Eastern Cape automotive sector analysis: an economic model for policy and investment development *

BY

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ABSTRACT

This paper presents recent development and trends in the Eastern Cape automotive sector. The impact analysis is conducted with the aim to examine the effect that the Eastern Cape automotive sector has on the regional and national economic growth, employment, and poverty alleviation. The paper uses the supply and use tables (SUTs) and the social accounting matrix (SAM) to derive demand-side multipliers also known as backward multipliers. The methodology used to develop the SUTs and SAM-based models are in line with the most recent 2008 system of national accounts released by the United Nations. Simulation results from the impact study reveal that for a hypothetical R1 million increase in Eastern Cape automotive sector's final demand, a higher knock on effect in the province occurs in employment than in economic growth. The paper highlights two areas that sector and policy analysts need to monitor carefully: firstly, the foreign trade markets that account for more than half of the demand for automotive products; and secondly, the declining overall productivity in the automotive sector.

** Key Words: Sector analysis, automotive sector, policy development, social accounting matrix, supply and use tables, impact analysis, investment.*

*** The views expressed in this paper are those of the author and in no way represent those of the Eastern Cape Socio Economic Consultative Counsel.*

1. Introduction

This paper presents the recent development trends (1995 – 2010) in the *"motor vehicles, parts and accessories"* sector. The aim of the document is two-fold. Firstly, it provides a comprehensive analysis of the automotive sector in terms of: fixed capital stock, gross domestic fixed investment (GDFI), imports, exports, employment and skill levels, taxes and subsidies on production, compensation of employees (labour remuneration), gross operating surplus (GOS), total production output, gross value added (GVA), intermediate consumption expenditure, and the number of jobs created in the sector. Secondly, it presents the simulation results or the impact of the Eastern Cape automotive sector on provincial national economic growth, employment and poverty alleviation. The data used in this document is from Statistics South Africa[1]. The paper uses two economic models (derived from the Eastern Cape supply and use tables, and the social accounting matrix). These models are in line with the most recent United Nation's 2008 system of national accounts[2] (2008 SNA) and international best practices.

The main findings of the automotive sector analysis and the simulation results from the SUTs and SAM-based model are summarised below.

- Labour productivity in the automotive sector has increased while the income share toward employees has declined.
- Between 1995 and 2010, on average, the automotive sector's input cost growth rate outpaced that of the output. As a result, the overall productivity (output/input) of the automotive sector declined from 1.27 in 1995 to 1.18 in 2010, signalling a slight drop in the sector's GVA contribution to the Eastern Cape economy.

[1] Statistics South Africa (2012): National Accounts, Statistical release P0441 on Gross Domestic Product, annual estimates 2002 – 2010.

[2] System of National Accounts, 2008. Pre-edited version 1. Commission of the European Communities, International Monetary Fund, Organisation for Economic Cooperation and Development, United Nations and World Bank.

- In 2010, the foreign market (51%) and local households (21%) accounted for almost three quarters of the final demand for automotive products. There are risks and benefits associated with foreign trade being larger than domestic trade.
- In most indicators analysed in this study, the Eastern Cape automotive sector performed below the average automotive sector for the country as a whole.
- Between 1995 and 2010, employment growth in the Eastern Cape automotive sector was insignificant. On average, jobs were created at 0.05% annually in the Eastern Cape while for the country as a whole, on average, jobs were shed at 0.6% annually.
- Looking at the sector productivity, the study shows that the fixed capital productivity ratio increased from 4.93 in 1995 to 7.17 in 2010, labour productivity ratio more than doubled from 0.67 in 1995 to 1.45 in 2010, but the overall productivity ratio in the automotive sector declined from 1.27 in 1995 to 1.18 in 2010.
- In 2010, employment in the Eastern Cape automotive sector accounted for 0.2% of the total employment in South Africa, 24.0% of the RSA automotive sector's employment, 2.0% of the total employment in the Eastern Cape, and 17.7% of the Eastern Cape manufacturing sector's employment.
- In the same year, the Eastern Cape automotive sector contributed 0.3% to the South African economy, 22.6% to the RSA automotive sector, 4.0% to the Eastern Cape economy, and 22.5% to the Eastern Cape manufacturing sector.
- Simulation results from the SUTs and SAM-based models[3] show that for R1 million of final demand spending in the Eastern Cape automotive sector, GDP (economy wide, including all induced impacts) would rise by some R0.437 million; labour remuneration would rise by R0.245 million; the gross operating surplus of companies could rise by R0.191 million; Fixed capital stock will need to rise by R0.796 million; and at least three more employees will be required (sustained) in the formal automotive sector.

[3] Juan Carlos Parra and Quentin Wodon developed the *"SimSIP SAM":* A Tool for the Analysis of Input-Output Tables and Social Accounting Matrices, the World Bank,2010

- Similarly, for R1 million of final demand spending in the Eastern Cape automotive sector, production output will rise by R3.160 million in South Africa of which R2.770 million in Eastern Cape and R0.390 in all other 8 provinces of RSA.
- In terms of the sector's contribution to economic growth, the results from the impact study reveals that the contribution of the Eastern Cape automotive sector is split almost by half between the Eastern Cape economy and the other 8 provinces of South Africa. In other words, the sector stimulates growth in other provinces.
- The top five sectors with the highest output multipliers in the Eastern Cape are: business services, wholesale & retail trade, food, finance & Insurance, and transport & storage.

  In terms of labour multiplier, manufacturing and trade are the top two sectors with the highest knock effect on employment.

The document is structured as follows: section one introduces the paper and presents the main findings of the study. Section two provides an economic analysis of the sector. It focuses on the developments, performance and trends for 1995 – 2010. In this section, important ratios are developed, the components of final demand are explained, and a comparison is made between the size of the Eastern Cape automotive sector and that of the country as a whole. An analytical framework and methodology is provided in section three with the aim to show how the multipliers were developed for the Eastern Cape economic model. Using the Eastern Cape economic model, section 4 presents simulation results for the automotive sector. It quantifies the impact of an additional R1 million in the Eastern Cape automotive sector on the provincial and national economies. Investors, sector analysts and policy-makers can have answers to hard questions such as the impact of the Eastern Cape automotive sector on poverty alleviation, job creation, economic growth, exports, imports, investment growth, etc. Section 5 concludes the study and provides recommendations.

2. Automotive sector analysis

2.1 Definition of the sector and the standard industrial classification (SIC)[4]

The manufacturing sector (SIC 3) is made up of different sub-sectors, one of which is the “manufacture of transport and equipment” (SIC 38). This sub-sector (SIC 38) is also subdivided in different sub-sub-sectors, for example the “manufacture of motor vehicle” (SIC 381); “manufacture of bodies for motor vehicles, trailers and semi-trailers” (SIC 382); and “manufacture of parts & accessories for motor vehicle & their engines” (SIC 383). These three sub-sub-sectors (SIC 381, 382 and 383) are aggregated into one group referred to in this document as the “motor vehicles, parts and accessories sector”. This group of sectors is the closest proxy for the automotive sector. Therefore, in this document, the automotive sector and “motor vehicles, parts and accessories” sector are used interchangeably. In other words, for the purpose of the study, the document uses the automotive sector to denote the combination of the three sub-sectors (SIC 381-382-383). Below is a break-down of the manufacturing sector:

Manufacturing sector (SIC 3)

31 Manufacture of textile, clothing and leather goods.

32 Manufacture of wood and of products of wood and oak.

33 Manufacture of coke, refined petroleum products and nuclear fuel.

34 Manufacture of other non-metallic mineral products.

35 Manufacture of basic metals and fabricated metal products.

36 Manufacture of electrical equipment and apparatus.

37 Manufacture of radio, television and communication equipment.

38 Manufacture of transport equipment

381 Manufacture of motor vehicle.

382 Manufacture of bodies for motor vehicles, trailers & semi-trailers.

[4] Standard Industrial Classification codes (SIC Codes) used by Statistics South Africa and South African Reserve Bank. These SIC codes are an internationally accepted set of codes for the standard classification of all economic activities. These codes are prescribed by the Department of International Economic and Social Affairs of the United Nations.

383 Manufacture of parts & accessories for motor vehicle & their engines.

384 Building and repairing of ships and boats.

385 Manufacture of railway and tramway locomotives and rolling stock.

386 Manufacture of aircraft and space craft.

387 Other transport & equipment: motor cycle, bicycles and invalid carriage.

39 Manufacture of furniture.

2.2. Selected ratios for the Eastern Cape automotive sector

Table 1 presents for selected indicators, the performance, development and trends of the Eastern Cape automotive sector. The analysis is shown in the form of ratios. The result reveals that the fixed capital productivity increased from 4.93 in 1995 to 7.17 in 2010, labour productivity more than doubled from 0.67 in 1995 to 1.45 in 2010, but the overall productivity in the automotive sector declined from 1.27 in 1995 to 1.18 in 2010.

Table 1: Eastern Cape automotive sector: Selected ratio 1995 - 2010

Labour	**1995**	**2000**	**2005**	**2010**
Labour productivity	0.67	0.90	1.01	1.45
Remuneration value added ratio	0.64	0.64	0.55	0.47
Income distribution	1.71	1.81	1.20	0.87
Unit labour cost	0.14	0.10	0.08	0.07
Overall productivity	1.27	1.19	1.17	1.18
Trade	**1995**	**2000**	**2005**	**2010**
Export-output ratio	0.04	0.18	0.43	0.43
Import-output ratio	0.31	0.28	0.58	0.49
Trade ratio (Exports/Imports)	0.12	0.64	0.74	0.88
Import leakages	0.24	0.22	0.37	0.33
Import penetration	0.25	0.26	0.50	0.46
Investment	**1995**	**2000**	**2005**	**2010**
Capital stock output ratio	0.20	0.16	0.19	0.14
GDFI output ratio	0.03	0.04	0.06	0.03
Fixed capital productivity	4.93	6.41	5.34	7.17

Source: Author's calculation derived from Statistics South Africa

Important lessons and definitions from table 1 are summarised below:

- **Employment output ratio** is a measure of *labour productivity* in the economy. Employment output ratio (EOR) is equal to the output produced by the workers (Q) divided by the number of workers (N): EOR = Q / N.
  Between 1995 and 2010, labour productivity in the Eastern Cape automotive sector improved significantly. In 2010, each worker in the automotive sector generated production output worth R1.45 million compared to R0.67 million generated in 1995. Increase in labour productivity in the sector could partly be attributed to the increase in highly skilled employees in the sector.

- **Remuneration value added ratio** is a measure of the *cost of labour* relative to the value added by the labour expressed as a percentage. Remuneration value added ratio is equal to the total remuneration received by the employees (C) divided by the value added to the products or services by the employees (VA) times one hundred: remuneration value added ratio = (C / VA)*100.
  Table 1 shows that in 2010, the labour remuneration in the Eastern Cape automotive sector accounted for 47% of the automotive sector's gross value added, compared to 64% experienced in 1995 and 2000.

- **Income distribution ratio** is a measure that compares the amount of money that employees receive in the form of compensation of employee (wages and salaries) with the amount of money that shareholders receive (in the form dividends). Income distribution ratio = compensation of employee divided by gross operating surplus. The income ratio shows that for every R1 that shareholders received, employees received R1.7 in 1995 down to R1.20 in 2005 and to R0.87 in 2010. As more income is generated in the sector, the distribution is skewed towards shareholders.

- **Unit labour cost** measures the average cost of producing one unit of output. Unit labour cost is equal to wage rate or earnings per worker (w) times the number of workers (N) divided by the output produced by the workers (Q):
  Unit labour cost = (w*N) / Q. Where w*N is a measure of the cost of labour. It is

evident from table 1 that between 1995 and 2010 the unit labour cost in the Eastern Cape automotive sector has declined by half. The unit labour cost represented 14% of output in 1995, down to 7% of output in 2010.

- **Overall productivity** is a ratio of what is produced to what is required to produce it. Usually this ratio is in the form of an average, expressing the total output divided by the total input (P = O/I). Productivity is a measure of output from a production process, per unit of input. The analysis shows that between 1995 and 2010, the cost of production grew much faster (input growth rate 128%) than that of output production (output growth rate 111%). As a result, the overall productivity ratio in the automotive sector fell to 1.18 in 2010 from 1.27 in 1995. The difference between output and input is the gross value added. Table 1 shows that in 1995, every R1.00 input generated R1.27 output (making R0.27 for GVA). In 2010, this GVA declined to R0.18 signalling a drop in the sector's contribution to the provincial economy, and a decline in the overall productivity in the automotive sector.

- **Fixed capital productivity** is a measure of output per unit of fixed capital input. Fixed capital productivity is equal to total output (Q) divided by the fixed capital input (C), i.e. the capital stock.

  The analysis contrasts two ratios namely capital (output divided by capital stock) and labour (output divided by compensation of employees) to determine which factor of production (capital or labour) yields greater production output. The result shows that every R1 fixed capital stock corresponds to R4.9 output in 1995 and R7.2 output in 2010. Similarly, every R1 wages and salary corresponds to R7.1 output in 1995 and R13.4 output in 2010. It can be concluded that capital stock yields more output than labour.

- **The import-domestic demand ratio** or (**import penetration**) is equal to total imports (Z) divided by total domestic demand (DD) times one hundred:

  Import-domestic demand ratio = (Z / DD)*100.

  Domestic demand is equal to total output plus imports minus exports. The import-domestic demand ratio is an indication of how much of the domestic

demand is satisfied by imports.

The result shows that between 1995 and 2010, imports penetration almost doubled. In 1995, a quarter (25%) of domestic demand in the automotive sector was imported compared to almost half (46%) of domestic demand imported in 2010.

- **Import leakage** is a measure of how much is imported to satisfy local demand. Import leakage is equal to total imports (Z) divided by total imports added total output (Q) times one hundred. Import leakage = [Z / (Z + Q)]*100. The import leakage ratio has improved significantly over the period under review.

- **The export-output ratio** is a measure of how much of a country's output they export. The export-output ratio is equal to total exports (X) divided by total output (Q) of an economy times one hundred. Export-output ratio = (X / Q)*100.

  The analysis shows that between 1995 and 2010, the export-output ratio grew over ten-fold. In 2010, nearly half (43%) of output produced in the Eastern Cape automotive sector was exported. The value of exports increased from R0.6 million in 1995 to R14 million in 2010. The export destinations fall outside the scope of this report.

- **Gross operating surplus** is the surplus generated by operating activities after the labour factor input has been recompensed. It can be calculated from the value added at factor cost less the personnel costs. It is the balance available to the unit which allows it to recompense the providers of own funds and debt, to pay taxes and eventually to finance all or a part of its investment

2.3 How significant is the size of the Eastern Cape automotive sector?

Table 2 shows the 2010 Eastern Cape automotive sector's contribution to the Eastern Cape manufacturing sector, total provincial (EC) economy, total South Africa's automotive sector, and total economy of South Africa.

Important lessons derived from the Table 2 are summarised below.

Province-wide, the Eastern Cape automotive sector's exports and imports contributed a lion share to the regional trade accounts. In 2010, the sector accounted for more than half (58%) of total imports in the province; slightly less than half (49%) of total exports in the Eastern Cape. Imports and exports in the Eastern Cape automotive represented 2.9% of total imports and 2.8% of total exports of the country as a whole. This means that the sector has a significant impact on the country's balance of payment. There are risks and benefits associated with having half of your demand-side and the supply-side dependent on foreign trade. This means that any significant shock or structural change that occurs in the foreign importing country's economy (recession, inflation/deflation, appreciation/depreciation of foreign currencies etc.) will also affect the automotive sector in the Eastern Cape. The automotive sector is not entirely dependent on the local economic conditions. The trade risk is split between domestic and foreign countries.

Table 2: Eastern Cape automotive sector's contribution (%) to the economy, 2010

	Total EC manufacturing sector	EC total economy	RSA automotive sector	RSA total economy
Gross value added at basic prices	22.5	4.0	22.6	0.3
Compensation of employees - Total	21.5	3.6	22.6	0.3
Compensation of employees - Highly skilled	26.1	3.5	22.9	0.3
Compensation of employees - Skilled	28.6	4.2	22.7	0.4
Compensation of employees - Semi & unskilled	14.1	4.1	21.9	0.3
Gross operating surplus	23.9	4.6	21.8	0.3
Tax on production	26.4	3.9	22.6	0.3
Subsidies on production	39.9	24.7	22.6	2.0
Intermediate consumption	36.1	15.6	22.6	1.3
Output at basic prices	33.1	10.9	21.9	0.9
Gross domestic fixed investment: Rm constant 2005 prices	23.9	4.0	23.0	0.3
Fixed capital stock: Rm constant 2005 prices	16.9	2.0	23.0	0.1
Imports	57.3	58.0	20.0	2.9
Exports	53.2	49.0	31.0	2.8
Number of people employed (formal & Informal)	17.7	2.0	24.0	0.2

Source: Author's calculation derived from Statistics South Africa

In terms of the labour market, table 2 shows that in 2010 the Eastern Cape (EC) automotive sector employed 18% of total employment in the EC manufacturing sector; 2% of total employment in the province; 24% of total employment in RSA automotive sector; and 0.2% of all total employment in RSA.

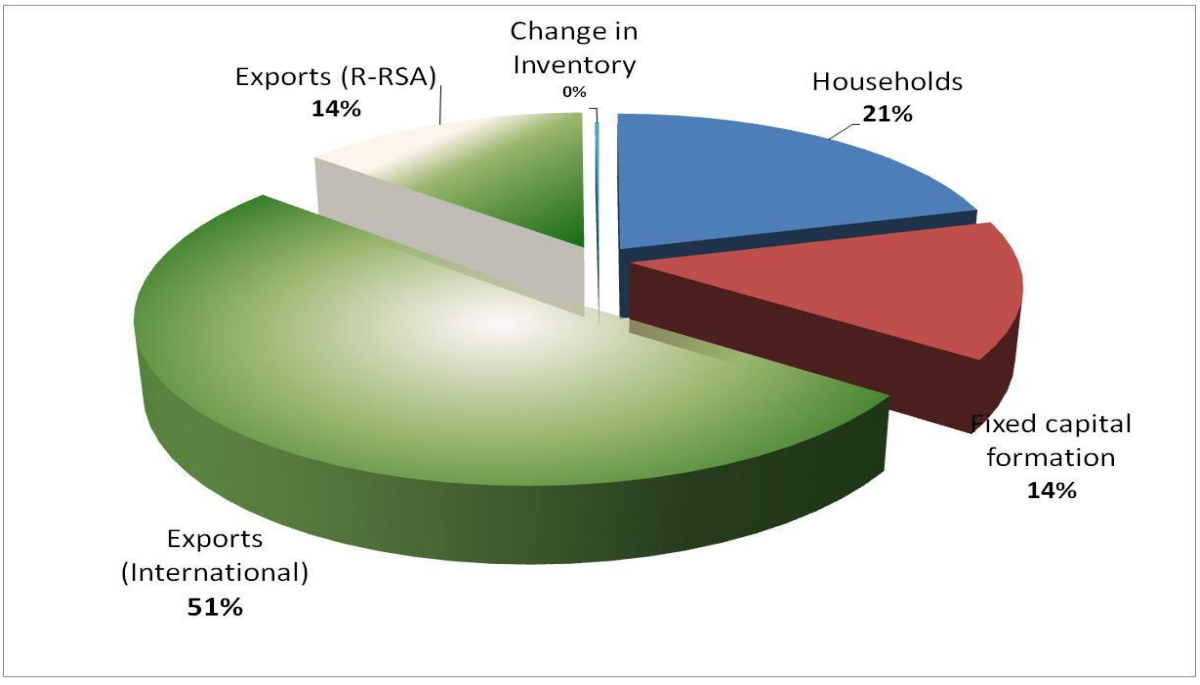
A quarter of subsidies on product in the Eastern Cape accrue to the automotive sector. Looking at total production output, the EC automotive sector's output accounts for a third (33%) of total output in the EC manufacturing sector; more than a tenth (11%) of total output in the EC economy; almost a quarter (23%) of total output in the RSA automotive sector; and 1% of the country's total output.

More than a third (36%) of total input cost in the EC manufacturing sector is allocated to the automotive sector. This input cost is by large affected by the imports as shown in the table above.

2.4 Breakdown of demand in the automotive sector

Who are the clients in the automotive sector? Asked differently, who are the consumers of the final products? Is the province producing for local (domestic) or for foreign market? Graph 1 presents the EC automotive products' final demand. It shows that more than half of final demand is from foreign markets. A fifth of the demand for the automotive products is from households.

Figure 1: Final demand in the EC automotive sector is driven by exports



Source: Author's calculation derived from Statistics South Africa

2.5. Performance, development and trends of the Eastern Cape automotive sector for selected indicators (1995 – 2010)

Table 3 compares the average annual performance of the Eastern Cape's automotive sector with that of the country as a whole.

Clear evidence from table 3 reveals that, for almost all the indicators analysed, the Eastern Cape automotive sector performed below the average automotive sector for the country as a whole. Other important lessons from the table are summarised below:

- Employment in the automotive sector was very negligible during the period under review. Between 1995 and 2010, job creation grew at an annual average rate of 0.05% in the Eastern Cape while that of the country as a whole declined at an annual average rate of 0.6%. However, with the decline in employment, total production output in the automotive sector did not suffer. It increased at an average annual rate of 5.8% in the Eastern Cape and 6.7% in South Africa.
- Between 1995 and 2010, the input cost outgrew the production output, eroding the value added in the automotive sector. Persistent increase in input cost could in the long run make the sector less competitive and unsustainable.
- It is also noted that on average between 1995 and 2010, subsidies on production grew faster than taxes on production.
- A very interesting fact is the ten-fold annual increase in the gross operating surplus compared to the compensation of employees. In other words, on average between 1995 and 2010, on an annual basis, the workers' income in the automotive sector grew ten times less than that of the shareholders.
- Export growth in the automotive sector performed above that of all other indicators. For the period under review, export grew on average three times faster than that of imports.

Table 3: Automotive sector's average annual growth rate (1995 – 2010) for selected indicators in the Eastern Cape and South Africa

	Eastern Cape		South Africa	
	Value (2010)	Average annual growth rate (%) (1995-2010)	Value (2010)	Average annual growth rate (%) (1995-2010)
Gross value added at basic prices, Rm	5 120	2.9	22 655	3.9
Compensation of employees - Total, Rm	2 414	0.7	10 681	1.7
Compensation of employees - Highly skilled, Rm	720	1.6	3 144	2.6
Compensation of employees - Skilled, Rm	1 192	0.9	5 249	1.9
Compensation of employees - Semi & unskilled, Rm	502	-0.6	2 288	0.4
Gross operating surplus, Rm	2 768	7.2	12 247	8.1
Tax on production, Rm	95	7.2	421	8.2
Subsidies on production, (-) Rm	-157	9.2	-695	10.6
Intermediate consumption, (-) Rm	29 145	6.5	128 962	7.4
Output at basic prices, Rm	34 264	5.8	151 617	6.7
Gross domestic fixed investment: Rm constant 2005 prices	897	4.7	3 940	5.5
Fixed capital stock: Rm constant 2005 prices	4 779	2.8	21 147	3.7
Imports value, Rm	16 771	10.3	85 458	14.8
Exports value in current Rands	14 686	34.1	47 418	23.3
Number of people employed (formal & Informal)	23 700	0.1	96 794	-0.6

Source: Author's calculation derived from Statistics South Africa

The next section provides a brief methodology in constructing the SUTs and SAM-based models. It explains the type of impacts analysing that can be derived from the supply and use tables (SUTs) and the social account matrix (SAM). It also shows how these models are used to analyse the impact of a particular sector of the economy.

3. Methodology and type of impact analysis

The economic model used in this study is based on the Eastern Cape supply and use tables (SUTs) and the social account matrix (SAM). The model is being used to simulate major investment projects and their impact on the province's economy. The SUTs and the SAM are based on the newly released 2008 system of national accounts developed by the United Nations.

This section presents very briefly the methodology used to derive the regional multipliers. It provides definitions of a range of multipliers. The central focus in this section is the explanation of the type of impacts analyses that are derived from the economic model. The section prepares the reader to have a better understanding of the results that are presented in section 4.

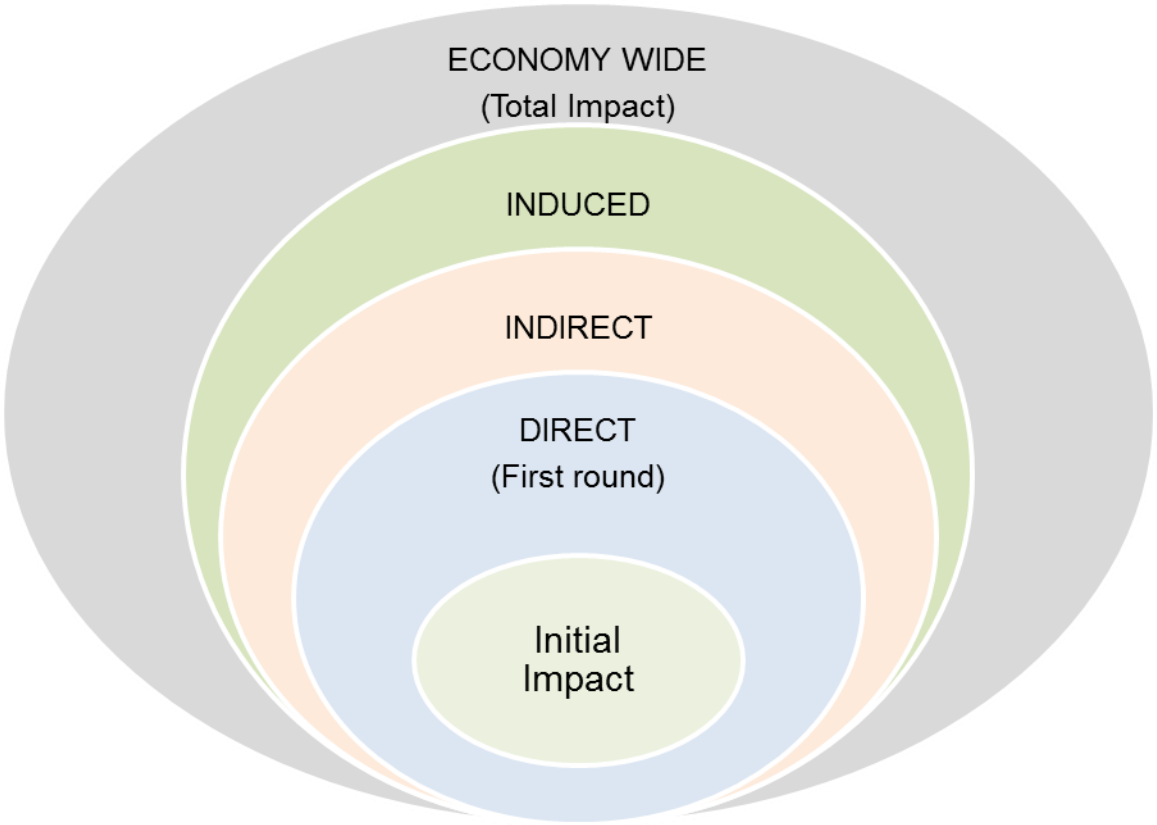
The section starts by defining the concept of the SUTs and the SAM. According to the United Nations' 2008 system of national accounts (2008 SNA), a SAM is defined as the presentation of SNA accounts in a matrix which elaborates the linkages between the supply and use tables and institutional sector accounts. In many instances, SAM's have been applied to an analysis of interrelationships between structural features of an economy and the distribution of income and expenditure among household groups (Kavese, 2007).

The 2008 SNA also provides the definition of the supply and use table. The supply table shows the origin of the resources of goods and services. The use table shows the uses of goods and services and the cost structure of the various industries. The supply and use tables have both statistical and analytical functions. As a statistical tool SUTs provide a coordinating framework for checking the consistency of economic statistics on flows of goods and services obtained from the different kinds of statistical sources. As an analytical tool, the SUTs are conveniently integrated into macroeconomic models in order to analyse the link and interaction between final demand and industrial output levels (Kavese 2007a, 2007).

3.1 Type of impact analysis

The SUTs and the SAM are valuable tools in estimating the effects of a major investment project, changes in government spending, or changes in income giving rise to changes in household spending. In principle, an increase in the demand for a product is not an once-off event: it triggers secondary effects along the way. However, it takes time for a particular increase in final demand to work through all the sectors in the economy (Jeffery Round, 2005 and Round, (2003). The type of impact analysis used in the SUTs and the SAM are shown diagrammatically in figure 2.

Figure 2: Effects caused by a change in final demand



- *Initial impact*: refers to the factors of production (capital, labour) that are initially brought into the project.
- *First round impact* (also referred to as first order effects): includes the impact of sectors required to produce more to meet the demand from the project. For example: the construction of a building plant will need brick, mortar, steel,

machinery, etc., so the other sectors in the economy need to supply these materials. First order effects are the changes in business activity and production occurring as a direct consequence of a project.

- *Direct impact*: The direct impact is the sum of the initial and first round impacts.
- *Indirect impact*: Indirect effects result from changes in sales by suppliers to the directly-affected businesses, including trade and services at the retail, wholesale, and producer levels. The businesses needing to supply the project will also need to expand, which will affect other businesses/sectors (theoretically an infinite number of times, until the change becomes too small to measure).
- *Direct and indirect impact*: This is the sum of the direct and indirect impacts.
- *Induced impact*: Induced effects are further shifts in spending on food, clothing, shelter, and other consumer goods and services caused by a change in personal income of workers employed by the directly and indirectly affected businesses.
- *Economy-wide impact***:** This is the sum of the direct, indirect, and induced effects.

Type I multipliers measure the direct and indirect effects, while *Type II multipliers* measure the induced effect.

In analysing the multipliers, it is important to specify which one to use. Depending on the problem at hand, one can use the type I and type II demand-side multipliers or type I and type II supply-side multipliers. This study uses type I and type II demand-side multipliers because it assumes R1 million increases in final demand in the automotive sector (Defourney and Thorbecke (1984): 111-136; Wassily Leontief (1905).

3.2 Methodology and structure of the two-region inter-regional economic model

3.2.1. Basic structure of the two-region inter-regional economic model[5]

Given region R (Eastern Cape) and N (the rest of South Africa excluding the Eastern Cape), the two region tables represent the complete intra-regional (Z^{RR} and Z^{NN}) and inter-regional (Z^{NR} and Z^{RN}) intermediate data flows. The inter-industry transactions table can be represented as shown in equation 1.

$$Z = \begin{bmatrix} Z^{RR} & \cdots & Z^{RN} \\ Z^{NR} & \cdots & Z^{NN} \end{bmatrix} \quad (1)$$

Where Z^{RR} and Z^{NN} represent intra-regional trade and Z^{RN} represents inter-regional trade (exports) of region R to region N and Z^{NR} of region N to region R.

The intra-regional input coefficients for regions R and N will be:

$$a_{ij}^{RR} = \frac{z_{ij}^{RR}}{x_j^R} \text{ and } a_{ij}^{NN} = \frac{z_{ij}^{NN}}{x_j^N} \quad (2)$$

The inter-regional input coefficients for regions NR and RN will be:

$$a_{ij}^{NR} = \frac{z_{ij}^{NR}}{x_j^R} \text{ and } a_{ij}^{RN} = \frac{z_{ij}^{RN}}{x_j^N} \quad (3)$$

Equations 2 and 3 can be compactly rewritten as two equations:

$$(I - A^{RR})X^R - A^{RN}X^N = Y^R \quad (4)$$

[5] Refer to the work done by Defourney, j., and E. Thorbecke (1984): 111-136; Wassily Leontief (1905)

$$-A^{NR}X^{R} + (I - A^{NN})X^{N} = Y^{N} \quad (5)$$

Where Y^{R} is the final demand for region R goods and services, and Y^{N} is the final demand for region N goods and services.

We can define the complete coefficient matrix for a two-region inter-regional model as consisting of the four sub-matrices:

$$A = \begin{bmatrix} A^{RR} & \cdots & A^{RN} \\ A^{NR} & \cdots & A^{NN} \end{bmatrix} \quad (6)$$

The gross output vector will be made up from the two regions output vectors X^{R} and X^{N} and can be defined as:

$$X = \begin{bmatrix} X^{R} \\ X^{N} \end{bmatrix} \quad (7)$$

The final demand vector will be made up from the two final demand vectors Y^{R} and Y^{N} and can be defined as:

$$Y = \begin{bmatrix} Y^{R} \\ Y^{N} \end{bmatrix} \quad (8)$$

The complete two-region inter-regional input-output system can be represented by:

$$(I - A)\, X = Y \quad (9)$$

From equation 9, we can easily derive the value of X which will be:

$$X = (I - A)^{-1}\, Y \quad (10)$$

Where $(I - A)^{-1}\, Y$ is the Leontief Inverse, or the total (initial, direct and indirect) requirements matrix. This can be expressed less compactly as:

$$\left(\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix} - \begin{bmatrix}A^{RR} & \cdots & A^{RN}\\ A^{NR} & \cdots & A^{NN}\end{bmatrix}\right)^{-1} \begin{bmatrix}X^R\\ X^N\end{bmatrix} = \begin{bmatrix}Y^R\\ Y^N\end{bmatrix} \quad (11)$$

3.2.2 Inter-regional feedbacks in the two-region: Eastern Cape and the rest of South Africa (excluding the Eastern Cape)

From the basic structure of the model (section 3.2.1) it is obvious that the inter-regional linkages between the two regions' industries will lead to inter-regional feedback effects as the various rounds of inter-regional trade takes place (Defourney and Thorbecke (1984): 111-136; Wassily Leontief (1905).

If $Y^N = 0$, that is we are assessing the change in final demands in region R only, solving equations (4 and 5) for X^N gives:

$$X^N = (I - A^{NN})^{-1} A^{NR} X^R \quad (13)$$

And putting this in equation (6), we have:

$$(I - A^{RR})X^R - A^{RN} (I - A^{NN})^{-1} A^{NR} X^R = Y^R \quad (14)$$

Note that $A^{RN} (I - A^{NN})^{-1} A^{NR} X^R$ represents the additional demand made on the output of region R because of inter-regional trade linkages.

3.2.3. The Eastern Cape output multipliers

The Leontief inverse can be represented in the following form:

$$M = \left(\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix} - \begin{bmatrix}A^{RR} & \cdots & A^{RN}\\ A^{NR} & \cdots & A^{NN}\end{bmatrix}\right) = \begin{bmatrix}M^{RR} & \cdots & M^{RN}\\ M^{NR} & \cdots & M^{NN}\end{bmatrix} \quad (15)$$

As shown in equation (10) the complete two-region inter-regional input-output system can be represented by:

$$X = (I - A)^{-1} Y = MY \quad (16)$$

And from (11) and (16) we get:

$$\begin{bmatrix} X^R \\ X^N \end{bmatrix} = \begin{bmatrix} M^{RR} & \cdots & M^{RN} \\ M^{NR} & \cdots & M^{NN} \end{bmatrix} \begin{bmatrix} Y^R \\ Y^N \end{bmatrix} \quad (17)$$

The column sum of the Leontief Inverse M represents the **production multipliers** (that is the initial, direct and indirect output impact across all industries of a R1 change in final demand), where:

The intra-regional output multipliers are:

$$O^{RR} = \{\sum_J m_{ij}^{RR}\} \quad (18)$$

$$O^{NN} = \{\sum_J m_{ij}^{NN}\} \quad (19)$$

The inter-regional (feedback) output multipliers are:

$$O^{NR} = \{\sum_J m_{ij}^{NR}\} \quad (20)$$

$$O^{RN} = \{\sum_J m_{ij}^{RN}\} \quad (21)$$

The national output multipliers are:

$$O^{R} = \{\sum_J m_{ij}^{RR} + m_{ij}^{NR}\} \quad (22)$$

$$O^{N} = \{\sum_J m_{ij}^{NN} + m_{ij}^{RN}\} \quad (23)$$

3.2.4 The Eastern Cape Type I and type II multipliers

Equations 16 to 23 illustrate the type of multipliers in both inter-regional and intra-regional contexts. By definition, the *type I output multipliers* (equation 16) show how much the intra-regional-wide, regional-wide or country-wide output have to increase to meet a R1 increase in final demand for the output of sector *j* in regions R or N respectively.

Using the type I multipliers, the matrix elements are restricted to those in the transactions matrix of the two-region interregional inter-industry table. However, this effectively excludes the impact of changes in household income and final demand arising from the positive impact of additional economic activity on employment, since household income and consumption is outside of the transactions matrix.

Type II multipliers address this issue by expanding the transactions matrix to include household consumption and compensation of employees. Households are effectively treated as another production industry in type II multiplier analysis, producing labour services and demanding consumption goods and services.

The *type II output multipliers* are calculated exactly as in equations (18) to (23) except for the expansion of the matrices to include an additional industry representing household's disposable income (sale of labour and unearned income after provision for personal tax) and consumption expenditure.

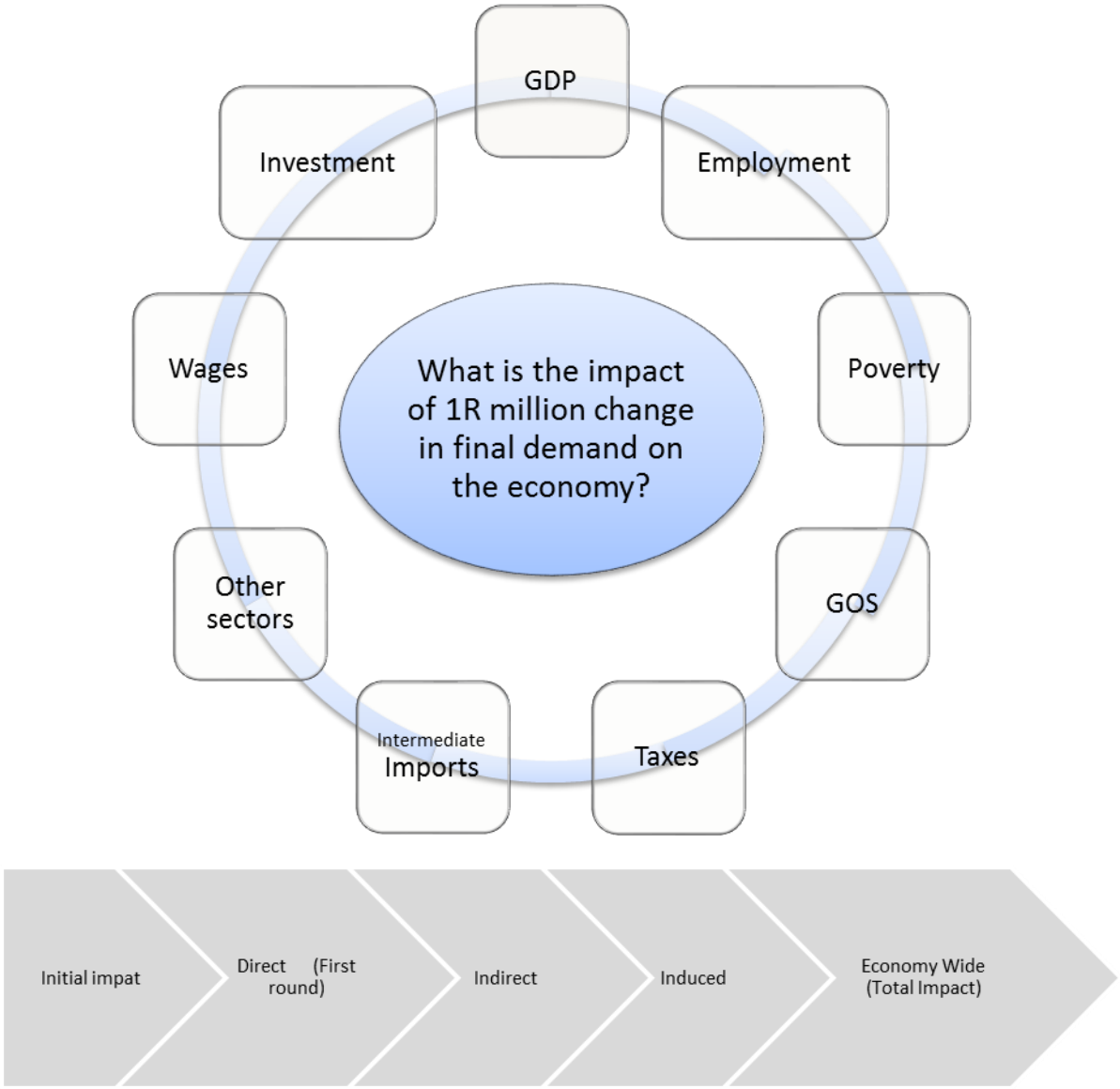
The next section provides simulation results for the Eastern Cape automotive sector. Results from the Eastern Cape economic models are presented to show the effect of R1million increase in final demand in the Eastern Cape automotive sector on provincial economy and on the other provinces' economies.

4. Simulation results for the Eastern Cape automotive sector

4.1 Background and specification of the model's multipliers

The Eastern Cape economic model outlines simulation results for the automotive sector. It quantifies the impact of an additional R1 million in the Eastern Cape automotive sector's final demand on the provincial economy (Figure 3).

Figure 3: Specification of the model's multipliers



Asked differently, from figure 3, assume households' (or exports') demand for automotive products change (increase or decrease) by say R1 million, what impact

will that have on economic growth (GDP), employment (job creation), poverty alleviation, gross operating surplus (GOS), taxes, intermediate imports, other economic sector's output, labour remuneration, and investment growth? Areas of interest differ: government is concerned most with economic growth, job creation, poverty alleviation and taxes. Investors are attracted by the performance in the gross operating surplus generated. Sector analysts, policy-makers, academics and researchers are interested in the entire model in order to respond to hard questions related to cost and benefit analysis and impact studies (Thorbecke, 2000 and Nganou, 2005). Results in table 4 cater for all these various stakeholders' requirements.

As shown in figure 2, the effects caused by a change in final demand is described at five levels, namely, the initial, direct, indirect, induced and total impacts. The impact is felt in the Easter Cape (region 1) and also in the other eight provinces of South Africa (combined in this model and referred to as region 2). The rationale behind this methodology was explained in section 3.2.1.

4.2 Simulation results[6]

Table 4 presents the demand-side multipliers (also known as backward multipliers) for a hypothetical R1 million final demand spending on products of the automotive sector in the Eastern Cape. These multipliers take into account the effects of increased spending by other sectors, but not the effect of direct and indirect imports that will result from such an increase in final demand. Simulation results in table 4 shows that for R1 million of final demand spending in the automotive sector, GDP (economy wide, including all induced impacts) could rise by some R0.437 million; labour remuneration (household income) would rise by R0.245 million; the gross operating surplus of companies (profits) could rise by R0.191 million; fixed capital stock will need to rise by R0.796 million; at least 3 more employees will be required (sustained) in the formal automotive sector.

[6] We used the World Bank SimSIP SAM tool to derive the multipliers. This tool was developed by Juan Carlos Parra and Quentin Wodon for the analysis of input-output tables and Social Accounting Matrices. World Bank,2010.

Table 4: Impact in the Eastern Cape economy: assume households (or exports) demand for automotive products increased by R1 million

Multipliers per R1 million final demand in Eastern Cape and foreign activity	Initial Impact	First Round	Direct Impact	Indirect impact	Direct and Indirect Impact	Induced Impact	Economy-wide Impact
Output/ sales at basic value	1.0000	0.3970	1.3970	0.8710	2.2680	0.5026	2.7706
Intermediate Imports	0.1437	0.1299	0.2736	0.1441	0.4177	0.0444	0.4622
Labour Remuneration	0.0388	0.0358	0.0746	0.0864	0.1610	0.0844	0.2454
Gross Operating Surplus	0.0189	0.0172	0.0361	0.0662	0.1023	0.0887	0.1910
GDP at basic values	0.0566	0.0521	0.1087	0.1533	0.2620	0.1756	0.4376
Capital Stock	0.0939	0.0850	0.1789	0.2709	0.4498	0.3465	0.7963
Employment (Total number)	0.3801	0.3503	0.7304	1.3468	2.0772	1.6820	3.7592
Employment Highly Skilled	0.0585	0.0533	0.1118	0.1306	0.2424	0.1439	0.3864
Employment Skilled	0.2048	0.1866	0.3914	0.4321	0.8235	0.4902	1.3137
Employment Unskilled	0.1168	0.1086	0.2254	0.4643	0.6897	0.6235	1.3132
Employment Informal	0.0000	0.0018	0.0018	0.3198	0.3216	0.4243	0.7459

In table 4, the effect of labour remuneration was R0.2 million. This is a portion of income that goes toward reducing poverty because it is an additional income to households. Obviously, household expenditure will increase as a result of household income. It is important to simulate the impact of household consumption expenditure as reflected in the induced impact. Induced effects are further shifts in spending on food, clothing, shelter, and other consumer goods and services caused by a change in personal income of workers employed by the directly and indirectly affected businesses. The impact of the additional spending by households shows that, total production output (in all sectors in the Eastern Cape Economy) will increase by R0.502 million (see table 3) and R0.641 million in the South African economy. In other words about R0.139 million will be spent in other provinces.

Table 5: Impact in the South African economy: demand-side multipliers (backward multipliers) for a hypothetical R1 million final demand spending on products of the automotive sector

Total impact for South Africa	Initial Impact	First Round	Direct Impact	Indirect Effect	Direct and Indirect Impact	Induced Impact	Economy-wide Impact
Output/ sales at basic value	1.0000	0.5410	1.5410	0.9774	2.5184	0.6419	3.1604
Intermediate Imports	0.3293	0.0926	0.4219	0.1578	0.5797	0.0529	0.6326
Labour Remuneration	0.0890	0.0987	0.1876	0.0871	0.2748	0.1022	0.3770
Gross Operating Surplus	0.0432	0.0906	0.1338	0.1092	0.2429	0.1252	0.3681
GDP at basic values	0.1297	0.1914	0.3212	0.1992	0.5203	0.2309	0.7512
Capital Stock	0.2150	0.2839	0.4990	0.4296	0.9285	0.4861	1.4146
Employment (Total number)	0.8707	1.7126	2.5833	1.4019	3.9852	1.7144	5.6995
Employment Highly Skilled	0.1340	0.1354	0.2695	0.1417	0.4112	0.1531	0.5643
Employment Skilled	0.4692	0.5257	0.9949	0.5827	1.5776	0.5313	2.1089
Employment Unskilled	0.2674	0.5640	0.8315	0.4037	1.2352	0.6433	1.8784
Employment Informal	0.0000	0.4875	0.4875	0.2737	0.7612	0.3867	1.1478

It is very interesting to see that the highest induced backward multipliers are for employment and output. This is in line with findings by South African scholars who affirmed that the South African economy is driven by consumption. Household spending stimulate demand for goods and services which lead to high production output and job creation in the sectors where the demand originated. There is not much difference between the induced impact on employment in region 1 and region 2. It means that most employment takes place in the Eastern Cape where households spend most of their income. This is expected because a province such as the Eastern Cape, rural in nature, with a high level of poverty, and poor households, are likely to spend their income within the province.

Table 6: The economy-wide total impact in the South African economy is made up of the impact in the Eastern Cape and the impact in other provinces for a hypothetical R1 million final demand spending on products of the automotive sector.

	RSA	Eastern Cape	Other Provinces
Output	3.1604	2.7706	0.3898
Intermediate Imports	0.6326	0.4622	0.1704
Labour Remuneration	0.3770	0.2454	0.1316
Gross Operating Surplus	0.3681	0.1910	0.1771
GDP at basic values	0.7512	0.4376	0.3136
Capital Stock	1.4146	0.7963	0.6183
Employment (Total number)	5.6995	3.7592	1.9403
Employment Highly Skilled	0.5643	0.3864	0.1780
Employment Skilled	2.1089	1.3137	0.7952
Employment Unskilled	1.8784	1.3132	0.5653
Employment Informal	1.1478	0.7459	0.4019

Table 6 shows that if demand for automotive products increase by R1 million, and a potential investor injects that R1 million rand to satisfy the demand, the production value chain will cause others economic sectors in the Eastern Cape to supply intermediate inputs required to meet the demand. The total knock on effect in table 6 shows that the total sector's output in South Africa will rise by R3.160 million of which R2.770 million in the Eastern Cape (88%) and R0.389 million in the other eight provinces (22%). This impact distribution between the Eastern Cape and the other eight provinces is shown in figure 4. Results from figure 4 for GDP clearly indicate that the automotive sector's contribution to the Eastern Cape economy is almost half of the contribution to other RSA provinces. The GOS impact is also almost shared between the Eastern Cape and the rest of the provinces in South Africa.

Table 8 shows how the R2.770 million output multipliers in the Eastern Cape are distributed across 43 economic sectors. For example, output in agriculture, forestry and fishing will increase by R0.0397 million (economy wide impact in the Eastern Cape) which is made up of R0.0082 million (direct and indirect impact) and R0.0315

million (induced impact). A similar sectoral breakdown is provided in table 7 for employment.

Figure 4: Impact distribution (%) in the Eastern Cape automotive sector

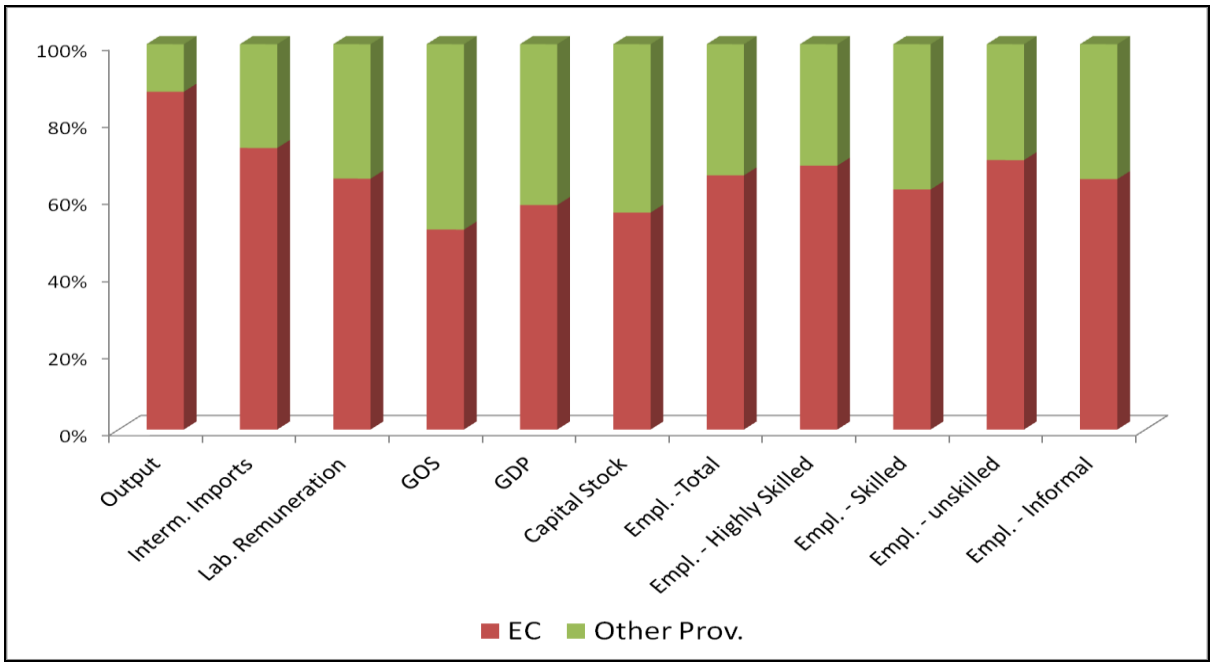


Figure 5: Ranking the Eastern Cape automotive sector's output multipliers

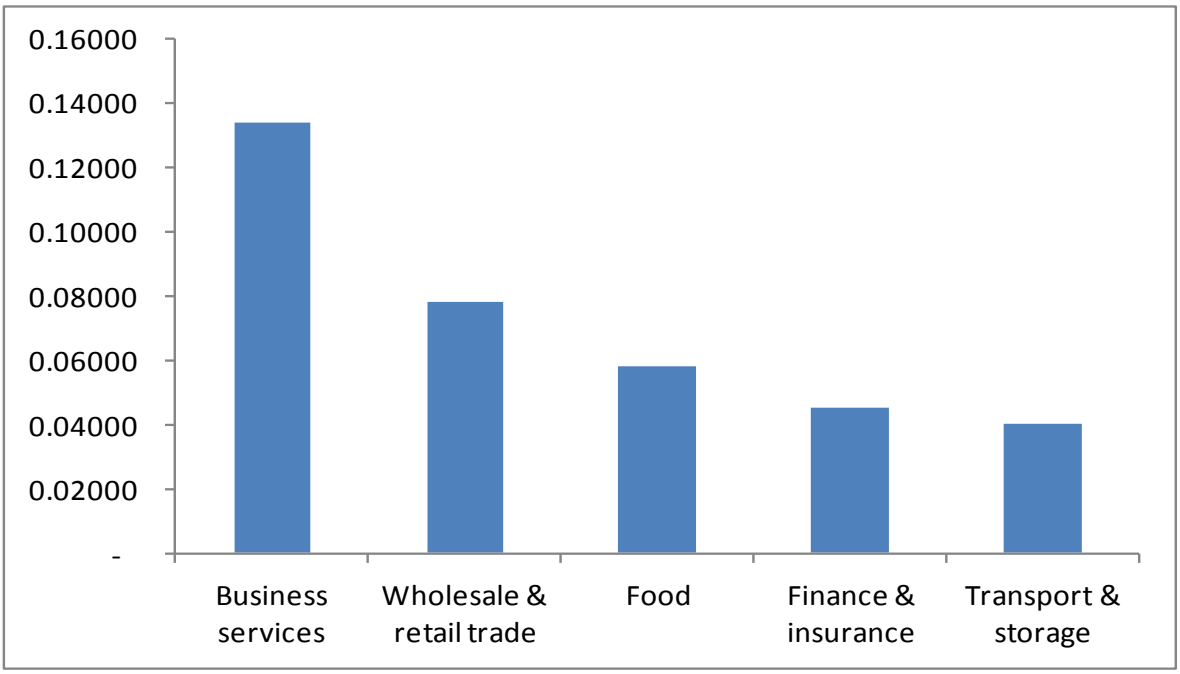


Figure 5 shows the top five sectors whose outputs will increase the most as a result of R1 million increases in final demand in the Eastern Cape automotive sector. Business services are ranked first. This can be attributed to the high cost in the

research and innovation in the automotive sector. Food features third on the list to confirm economic theory that says that poor people spend most of their income on food. The induce effect shows up, confirming that the South African economy is driven by household consumption, and in the case of the Eastern Cape, this consumption expenditure is mainly on food.

Impact analysis in the Eastern Cape automotive sector shows contrasting results between output multipliers (see figure 5, where the business services sector is ranked first) and employment multipliers (see table 7, where the manufacturing sector is ranked first). In other words, output effect is more felt in the tertiary sector while the employment effect is more felt in the secondary sector.

Table 7: Sector employment multipliers and number of jobs to be created in the Eastern Cape for a hypothetical R1 000 000 000 final demand spending on products of the automotive sector (direct and indirect effect).

	Multipliers	Number of jobs
Agriculture	0.02569	26
Mining	-	1
Manufacturing	1.76660	1 767
Electricity	0.00001	1
Construction	0.00536	5
Trade	0.15682	157
Transport	0.00932	9
Finance	0.08629	86
Government	0.02677	27
TOTAL	**2.07686**	**2 077**

The model assumes full employment. In practice, when demand to produce more occurs, firms have many choices. They can work overtime, improve on technology rather than employing new people or improve on labour productivity. Therefore, these 2077 jobs are not new jobs created.

Table 8: Eastern Cape Automotive sector's Output multipliers

	Industries	Open Model	Close Model	Induced Impact
1	Agriculture, forestry & fishing	0.0082	0.0397	0.0315
2	Coal mining	-	0.0000	0.0000
3	Gold & uranium ore mining	-	-	-
4	Other mining	0.0043	0.0077	0.0034
5	Food	0.0035	0.0579	0.0543
6	Beverages & tobacco	0.0005	0.0188	0.0183
7	Textiles	0.0105	0.0164	0.0060
8	Wearing apparel	0.0007	0.0068	0.0061
9	Leather & leather products	0.0015	0.0026	0.0011
10	Footwear	0.0001	0.0025	0.0025
11	Wood & wood products	0.0026	0.0049	0.0024
12	Paper & paper products	0.0032	0.0076	0.0043
13	Printing, publishing & recorded media	0.0018	0.0050	0.0032
14	Coke & refined petroleum products	0.0067	0.0208	0.0141
15	Basic chemicals	0.0052	0.0106	0.0054
16	Other chemicals & man-made fibres	0.0119	0.0231	0.0112
17	Rubber products	0.0267	0.0300	0.0033
18	Plastic products	0.0073	0.0098	0.0025
19	Glass & glass products	0.0047	0.0058	0.0011
20	Non-metallic minerals	0.0011	0.0028	0.0016
21	Basic iron & steel	0.0140	0.0159	0.0019
22	Basic non-ferrous metals	0.0043	0.0052	0.0009
23	Metal products excluding machinery	0.0123	0.0150	0.0027
24	Machinery & equipment	0.0068	0.0097	0.0028
25	Electrical machinery	0.0125	0.0158	0.0033
26	Television, radio & communication equipment	0.0003	0.0012	0.0008
27	Professional & scientific equipment	0.0003	0.0016	0.0013
28	Motor vehicles, parts & accessories	1.9605	1.9907	0.0301
29	Other transport equipment	0.0007	0.0015	0.0007
30	Furniture	0.0009	0.0048	0.0039
31	Other industries	0.0022	0.0088	0.0066
32	Electricity, gas & steam	0.0034	0.0093	0.0059
33	Water supply	0.0011	0.0041	0.0030
34	Building construction	0.0041	0.0105	0.0063
35	Wholesale & retail trade	0.0422	0.0785	0.0363
36	Catering & accommodation services	0.0017	0.0095	0.0079
37	Transport & storage	0.0139	0.0405	0.0266
38	Communication	0.0084	0.0276	0.0193
39	Finance & insurance	0.0160	0.0454	0.0294
40	Business services	0.0475	0.1344	0.0869
41	Medical, dental & other health & veterinary services	0.0038	0.0396	0.0358
42	Community, social & personal services	0.0106	0.0274	0.0169
43	General government	0.0001	0.0008	0.0007
	TOTAL IMPACT	**2.2680**	**2.7706**	**0.5026**

5. Conclusion and policy recommendations

The Eastern Cape automotive sector is renowned internationally for its technological sophistication, expertise, and flexibility. This document presented the automotive sector analysis with the aim of examining the impact that the Eastern Cape automotive sector has on the regional and national economies. In terms of the sector's contribution to economic growth, the results from the impact study reveals that the contribution of the Eastern Cape automotive sector is split almost by half between the Eastern Cape economy and the other eight provinces of South Africa. In other words, the sector stimulates growth in other provinces as well. Simulation results from the model reveal that for a hypothetical R1 million increase in final demand, four jobs are created/sustained in the Eastern Cape and two jobs in the other eight provinces. This implies that, as far as the province is concerned, the knock on effect is more on employment than it is on economic growth. In the Eastern Cape, employment multipliers in the automotive sector show high effect in the manufacturing sector followed by the wholesale and retail trade sector. While the model shows that more jobs will be created in these two sectors, output multipliers reveals that production (output) will increase most in business services followed by wholesale and retail trade, food, finance and insurance, and transport sectors. In terms of the sectors contribution to poverty, simulation results from the model shows, for a hypothetical R1 million increase in final demand, that almost a quarter of it will be directly and indirectly cascaded down to households in the form of wages and salaries (labour remuneration), which in turn will have an effect on poverty alleviation.

The study highlighted the risks and benefits associated with the Eastern Cape automotive sector being driven by more than half by the foreign market. Export-output ratio improved more than ten-fold during the period under review. Import leakages ratio sat at 0.33 and import penetration ratio at 0.46. Sector policy analysis should investigate further the impact of foreign trade on the Eastern Cape automotive sector.

Another area of concern is the decline in the automotive sector's overall productivity during the period under review. Policy and sector analysts should investigate more about the factors that cause input cost growth rate to outpace that of production output growth rate. The study finds that, should this trend persist, the automotive sector could, in the long run, become less competitive.

Annexure 1: List of industries in the SUTs/SAM

	Industry	Sic Code	Major Industry
1	Agriculture, forestry & fishing	11 - 13	Agriculture
2	Coal mining	21	Mining
3	Gold & uranium ore mining	23	
4	Other mining	22, 24, 25, 29	
5	Food	301 - 304	Manufacturing
6	Beverages & Tobacco	305 - 306	
7	Textiles	311 - 312	
8	Wearing apparel	313 - 315	
9	Leather & leather products	316	
10	Footwear	317	
11	Wood & wood products	321 - 322	
12	Paper & paper products	323	
13	Printing, publishing & recorded media	324 - 326	
14	Coke & refined petroleum products	331 - 333	
15	Basic chemicals	334	
16	Other chemicals & man-made fibres	335 - 336	
17	Rubber products	337	
18	Plastic products	338	
19	Glass & glass products	341	
20	Non-metallic minerals	342	
21	Basic iron & steel	351	
22	Basic non-ferrous metals	352	
23	Metal products excluding machinery	353 - 355	
24	Machinery & equipment	356 - 359	
25	Electrical machinery	361 - 366	
26	Television, radio & communication equipment	371 - 373	
27	Professional & scientific equipment	374 - 376	
28	Motor vehicles, parts & accessories	381 - 383	
29	Other transport equipment	384 - 387	
30	Furniture	391	
31	Other industries	392	
32	Electricity, gas & steam	41	Electricity and water
33	Water supply	42	
34	Construction	51 - 53	Construction
35	Wholesale & retail trade	61 - 62	Trade
36	Catering & accommodation services	63	
37	Transport & storage	71	Transport and telecommunication
38	Communication	72	
39	Finance & insurance	81 - 82	Fianance
40	Business services	83	
41	Medical, dental & other health & veterinary services	93	Government and community services
42	Other community, social & personal services	97	
43	Government	9	

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