# *AU South Africa*

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## AU.1 Introduction

The World Bank (WB) has identified a crucial need to understand the impact of South Africa's trade and industrial policies. The Global Trade Analysis Project (GTAP) data base and modelling framework allows for many policy relevant economy-wide analyses to be conducted in a global and national context. In order to improve the analysis for this purpose, the South African data in the V10/11 GTAP data base needs to be updated from its current 2008 base year. This report describes how 2017 South African data was prepared for inclusion in the V10/11 GTAP data base. The discussion starts with the high level broad approach adopted, followed by a discussion of ad-hoc adjustments to accommodate specific GTAP industry/product classifications.

## AU.2 High Level

The benchmark data is taken from the Supply Table (ST) and Use Table (UT) data that was recently released by Statistics South Africa as part of their rebased GDP release (SSA, 2021a). The ST and UT can be combined into a Supply-Use Table (SUT). A macro SUT is shown in the next table. Its elements constitute the macro building blocks for the SA GTAP IOT and are consistent with the income and expenditure national accounts of the rebased GDP release (SSA, 2021a).

Table 8.93: A Macro Supply-Use Table for South Africa, 2017

| | activities | commodities | household expenditure | government expenditure | change in stocks | investment demand | exports | total |
|---|---|---|---|---|---|---|---|---|
| activities | | 9,920,716 | | | | | | 9,920,716 |
| commodities | 5,328,266 | | 3,199,713 | 976,845 | 10,762 | 832,762 | 1,388,383 | 11,736,731 |
| labour | 2,500,121 | | | | | | | 2,500,121 |
| capital | 2,005,477 | | | | | | | 2,005,477 |
| activity taxes | 86,852 | | | | | | | 86,852 |
| product taxes | | 485,740 | | | | | | 437,835 |
| imports | | 1,330,275 | | | | | | 1,330,275 |
| total | 9,920,716 | 11,736,731 | 3,199,713 | 976,845 | 10,762 | 832,762 | 1,388,383 | |

Source: rearranged by the authors, derived from SSA (2021a)

It can be seen that the industry and the commodity accounts balance. Income GDP and expenditure GDP can be derived from Table 8.93 above as shown below in Table 8.94.

Table 8.94: GDP Accounting for South Africa, 2017

| | GDP Income | | GDP Expenditure |
|---|---|---|---|
| labour | 2,500,121 | households expenditure | 3,199,713 |
| capital | 2,005,477 | government expenditure | 976,845 |
| activity taxes | 86,852 | change in stocks | 10,762 |
| product taxes | 485,740 | investment demand | 832,762 |
| Total | 5,078,190 | exports | 1,388,383 |
| | | imports | -1,330,275 |
| | | Total | 5,078,190 |

Source: authors calculations based on SSA (2021a)

The Stats SA SUT identifies 124 industries (activities) and 108 products (commodities). They can be mapped to the GTAP v10/11 classification (GTAP Data Bases: Two Concordances (purdue.edu)) as shown in Appendix 1.The Stats SA SUT does not offer sufficient detail to match all the GTAP classifications requirements. Other data sources have been used. Agriculture and processed food industry data is available from Phoofolo (2018) in a South African SAM for the year 2014. The non-agriculture and non-processed food industries and products are based on the classification of a previous series of SUTs by Stats SA (2020). The mapping of the 2014 SAM with agriculture and processed food detail is shown in Appendix 2.

The broad modelling strategy adopted to arrive at a SA GTAP IOT, and described in the rest of this report, is to aggregate up the Stats SA SUT as well as the 2014 SAM with agricultural and processed food detail as close as possible to the GTAP classifications. Then, use the shares of the 2014 SAM to disaggregate the Stats SA SUT's agricultural main industry and main products into a prior SUT with matching industries and products. This applies to the cost of production in the Use Matrix, the domestic supply by activities to product accounts and imports, margins and product taxes in the Supply Matrix as well as intermediate and final demand of products in the Use Matrix. The initial results are combined with the FAO Gross Value of Production shares. Agriculture's detailed gross value of production is benchmarked on FAO shares for the years 2017 in such a way that the absolute values remain consistent with the Stats SA SUT intermediate and primary inputs for agriculture as a whole. The FAO mapping is reported in Appendix 3.

For the food processing cluster, the limited industry detail offered by the 2017 Stats SA SUT is expanded using more food processing detail from the 2014 SA SAM to arrive at cost structures that match the GTAP classification as close as possible. In the supply matrix of the newly created SUT, domestic supply by these new industries is limited to core products identified by the Stats SA SUT. This required some ad-hoc rearranging. For example, the meat industry only supplies meat products, the oils and fats industry only supplies oils and fats products etc. Non-core non-processed food supplies by these industries of say business services are derived by using supply structures of relevant parent industries in the underlying 2017 Stats SA SUT. Other elements of marketed supply of processed food products (non-core domestic supply by non-food processing industries, imports, duties collected, margins and sales tax) remains the same as in the underlying

2017 Stats SA SUT. Imports, import duties and exports for detailed agriculture and processed food are derived from South African Revenue Services trade data for the year 2017 instead of using 2014 SAM data. Import duties for all products are only available at the Harmonised System (HS) section level and had to be adjusted manually to avoid negative domestic sales tax when subtracted from their combined values in the Stats SA SUT. The GTAP classification splits factor income associated with land off from gross operating surplus. This is not available from the Stats SA SUT. The breakdown ratios for farming has been taken from the 2014 SA SAM with agriculture and processed food detail.

## AU.3 Ad-Hoc Disaggregations

Additional ad-hoc disaggregation is required for a range of products and industries that are not available from the Stats SA SUT nor the 2014 SAM, to match the GTAP classification. They are discussed in terms of relevant cluster below.

a Paddy Rice, Plant Based Fibres, Wool

Gross value of production is obtained from FAO data while a proxy for the input structure is derived from the parent activities of grains nec, crops nec and goats/sheep farming respectively. Domestic marketed supply, given by the FAO data above, is shifted to new product accounts that match the activity accounts. Domestic supply is made to be equal to the cost of production for the new activities. The value of imports and import duties, obtained and derived from South African Revenue Services (SARS) are added to marketed domestic supply of the new products. Intermediate and final domestics demands for the new products are split-off from their parent products using the demand shares of the latter while accounting for exports that are taken from SARS trade data.

b Processed Rice and Other Processed Meat

Processed rice needs to be split-off from all grain milling products and as an industry from other food products. Imports and their derived duties are available from SARS trade tax data. Demand for processed rice is dominated by households. CPI weights available from Stats SA (2021b) are used to derive the value.[68] Exports of processed rice is taken from SARS trade data. Intermediate use of processed rice by other industries is derived using the parent's product (grain milling and related products) sales shares. Given demand of processed rice and imported supply, domestic supply can be derived. This constitutes the gross output of the processed rice industry, with their intermediate and primary costs derived from the parent industry (other foods). A similar sequence of calculations is used to split processed meat into meat from cattle (beef) and other (poultry/ pork) meat. Exports, imports

[68] CPI weights are set by Stats SA to 100 for Dec 2016. The monthly progression of the CPI weight is presented as an index with December 2016 = 100. The weights are recalculated for every month of the 2017 calendar year and rescaled to make them add to 100%. The unweighted average of the 12 monthly calculated and rescaled CPI weights is used as a proxy for household expenditure. The result is lowered by 5% in order to avoid deriving negative values for intermediate sales processed rice. Inventory changes were manually adjusted downwards for the same reason.

(and derived duties collected) of pork and poultry are available from the SARS trade data and household demands are derived from the CPI weights.[69]

c Gas and Oil Extraction and Electricity Generation and Distribution and Gas Distribution

Splitting “Gas Extraction” from “Oil and Gas Extraction” and “Gas Distribution” from “Electricity and Gas Generation and Distribution” in the 2017 Stats SA SUT required the following steps:

1 South African Revenue Service (SARS) trade data identifies the value of imported gas. The South African Department of Energy’s Energy Balances (ongoing) allows for the ratio of imported versus domestically produced gas to be calculated in physical energy units. Assuming the same unit of energy quantity and the same price, the value of the total supply of gas can be determined.

2 Consumption of gas as well as electricity by a range of industries is available from the same Energy Balances. The industries can be mapped to the new SUT industries. Ratios of gas to electricity can be determined for all 2017 Stats SA SUT industries (using proxies) and final users (households) based on the same assumptions as in 2 above.

3 The 2017 Stats SA SUT shows that the parent product “Oil and Gas Extraction” is only purchased by petrochemical and chemical industries while “Electricity and Gas” is supplied to all industries in the 2017 Stats SA SUT. The value of the total supply of gas determined in 1 above is subtracted pro-rata from the “Oil and Gas” intermediate inputs of the petrochemical and chemical industries and shifted to the new industry “Gas Distribution”. Other input cost of this new industry are based on the costs shares of the original 2017 Stats SA SUT’s gas and electricity industry and subtracted from the latter. This includes the use of coal by “Gas Works”.

4 In the Supply Matrix, the new gas industry only supplies the single product of “Distributed Gas”.

5 As a product, distributed gas is used as an intermediate input in all industries that use “Electricity and Gas” as reported in the 2017 Stats SA SUT. Intermediate use of gas is based on the ratios of gas to electricity consumption reported in the Energy Balances mentioned in 2 above. This includes what was subtracted from the combined “Oil and Gas” intermediate inputs by petrochemical and chemical industries. Also accounted for is residential gas use as it is identified in the Energy Balances.

6 The economy-wide average share of gas in electricity and gas combined can now be calculated (about 5%) and used to break the original electricity and gas distribution margins identified in the Stats SA SUT down into its respective components. SARS trade data also identifies some exports of gas which is duly accounted for.

d Basic Pharmaceuticals

[69] Data on processed meat that uses both pork and beef (sausage, biltong) is ignored here for lack of information on the relevant shares.

Basic pharmaceuticals is identified in the GTAP classification while it is in the product listing of the 2017 Stats SA SUT reported as pharmaceutical products. It is assumed that they represent the same. Although in the 2017 Stats SA SUT, basic pharmaceuticals is not represented as an industry, the Stats SA SUT supply matrix shows the domestic supply of pharmaceuticals. It is assumed that this is all produced by a newly introduced basic pharmaceutical industry. Moreover, it is assumed that the newly introduced basic pharmaceutical industry only supplies basic pharmaceutical products, i.e, no by-products. All chemicals production of the other chemicals industries other than the basic pharmaceutical industry is added to the chemicals industry. The latter adopts the "other chemicals" label of the GTAP classification. This determines the gross value of production of the newly introduced basic pharmaceutical industry as well as all the other chemicals industries. Cost structures of both industries are derived pro-rata from their relevant original parent industries as reported in the 2017 Stats SA SUT. Intermediate and final demand for basic pharmaceutical products remains the same as in the 2017 Stats SA SUT.

e Transport by mode (air, water and land based)

In the case of transportation, the situation is somewhat the opposite to that of basic pharmaceuticals discussed in section d above. The underlying 2017 Stats SA SUT identifies transport services as industries by mode in the same way as the GTAP classification, i.e., air, water and other (land based rail, road and pipeline). However, the matching products identified by the 2017 Stats SA SUT are disaggregated by passenger and freight only. The supply matrix of the 2017 Stats SA SUT shows domestic supply of passenger and freight transport services by mode of transport (air, water and other). This allows the marketed supply of passenger transport services and freight transport services both to be disaggregated by mode of transport. Imports of air passenger transport services are available from the South Africa Reserve Bank (SARB, 2021) reporting of the Balance of Payment. It is assumed that there are no imports of water and land based passenger transport services. Imports of freight transport services are off-set against CIF in the Stats SA SUT and are reported as zero. This is assumed to also apply to air, water and land based freight transport.

Sales tax on passenger transport services is reported to be negative in the 2017 Stats SA SUT. This negative value represents net passenger transport subsidies. For purposes of the new SUT, these subsidies are assumed to only apply to land based mode of passenger transport services, i.e., not to passenger transport by air or water. Gross subsidies are available from the SARB (2021) reporting of Public Finance statistics.[70] The difference between gross and net subsidies is assumed to be domestic sales tax and apportioned pro-rata to the domestic supply of passenger transport by transport mode.

Finally, passenger and freight transport services are aggregated across mode of transport to match the industry side of transport services. Non-core supply of transport service by industries other than transport services, in particular by recreational and other services is

[70] It is assumed that there are no other product subsidies. This is most likely incorrect but Stats SA's (2021c, 59) notes on sources and methods is not sufficiently specific on this issue: "The subsidy commodity structures (where the subsidies are allocated) consist of transportation products and telecommunications.". We ignore subsidies on telecommunication. Moreover, there may be zero rating of sales tax on selected detailed products but this should be reflected in the sales tax collection values of the SUT.

distributed across the modes of transport according to the domestic supply shares of the latter.

## AU.4 A Prior SUT

The data manipulations described in sections 2 and 3 above allows for the derivation of an new, albeit unbalanced, prior SUT which is consistent with the GTAP classification and with the Macro SUT of Table 8.93. However, while the detailed industry accounts of total costs of production (gross value of production) and total domestic supply match, imbalances in the product supply and demand accounts remain. The sum of these imbalances is zero so that there is no imbalance between the column and row totals of the commodity account in the Macro SUT of Table 8.93.

## AU.5 Entropy Balancing

It is generally argued that any mechanical balancing routine (entropy/RAS) should only be employed after all available information has been used to reduce the imbalances as much as possible. This is described in section 3 above. Two options were considered to resolve the differences between demand and supply at the detailed product level:

1. Manual ad-hoc shifting around amongst detailed product accounts of intermediate inputs (production costs), household expenditures or changes in stock, in order to reduce these differences. This is followed by a balancing routine to eliminate the differences.

2. Leave initial differences as is and allow a balancing routine to eliminate the differences.

The next table shows the absolute differences between supply and demand for the top 20 product markets

It can be seen that there are substantial differences which are most prominent for those products that are newly introduced, in particular where ad-hoc treatment was required. The question is whether an ad-hoc manual adjustment would be better rather than a mechanical adjustment. Ad-hoc manual adjustments are rather arbitrary but have less impact on other product markets in the SUT. Without further manual adjustments, the balancing is achieved by means of a mechanical routine (discussed below) and will lead to larger adjustments in product accounts other than those where initial manual adjustments could be considered. At this stage the latter, i.e., absolute imbalance WITHOUT manual adjustment is given preferences.

Cross entropy is used as the balancing routine here [see Robinson, Cattaneo, & El-Said (1998)]. The application is described by Davies and Thurlow (2013). Table 8.96 presents the equations defining the balancing routine. Starting from a prior estimate, additional information is imposed in the form of constraints on the estimation. Equation 1 specifies that row sums and corresponding column sums must be equal, which is the defining characteristic for a consistent set

Table 8.95: Supply-Demand Absolute Imbalances, Rm 2017 prices

| | 1 | 2 | 3 |
|---|---|---|---|
| | | Absolute imbalance | % of Demand |
| 1 | Vegetables, fruits, nuts | 17,531 | 17.7% |
| 2 | Meat products nec | 9,572 | 13.7% |
| 3 | Food products nec | 9,438 | 2.8% |
| 4 | Cereal grains nec | 6,035 | 11.6% |
| 5 | Crops nec | 5,485 | 41.1% |
| 6 | Wheat | 4,806 | 60.6% |
| 7 | Animal products nec | 4,341 | 7.5% |
| 8 | Wool, silk-worm cocoons | 2,674 | 41.5% |
| 9 | Sugar cane, sugar beet | 2,384 | 21.2% |
| 10 | Bovine cattle, sheep and goats, horses | 1,655 | 5.7% |
| 11 | Oilseeds | 1,628 | 8.3% |
| 12 | Processed rice | 1,332 | 10% |
| 13 | Bovine meat products | 1,104 | 1.8% |
| 14 | Manufactures nec | 856 | 0.5% |
| 15 | Business services nec | 575 | 0% |
| 16 | Raw milk | 530 | 5.1% |
| 17 | Plant-based fibers | 285 | 31.2% |
| 18 | Chemical products | 260 | 0.1% |
| 19 | Metals nec | 9 | 0% |
| 20 | Paddy rice | 7 | 11.8% |

Source: own calculations

of industry and product accounts. Equation 2 specifies that sub-accounts must equal control totals, and that these totals are assumed to be measured with error (Equation 3). An example would be the estimate of total wage earnings provided by 2017 Stats SA SUT national accounts as shown in Table 8.93. In the case of the new SUT, the imposed errors on all macro SUT entries shown in Table 8.93 are set to zero. In other word, the macro SUT of the new micro SUT must report the values in Table 8.93.

The matrix G is an aggregator matrix, with entries equal to 0 or 1. The index k is general and can include individual cells, column/row sums, and any combination of cells such as macro aggregates. Equation 4 allows for the imposition of information about column coefficients in the matrix rather than cell values, also allowing for error (Equation 5).

The error specification in Equations 2 and 3 describes the errors as a weighted sum of a specified 'support set' (the V parameters). The weights (W) are probabilities to be estimated, starting from a prior on the standard error of measurement of aggregates of flows (Equation 8) or coefficients (Equation 9). The number of elements in the error support set (w) determines how many moments of the error distribution are estimated. The probability weights must be non-negative and sum to one (Equations 8 and 9). The objective function (equation 10) is the cross-entropy distance between the estimated probability weights and their prior for the errors in both coefficients and aggregates of matrix flows. It can be shown that this minimand is uniquely appropriate, and that

Table 8.96: Equations for Cross-entropy estimation

| | | |
|---|---|---|
| Index | | |
| $i, j$ | Row (i) and column (j) entries | |
| k | Set of constraints | |
| w | Set of weights | |
| Symbol | | |
| $T_{ij}$ | Matrix in values | |
| $A_{ij}, \bar{A}_{ij}$ | Matrix in column coefficients | |
| $G_{kij}$ | Aggregator matrix for each constraint k | |
| $\gamma_{ij}, \bar{\gamma}_{ij}$ | Aggregate value for constraint k | |
| $e_k$ | Error on each constraint k | |
| $e^A_{i,j}$ | Error on each cell coefficient | |
| $W, \bar{W}$ | Weights and prior on error term for each constraint k or cell coefficient i,j | |
| $\bar{V}$ | Error support set indexed over w for each constraint k or cell coefficient i,j | |
| Equations | | |
| $\sum_i T_{ij} = \sum_j T_{ij}$ | | (1) |
| $\sum_i \sum_j G_{kij} T_{ij} = y_k$ | | (2) |
| $\gamma_k = \bar{\gamma}_k + e_k$ | | (3) |
| $A_{ij} = T_{ij} / \sum_i T_{ij}$ | with $\sum_i A_{ij} = 1 \forall i$ | (4) |
| $A_{ij} = \bar{A}_{ij} + e^A_{i,j}$ | for some i and j | (5) |
| $e_k = \sum_w W_{kw} \bar{V}_{kw}$ | | (6) |
| $e^A_{i,j} = \sum_w W^A_{ijw} \bar{V}^A_{ij}$ | | (7) |
| $\sum_w W_{kw} = 1$ | with $0 \leq W_{kw} \leq 1$ | (8) |
| $\sum_w W^A_{ijw} = 1$ | with $0 \leq W^A_{ijw} \leq 1$ | (9) |
| $min[\sum_k \sum_w W_{kw}(lnW_{kw} - ln\bar{W}_{kw}) + \sum_i \sum_j \sum_w W^A_{ijw}(lnW^A_{ijw} - ln\bar{W}^A_{ijw})]$ | | (10) |

Source: Davies and Thurlow 2013, p14

using any other minimand introduces unwarranted assumptions (or information) about the errors.

As mentioned above, the standard error on the macro SUT totals is set to zero. The standard error on the column totals is set to 0.1 and the standard error on cell values and coefficients to 0.2. A prior mean of zero is assumed and a two parameter distribution thereof. The error support set is 3 times the standard error either side of the mean with weights 1/18, 16/18 and 1/18 for the lower bound, mean and upper bound respectively.

## AU.6 IOT conversion methodology

The result of the balancing routine described in the previous section is a balanced SA SUT with GTAP consistent classifications. Exports are equal to or less than domestic supply for each product identified in this framework.

The SUT is already square in that industries match commodities. It is subsequently converted into a GTAP V.10/11 IOT, at basic prices according to the following steps:

1. The Supply Matrix of the square SUT is diagonalized. Off-diagonal entries in the Supply Matrix (secondary and by-products) are removed. This is achieved by summing the off-diagonal elements of each row and matching column and adding it to:

   a The diagonal of the relevant row/column in the Supply Matrix. Secondary and by-products become primary products.

   b Intermediate demand of the on-diagonal supplying activity in the Use Matrix for its own primary product. As described below, this becomes intra-industry intermediate demand.

   In doing so, consistency is maintained, i.e., demand and supply of the relevant activity and commodity remain the same. See Appendix 4 for further discussion on this issue.

2. Since, intermediate demand in the Use Matrix is still valued in market prices while the consolidation of off-diagonal elements in the Supply Matrix is valued in basic prices, the Use Matrix is converted from market prices to basic prices by removing:

   a Indirect taxes on products (domestic sales tax and import duties) according to the shares of intermediate and final demand for each product (excluding exports) and allocating them to a specific row for indirect taxes on products.

      The preference is to apply these shares according to underlying tax matrices used and described in broad terms by Stats SA (2021c, 55-59). In absence of such data, the demand shares are adjusted to accommodate the tax refund situation on intermediate and final consumption in South Africa by a range of ad-hoc assumptions. This applies, in particular to value added tax (VAT) but not to other product taxes such as import and excise duties and others. Stats SA (2021c) reports that a number of industries pay non-refundable VAT. These industries can be mapped to the GTAP classification in an ad-hoc way. Details are available in Appendix 5, Table A5 1. Assumption can be made for these industries about the portion of non-refundable product taxes, say 50% while for all other industries the assumption can be made that 95% is refundable. However, more industry level detail can be obtained from SARS (2018, p228) which reports gross VAT payments (domestic plus on imports) as well as VAT refunds. The mapping of the 34 SARS industries to the GTAP classification and associated ratios of VAT refunds to gross VAT payment is reported in Appendix 5, Table A5 2. The ratios of VAT refunds to gross VAT payments is used to adjust the demand shares. Ratios that are greater than unity result in negative product taxes and they are set to a maximum of 0.95.

      The 95% assumption is also made for gross fixed capital formation, government expenditure and inventory changes, while households are assumed to be able to collect refunds up to 5% of taxes paid.

      These adjustments to the demand shares are made uniformly to all products in the Use Matrix. This requires a rescaling such that the product taxes extracted and reallocated remain consistent with the total product taxes reported in the National Accounts. However, the uniform application of the adjustment across products creates an imbalance in the Use Matrix. This imbalance is corrected by means of a biproportional scaling routine that is applied right at the end of the process when the data is assembled in GTAP IOT format in step 4) below.

Other domestic product taxes received the same treatment as VAT due to lack of specific data while import duties are reallocated according to the unadjusted demand share of the use matrix.

b Trade margins on products according to the shares of each row of the matrix created in the previous point and allocating them to the rows of trade and transport, electricity, gas and water distribution service.

3. Imports of products are removed from intermediate and final demand (excluding exports) according to the shares of each product's row and allocated to a specific row of intermediate imports. Instead of aggregating them up into a row, as is the case with product taxes, imports are left in matrix format to suit GTAP requirements.

4. The diagonalized SUT is collapsed (removed) so that there is no separation of products and industries. Imbalances discussed in 2)a above are resolved by means of biproportional scaling.

The resulting IOT can now be assembled to achieve the format set out in GTAP Data Bases: GTAP I-O Table Format (purdue.edu)

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## Appendix

### Stats SA Supply – Use Table Industry and Products and their Mapping to the GTAP v10/11 classification

Table 8.97: Industry Mapping

| SASUT Code | Short Industry Description | SIC Classifications in the SUT Publication | GTAP Destination: codes (descriptions) |
|---|---|---|---|
| i001 | Agriculture | 11 | pdr (Paddy rice)/wht (Wheat)/gro (Cereal grains nec)/v_f (Vegetables, fruits, nuts)/osd (Oilseeds)/c_b (Sugar cane, sugar beet)/pfb (Plant-based fibers)/ocr (Crops nec)/ctl (Bovine cattle, sheep and goats, horses)/oap (Animal products nec)/rmk (Raw milk)/wol (Wool, silk-worm cocoons) |
| i002 | Forestry | 12 | frs (Forestry) |
| i003 | Fishing | 13 | fsh (Fishing) |
| i004 | Coal | 21 | col (Coal) |
| i005 | Petroleum | 22 | oil (Oil))/gas (Gas) |
| i006 | Gold | 23 | oxt (Other Extraction (formerly omn Minerals nec)) |

Continued ...

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| SASUT Code | Short Industry Description | SIC Classifications in the SUT Publication | GTAP Destination: codes (descriptions) |
|---|---|---|---|
| i007 | Metal Ores | 24 | oxt (Other Extraction (formerly omn Minerals nec)) |
| i008 | Stone | 25 | oxt (Other Extraction (formerly omn Minerals nec)) |
| i009 | Services | 29 | oxt (Other Extraction (formerly omn Minerals nec)) |
| i010 | Meat, fish, fruit, vegetables, oils and fats | 301 | cmt (Bovine meat products)/omt (Meat products nec)/vol (Vegetable oils and fats)/ofd (Food products nec) |
| i011 | Dairy | 302 | mil (Dairy products) |
| i012 | Grain and animal feeds | 303 | ofd (Food products nec))/pcr (Processed rice) |
| i013 | Other food products | 304 | ofd (Food products nec))/sgr (Sugar) |
| i014 | Beverages | 305 | b_t (Beverages and tobacco products) |
| i015 | Tobacco | 306 | b_t (Beverages and tobacco products) |
| i016 | Textiles | 311 | tex (Textiles) |
| i017 | Other textiles | 312 | tex (Textiles) |
| i018 | Knitted fabrics | 313 | wap (Wearing apparel) |
| i019 | Wearing apparel | 314 | wap (Wearing apparel) |
| i020 | Leather | 315 | lea (Leather products) |
| i021 | Footwear | 317 | lea (Leather products) |
| i022 | Sawmilling of wood | 321 | lum (Wood products) |
| i023 | Wood products | 322 | lum (Wood products) |
| i024 | Paper | 323 | ppp (Paper products, publishing) |
| i025 | Publishing | 324 | ppp (Paper products, publishing) |
| i026 | Printing and reproduction | 325-6 | ppp (Paper products, publishing) |
| i027 | Coke products | 331 | p_c (Petroleum, coal products) |
| i028 | Petroleum refineries | 332 | p_c (Petroleum, coal products) |
| i029 | Basic chemicals | 334 | chm (Chemical products) |
| i030 | Other chemicals | 335 | chm (Chemical products))/bph (Basic pharmaceutical products) |
| i031 | Rubber | 337 | rpp (Rubber and plastic products) |
| i032 | Plastic | 338 | rpp (Rubber and plastic products) |
| i033 | Glass | 341 | nmm (Mineral products nec) |
| i034 | Non-metallic minerals | 342 | nmm (Mineral products nec) |
| i035 | Iron and steel | 351 | i_s (Ferrous metals) |
| i036 | Precious metals | 352 | nfm (Metals nec) |
| i037 | Casting of metals | 353 | fmp (Metal products) |
| i038 | Structural metal | 354 | fmp (Metal products) |
| i039 | Other fabricated metal | 355 | fmp (Metal products) |
| i040 | General purpose machinery | 356 | ome (Machinery and equipment nec) |
| i041 | Special purpose machinery | 357 | ome (Machinery and equipment nec) |
| i042 | Household appliances | 358 | ome (Machinery and equipment nec) |
| i043 | Computing machinery | 359 | eeq (Electrical equipment) |
| i044 | Electric motors | 361 | eeq (Electrical equipment) |
| i045 | Other electric | 366 | eeq (Electrical equipment) |
| i046 | Other electric components | 371-2 | ele (Computer, electronic and optical products) |

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| SASUT Code | Short Industry Description | SIC Classifications in the SUT Publication | GTAP Destination: codes (descriptions) |
|---|---|---|---|
| i047 | Television and radios | 373 | ele (Computer, electronic and optical products) |
| i048 | Medical appliances | 374-5 | ele (Computer, electronic and optical products) |
| i049 | Motor vehicles | 381 | mvh (Motor vehicles and parts) |
| i050 | Vehicle bodies | 382 | mvh (Motor vehicles and parts) |
| i051 | Vehicle parts | 383 | mvh (Motor vehicles and parts) |
| i052 | Ships, boats | 384 | otn (Transport equipment nec) |
| i053 | Locomotives | 385 | otn (Transport equipment nec) |
| i054 | Aircraft | 386 | otn (Transport equipment nec) |
| i055 | Equipment | 387 | otn (Transport equipment nec) |
| i056 | Furniture | 391 | omf (Manufactures nec) |
| i057 | Other manufacturing | 392 | omf (Manufactures nec) |
| i058 | Recycling | 395 | omf (Manufactures nec) |
| i059 | Electricity | 41 | ely (Electricity))/gas (Gas) |
| i060 | Water | 42 | wtr (Water) |
| i061 | Site preparation | 501 | cns (Construction) |
| i062 | Engineering | 502 | cns (Construction) |
| i063 | Installation | 503 | cns (Construction) |
| i064 | Completion | 504 | cns (Construction) |
| i065 | Equipment | 505 | cns (Construction) |
| i066 | Fee basis | 611 | trd (Trade) |
| i067 | Agricultural raw materials | 612 | trd (Trade) |
| i068 | Household goods | 613 | trd (Trade) |
| i069 | Non-agricultural products | 614 | trd (Trade) |
| i070 | Machinery, equipment and supplies | 615 | trd (Trade) |
| i071 | Other wholesale trade | 619 | trd (Trade) |
| i072 | Non-specialised retail trade | 621 | trd (Trade) |
| i073 | Retail trade in food | 622 | trd (Trade) |
| i074 | Other retail trade | 623/4 | trd (Trade) |
| i075 | Other retail trade | 625 | trd (Trade) |
| i076 | Repair of goods | 626 | trd (Trade) |
| i077 | Motor vehicles | 631/4 | trd (Trade) |
| i078 | Repair of vehicles | 632 | trd (Trade) |
| i079 | Motor vehicle parts | 633 | trd (Trade) |
| i080 | Automotive fuel | 635 | trd (Trade) |
| i081 | Hotels | 641 | afs (Accommodation, Food and service activities) |
| i082 | Restaurants | 642 | afs (Accommodation, Food and service activities) |
| i083 | Railway transport | 711 | otp (Transport nec) |
| i084 | Other land transport | 712 | otp (Transport nec) |
| i085 | Water transport | 72 | wtp (Water transport) |
| i086 | Air transport | 73 | atp (Air transport) |
| i087 | Supporting transport activities | 741 | whs (Warehousing and support activities) |
| i088 | Postal courier activities | 751 | cmn (Communication) |
| i089 | Telecommuni-cations | 752 | cmn (Communication) |

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| SASUT Code | Short Industry Description | SIC Classifications in the SUT Publication | GTAP Destination: codes (descriptions) |
|---|---|---|---|
| i090 | Monetary | 811 | ofi (Financial services nec) |
| i091 | Other financial | 812 | ofi (Financial services nec) |
| i092 | Insurance and pensions | 821 | ins (Insurance (formerly isr)) |
| i093 | Auxiliary financial | 831 | ofi (Financial services nec) |
| i094 | Activities to insurance and pension | 832 | ins (Insurance (formerly isr)) |
| i095 | Owner occupied | 84 Own | dwe (Dwellings) |
| i096 | Lease | 841 | rsa (Real estate activities) |
| i097 | Fee basis | 842 | rsa (Real estate activities) |
| i098 | Renting of transport equipment | 851 | rsa (Real estate activities) |
| i099 | Renting of machinery | 852 | obs (Business services nec) |
| i100 | Renting of goods | 853 | obs (Business services nec) |
| i101 | Hardware consultancy | 861 | obs (Business services nec) |
| i102 | Software consultancy | 862 | obs (Business services nec) |
| i103 | Data processing | 863 | obs (Business services nec) |
| i104 | Repair of computers | 865 | obs (Business services nec) |
| i105 | Research and development | 87 | obs (Business services nec) |
| i106 | Legal and accounting | 881 | obs (Business services nec) |
| i107 | Architectural and engineering | 882 | obs (Business services nec) |
| i108 | Advertising | 883 | obs (Business services nec) |
| i109 | Other business activities | 889 | obs (Business services nec) |
| i110 | Central government | 91 Central | osg (Public Administration and defense) |
| i111 | Provincial government | 91 Provincial | osg (Public Administration and defense) |
| i112 | Local government | 91 Local | osg (Public Administration and defense) |
| i113 | Education | 92 | edu (Education) |
| i114 | Human health | 931 | hht (Human health and social work activities) |
| i115 | Veterinary | 932 | hht (Human health and social work activities) |
| i116 | Social work | 933 | hht (Human health and social work activities) |
| i117 | Sewage and refuse | 94 | ros (Recreational and other services) |
| i118 | Professional | 951 | ros (Recreational and other services) |
| i119 | Membership | 952 | ros (Recreational and other services) |
| i120 | Entertainment | 961 | ros (Recreational and other services) |
| i121 | Museums | 963 | ros (Recreational and other services) |
| i122 | Recreational | 964 | ros (Recreational and other services) |
| i123 | Other services | 990 | ros (Recreational and other services) |
| i124 | Informal, illicit, non-profit, and households | Non-observed | ros (Recreational and other services) |

Source: Authors' arrangements based on Stats SA (2017) and GTAP

Table 8.98: Product Mapping

| SASUT Code | Short Product Description | CPC Classifications in the SUT Publication | GTAP Destination: codes (descriptions) |
|---|---|---|---|
| p001 | Cereals, oilseeds | 011/4 | pdr (Paddy rice)/wht (Wheat)/gro (Cereal grains nec)/osd (Oilseeds) |
| p002 | Vegetables, fruits | 012-3/5-9 | v_f (Vegetables, fruits, nuts)/c_b (Sugar cane, sugar beet)/pfb (Plant-based fibers)/ocr (Crops nec) |
| p003 | Live animals | 021-9 | ctl (Bovine cattle, sheep and goats, horses)/oap (Animal products nec)/rmk (Raw milk)/wol (Wool, silk-worm cocoons) |
| p004 | Forestry | 031-2 | frs (Forestry) |
| p005 | Fish | 041-2/9 | fsh (Fishing) |
| p006 | Coal, lignite; peat | 110 | col (Coal) |
| p007 | Crude petroleum, gas | 120 | oil (Oil)/gas (Gas) |
| p008 | Metal ores | 141-2 | oxt (Other Extraction (formerly omn Minerals nec)) |
| p009 | Stone, sand, clay | 150-4 | oxt (Other Extraction (formerly omn Minerals nec)) |
| p010 | Other minerals | 161-3 | oxt (Other Extraction (formerly omn Minerals nec)) |
| p011 | Electricity, steam | 171-4 | ely (Electricity)/gdt (Gas manufacture, distribution) |
| p012 | Natural water | 180 | wtr (Water) |
| p013 | Meat | 211 | cmt (Bovine meat products) |
| p014 | Prepared fish | 212 | ofd (Food products nec) |
| p015 | Prepared vegetables | 213 | ofd (Food products nec) |
| p016 | Prepared fruit, nuts | 214 | ofd (Food products nec) |
| p017 | Oils, fats | 215-7 | vol (Vegetable oils and fats) |
| p018 | Dairy products, egg | 221-3 | mil (Dairy products) |
| p019 | Grain mill, starches and syrup products | 231 | ofd (Food products nec) |
| p020 | Animal feeding | 233 | ofd (Food products nec) |
| p021 | Bakery products | 234 | ofd (Food products nec) |
| p022 | Sugar | 235 | sgr (Sugar) |
| p023 | Cocoa, chocolate | 236 | ofd (Food products nec) |
| p024 | Macaroni, noodles and food n.e.c. | 239 | ofd (Food products nec) |
| p025 | Alcohol beverages | 241-3 | b_t (Beverages and tobacco products) |
| p026 | Soft drinks | 244 | b_t (Beverages and tobacco products) |
| p027 | Tobacco products | 250 | b_t (Beverages and tobacco products) |
| p028 | Yarn, thread; textile | 261-8 | tex (Textiles) |
| p029 | Made-up textile | 271 | tex (Textiles) |
| p030 | Carpets | 272 | tex (Textiles) |
| p031 | Textile n.e.c. | 273/9 | tex (Textiles) |
| p032 | Knitted, crocheted | 281 | wap (Wearing apparel) |
| p033 | Wearing apparel | 282-3 | wap (Wearing apparel) |
| p034 | Leather | 291-2 | lea (Leather products) |
| p035 | Footwear | 293-6 | lea (Leather products) |
| p036 | Wood | 311-7/9 | lum (Wood products) |
| p037 | Pulp, paper | 321 | ppp (Paper products, publishing) |

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| SASUT Code | Short Industry Description | SIC Classifications in the SUT Publication | GTAP Destination: codes (descriptions) |
|---|---|---|---|
| p038 | Printing | 322-8 | ppp (Paper products, publishing) |
| p039 | Coke oven | 331-2/6-7 | p_c (Petroleum, coal products) |
| p040 | Petroleum oils | 333-5 | p_c (Petroleum, coal products) |
| p041 | Basic chemicals, fertilizers and pesticides | 341-8 | chm (Chemical products) |
| p042 | Paints, varnishes | 351 | chm (Chemical products) |
| p043 | Pharmaceutical | 352 | bph (Basic pharmaceutical products) |
| p044 | Soap, perfumes | 353 | chm (Chemical products) |
| p045 | Chemicals n.e.c. | 354-5 | chm (Chemical products) |
| p046 | Rubber tyres, tubes and other rubber | 361-2 | rpp (Rubber and plastic products) |
| p047 | Plastics | 363-4/9 | rpp (Rubber and plastic products) |
| p048 | Glass | 371 | nmm (Mineral products nec) |
| p049 | Non-structural ceramic | 372 | nmm (Mineral products nec) |
| p050 | Clay products | 373 | nmm (Mineral products nec) |
| p051 | Plaster, lime, cement | 374 | nmm (Mineral products nec) |
| p052 | Concrete, cement, plaster | 375 | nmm (Mineral products nec) |
| p053 | Other non-metallic | 376/9 | nmm (Mineral products nec) |
| p054 | Furniture | 381 | omf (Manufactures nec) |
| p055 | Jewellery | 382 | omf (Manufactures nec) |
| p056 | Other manufacturing | 383-7/9 | omf (Manufactures nec) |
| p057 | Wastes, scraps | 391-3/9 | omf (Manufactures nec) |
| p058 | Basic iron, steel | 411 | i_s (Ferrous metals) |
| p059 | Iron, steel products | 412 | i_s (Ferrous metals) |
| p060 | Basic precious metals | 413-6 | nfm (Metals nec) |
| p061 | Structural metal, tanks and reservoirs | 421-3 | fmp (Metal products) |
| p062 | Other fabricated metal | 429 | fmp (Metal products) |
| p063 | Engines, turbines, pumps, compressors, bearings and gears | 431-3 | ome (Machinery and equipment nec) |
| p064 | Lifting, handling equipment | 435 | ome (Machinery and equipment nec) |
| p065 | Other general machinery | 434/9 | ome (Machinery and equipment nec) |
| p066 | Special-purpose machinery | 441-7/9 | ome (Machinery and equipment nec) |
| p067 | Domestic appliances | 448 | ome (Machinery and equipment nec) |
| p068 | Office machinery | 451-2 | eeq (Electrical equipment) |
| p069 | Electrical machinery | 461-5/9 | eeq (Electrical equipment) |
| p070 | Radio, television | 471-6/8-9 | ele (Computer, electronic and optical products) |
| p071 | Medical appliances | 481-4 | ele (Computer, electronic and optical products) |
| p072 | Motor vehicles, parts | 491 | mvh (Motor vehicles and parts) |
| p073 | Bodies (coachwork) | 492 | mvh (Motor vehicles and parts) |
| p074 | Ships, boats | 493-4 | otn (Transport equipment nec) |
| p075 | Railway, rolling stock | 495 | otn (Transport equipment nec) |
| p076 | Aircraft, spacecraft | 496 | otn (Transport equipment nec) |

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| SASUT Code | Short Industry Description | SIC Classifications in the SUT Publication | GTAP Destination: codes (descriptions) |
|---|---|---|---|
| p077 | Other transport equipment | 499 | otn (Transport equipment nec) |
| p078 | Construction services | 5 | cns (Construction) |
| p079 | Wholesale trade | 611-2 | trd (Trade) |
| p080 | Retail trade | 621-5 | trd (Trade) |
| p081 | Accommodation | 631-2 | afs (Accommodation, Food and service activities) |
| p082 | Food serving services | 633-4 | afs (Accommodation, Food and service activities) |
| p083 | Passenger transportation | 641-2 | otp (Transport nec) |
| p084 | Freight transport services | 651-3 | otp (Transport nec) |
| p085 | Rental, supporting transport | 660/71-6/9 | whs (Warehousing and support activities) |
| p086 | Postal, courier services | 681 | cmn (Communication) |
| p087 | Electricity, gas distribution | 691 | ely (Electricity)/gdt (Gas manufacture, distribution) |
| p088 | Water distribution services | 692 | wtr (Water) |
| p089 | FISIM | FISIM | ofi (Financial services nec) |
| p090 | Other Financial Services | 711-2 | ofi (Financial services nec) |
| p091 | Insurance, pension services | 713-4 | ins (Insurance (formerly isr)) |
| p092 | Auxiliary to financial services | 715-6 | ofi (Financial services nec) |
| p093 | Owner Occupied | Owner Occ | dwe (Dwellings) |
| p094 | Other Real estate services | 721-2 | rsa (Real estate activities) |
| p095 | Leasing or rental services | 731-3 | obs (Business services nec) |
| p096 | Research and development | 811-4 | obs (Business services nec) |
| p097 | Legal, accounting services | 821-4 | obs (Business services nec) |
| p098 | Other business services | 831-9 | obs (Business services nec) |
| p099 | Telecommunications | 841-6 | cmn (Communication) |
| p100 | Support services | 85/6/7/8 | obs (Business services nec) |
| p101 | Publishing, printing | 891-4 | obs (Business services nec) |
| p102 | Public administration | 911-3/41-5/9 | osg (Public Administration and defense) |
| p103 | Education services | 921-5/9 | edu (Education) |
| p104 | Human health, social care | 931-5 | hht (Human health and social work activities) |
| p105 | Membership organizations | 951-2/9/90 | ros (Recreational and other services) |
| p106 | Recreational, cultural | 961-6/9 | ros (Recreational and other services) |
| p107 | Other services n.e.c. | 971-3/9 | ros (Recreational and other services) |
| p108 | Domestic services | 980 | ros (Recreational and other services) |

Source: Authors' arrangements based on Stats SA (2021) and GTAP

## Industries (and matching products) identified in a 2014 Social Accounting Matrix for South Africa with Agriculture and Food Processing details and their Mapping to the GTAP v10/11 classification

Table 8.99: Product Mapping

| Codes | Industry and Product Descriptions | GTAP Destination: Codes (Descriptions) |
|---|---|---|
| iwheat | Wheat | wht (Wheat) |
| imaize | Maize | gro (Cereal grains nec) |
| isorghum | Sorghum | gro (Cereal grains nec)/pdr (Paddy rice) |
| icereal | Other cereals | gro (Cereal grains nec) |
| ileafyv | Leafy vegetables | v_f (Vegetables, fruits, nuts) |
| imelons | Melons | v_f (Vegetables, fruits, nuts) |
| ifruitbv | Fruit bearing vegetables | v_f (Vegetables, fruits, nuts) |
| igreenlv | Green leguminious vegetables | v_f (Vegetables, fruits, nuts) |
| irbtv | Root,bulb and tuberous vegetables, n.e.c. | v_f (Vegetables, fruits, nuts) |
| ivegetab | Other vegetables | v_f (Vegetables, fruits, nuts) |
| itrosu | Tropical and subtropical fruits | v_f (Vegetables, fruits, nuts) |
| ioranges | Oranges | v_f (Vegetables, fruits, nuts) |
| icitrusf | Other citrus fruits | v_f (Vegetables, fruits, nuts) |
| igrapes | Grapes | v_f (Vegetables, fruits, nuts) |
| iapples | Apples | v_f (Vegetables, fruits, nuts) |
| ifruits | Other fruits | v_f (Vegetables, fruits, nuts) |
| inuts | Nuts | v_f (Vegetables, fruits, nuts) |
| ioilseeds | Oilseeds and oleaginous fruits | osd (Oilseeds) |
| ipotatoes | Potatoes | v_f (Vegetables, fruits, nuts) |
| itubers | Other tubers and edible roots | v_f (Vegetables, fruits, nuts) |
| issacro | Stimulant,spice and aromatic crops | ocr (Crops nec) |
| ipulses | Pulses | v_f (Vegetables, fruits, nuts) |
| isugarcro | Sugar crops | c_b (Sugar cane, sugar beet) |
| iplants | Other plants | ocr (Crops nec)/pfb (Plant-based fibers) |
| icattle | Cattle | ctl (Bovine cattle, sheep and goats, horses) |
| igoatsheep | Goats and sheep | ctl (Bovine cattle, sheep and goats, horses)/wol (Wool, silk-worm cocoons) |
| ipoultry | Poultry | oap (Animal products nec) |
| ipig | Pig | oap (Animal products nec) |
| irawmilk | Raw milk | rmk (Raw milk) |
| ieggs | Eggs | oap (Animal products nec) |
| ioanimals | Other animals | oap (Animal products nec) |
| ifore | Forestry | frs (Forestry) |
| ifish | Fishing | fsh (Fishing) |
| icoal | Mining of coal and lignite | col (Coal) |
| igold | Mining of gold and uranium ore | oxt (Other Extraction (formerly omn Minerals nec)) |
| imore | Mining of metal ores | oxt (Other Extraction (formerly omn Minerals nec)) |
| iomin | Other mining and quarrying | oxt (Other Extraction (formerly omn Minerals nec))/oil (Oil)/gas (Gas) |
| imeat | Meat | cmt (Bovine meat products)/omt (Meat products nec) |

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| Codes | Industry and Product Descriptions | GTAP Destination: Codes (Descriptions) |
|---|---|---|
| ipfis | Fish | ofd (Food products nec) |
| ivegefrui | Fruit, vegetables | ofd (Food products nec) |
| ifats | Oils, fats | vol (Vegetable oils and fats) |
| idair | Dairy | mil (Dairy products) |
| igrai | Grain mill | ofd (Food products nec) |
| istar | Starches | ofd (Food products nec) |
| iafee | Animal feeds | ofd (Food products nec) |
| ibake | Bakery | ofd (Food products nec) |
| isuga | Sugar | sgr (Sugar) |
| iconf | Cocoa, chocolate | ofd (Food products nec) |
| ipast | Pastas | ofd (Food products nec) |
| iofoo | Other food | ofd (Food products nec) |
| ibevt | Beverages and tobacco | b_t (Beverages and tobacco products) |
| iweav | Spinning, weaving and finishing of textiles | tex (Textiles) |
| iknit | Knitted, crouched fabrics, wearing apparel, fur articles | wap (Wearing apparel) |
| ileat | Tanning and dressing of leather | lea (Leather products) |
| ifoot | Footwear | lea (Leather products) |
| iwood | Sawmilling, planing of wood, cork, straw | lum (Wood products) |
| ipapr | Paper | ppp (Paper products, publishing) |
| iprnt | Publishing, printing, recorded media | ppp (Paper products, publishing) |
| ipetr | Coke oven, petroleum refineries | p_c (Petroleum, coal products) |
| ibchm | Nuclear fuel, basic chemicals | chm (Chemical products) |
| iochm | Other chemical products, man-made fibres | bph (Basic pharmaceutical products)/chm (Chemical products) |
| irubb | Rubber | rpp (Rubber and plastic products) |
| iplas | Plastic | rpp (Rubber and plastic products) |
| iglss | Glass | nmm (Mineral products nec) |
| inmmi | Non-metallic minerals | nmm (Mineral products nec) |
| ibisc | Basic iron and steel, casting of metals | i_s (Ferrous metals) |
| infme | Basic precious and non-ferrous metals | nfm (Metals nec) |
| ifabm | Fabricated metal products | fmp (Metal products) |
| imach | Machinery and equipment | ome (Machinery and equipment nec) |
| iemch | Electrical machinery and apparatus | eeq (Electrical equipment) |
| irdtv | Radio, television, communication equipment and apparatus | ele (Computer, electronic and optical products) |
| imopt | Medical, precision, optical instruments, watches and clocks | ele (Computer, electronic and optical products) |
| imtvp | Motor vehicles, trailers, parts | mvh (Motor vehicles and parts) |
| iotrp | Other transport equipment | otn (Transport equipment nec) |
| ifurn | Furniture | omf (Manufactures nec) |
| iomnf | Manufacturing n.e.c, recycling | omf (Manufactures nec) |
| ielcg | Electricity, gas, steam and hot water supply | ely (Electricity)/gdt (Gas manufacture, distribution) |
| iwatd | Collection, purification and distribution of water | wtr (Water) |

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| Codes | Industry and Product Descriptions | GTAP Destination: Codes (Descriptions) |
|---|---|---|
| icnst | Construction | cns (Construction) |
| iwtrd | Wholesale trade, commission trade | trd (Trade) |
| irtrd | Retail trade | trd (Trade) |
| imtvs | Sale, maintenance, repair of motor vehicles | trd (Trade) |
| iacct | Hotels and restaurants | afs (Accommodation, Food and service activities) |
| iltrp | Land transport, transport via pipe lines | otp (Transport nec) |
| iwtrp | Water transport | wtp (Water transport) |
| iatrp | Air transport | atp (Air transport) |
| itrps | Auxiliary transport | whs (Warehousing and support activities) |
| ipost | Post and telecommunication | cmn (Communication) |
| ifins | Financial intermediation | ofi (Financial services nec) |
| iinsp | Insurance and pension funding | ins (Insurance (formerly isr)) |
| iofin | Activities to financial intermediation | ofi (Financial services nec) |
| ireal | Real estate activities | rsa (Real estate activities) |
| irent | Renting of machinery and equipment | obs (Business services nec) |
| icomp | Computer and related activities | obs (Business services nec) |
| irsea | Research and experimental development | obs (Business services nec) |
| iobus | Other business activities | obs (Business services nec) |
| ipuba | Government | osg (Public Administration and defense) |
| ieduc | Education | edu (Education) |
| iheal | Health and social work | hht (Human health and social work activities) |
| iwast | Sewerage and refuse disposal | ros (Recreational and other services) |
| imorg | Activities of membership organisations | ros (Recreational and other services) |
| irecr | Recreational, cultural and sporting activities | ros (Recreational and other services) |
| ioact | Other activities | ros (Recreational and other services) |
| inobs | Non-observed, informal, non-profit, households, | ros (Recreational and other services) |

Source: Authors' arrangements based on Phoofolo (2018) and GTAP

Table 8.100: FAO activities and their Mapping to the GTAP v10/11 classification

| | FAO | GTAP Destination: codes (descriptions) |
|---|---|---|
| 1 | Apples [515] | v_f (Vegetables, fruits, nuts) |
| 2 | Apricots [526] | v_f (Vegetables, fruits, nuts) |
| 3 | Asparagus [367] | v_f (Vegetables, fruits, nuts) |
| 4 | Avocados [572] | v_f (Vegetables, fruits, nuts) |
| 5 | Bananas [486] | v_f (Vegetables, fruits, nuts) |
| 6 | Barley [44] | gro (Cereal grains nec) |
| 7 | Bastfibres, other [782] | pfb (Plant-based fibers) |
| 8 | Beans, dry [176] | v_f (Vegetables, fruits, nuts) |
| 9 | Beans, green [414] | v_f (Vegetables, fruits, nuts) |

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| | FAO | GTAP Destination: codes (descriptions) |
|---|---|---|
| 10 | Berries nes [558] | v_f (Vegetables, fruits, nuts) |
| 11 | Buckwheat [89] | gro (Cereal grains nec) |
| 12 | Cabbages and other brassicas [358] | v_f (Vegetables, fruits, nuts) |
| 13 | Carrots and turnips [426] | v_f (Vegetables, fruits, nuts) |
| 14 | Castor oil seed [265] | osd (Oilseeds) |
| 15 | Cauliflowers and broccoli [393] | v_f (Vegetables, fruits, nuts) |
| 16 | Cereals nes [108] | gro (Cereal grains nec) |
| 17 | Cherries [531] | v_f (Vegetables, fruits, nuts) |
| 18 | Chicory roots [459] | v_f (Vegetables, fruits, nuts) |
| 19 | Chillies and peppers, dry [689] | v_f (Vegetables, fruits, nuts) |
| 20 | Chillies and peppers, green [401] | v_f (Vegetables, fruits, nuts) |
| 21 | Cow peas, dry [195] | v_f (Vegetables, fruits, nuts) |
| 22 | Cucumbers and gherkins [397] | v_f (Vegetables, fruits, nuts) |
| 23 | Eggs, hen, in shell [1062] | oap (Animal products nec) |
| 24 | Fibre crops nes [821] | pfb (Plant-based fibers) |
| 25 | Figs [569] | v_f (Vegetables, fruits, nuts) |
| 26 | Fruit, citrus nes [512] | v_f (Vegetables, fruits, nuts) |
| 27 | Fruit, fresh nes [619] | v_f (Vegetables, fruits, nuts) |
| 28 | Grapefruit (inc. pomelos) [507] | v_f (Vegetables, fruits, nuts) |
| 29 | Grapes [560] | v_f (Vegetables, fruits, nuts) |
| 30 | Groundnuts, with shell [242] | osd (Oilseeds) |
| 31 | Honey, natural [1182] | oap (Animal products nec) |
| 32 | Hops [677] | gro (Cereal grains nec) |
| 33 | Lemons and limes [497] | v_f (Vegetables, fruits, nuts) |
| 34 | Lettuce and chicory [372] | v_f (Vegetables, fruits, nuts) |
| 35 | Lupins [210] | ocr (Crops nec) |
| 36 | Maize [56] | gro (Cereal grains nec) |
| 37 | Maize, green [446] | gro (Cereal grains nec) |
| 38 | Mangoes, mangosteens, guavas [571] | v_f (Vegetables, fruits, nuts) |
| 39 | Meat indigenous, cattle [944] | ctl (Bovine cattle, sheep and goats, horses) |
| 40 | Meat indigenous, chicken [1094] | oap (Animal products nec) |
| 41 | Meat indigenous, duck [1070] | oap (Animal products nec) |
| 42 | Meat indigenous, geese [1077] | oap (Animal products nec) |
| 43 | Meat indigenous, goat [1032] | ctl (Bovine cattle, sheep and goats, horses) |
| 44 | Meat indigenous, horse [1120] | ctl (Bovine cattle, sheep and goats, horses) |
| 45 | Meat indigenous, pig [1055] | oap (Animal products nec) |
| 46 | Meat indigenous, sheep [1012] | ctl (Bovine cattle, sheep and goats, horses) |
| 47 | Meat indigenous, turkey [1087] | oap (Animal products nec) |
| 48 | Melons, other (inc.cantaloupes) [568] | v_f (Vegetables, fruits, nuts) |
| 49 | Milk, whole fresh cow [882] | rmk (Raw milk) |
| 50 | Millet [79] | gro (Cereal grains nec) |
| 51 | Mushrooms and truffles [449] | v_f (Vegetables, fruits, nuts) |
| 52 | Nuts nes [234] | v_f (Vegetables, fruits, nuts) |
| 53 | Oats [75] | gro (Cereal grains nec) |
| 54 | Oilseeds nes [339] | osd (Oilseeds) |
| 55 | Onions, dry [403] | v_f (Vegetables, fruits, nuts) |
| 56 | Oranges [490] | v_f (Vegetables, fruits, nuts) |
| 57 | Papayas [600] | v_f (Vegetables, fruits, nuts) |
| 58 | Peaches and nectarines [534] | v_f (Vegetables, fruits, nuts) |

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| | FAO | GTAP Destination: codes (descriptions) |
|---|---|---|
| 59 | Pears [521] | v_f (Vegetables, fruits, nuts) |
| 60 | Peas, dry [187] | v_f (Vegetables, fruits, nuts) |
| 61 | Peas, green [417] | v_f (Vegetables, fruits, nuts) |
| 62 | Pineapples [574] | v_f (Vegetables, fruits, nuts) |
| 63 | Plums and sloes [536] | v_f (Vegetables, fruits, nuts) |
| 64 | Potatoes [116] | v_f (Vegetables, fruits, nuts) |
| 65 | Pumpkins, squash and gourds [394] | v_f (Vegetables, fruits, nuts) |
| 66 | Quinces [523] | v_f (Vegetables, fruits, nuts) |
| 67 | Rice, paddy [27] | pdr (Paddy rice) |
| 68 | Rye [71] | gro (Cereal grains nec) |
| 69 | Seed cotton [328] | osd (Oilseeds) |
| 70 | Sisal [789] | pfb (Plant-based fibers) |
| 71 | Sorghum [83] | gro (Cereal grains nec) |
| 72 | Soybeans [236] | osd (Oilseeds) |
| 73 | Strawberries [544] | v_f (Vegetables, fruits, nuts) |
| 74 | Sugar cane [156] | c_b (Sugar cane, sugar beet) |
| 75 | Sunflower seed [267] | osd (Oilseeds) |
| 76 | Sweet potatoes [122] | v_f (Vegetables, fruits, nuts) |
| 77 | Tangerines, mandarins, clementines, satsumas [495] | v_f (Vegetables, fruits, nuts) |
| 78 | Tea [667] | ocr (Crops nec) |
| 79 | Tobacco, unmanufactured [826] | ocr (Crops nec) |
| 80 | Tomatoes [388] | v_f (Vegetables, fruits, nuts) |
| 81 | Vegetables, fresh nes [463] | v_f (Vegetables, fruits, nuts) |
| 82 | Watermelons [567] | v_f (Vegetables, fruits, nuts) |
| 83 | Wheat [15] | wht (Wheat) |
| 84 | Wool, greasy [987] | wol (Wool, silk-worm cocoons) |

Source: Authors' arrangements based on FAO(ongoing) and GTAP

## Notes on diagonalizing a Supply-Use Table

For illustration purposes, an original Supply-Use Table (SUT) is shown in the table below in which activity A2 produces core commodity C2 and commodity C1 as a by-product.

Table 8.101: Illustrative Original Supply-Use Table

| | A1 | A2 | C1 | C2 | | Total |
|---|---|---|---|---|---|---|
| A1 | | | S(A1,C1) | | ... | X1 |
| A2 | | | S(A2,C1) | S(A2,C2) | ... | X2 |
| C1 | Z(C1,A1) | Z(C1,A2) | | | ... | C1 |
| C2 | Z(C2,A1) | Z(C2,A2) | | | ... | C2 |
| ... | ... | ... | ... | ... | | |
| Total | X1 | X2 | C1 | C2 | | |

Source: authors' original

As an intermediate step, the next table shows how the values of the by-product of activity 2 is shifted as shown in red. The by-product is added to the core production of commodity 1 produced by activity 1 [S(A1,C1) + S(A2,C1)]. In that way the domestic supply of commodity 1 remains the same. In order to maintain the same total supply by activity 2, its by-product is also added to its own core commodity supplied [S(A2,C2) + S(A2,C1)] so that the supply of activity 2 (X2) remains the same. As a result, total supply by activity 1 increases with the by-product [X1 + S(A2,C1)] and the total supply of the second commodity increases by the same [C2 + S(A2,C1)].

Table 8.102: Illustrative Intermediate Supply-Use Table

| | A1 | A2 | C1 | C2 | | Total |
|---|---|---|---|---|---|---|
| A1 | | | S(A1,C1) + S(A2,C1) | | … | X1 + S(A2,C1) |
| A2 | | | S(A2,C1) - S(A2,C1) | S(A2,C2) + S(A2,C1) | … | X2 |
| C1 | Z(C1,A1) | Z(C1,A2) | | | … | C1 |
| C2 | Z(C2,A1) | Z(C2,A2) | | | … | C2 |
| … | … | … | … | … | | |
| Total | X1 | X2 | C1 | C2 + S(A2,C1) | | |

Source: authors' original

In the final table, intermediate demand of the second commodity by the first activity is raised with the by-product of the second activity [Z(C2,A1) + S(A2,C1)]. In that way the total demand for the second commodity [C2 + S(A2,C1)] now matches the expanded total supply as shown in the previous table, while total production of activity 1 is raised such that it matches its increased supply [X1 + S(A2,C1)].

Table 8.103: Illustrative Final Supply-Use Table

| | A1 | A2 | C1 | C2 | | Total |
|---|---|---|---|---|---|---|
| A1 | | | S(A1,C1) + S(A2,C1) | | … | X1 + S(A2,C1) |
| A2 | | | S(A2,C1) - S(A2,C1) | S(A2,C2) + S(A2,C1) | … | X2 |
| C1 | Z(C1,A1) | Z(C1,A2) | | | … | C1 |
| C2 | Z(C2,A1) + S(A2,C1) | Z(C2,A2) | | | … | C2 + S(A2,C1) |
| … | … | … | … | … | | |
| Total | X1 + S(A2,C1) | X2 | C1 | C2 + S(A2,C1) | | |

Source: authors' original

The economics of this is that the second activity continues to produce and supply commodity 1 (so does not need to change its inputs), and supplies it to the first activity as an intermediate input, which in turn sells it on directly. It is thus a hybrid transfer method.

In broad terms of technology used, the literature makes a distinction between using product or industry technology. To do this properly, we would have to adjust the input coefficients. When a product is being supplied as a secondary product of an industry, we can move it to the industry that supplies the product as its main output. But we then need to adjust the production process too. If we move some output, we should move the inputs that were used to produce it.

Since we are dealing with finalised SUTs (as opposed to constructing them by collecting primary data), the only information we have about the inputs that have gone into the secondary product is contained in the SUT itself. We can make one of two assumptions.

— Product technology: the product we are moving was produced by the same method that all similar products used, according to the data in the receiving industry.

— Industry technology: The product was produced by the same method as the output in the industry for which it is a secondary product.

Regarding the product technology approach, say there is some food produced outside the food sector, we assume it required the same inputs as the food produced in the food sector itself. Suppose that the food produced elsewhere represents 10% of total food produced. Then, as far as the receiving sector is concerned, when we move it, we should also raise all inputs in the food sector by 10%. While this is straightforward for the food sector, those increased inputs have to come from the sector(s) out of which the food output is being moved. It is immediately apparent this could result in some negative inputs in the sending sector. Most obviously, there may be some inputs into food that are not inputs in the sending sector. But even where there are common inputs, the amounts of inputs to be shifted are determined in the receiving sector, and there is no reason why the sending sector should be using enough of it to send.

The alternative, i.e., the industry technology approach, is to assume that the secondary product was produced using the same input structure as the industry in which it was produced. If the secondary product represents 10% of the output of the sending sector, we move 10% of all the inputs across to the receiving sector. Unlike the product-technology approach, this cannot end up with negative inputs. While this avoids the problem of negative inputs, it creates other changes that might be problematical. It may result in inputs being assigned to the dominant producer that are not there in the original data. If the off-diagonal product is a by-product of the producing sector, some inputs may not be recorded since they may not be traded. For example, a forestry company that converts its waste sawdust into blockboard may not record the homegrown timber as a cost, whereas the company that specializes in blockboard production, and purchases the timber, will. When the inputs are transferred from the forestry sector to the wood sector, the resulting technology understates the timber used in blockboard. Problems can be caused also where the by-product is a high value product compared to the main product. Thus, precious metals produced as part of platinum mining may have a high share in the value of output of the platinum metals sector. This results in more inputs transferred out of platinum mining to the platinum metal sector than went into their production.

These, and other, methods have been discussed and assessed in the literature, but no single method has been adopted as the most appropriate. Ten Raa and Kop Jansen (1990) reviewed the literature and recommend the commodity technology assumption. However, absent a clear way of dealing with negatives, this is difficult to apply.

We therefore use our method, loosely referred to as a hybrid transfer approach. As explained above, a possible economic interpretation is that it assumes that the original industry continues producing the off diagonal (and so does not change its inputs) and supplies it to the diagonal industry which supplies it to the market. Although it changes the coefficients of the diagonal industry, the system as a whole reflects the original depiction.

### Notes on non-refundable product taxes

Table 8.104: Stats SA SIC Industries with a non-refundable portion of product taxes and matching GTAP classification

| GTAP Code | GTAP industries with a non-refundable portion of product taxes | Stats SA SIC Industries with a non-refundable portion of product taxes |
|---|---|---|
| otp | Transport nec | railway transport (SIC 7111), |
| wtp | Water transport | other scheduled passenger transport (SIC 7121), |
| atp | Air transport | other non-scheduled passenger transport (SIC 7122), |
| ofi | Financial services nec | monetary (SIC 8110), |
| ins | Insurance (formerly isr) | other financial (SIC 8120-90), |
| osg | Public Administration and defense | life insurance (SIC 8211), |
| edu | Education | pension (SIC 8212), |
| dwe | Dwellings | medical aid (SIC 8213), |
| | | owner-occupied (SIC 84 own), |
| | | central government (SIC 91 central), |
| | | provincial government (SIC 91 provincial), |
| | | local government (SIC 91 local) |
| | | education (SIC 9200) |

Source: adapted from Stats SA (2021c)

Table 8.105: Stats SA SIC Industries with a non-refundable portion of product taxes and matching GTAP classification

| | SARS Label | GTAP Code | GTAP Description | VAT Refund / Gross VAT |
|---|---|---|---|---|
| 1 | Agriculture, forestry and fishing2 | pdr | Paddy rice | 0.8935 |
| 2 | Agriculture, forestry and fishing2 | wht | Wheat | 0.8935 |
| 3 | Agriculture, forestry and fishing2 | gro | Cereal grains nec | 0.8935 |
| 4 | Agriculture, forestry and fishing2 | v_f | Vegetables, fruits, nuts | 0.8935 |
| 5 | Agriculture, forestry and fishing2 | osd | Oilseeds | 0.8935 |
| 6 | Agriculture, forestry and fishing2 | c_b | Sugar cane, sugar beet | 0.8935 |
| 7 | Agriculture, forestry and fishing2 | pfb | Plant-based fibers | 0.8935 |
| 8 | Agriculture, forestry and fishing2 | ocr | Crops nec | 0.8935 |
| 9 | Agriculture, forestry and fishing2 | ctl | Bovine cattle, sheep and goats, horses | 0.8935 |
| 10 | Agriculture, forestry and fishing2 | oap | Animal products nec | 0.8935 |
| 11 | Agriculture, forestry and fishing2 | rmk | Raw milk | 0.8935 |
| 12 | Agriculture, forestry and fishing2 | wol | Wool, silk-worm cocoons | 0.8935 |
| 13 | Agriculture, forestry and fishing2 | frs | Forestry | 0.8935 |
| 14 | Agriculture, forestry and fishing2 | fsh | Fishing | 0.8935 |
| 15 | Coal and petroleum products | col | Coal | 1.7893 |
| 16 | Coal and petroleum products | oil | Oil | 1.7893 |
| 17 | Coal and petroleum products | gas | Gas | 1.7893 |
| 18 | Mining and quarrying | oxt | Other Extraction (formerly omn Minerals nec) | 2.7364 |
| 19 | Food, drink and tobacco | cmt | Bovine meat products | 0.2615 |
| 20 | Food, drink and tobacco | omt | Meat products nec | 0.2615 |
| 21 | Food, drink and tobacco | vol | Vegetable oils and fats | 0.2615 |
| 22 | Food, drink and tobacco | mil | Dairy products | 0.2615 |
| 23 | Food, drink and tobacco | pcr | Processed rice | 0.2615 |
| 24 | Food, drink and tobacco | sgr | Sugar | 0.2615 |
| 25 | Food, drink and tobacco | ofd | Food products nec | 0.2615 |
| 26 | Food, drink and tobacco | b_t | Beverages and tobacco products | 0.2615 |
| 27 | Textiles | tex | Textiles | 0.1845 |
| 28 | Clothing and footwear | wap | Wearing apparel | 0.0778 |
| 29 | Leather, leather goods and fur (excl. footwear & clothing) | lea | Leather products | 0.4598 |
| 30 | Wood, wood products and furniture | lum | Wood products | 0.3174 |
| 31 | Paper, printing and publishing | ppp | Paper products, publishing | 0.1543 |
| 32 | Coal and petroleum products | p_c | Petroleum, coal products | 1.7893 |
| 33 | Chemicals and chemical, rubber and plastic products | chm | Chemical products | 0.2798 |
| 34 | Chemicals and chemical, rubber and plastic products | bph | Basic pharmaceutical products | 0.2798 |
| 35 | Chemicals and chemical, rubber and plastic products | rpp | Rubber and plastic products | 0.2798 |
| 36 | Bricks, ceramic, glass, cement and similar products | nmm | Mineral products nec | 0.1678 |
| 37 | Metal (including metal products) | i_s | Ferrous metals | 0.8242 |
| 38 | Metal (including metal products) | nfm | Metals nec | 0.8242 |

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| | SARS Label | GTAP Code | GTAP Description | VAT Refund / Gross VAT |
|---|---|---|---|---|
| 39 | Metal (including metal products) | fmp | Metal products | 0.8242 |
| 40 | Machinery and related items | ele | Computer, electronic and optical products | 0.1796 |
| 41 | Machinery and related items | eeq | Electrical equipment | 0.1796 |
| 42 | Machinery and related items | ome | Machinery and equipment nec | 0.1796 |
| 43 | Vehicles, parts and accessories | mvh | Motor vehicles and parts | 0.5732 |
| 44 | Vehicles, parts and accessories | otn | Transport equipment nec | 0.5732 |
| 45 | Manufactures nec | omf | Manufactures nec | 0.5024 |
| 46 | Electricity, gas and water2 | ely | Electricity | 0.3004 |
| 47 | Electricity, gas and water2 | gdt | Gas manufacture, distribution | 0.3004 |
| 48 | Electricity, gas and water2 | wtr | Water | 0.3004 |
| 49 | Construction | cns | Construction | 0.2627 |
| 50 | Trade | trd | Trade | 0.2303 |
| 51 | Catering and accommodation | afs | Accommodation, Food and service activities | 0.1972 |
| 52 | Transport, storage and communications | otp | Transport nec | 0.2847 |
| 53 | Transport, storage and communications | wtp | Water transport | 0.2847 |
| 54 | Transport, storage and communications | atp | Air transport | 0.2847 |
| 55 | Transport, storage and communications | whs | Warehousing and support activities | 0.2847 |
| 56 | Transport, storage and communications | cmn | Communication | 0.2847 |
| 57 | Financing, insurance, real estate and business services2 | ofi | Financial services nec | 0.1972 |
| 58 | Financing, insurance, real estate and business services2 | ins | Insurance (formerly isr) | 0.1972 |
| 59 | Financing, insurance, real estate and business services2 | rsa | Real estate activities | 0.1972 |
| 60 | Business services nec | obs | Business services nec | 0.2167 |
| 61 | Recreation and cultural services | ros | Recreational and other services | 0.1882 |
| 62 | Public administration | osg | Public Administration and defense | 2.226 |
| 63 | Educational services | edu | Education | 0.2703 |
| 64 | Human health and social work activities | hht | Human health and social work activities | 0.1185 |
| 65 | Financing, insurance, real estate and business services2 | dwe | Dwellings | 0.1972 |

Source: adapted from SARS 2018

Note: the shaded cells in the 2nd column indicate that SARS industries have been aggregated to create a more appropriate proxy for the relevant GTAP industry in the 4th column. For example, in row 50 "Trade" is an aggregation of retail trade and wholesale trade in the underlying SARS data.