A regional analysis of the industry performance of the Nelson Mandela Bay Metropolitan Municipality with the use of input-output tables

Roan Neethling (roanneethling5@gmail.com)
North-West University - Vaal Campus https://orcid.org/0000-0002-3195-8153
Wynand Grobler
North West University Faculty of Economic and Management Sciences

Research Article

Keywords: Nelson Mandela Bay Metropolitan Municipality, regional, analysis, input-output, Industrial Development Zone (IDZ), economic growth, employment

Posted Date: July 11th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1773552/v1

Abstract

The aim of this paper is to form an input-output table for the Nelson Mandela Bay Metropolitan Municipality by means of the non-survey method that is based on the estimates of the location quotient, which is derived from the South African National Social Accounting Matrix (SAM). The Nelson Mandela Bay Metropolitan Municipality is a region with major potential in its economic development and growth structures since it is host to the largest Industrial Development Zone (IDZ) in Southern Africa. Economic trends and economic analysis present imperative information that illustrates the strength of the region and the neighbouring population. The information provided from the economic analysis can support businesses and potential investors in making strategic judgements concerning the development in a community. The data can also be utilised to classify possible opportunities as the central region in the community. These probable opportunities may cause the specific region's connection to the regions industry, local amenities and institutions. The first step in the investigation will be to acquire the input-output table for the Nelson Mandela Bay Metropolitan Municipality originating from the South African national input-output table by means of the Flegg technique, which is an established systemic method to measure the input coefficient of a given sub-national economy with indication to a specific time period. The Nelson Mandela Bay Metropolitan Municipality is a region with a rich history and the potential for growth is significant. Policy direction within the region should focus more on agricultural production, manufacturing, finance and trade, which will enable economic growth and employment opportunities.

1. Introduction

The Nelson Mandela Bay Metropolitan Municipality is a region with major potential in its economic development and growth structures since it is host to the largest Industrial Development Zone (IDZ) in Southern Africa (Nelson Mandela Bay Municipality, 2020:29). The performance of an economy is occasionally difficult to explore immediately; however, economic trends and economic analysis present imperative information that illustrates the strength of the region as well as the neighbouring population. The information provided from the economic analysis can support businesses and potential investors to make strategic judgements concerning the development in a community (Ryan, 2011:1). The data can also be utilised to classify possible opportunities as the central region in the community. These probable opportunities may cause the specific region's connection to the region's industry, local amenities and institutions (Ryan, 2011:1).

One of the methods to analyse industry performance is the use of input-output tables, which model record the "flows of products from each sector reflected as a producer to each of the industries measured as consumers" (Sargento, 2009:7). The fundamental applications of the input-output model were made at a country-wide level. However, the significance in expanding the application of the same structure to a sub-regional unit different from the country that led to the reformation in the national model, creates a set of regional input-output models (Sargento, 2009:7). Often the regional input-output tables are obtained from the national input-output tables under the hypothesis that the regional production technologies, as indicated in input coefficients, are equal to those of the whole nation (Bonfiglio, 2009:115)

An input-output (I-O) table is signified by the basis for developing SAMs (social accounting matrixes), which entail knowledge of all flows of goods and services among a specific period (Bonfiglio & Chelli, 2008:244). This entails the collection of a large volume of data, which is difficult to obtain and use. To simplify the input-output tables, an alternative method is used, with three tactics, including the non-survey, hybrid and survey approaches. The non-

survey method will be used to obtain the elements of a transactions table from the national table through numerous adjustment techniques (Bonfiglio & Chelli, 2008:244).

The regional input-output tables differ from those of the national input-output tables since the productive arrangement of each region is detailed; secondly, the more modest the focusing economy, the more it depends on other regions for importation (Sargento, 2009:7). Choosing the ideal input-output model will depend on the following factors: (a) the number of regions taken into account, (b) the significance of interregional linkages, (c) the scale of interregional trade flows, and (d) the style of hypothesis presumed to assess the trade coefficients (Sargento, 2009:7).

The single-region model will be utilised in the study since the goal of the single-region input-output model is to assess the impact of regional output as a result of variations in the regional final demand (Sargento, 2009:7). The aim of this paper is to comprise an input-output table of the Nelson Mandela Bay Metropolitan Municipality by means of the non-survey method, which is based on the calculations of the location quotients, which are derived from the national social accounting matrix (SAM).

The first step in the analysis will focus on acquiring the input-output table for the Nelson Mandela Bay Metropolitan Municipality, which is derived from the South African national input-output table by means of the Flegg *et al.* location quotient (FLQ), which is a prevalent systemic technique to assess the input coefficient of a given sub-national economy with indication to a given time period. The following step is to calculate technical coefficient, also known as the A-matrix, which can be defined as the input requirements (number of commodities) for one unit of output.

After the calculation of the technical coefficient, the Leontief inverse was calculated, which can be interpreted as the coefficients that signify the impact of one unit change in the exogenic final demand on the total output of the industry. After calculating the Leontief inverse matrix, the following step was to provide a detailed description of each sector of the economy by evaluating the forward and backward linkages, and the final demand multipliers (Type I).

2. The Structure Of The Input-output Table

The national input-output models are a reference to the operational investigations of basic economic processes within a country or region (Sargento, 2009:6). Cameron (2003:1) explains that the input-output analysis is a systemic framework with the essential aim to investigate the linkages of industries within an economy.

Table 1 is the input-output table. Firstly, the rows of the input-output table signify the supply sector, which shows the intermediate inputs as well as the GVA, all of which are equal to the national production (gross inputs). The columns of the input-output table exemplify the demand sector, which includes both the intermediate demand as well as the final demand.

The intermediate demand shows the goods and services produced (inputs), while the final demand indicates the total demand by government, households, consumption, capital formation and exports. As seen in Table 1, the total output (last column) and the national production (gross inputs of last row) should be equal, since the total input should equal total output in all sectors of the economy.

3. Methodology

3.1 Research design

The primary aim of this study is to evaluate the industry performance of the various sectors of the Nelson Mandela Bay Metropolitan Municipality through the non-survey method, which is based on the calculations of the location quotient, which are derived from the national social accounting matrix (SAM). For each industry within the municipality, the aim is to evaluate its economic performance by means of the GVA and employment, the industry's forward and backward linkages with the other industries in the economy, and lastly to evaluate the multiplier effects (i.e. final demand multipliers type I and type II) for a total of 10 sectors in the Nelson Mandela Bay Metropolitan Municipality.

3.2 Study area and sample

The study was conducted in the Eastern Cape Province of South Africa, situated in the Nelson Mandela Bay Metropolitan Municipality. The reason for choosing the specific study region is because the COEGA IDZ is situated within the Nelson Mandela Bay Metropolitan Municipality, which is the largest IDZ and longest active operational IDZ in South Africa. The specific region was also chosen due to the impact of the IDZ's operational procedures and its valuable linkages with other sectors of the local economy.

3.3 Data collection method

The non-survey method was utilised to acquire the input-output tables, which were derived from the South African national input-output table, otherwise known as the social accounting matrix (SAM). SAM can be defined as the "demonstration of System of National Account (SNA) accounts in a matrix which particularizes the linkages between supply and use tables and institutional sector accounts" (Statistics South Africa, 2005:i). The method used to calculate the input-output table is based on a single region non-survey method that is based on the calculation of the location quotient (Szabó, 2015:50).

3.3.1 The standard location quotient (SLQ)

The standard location quotient is used as an indicator to categorise the clustering of industries within a specific region or country (Strotebeck, 2010:1). The standard location quotient is valuable to see whether the employment is above or below the national average for the industry in question (Strotebeck, 2010:1). The indicator exemplifies the influence of employment that a specific industry such as the agricultural sector has in a specific region in correlation with the employment levels of the agricultural sector within a country. The location quotient for a region *i* can be presented in Eq. 1:

$$L\sigma_i = \frac{Ei,r}{Er} \;/\; \frac{Ei,n}{En} \quad \text{.....(1)}$$

where:

$E_{i,r}$ = Industry employment i in subregion r

Er = Overall employment in subregion r

Ei, n = Industry employment i in region n

En = Overall employment in region n

3.3.2 The cross-industry location quotient (CILQ)

After the calculation of the standard location quotient (SLQ), the following step is to calculate the CILQ which amends the coefficients only by the rows as supposed to the columns. The CILQ therefore takes into account both the producer i and the purchaser j, which can affect the ability for individual supply within the region (Schaffer & Chu, 1969). The CILQ function can be represented in Eq. 2:

$$CILQ_{ij} = \frac{SLQ-i}{SLQj} \quad \text{.....(2)}$$

The CILQ function is based on two vectors of similar elements, which are the GVA (a) and the country (b), which replaces an array $n * n$. The logic of the CILQ can be reasoned as follows: If the share of sector (i) within the area is greater than the share of sector (j) in the similar region, then the area can reassure industry $j's$ input requirement in industry i ($CILQ^{r}_{ij}$>1).

3.3.3 The Flegg *et al.* location quotient (FLQ) (a,b,c function)

The Flegg *et al*, location quotient (FLQ) is derived from the cross-industry location quotient (CILQ) and is used as an alteration of both the SLQ and the CILQ. Bakhtiari and Dehghanizadeh (2012:6905) explain that the FLQ provides a feasible presentation of a location quotient whereby the size of the region is exposed in the calculation thereof. The FLQ can be illustrated in Eq. 3:

$$FLQ_{ij} = CILQ_{ij}[log_2(1 - \frac{x^R}{x^N})]^{\phi} \quad \text{..... (3)}$$

The symbol φ represents the scope of the area or region; however, the FLQ does not rely too much on the relative size of the area, but rather on the the size of the producer and purchasing sector and the comparative specialisation within the region (Szabó, 2015:52). However, the region does play a significant role in the calculation of the FLQ, since the larger the value of φ, the greater the value of the FLQ will be. In simple terms, the FLQ can be illustrated in Eq. 4:

$$FLQ_{ij} = Log1 + \frac{GDPatbasicprices(Region)}{GDPatbasicprices(SA)} \times RegionalshareofGDPin\% \quad \text{..... (4)}$$

As illustrated in the equation above, the FLQ is a basic calculation of an SLQ multiplied by the regional share of GDP in percentage (%).

3.3.4 Regional Flegg location quotient (regio FLQ)

The following step is to calculate the regional FLQ, and is illustrated in Eq. 5:

$$RegioFLQ = (A_N \times CILQ_0 + A_N * FLQ_1 * CILQ_1) \quad \text{.....(5)}$$

The $RegioFLQ$ function is obtained by procuring the regional coefficients from the national coefficients A_N by utilising the FLQ coefficients. The RegioFLQ performs on two vectors of the same measurement, which are the value-added for the region (a) and the country (b), the delta coefficient (c) and the matrix A_N is the national technical coefficient.

3.3.5 Regional intermediate use/sales matrix

The next step is to estimate the regional intermediate use/sales matrix, which is based on the coefficients attained from the $RegioFLQ$, which are multiplied by the region's intermediate use/costs. The intermediate costs are calculated as follows:

$Regionalintermediateuseorsalesmatrix = RegioFLQ * Intermediateuseorsales$. The regional intermediate use/sale matrix will indicate the numerical values for all ten industries. Once the regional intermediate use/sales matrix has been estimated, the following step is to add all the other data, such as the value-added variables and total demand within the input-output table.

3.3.6 Regional input-output table (balanced)

Once the regional intermediate use/sales matrix has been calculated, the following step is to determine the regional input-output table (balanced). The input-output table for the region is estimated whereby all the cells within the table must be estimates; however, this is obtained with the relevant data for the region; the input-output table calculated is accurate (Szabó, 2015:54). The RAS method is then used to develop the input-output. The RAS method is utilised to develop the input-output templates by means of calculating the method of automatic adjustment of a matrix by columns and rows (Trinh & Phong, 2013:133).

3.3.7 Determining the Leontief inverse

The next step of the input-output analyses was to determine the Leontief inverse. If the $I - A$ matrix is positive and non-singular, then the non-negative description to the method can be represented in Eq. 6:

$$Y = (X - AX)$$

6

……..

However, the Leontief inverse exemplifies that $I - A^{-1}$ is the Leontief inverse, which is also known as the multiplier matrix, matrix of multipliers or the non-negative solution of the input-output model and can be presented in Eq. 7:

$$X = (I - A)^{-1}Y$$

7

……..……

Where X represents the output vector, Y is the final demand, A represents the technical coefficient matrix and $I - A^{-1}$ demonstrates the Leontief inverse matrix (Mun-Heng, 1998:1). The Leontief inverse can be clarified as coefficients that indicate the effect of one unit change in the exogenous demand on the total output of the industry (Mun-Heng, 1998:1). The Type I inverse matrix illustrates how many of each sector's output is required in terms of both the indirect and direct requirements to manufacture one unit of a sector's output (D'Hernoncourt et al., 2011:10) and can be illustrated in Eq. 8. Table 2 indicates the identity matrix and Type I multiplier Leontief inverse.

$$L = (I - A)^{-1}$$

8

……..

where:

L = Leontief inverse matrix, *I* = identity matrix and *A* = technical coefficient matrix

After calculating the technical coefficients, the I matrix (identity matrix) and the Leontief matrix, it is possible to calculate the final demand multipliers. Table 3 indicates the final demand multipliers (Type I). This model was used in the study to determine both the positive (i.e., establishing a new sector within the region) and negative (i.e., an external shock and disinvestment) changes within the Nelson Mandela Bay Metropolitan Municipality on variables

such as employment, income, tax multipliers and value added (Slabbert, 2005:46). This specific model was used to represent various economic relations (interregional and intraregional) for the Nelson Mandela Bay Metropolitan Municipality to evaluate the direct and indirect impacts in the final demand for both income and employment.

With more attentiveness and emphasis on the regional level in the advanced development of the literature, the focus of the input-output analysis research has been adjusted from the national level to a more decisive regional level (Szabó, 2015:44). With a significant attentiveness towards the evaluation and analyses of regional development, combined with other distinguished methods of data availability, the attention on regional development methods and evaluations gained more attentiveness towards the single region input-output table and analysis (Lindberg, 2010:1).

The regionalised input-output tables utilised in this study for the Nelson Mandela Bay Metropolitan Municipality are ready-made input-output tables, which means they have collective characteristics such as: (i) they depend on national input-output tables and regional level employment and labour data, (ii) the customers are presumed to have comparable preferences, and (iii) they are applied using a parallel method (Boero, Edwards & Rivera, 2018:227).

The non-survey method is utilised in this study by means of direct coefficients of the most current national input-output table at our disposal being calculated, otherwise known as the SAM (Boero, Edwards & Rivera, 2018:227). Secondly, using the many deviations of the tactic of LQs for each industry comprises various location quotients such as the SLQ, the FLQ as well as the semilogarithmic location quotient (RLQ) (Bonfoglio & Chelli, 2008:245).

3.4.8 Estimating the forward and backward linkages

Substantial backward linkages indicate that the production of output involves broad intermediate inputs from other industries within a region (Ncube & Tregenna, 2021:12). Forward linkages, on the other hand, are the straight converse of the backward linkages since a considerable amount of its total output is utilised by other industries as intermediate inputs to their total production (Dine, 2019:310). The input-output analysis is classified into the following categories, as shown by Temursho (2016:12), indicated in Table 4.

The first classification is the weak linkages (W), meaning they are not strongly connected to the additional industries both in terms of their output supply and input demand, meaning that both their forward and backward linkages are less than 1.

(B) is the opposite of (W), since a numerical value >1 has strong backward linkages.

(F) is a representation of industries with strong forward linkages, which are greater than economy-wide average of forward linkages of all sectors; however, it does not have strong backward linkages.

The key sector (K) is a ‘leading industry’, which is strongly linked to other industries both from the output supply chains and input demand in which the industry has good forward and backward linkages greater than 1.

4. Results And Discussion

4.1 An analysis of the 2020 input-output table for the Nelson Mandela Bay Metropolitan Municipality

Table 5 is an illustration of the 2020 input-output table for the Nelson Mandela Bay Metropolitan Municipality. The calculation of the input-output table for the Nelson Mandela Bay Metropolitan Municipality was utilised by means of the non-survey method and the calculation, therefore, was utilised by means of the RAS method. The columns

represent the demand per sector (intermediate demand and final demand), which equals the total output. The rows represent the total supply per sector (intermediate input and GVA), which equals the total national production (gross inputs).

The manufacturing sector [SIC3] indicated that the industry itself produced R76 306 million in output within the 2020 fiscal year. The input-output table tells us that it used R13 181 million in products from the wholesale and retail trade (17, 91%), R4 116 million in transport and storage (5,39%), and R3 618 million in finance and insurance (4,74%). The manufacturing sector also used R27 903 million (36.57%) of the domestic manufacturing sector, which can be in the form of petroleum products, metal products, electrical machinery and textiles.

The second largest sector, finance and insurance [SIC 8], shows that the industry produced R42 012 million in output for the 2020 financial year. The input-output table further illustrates that it used R3 224 million in products from the manufacturing sector (7.67%), and R2 238 million in products and services from the community services (5.33%).

Table 5 further illustrates the intermediate demand as well as the final demand and the intermediate input and GVA. The total demand (columns) should be equal the total output (rows) for each of the sectors.

4.2 An analysis of the 2020 A-matrix (technical coefficients) for the Nelson Mandela Bay Metropolitan Municipality

Table 6 is an illustration of the technical coefficients, also known as the A-matrix. The technical coefficient is described as the input requirements (number of commodities) needed for one unit of output (Ten Raa, 2006:14). The technical coefficient can be measured through the requirements needed for numerous input units needed to produce one unit of output; for example, the amount of baking flour to produce one cake.

For example, when looking at Table 6, it illustrates that in the transport and storage sector you will need 0.102 units of products within the transport and storage sector to produce one unit of goods in the mining sector. The table also illustrates that you will need 0.173 units within the manufacturing sector to produce/supply one unit in the wholesale and retail trade industry. The calculation of these technical coefficients is broad; however, it indicates how much one industry needs to put in (in terms of supply) to acquire one unit of output in another industry.

As illustrated in Table 6, the total output coefficient for transport and storage is 0.428; however, various calculations can be used to calculate the total number of inputs that are needed to acquire an output coefficient of 0.5 or more. In other words, the role of the technical coefficient is to illustrate the numerical values that are needed to produce one output for a specific industry or sector.

Let us say, for instance, that the Nelson Mandela Bay Metro wants to expand its transport and storage sector, then the total inputs required by the sectors, including the manufacturing, construction and wholesale and retail trade, will need to increase to obtain a larger output for the storage and transport sector. The technical coefficients are useful in the local economy to establish which industries have the greatest impact on the local economy in terms of the overall input-output coefficient matrices.

The impact analyses of the technical coefficient are functional because they can justify what the effect on other industries will be if there is a critical shock in one of the industries. The impact analyses of the technical coefficients are useful, since they can explain what the impact on other industries will be if there is a severe shock in one of the industries.

For example, let us say that there is a severe shock in the Nelson Mandela Bay Metro and the Coega IDZ needs to shut down (which causes the total manufacturing output to decrease by 50%); this will cause a major downturn and halve the inputs in various sectors, which will cause sectors such as the construction industry's total output to decline by 0.150 and effectively cause major job losses, as well as losses in production for various other industries and sectors of the local economy.

4.3 An analysis of the 2020 Leontief inverse matrix (forward and backward linkages and multiplier analysis) for the Nelson Mandela Bay Metropolitan Municipality

4.3.1 Primary sector

The first analysis involves the primary sector, which includes agriculture, forestry and fishing as well as mining and quarrying. The forward and backward linkages for each industry will be explained, and secondly, the final demand multipliers (Type I) will be evaluated. Table 7 represents the Leontief inverse matrix, while Table 8 shows the final demand multipliers (Types I and II)

4.3.1.1 Agriculture, forestry and fishing

(a) Forward and backward linkages

The backward linkage for agriculture, forestry and fishing is 0.985, which is strong; however, the numerical value is not higher than 1, showing weak sectoral linkages. The forward linkages show that the numerical value is 0.589, which is weak – both the forward and backward linkages are weak (W) for the agricultural sector. Capable value chains are needed within the Nelson Mandela Bay region to improve its overall sectoral linkages with other industries.

(b) Final demand multipliers – Type I

According to the Northern Ireland Statistics and Research Agency (NIRSA) (2021), the Type I multipliers or supplier linkage effects include both indirect and direct effects only. The Type I multiplier is used to assess the influence on the supply chain stemming from an increase in the total output to meet demand.

An increase in the final demand of the agricultural sector of, let us assume R1 000 000 per annum, will have the following impact:

- Income/remuneration earned by households will increase by R340 000.
- The total GVA will increase by R900 000.
- Job opportunities (total number of jobs) will increase by an added 7.92 workers.
- Total output within the region will increase by a significant R1 730 000.

An increase in investments of agriculture will aid the region in terms of employment opportunities, especially since the Eastern Cape has a high unemployment rate. The potential for agriculture is there, especially when considering the significant increase of employment by 14.3% from 2014 to 2019.

4.3.1.2 Mining and quarrying

(a) Forward and backward linkages

The backward linkage for mining and quarrying is 0.985, which shows that there are weak sectoral linkages between the mining and quarrying sector and the other sectors of the economy. The forward linkages for mining and quarrying show a numerical value of 0.572, which shows that the sector has an insignificant amount of total output used by other industries as intermediate inputs to their total production within the Nelson Mandela Bay Metropolitan Municipality.

(b) Final demand multipliers – Type I

An increase in the final demand of the mining and querying sector of, let us assume R1 000 000 per annum, will have the following impact:

- Income/remuneration earned by households will increase by R420 000.
- The total GVA will increase by R900 000.
- Job opportunities (total number of jobs) will increase by an added 1.82 workers.
- Total output within the region will increase by a significant R1 620 000.

An increase in investment of mining and querying will not have a significant impact on the local economy due to its insignificant contribution to total job opportunities, the lack of income and an inadequate competitive advantage in terms of employment within the sector.

4.3.2 Secondary sector

The second analysis involves the secondary sector, which includes manufacturing, electricity, gas and water, and construction. The forward and backward linkages for each industry will be explained, and secondly, the final demand multipliers (Type I) will be evaluated.

4.3.2.1 Manufacturing

(a) Forward and backward linkages

The backward linkage for the manufacturing sector is 1.361, which shows that there are strong sectoral linkages between the manufacturing sector and the other sectors of the economy. The forward linkages for the manufacturing sector show a numerical value of 2.313, which indicates that the sector has a significant amount of total output used by other industries as intermediate inputs to their total production within the Nelson Mandela Bay Metropolitan Municipality. The manufacturing sector is regarded as a key sector within the Nelson Mandela Bay Metropolitan Municipality, especially considering its strong forward and backward linkages with other sectors of the economy.

(b) Final demand multipliers – Type I

An increase in the final demand of the manufacturing sector of, let us assume R1 000 000 per annum, will have the following impact:

- Income/remuneration earned by households will increase by R470 000.
- The total GVA will increase by R870 000.
- Job opportunities (total number of jobs) will increase by an added 2.19 workers.
- Total output within the region will increase by a significant R2 400 000.

An increase in investments of the manufacturing sector shows that it will have a significant impact on the local economy, especially with regard to employment and total output. The manufacturing sector is a key sector within the economy due to its strong linkages with other sectors of the economy and its significant contribution towards total employment.

4.3.2.2 Electricity, gas and water

(a) Forward and backward linkages

The backward linkage for the electricity, gas and water sector is 0.714, showing weak sectoral linkages between the electricity, gas and water sector and the other sectors of the economy. The forward linkages (0.662) indicate that there is an insignificant amount of output used by other industries as intermediate inputs to their total production within the Nelson Mandela Bay Metropolitan Municipality. The forward and backward linkages show weak supply between the electricity, gas and water sector and the other sectors of the economy.

(b) Final demand multipliers – Type I

An increase in the final demand of the electricity, gas and water sector of, let us assume R1 000 000 per annum, will have the following impact:

- Income/remuneration earned by households will increase by R300 000.
- The total GVA will increase by R910 000.
- Job opportunities (total number of jobs) will increase by an added 0.49 workers.
- Total output within the region will increase by a significant R1 260 000.

An increase in investments of the electricity, gas and water sector will not have a significant impact on the local economy, especially in terms of total employment and total output. This sector is not a key sector within the economy due to its weak linkages with other sectors of the economy and its insignificant contribution towards total output and employment.

4.3.2.3 Construction

(a) Forward and backward linkages

The backward linkage for construction is 1.343, showing strong sectoral linkages between construction and the other sectors of the economy. The forward linkages (0.726) show that there is an insignificant amount of output used by other industries as intermediate inputs to their total production within the Nelson Mandela Bay Metropolitan Municipality. The construction industry is classified as a strong backward linkage sector (B); however, there is an insignificant amount of the construction sectors' total output that is used by other industries for production.

Final demand multipliers – Type I

An increase in the final demand of the construction sector of, let us assume R1 000 000 per annum, will have the following impact:

- Income/ remuneration earned by households will increase by R440 000.
- The total GVA will increase by R870 000.

- Job opportunities (total number of jobs) will increase by an added 2.93 workers.
- Total output within the region will increase by a significant R2 360 000.

An investment in the construction industry will have a significant impact on total output and create more job opportunities. The sector creates sufficient backward linkages for the other sectors of the economy and the investment in construction towards new projects and plans will help the local economy significantly towards total output.

4.3.3 Tertiary sector

The third analysis involves the tertiary sector, which includes wholesale and retail trade, catering and accommodation, transport, storage and communication, finance, real estate and business services, general government and lastly community, social and personal services. The forward and backward linkages for each industry will be explained, and secondly, the final demand multipliers (Type I and Type II) will be evaluated.

4.3.3.1 Wholesale and retail trade, catering, and accommodation

(a) Forward and backward linkages

The backward linkage for wholesale and retail trade is 0.877, showing weak sectoral linkages between wholesale and retail trade and the other sectors of the Nelson Mandela Bay Metropolitan Municipality economy. The forward linkage is 1.378; however, it shows that the sector has a significant amount of its output being used by the other industries as intermediate inputs to their total production within the Nelson Mandela Bay Metropolitan Municipality. The wholesale and retail trade industry is classified as a sector with weak backward linkages, but a strong forward linkage sector (F).

(b) Final demand multipliers – Type I

The increase in final demand of the wholesale and retail trade sector of R1 000 000 per annum will have a significant impact on the following aspects:

- Income/remuneration earned by households will increase by R410 000.
- The total GVA will increase by R910 000.
- Job opportunities (total number of jobs) will increase by an added 2.85 workers.
- Total output within the region will increase by a significant R1 540 000.

An investment in the wholesale and retail industry will have a significant impact on total output and create moderate potential job opportunities. The sector, however, does not create sufficient backward linkages for other sectors of the economy, but creates sufficient forward linkages for other sectors of the Nelson Mandela Bay Metropolitan Municipality.

4.3.3.2 Transport, storage and communication

(a) Forward and backward linkages

The backward linkage for transport, storage and communication is 1.051, indicating strong sectoral linkages and supply between the transport and storage industry and other sectors of the Nelson Mandela Bay Metropolitan

Municipality. The forward linkages (1.020) also show that a significant amount of the transport and storage industry's output is used as intermediate inputs towards the total production of the Nelson Mandela Bay Metropolitan Municipality. The transport, storage and communication sector is a key sector (K), since the forward and backward linkages are significant, meaning many industries use this sector in its output and intermediate inputs.

(b) Final demand multipliers – Type I

The increase in final demand of the transport, storage and communication sector of R1 000 000 per annum will have a significant impact on the following aspects:

- Income/ remuneration earned by households will increase by R370 000.
- The total GVA will increase by R890 000.
- Job opportunities (total number of jobs) will increase by an added 1.77 workers.
- Total output within the region will increase by a significant R1 850 000.

An investment in the transport, storage and communication industry will have a significant impact on total output and create moderate potential job opportunities. The sector creates sufficient forward and backward linkages for other sectors within the Nelson Mandela Bay Metropolitan Municipality.

4.3.3.3 Finance, real estate and business services

(a) Forward and backward linkages

The backward linkage for finance, insurance, real estate and business services is 1.011, showing strong sectoral linkages and supply between the finance, insurance and real estate industry and other sectors of the Nelson Mandela Bay Metropolitan Municipality. The forward linkages (1.381) also show that a significant amount of the financial industry's output is used as intermediate inputs towards the total production of the Nelson Mandela Bay Metropolitan Municipality. The finance, insurance, real estate and business services are a key sector (K), since the forward and backward linkages are significant, meaning many industries use this sector in its output and intermediate inputs.

(b) Final demand multipliers – Type I

The increase in final demand of the finance, insurance, real estate and business services of R1 000 000 per annum will have a significant impact on the following aspects:

- Income/ remuneration earned by households will increase by R410 000.
- The total GVA will increase by R900 000.
- Job opportunities (total number of jobs) will increase by an added 2.26 workers.
- Total output within the region will increase by a significant R1 780 000.

An investment in the finance, insurance, real estate and business services industry will have a significant impact on total output and create moderate potential job opportunities. The sector creates sufficient forward and backward linkages for other sectors within the Nelson Mandela Bay Metropolitan Municipality.

4.3.3.4 General government

(a) Forward and backward linkages

The backward linkage for the government sector is 0.721, indicating weak sectoral linkages and supply between the government and other sectors of the Nelson Mandela Bay Metropolitan Municipality. The forward linkages (0.626) also show that an insignificant amount of the government sector output is used in other sectors. The government sector is a weak sector (W), since the forward and backward linkages are insignificant, meaning the industries do not use this sector in its output and intermediate inputs.

(b) Final demand multipliers – Type I

The increase in final demand of the government services of R1 000 000 per annum will have a significant impact/effect on the following aspects:

- Income/remuneration earned by households will increase by R760 000.
- The total GVA will increase by R920 000.
- Job opportunities (total number of jobs) will increase by an added 2.24 workers.
- Total output within the region will increase by a significant R1 270 000.

The government does not provide adequate forward and backward linkages within the economy; however, the local community is largely dependent on government for income, job opportunities and total output.

4.3.3.5 Community, social and personal services

Forward and backward linkages

The backward linkage for the government sector is 1.011, indicating strong sectoral linkages and supply between the community, social and personal services and other sectors of the Nelson Mandela Bay Metropolitan Municipality. The forward linkages (0.735) show that an insignificant amount of the community services output is used in other sectors. The community, social and personal services have a strong backward linkage (B); however, the forward linkage within the sector is insignificant.

Final demand multipliers – Type I

The increase in final demand of the government services of R1 000 000 per annum will have a significant impact on the following aspects:

- Income/remuneration earned by households will increase by R510 000.
- The total GVA will increase by R890 000.
- Job opportunities (total number of jobs) will increase by an added 5.22 workers.
- Total output within the region will increase by a significant R1 790 000.

Community, social and personal services do not provide adequate forward and backward linkages within the economy; however, the local community is largely dependent on community services for income, job opportunities and total output./p>

5. Conclusion And Recommendations

The 2020 input-output table of the Nelson Mandela Bay Metropolitan Municipality showed that the manufacturing sector, finance, and insurance sector as well as the wholesale and retail trade sector contribute significantly towards total output and total demand. This means that the region is highly dependent on these sectors for local economic growth, job creation and overall trade activities.

Considering the Leontief inverse matrix, which can be explained as coefficients that show the influence of a one-unit alteration in the total output of the industry as well as the effect of a one-unit change in the exogenous demand on total output of the industry (Mun-Heng, 1998:1). The Leontief inverse matrix for the Nelson Mandela Bay Metropolitan Municipality also showed the forward and backward linkages for the ten sectors of the economy. The sectors that are key within the Nelson Mandela Bay Metropolitan Municipality include manufacturing, transport, storage, communication, and finance, insurance, real estate, and business services. The industry with weak linkages includes agriculture, forestry and fishing, mining and quarrying, electricity, gas and water as well as the general government.

The industries that have a significant forward linkage include wholesale and retail trade, catering, and accommodation, meaning that the relationship in the supply chain moves products toward the supply chain. The industries with strong backward linkages include construction as well as community, social and personal services (meaning its output and production involves extensive intermediate inputs from many other industries within the same industry). Table 9 illustrates the forward and backward linkages for the various industries within the Nelson Mandela Bay Metropolitan Municipality.

The Type I inverse matrix illustrates how many of each sector's output is required in terms of both the indirect and direct requirements to manufacture one unit of a sector's output (D'Hernoncourt *et al.,* 2011:10). Considering the Type I inverse matrix (or also known as the final demand multipliers), the manufacturing sector, construction, transport, and storage as well as community, social and personal services are sectors that contribute significantly towards total output within the region. The industries that receive the most earnings include general government, community, social and personal services as well as manufacturing. The industries that create the most jobs include agriculture, forestry and fishing, community, social and personal services, construction as well as wholesale and retail trade, catering, and accommodation. Here are some of the recommendations:

- As a result of the low agricultural forward and backward linkages, it is important that the Nelson Mandela Bay Metropolitan municipality *places more emphasis on agricultural production and retail distribution* to contribute towards the total output and GVA within the region; however, as said by Sihlobo (2019), water policies and land reform remain a focused argument to expand agricultural production.
- From the final demand multipliers, it is noticeable that the general government receives the highest income, as discussed by Phillip (2022), and while the economic hubs such as Gauteng, Western Cape and KwaZulu-Natal are driven by manufacturing, finance and trade, the Eastern Cape is driven by the government. The Eastern Cape should therefore *focus more on other sectors of the economy as a technique to improve and progress in terms of overall economic growth.*
- The Eastern Cape experiences the highest unemployment rate of 47.4%, while with the expanded definition, the unemployment figure is 54.5% (Phillips, 2002). To alleviate the high unemployment rates within the region, it is important that policies are directed towards creating employment opportunities in the manufacturing sector, especially industries such as textiles, clothing and leather goods, wood and paper, transport equipment and furniture.

The Nelson Mandela Bay Metropolitan Municipality is a region with high potential for economic growth and development. The region has a rich history, and is host to the most important natural resources in the country. Even though the region is reliant on the government for the majority of its income and earnings, there is major potential for the region to create more jobs and work opportunities, especially among the youth of the region. The policy direction by the Metropolitan Municipality should focus on industry development and growth, especially among the stagnant and non-progressive industries, which will create more employment opportunities and regional growth.

Abbreviations

CILQ	Cross Industry Location Quotient
FLQ	Flegg Location Quotient
GVA	Gross Value Added
IDZ	Industrial Development Zone
I-O	Input-Output
SAM	Social Accounting Matrix
SIC	Standard Industrial Classification
SLQ	Standard Location Quotient

Declarations

Acknowledgements

The authors acknowledge the support from the Faculty of Economic and Management Sciences and the TRADE research focus area, North-West University (NWU). The findings, views and opinions expressed, and conclusions arrived at in this article are those of the authors and should not necessarily be attributed to the funding institutions.

Authors contribution

All authors read and approved the final manuscript. This is part of a Ph.D. dissertation by Dr Jan Roan Neethling named *"An analysis of the regional economic development functionality of selected SEZs in the Eastern Cape, South Africa".*

Availability of data

The datasets generated and/or analysed during the current study are available on Quantec Easy Data: https://www.quantec.co.za/easydata/.

Ethics approval and consent to participate

The researchers obtained an ethics clearance certificate number (NWU-00981-21-S4) from the Faculty of Economic and Management Sciences Research Ethics Committee (EMS-REC), North-West University. The ethics clearance certificate was part of the Ph.D by Dr Jan Roan Neethling.

Competing interests

The authors declare that they have no competing interests.

References

1. Bakhtiari S, Dehghanizadeh M (2012) Proposing a new version of location quotients for estimating regional input output coefficients: A case study of Iran's Yazd province. Afr J Bus Manage 6(23):6903–6909. DOI: 10.5897/AJBM11.2934
2. Bess R, Ambargis Z (2011) Input-output models for impact analysis: Suggestions for practitioners using RIMS II multipliers. In 50th Southern Regional Science Association Conference (pp. 23–27). Southern Regional Science Association Morgantown WV. https://www.bea.gov/research/papers/2011/input-output-models-impact-analysis-suggestions-practitioners-using-rims-ii. Accessed 21 January 2022
3. Boero R, Edwards B, Rivera M (2018) Regional input–output tables and trade flows: an integrated and interregional non-survey approach. Reg Stud 52(2):225–238. DOI:10.1080/00343404.2017.1286009
4. Bonfiglio A (2009) On the parameterization of techniques for representing regional economic structures. Econ Syst Res 21(2):115–127. DOI: 10.1080/09535310902995727
5. Bonfiglio A, Chelli F (2008) Assessing the behaviour of non-survey methods for constructing regional input–output tables through a Monte Carlo simulation. Econ Syst Res 20(3):243–258. DOI: 10.1080/09535310802344315
6. Cameron MJ (2003) The relationship between input-output (IO) analysis, social accounting matrices (SAM) and computable general equilibrium (CGE) models in a nutshell. Unpublished working paper
7. Crawley A, Beynon M, Munday M (2013) Making location quotients more relevant as a policy aid in regional spatial analysis. Urban Stud 50(9):1854–1869. http://www.jstor.org/stable/26144333
8. D'Hernoncourt J, Cordier M, Hadley D Input-Output Multipliers – Specification sheet and supporting material, Spicosa Project Report,Université Libre de Bruxelles – CEESE, Brussels(2011) DOI:10.13140/RG.2.2.35295.79529
9. Dine MN (2019) Impact of Global Value Chains' Participation on Employment in Turkey and Spillovers Effects. J Econ Integr 34(2):308–326. https://doi.org/10.11130/jei.2019.34.2.308
10. Japanese Ministry of economy, trade, and industry (2016) How to View the Input-Output Tables—Input-Output Tables Showing the Flow of Goods and Services in Japan. Available: https://www.meti.go.jp/english/statistics/tyo/entyoio/result_3/reference1.pdf. Accessed 12 April 2022
11. Lindberg G(2010) On the proper use of (input-output) coefficients to generate non-survey regional input-output tables: Implications for the determination of output multipliers, 50th Congress of the European Regional Science Association. August 2010. Jönköping, Sweden
12. Miller R, Blair P(2009) Input-output analysis: foundations and extensions. Cambridge university press. https://doi.org/10.1017/CBO9780511626982
13. Mun-Heng T(1998) Projecting the Leontief inverse directly by the RAS method. In presentation at the 12th International Conference on Input-Output Techniques, New York. https://www.iioa.org/conferences/12th/pdf/mhtoh.pdf. Accessed 25 June 2021
14. Nelson Mandela Bay Municipality (2020) Integrated Development Plan 2017/18–2021/22 – fourth edition.http://vital.seals.ac.za:8080/vital/access/services/Download/vital:28829/SOURCE1. Accessed 12 April

2022
15. NIRSA (Norther Ireland Statistics and Research Agency) (2021) The Analytical Input-Output tables. https://www.nisra.gov.uk/statistics/economic-accounts-project/analytical-input-output-tables. Accessed 20 September 2021
16. Phillip X(2022) Home of hardship: Why the Eastern Cape economy is no place for young talent. Available: https://www.dailymaverick.co.za/opinionista/2022-01-20-home-of-hardship-why-the-eastern-cape-economy-is-no-place-for-young-talent/. Accessed 20 May 2022
17. Ryan B(2011) Downtown and Business District Market Analysis: Tools to create economically vibrant commercial districts in Small Cities. Available: https://economicdevelopment.extension.wisc.edu/articles/local-regional-economic-analysis. Accessed 12 May 2022
18. Safr K, Vltavska K (2017) Illustration of Single-Regional and Inter-Regional Approach in Regional Input-Output Analysis. Statistika-Statistics and Economy Journal 97(1):18–31
19. Sargento AL(2009) *Introducing input-output analysis at the regional level: Basic notions and specific issues*. The Regional Economics Application Laboratory (REAL) (Discussion Paper, REAL 09-T-4). https://eg.uc.pt/bitstream/10316/10120/3/Regional%20io%20tables%20and%20models_cd%20pdf%20file.pdf. Date of access: 11 April 2022
20. Schaffer W, Chu K (1969) No survey techniques for constructing regional interindustry models. Papers of the Regional Science Association 23,(1):83–101. http://dx.doi.org/10.1007/BF01941876
21. Seneta E (2006) Non-negative matrices and Markov chains. Springer, New York
22. Sihlobo W(2019) A sleeping giant: the Eastern Cape and its agriculture. Available: https://wandilesihlobo.com/2019/09/27/a-sleeping-giant-the-eastern-cape-and-its-agriculture/. Accessed 20 May 2022
23. Statistics South Africa (2005) Constructing a social accounting matrix: Comparisons across eleven countries. Available online: https://www.statssa.gov.za/publications/D04031/D04031.pdf. Accessed 17 April 2021
24. Strotebeck F(2010) The Location Quotient–Assembly and application of methodological enhancements. MPRA Paper No. 47988. Available: http://mpra.ub.uni-muenchen.de/47988/. Accessed 30 June 2021
25. Szabó N(2015) Methods for regionalizing input-output tables.Regional Statistics, (1) 2,44–65
26. Temursho U(2016) Backward and forward linkages and key sectors in the Kazakhstan economy. Joint Government of Kazakhstan and the Asian Development Bank Knowledge and Experience Exchange Program (KEEP). https://www.adb.org/sites/default/files/project documents/.../47110-001-dpta-en_2.pdf. Accessed 12 October 2021
27. Ten Raa T (2006) The economics of input-output analysis. Cambridge University Press
28. Trinh B, Phong NV (2013) A brief note on RAS method. Adv Manage Appl Econ 3(4):133

Tables

Tables 1 to 9 are available in the Supplementary Files section

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.docx