a particular focus on imports originating from China. Several lessons can be drawn from the factor decomposition analysis on employment in the rubber industry:

Firstly, the results indicate that the change in domestic demand contributed positively to employment between 1999 and 2005 and contributed negatively between 2008 and 2014 as illustrated in Figure 6.11. However, over the entire period of 1999 to 2014, the net effect of change in domestic demand had a relatively negligible effect on employment compared to the other three factors.

Secondly, the results illustrates that export expansion between 2008 and 2014 had a significant positive effect on employment resulting in over 3000 extra jobs. This was most likely due to the surge in exports in the non-tyre sector in this period (Ryan & Chikandiwa 2016).

Thirdly, the findings of the study show that increasing import penetration had a negative effect on employment leading to the effective loss of over 2500 jobs between 1999 and 2014.

Fourthly, the results of the analysis demonstrate that improvements in labour productivity (i.e. a reduction in the labour required per unit of output for the industry) between 1999 and 2014, had a negative effect on employment. 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.

Last but not least, the results of a further decomposition analysis showed that Chinese imports detracted almost 1704 jobs from employment in the rubber industry in the 1999 to 2014 period. The findings of this analysis are encouraging as they are similar to Edoun & Netshiozwi (2015) who used the 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". Furthermore, the results of the decomposition analysis show that imports of rubber products, in addition to improvements in labour productivity, had a significant and negative effect on employment in the SA rubber industry between 1999 and 2014. Similar trends were observed by Edwards & Jenkins (2015) for South Africa's overall manufacturing industry between 1992 and 2010.

6. Managerial Implication and the Strategic Way Forward

Arising from the findings of the study, the several recommendations to improve the South African rubber industry are offered, which are directly linked to the policy makers and market participants. To build a thriving and sustainable rubber industry in South Africa all stakeholders need to be actively involved. The major drive must come from the collective rubber industry through collaborative effort. However, the rubber industry is highly competitive and it would almost be counter-intuitive for a company to start entering into cooperative endeavours with its 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 instance, strategic collaboration endeavours could be a major boost in the direct import of raw materials. Pooling of resources makes global sourcing viable of raw materials even for small and medium enterprises. However, this may mean sharing some information with competitors in terms of the types and costs of materials being imported. Nevertheless, the approach comes with several advantages such as sharing knowledge, expertise and cost savings in shipping and procurement costs. The rubber industry and employment will ultimately benefit in the long run.

7. Conclusion

In concluding this article, we note that the findings of this article provide tentative evidence which seems to support that the import penetration had a negative linear effect on employment. The results demonstrate that importation of the rubber products has had a negative effect on employment. Moreover, the results of the decomposition analysis show that imports of rubber products, in addition to improvements in labour productivity, had a significant and negative effect on employment in the SA rubber industry during the period which was analysed. The findings provide critical insights into the effect of Chinese imports on employment in the rubber manufacturing sector in South Africa. Above and beyond, building a thriving and sustainable economy and domestic manufacturing sector is the source of hope for many livelihoods living in the developing countries.

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