Export and Import Unit Value Indices

Methods and Sources

March 2014

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Chapter 1: Introduction to the South African export and import unit value indices

1.1 Introduction

This methods and sources manual aims to provide users with an understanding of the composition and compilation of the export and import unit value indices (XMUVIs) published by Statistics South Africa since January 2014. The XMUVIs replace the export and import price indices that were published for many years and represent a significant improvement in the coverage of price changes as they affect South Africa's international trade.

1.2 History and changes in the South African export and import indices

Prior to 2014, Statistics South Africa compiled export and import price indices on a gross industry basis, i.e. each index relates to those articles which are imported and exported by the designated industries of the South African economy; and export and import prices were collected from importers and exporters.

From 2014, export and import indices are calculated based on trade (customs) data provided by the South African Revenue Service (SARS). This implies that no price collection will take place. In addition, indices are compiled on a gross product basis rather than an industry basis.

1.3 Definition of the export and import unit value indices

Export and import unit value indices measure the overall change in the prices of transactions in goods and services between the residents of an economic territory and residents of the rest of the world (IMF; 2010).

Export and import unit value indices are based on data from customs documentation and are so named because they take as their building blocks, for individual commodity classes, the ratio of the unit value in the current to the base period. They measure, for individual commodity classes, the change over time in the total value of shipments divided by the corresponding total quantity[1] (as opposed to a price being collected). These elementary level unit value ratios are subsequently aggregated across commodity classes using standard weighted index number formulas where the weights are the relative shares of the commodity group in total exports/imports (IMF, 2008).

A main advantage of the use of unit value indices is held to be their comprehensive coverage and relatively low resource cost of compilation.

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[1] Unit Value = Value/Quantity (for a unique transaction based on the month)

1.4 Uses of the export and import unit value indices

Export and import indices are used for a variety of different purposes, including,

⇒ A deflator in the compilation of national accounts

⇒ An indicator of inflationary trends

Chapter 2: Classification

2.1 Background

The XMUVIs use two classification systems. The first is the Harmonised Commodity Description and Coding System - commonly known as the Harmonised System (HS) - which represents sampled products (actual items traded) and indicator products (first level product group with a weight). The second is the Central Product Classification (CPC) system which is used for aggregation. The CPC is a classification based on the physical characteristics of goods or on the nature of the services rendered.

The CPC covers products that are an output of economic activities, including transportable goods, non-transportable goods and services (OECD).

The CPC is a 5-digit classification system, consisting of sections (one digit code); divisions (two-digit) code; Groups (three-digit code), classes (four-digit code) and subclasses (five-digit code).

2.2 The structure of classification of the South African XMUVIs

The structure of the XMUVIs is made up of 1-digit, 2-digit and 3-digit classification levels (within CPC), where the product level is an indicator product (6-digit HS tariff code) or elementary index attached to a weight.

For example, the hierarchy of product description for the prices of the commonly referred to "vehicles" products is the following:

Table 1: XMUVIs hierarchy

Product hierarchy		Product description
CPC Section	4	Metal products, machinery and equipment
CPC Division	49	Transport equipment
CPC Group	491	Motor vehicles, trailers and semi-trailers; parts and accessories thereof
HS Code (Indicator product)	870321	Vehicles (Excluding Railway Or Tramway Rolling-Stock), And Parts And Accessories Thereof
HS Code (Sampled product)	8703210 0	Motor Cars And Other Motor Vehicles Principally Designed For The Transport Of Persons Including Station Wagons And Racing Cars - Other Vehicles, With Spark-Ignition Internal Combustion Reciprocating Piston Engine - Of A Cylinder Capacity Not Exceeding 1 000 Cm³
	8703219 0	Motor Cars And Other Motor Vehicles Principally Designed For The Transport Of Persons (Excluding Those Of Heading 87.02), Including Station Wagons And Racing Cars - Other Vehicles, With Spark-Ignition Internal Combustion Reciprocating Piston Engine - Other

Chapter 3: Weights and indicators

3.1 Weights source

Customs data obtained from SARS are used for the derivation of weights as well as monthly unit value calculations.

3.2 Weights derivation

They weights are derived in the following manner:

Step 1: Select the HS chapters (2-digit HS) which comprise a cumulative 80% of exports and imports for a particular year, ensuring consistency over time.

Step 2: Within each of the selected HS chapters; select the top 80% 6-digit HS (indicator products)

Step 3: Redistribute the remainder at each step.

Refer to Appendix A for tariff chapters that constitute the top 80% in terms of value from 2009 to 2013.

Indicators and their weights are converted into CPC format for aggregation on publication level.

3.3 Weights update

The weights for the XMUVIs will be updated annually with the previous year's data. The publication weights from 2010 to 2014 are given in Appendix B.

3.4 Sampled product selection

Specific HS 8-digit codes are tracked throughout time, and these are the basis of the XMUVIs. The top 80% of sampled products (8-digit HS codes) within the indicator products are selected as the representative of the indicator product. This process is repeated annually to ensure the correct sampled products are included in the basket of exports and imports.

3.5 The number of products in the basket

The total number of indicator products in the basket is 414 (Exports – 123 and Imports – 291).

3.6 Special case - Gold

Gold in the XMUVIs is not measured using the SARS values and quantities, but rather those from the South African Reserve Bank (SARB). SARS measures physical movement, where the SARB measures change in ownership. Gold will only be reflected quarterly as the SARB's data become available.

Chapter 4: Unit value and index calculation

4.1 Unit value calculation

Unit values in the South African XMUVIs are calculated per unique transaction in a specific month. The following conditions should hold. The value and quantity data must:

- ⇒ be those for the whole month;
- ⇒ have a specific 8-digit tariff code;
- ⇒ have a specific unit of measure;
- ⇒ be linked to a unique trader (exporter or importer).

Once this is established the value is divided by the quantity to obtain a unit value for the specific month (this occurs each month). Under normal conditions, exports and imports are volatile, which is expected, since various quantities of products are traded at different prices (which may be influenced by production factors, seasonality, the exchange rate or other factors). In order to reduce the volatility, a moving average is applied to the XMUVIs. In the case of exports a three-month moving average is applied with the exception of miscellaneous chemical products, machinery and agricultural products, which use a five-month moving average. For imports a five-month moving average is used for all products.

Once this is completed the index is compiled.

4.2 Index calculation

The calculation of price indices is conducted in two stages. First, price indices are calculated for the elementary aggregates, and then these elementary price indices are averaged to obtain higher-level indices using the relative sales values of the elementary aggregates as weights.

4.2.1 Elementary indices

For elementary index compilation, the Jevons index is used. The Jevons index is defined as the unweighted geometric mean of the price ratios (pt/pt-1), which is identical to the ratio of the unweighted geometric mean prices.

The formula is given as:

$$P_J^{0:t} = \prod \left(\frac{p_i^t}{p_i^0} \right)^{1/n} = \frac{\prod \left(p_i^t \right)^{1/n}}{\prod \left(p_i^0 \right)^{1/n}}$$

The chained monthly indices link together the month-to-month changes through successive multiplication. The Jevons formula is transitive as the chained monthly indices are identical to the corresponding direct indices which compare prices in each successive month directly with those of the reference month.

4.2.2 High-level indices

The second stage of calculating the XMUVIs does not involve individual prices or quantities. Instead, a higher-level index is calculated as a Young index in which the elementary price indices are averaged using a set of predetermined weights. The formula can be written as follows:

$$I^{0:t} = \sum w_i^b I_i^{0:t}, \sum w_i^b = 1$$

where $I^{0:t}$ denotes the overall XMUVI, or any high-level index, from period 0 to t; w_i^b is the weight attached to each of the elementary price indices; and $I_i^{0:t}$ is the corresponding elementary price index. The elementary indices are identified by the subscript i, whereas the higher-level index carries no subscript. The weights are derived in period b, which in practice has to precede period 0, the price reference period.

Almost certainly the most important aspect of index compilation is consistency. Consistency in aggregation means that if an index is calculated stepwise by aggregating lower-level indices to obtain indices at progressively higher levels of aggregation, the same overall result should be obtained as if the calculation had been made in one step.

4.2.3 Linking of the XMUVIs

The XMUVI high-level weights as well as certain elementary indices will be updated annually. When new weights are introduced the price reference period for the new index will be the last period of the old index; the old and the new indices being linked together at this point. The old and the new indices constitute a linked index.

The introduction of new weights is often a complex operation because it provides an opportunity to introduce new items, new samples, new data sources, new compilation practices, new elementary aggregates, new higher-level indices or new classifications. These tasks are often undertaken simultaneously at the time of reweighting to minimise overall disruption to the time series and any resulting inconvenience to users of the indices.

Annual chaining has the advantage that changes (such as the inclusion of new goods) can be introduced on a regular basis, although every index needs some ongoing maintenance, whether annually chained or not.

4.2.3.1 Features of a linked index

There are several important features of a linked index:

- The linked index formula allows weights to be updated, and facilitates the introduction of new items and sub-indices and the removal of obsolete ones.

- In order to be able to link the old and the new series, an overlapping period (k) is needed in which the index has to be calculated using both the old and the new set of weights.

- A linked index may have two or more links. Between each link period, the index may be calculated as a fixed weight index using any index number formula. The link period may be a month or a year, provided the weights and indices refer to the same period.

- Linking is intended to ensure that the individual indices on all levels show the correct development through time.

Linking leads to non-additivity. When the new series is chained onto the old one the higher-level indices after the link cannot be obtained as weighted arithmetic averages of individual indices using the new weights. If, on the other hand, the index reference period is changed and the index series prior to the link period is rescaled to the new index reference period, this historical series cannot be aggregated to higher-level indices by use of the new weights.

4.2.3.2 Method of linking the XMUVIs

The method used to link the XMUVIs is known as splicing and chaining. When weights are updated to reflect the latest transaction patterns, a new series is created. Consequently, two series exist, the old and the new. However, as with all prices statistics, a continuous series is required. To accomplish this, the splicing technique is applied; this means that to make the new index comparable to the old, the indices are spliced at a period that is common to both series.

Chaining occurs when the final index number of the old series is multiplied by the spliced index change to obtain a continuous series.

The process followed for the XMUVIs is as follows:

1. Rebase the elementary indices to 2012=100 (will maintain same base period as the PPI);

2. Calculate the 2012 publication level indices based on the 2011 gross product weights;

3. Calculate the December 2012 and January 2013 publication level indices based on the 2012 weights[2];

4. Calculate the ratio between indices (from step 3) between January 2013 and December 2012;

5. Apply the ratio calculated (from step 4) to the published aggregates to obtain the index for January 2013[3];

6. The following month and each month after that steps 4 and 5 are repeated.

Note that chain-linking leads to non-additivity.

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[2] Step 3 and 4 is splicing
[3] Step 5 is chaining

Table 2: Example – Linking and splicing the index

EXAMPLE	Weight 2011	Weight 2012	Jan-12	Nov-12	Old index Dec-12	Average index of products 2012	New index Dec-12	Jan-13	Feb-13	Mar-13
Elementary price indices										
A	21.2	24.6	101.2	109.1	111.3					
B	25.8	24.1	102.1	121.3	122.3					
C	16.9	18.1	99.0	110.0	112.4					
D	15.9	15.9	97.1	115.7	117.6					
E	20.2	17.3	100.0	113.6	111.4					
Elementary price indices rebased							Derived from monthly price ratios			
A			91.8	99.0	101.0	110.2	101.0	102.3	103.6	105.0
B			83.8	99.6	100.4	121.8	100.4	100.3	101.6	102.9
C			89.0	98.9	101.1	111.2	101.1	101.7	102.3	102.9
D			83.2	99.2	100.8	116.7	100.8	101.6	101.9	102.6
E			88.9	101.0	99.0	112.5	99.0	102.7	103.0	103.5
Higher-level indices	Old						New			
G= A+B+C	63.9	66.8	87.9	99.2	100.8		100.8	101.4	102.5	103.7
H=D+E	36.1	33.2	86.4	100.2	99.8		99.9	102.2	102.5	103.1
Total	100.0	100.0	87.3	99.6	100.4		100.5	101.7	102.5	103.5
Chaining of higher-level indices to 2008=100							Ratios			
G= A+B+C								1.006	1.011	1.011
H=D+E								1.023	1.003	1.006
Total								1.012	1.008	1.009
Chaining of higher-level indices to 2008=100							Apply ratio to previous index			
G= A+B+C	63.9	66.8	87.9	99.2	100.8		100.8	101.4	102.5	103.7
H=D+E	36.1	33.2	86.4	100.2	99.8		99.8	102.1	102.4	103.0
Total	100.0	100.0	87.3	99.6	100.4		100.4	101.6	102.4	103.4

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International Labor Organization. (ILO). Consumer Price Index Manual: Theory and Practice (2004).

Source: www.ilo.org/public/english/bureau/stat/guides/cpi/index.htm

Practical Guide to Producing Consumer Price Indices, United nations, 2009

Appendix A: Top 80% tariffs

Trade Type	HS Chapter Tariff	HS Chapter Tariff description
	08	Edible fruit and nuts; peel of citrus fruit or melons
	22	Beverages, spirits and vinegar
	26	Ores, slag and ash
	27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes
	28	Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes
	29	Organic chemicals
	38	Miscellaneous chemical products
	39	Plastics and articles thereof
	71	Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation jewellery; coin
	72	Iron and steel
	73	Articles of iron or steel
	76	Aluminium and articles thereof
	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof
	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles
Exports	87	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof
	10	Cereals
	15	Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes
	27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes
	28	Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes
	29	Organic chemicals
	30	Pharmaceutical products
	38	Miscellaneous chemical products
	39	Plastics and articles thereof
	40	Rubber and articles thereof
	48	Paper and paperboard; articles of paper pulp, of paper or of paperboard
	61	Articles of apparel and clothing accessories, knitted or crocheted
	62	Articles of apparel and clothing accessories, not knitted or crocheted
	64	Footwear, gaiters and the like; parts of such articles
	71	Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation jewellery; coin
	72	Iron and steel
	73	Articles of iron or steel
	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof
	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles
	87	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof
	88	Aircraft, spacecraft, and parts thereof
Imports	90	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof

Appendix B: Publication level weights over time

The table below give the publication weights for each of the years from index year 2010 to 2014

Trade type	Series code	Series name	2010	2011	2012	2013	2014
	UVI10000	Exports	100,00	100,00	100,00	100,00	100.00
	UVI31000	Exports excluding gold	90,66	90,72	90,10	90,97	92.77
	UVI32000	Exports excluding ores and minerals	83,08	80,78	77,70	78,16	77.33
	UVI33000	Exports excluding basic metals	69,72	68,11	69,51	73,54	74.08
	UVI40000	All items	100,00	100,00	100,00	100,00	100.00
	UVI41000	Agriculture	4,33	3,88	3,95	4,12	4.96
	UVI42000	Beverages	7,95	7,12	6,20	6,67	7.06
	UVI43000	Ores and minerals	16,92	19,22	22,30	21,84	22.67
	UVI43100	Coal	6,44	6,44	7,24	7,15	6.54
	UVI43200	Metal ores	8,97	11,28	13,63	13,10	14.53
	UVI43210	Iron ores and concentrates	4,77	6,35	8,67	8,21	9.20
	UVI43220	Non-ferrous metal ores and concentrates	4,20	4,93	4,96	4,89	5.33
	UVI43300	Other minerals	1,51	1,50	1,43	1,59	1.60
	UVI44000	Other transportable goods, except metal products, machinery and equipment	19,56	17,94	17,74	20,02	19.23
	UVI44100	Coke oven and refined petroleum products	5,14	4,57	4,54	5,82	5.20
	UVI44200	Basic chemicals	6,39	6,13	5,97	6,44	6.22
	UVI44300	Other chemical products	3,60	3,16	3,01	3,09	3.32
	UVI44400	Waste and scrap	2,54	2,45	2,61	3,02	2.82
	UVI44500	Rubber and plastic products	1,89	1,63	1,61	1,65	1.67
	UVI45000	Metal products, machinery and equipment	51,24	51,84	49,81	47,35	46.08
	UVI45100	Basic metals	30,28	31,89	30,49	26,46	25.92
	UVI45110	Basic iron and steel	4,60	5,80	4,85	4,14	4.40
	UVI45120	Products of iron and steel	3,34	3,27	2,67	2,82	2.41
	UVI45130	Basic precious metals and metals clad with precious metals	19,42	19,89	20,38	17,30	16.41
	UVI45140	Other semi-finished metal products	2,92	2,93	2,59	2,20	2.70
	UVI45200	General purpose machinery	4,50	4,55	4,65	4,49	4.38
	UVI45300	Special-purpose machinery	2,71	2,50	2,42	3,05	2.71
	UVI45400	Transport equipment	9,18	8,75	8,30	9,08	8.99
	UVI45410	Motor vehicles	8,00	7,68	7,21	8,01	8.02
	UVI45420	Parts and accessories for motor vehicles and their engines	1,18	1,07	1,09	1,07	0.97
	UVI45500	Other machinery and equipment	2,53	2,22	2,26	2,35	2.38
Exports	UVI45600	Fabricated metal products, except machinery and equipment	2,04	1,93	1,69	1,92	1.70
	UVI20000	Imports	100,00	100,00	100,00	100,00	100.00
	UVI34000	Imports excluding crude	81,44	83,59	83,39	82,04	82.89
	UVI50000	All items	100,00	100,00	100,00	100,00	100.00
	UVI51000	Crude petroleum	18,56	16,41	16,61	17,96	17.11
	UVI52000	Food products	7,19	6,96	7,10	7,26	6.65
	UVI52100	Fats and oils	3,72	3,95	3,86	4,07	3.55
Imports	UVI52200	Grain mill products	3,47	3,01	3,24	3,19	3.10

UVI53000	Clothing and footwear	4,47	4,53	4,32	4,18	4.38
UVI53100	Clothing	2,78	2,81	2,62	2,47	2.63
UVI53200	Footwear	1,69	1,72	1,70	1,71	1.75
UVI54000	Other transportable goods, except metal products, machinery and equipment	24,45	25,09	25,91	25,99	26.06
UVI54100	Paper and paperboard	2,03	1,90	1,61	1,69	1.70
UVI54200	Coke oven and refined petroleum products	5,27	5,12	7,32	7,16	7.51
UVI54300	Basic chemicals	5,75	6,23	6,17	5,75	5.46
UVI54400	Pharmaceutical and other chemical products	6,41	6,40	5,68	6,20	6.33
UVI54410	Pharmaceutical products	3,97	4,08	3,44	3,63	3.59
UVI54420	Other chemical products	2,44	2,32	2,24	2,57	2.74
UVI54500	Rubber and plastic products	2,61	2,93	2,82	2,82	2.89
UVI54600	Other transportable goods n.e.c.	2,38	2,51	2,31	2,37	2.17
UVI55000	Metal products, machinery and equipment	45,33	47,01	46,06	44,61	45.80
UVI55100	Basic metals	3,22	3,69	3,73	3,52	3.95
UVI55200	Fabricated metal products	1,96	2,06	1,98	1,90	2.09
UVI55300	General purpose machinery	7,46	7,20	7,18	6,74	6.52
UVI55400	Special purpose machinery	7,12	6,67	7,35	8,03	7.44
UVI55410	Machinery for mining, quarrying and construction, and parts thereof	2,37	2,36	3,13	3,75	3.05
UVI55420	Agricultural or forestry machinery and parts thereof	0,91	0,69	0,83	0,98	1.00
UVI55430	Other machinery and parts thereof	3,84	3,62	3,39	3,30	3.39
UVI55500	Office, accounting and computing machinery	3,15	3,43	3,18	2,99	2.98
UVI55600	Electrical machinery and apparatus	4,15	3,67	3,22	3,46	4.32
UVI55700	Radio, television and communication equipment and apparatus	6,39	7,08	6,06	5,38	6.09
UVI55800	Medical appliances, precision and optical instruments, watches and clocks	3,37	3,12	2,93	2,80	2.88
UVI55900	Transport equipment	8,51	10,09	10,41	9,79	9.53
UVI55910	Vehicles	5,11	6,90	7,01	7,02	7.25
UVI55920	Bodies and parts of vehicles	1,84	1,83	1,68	1,61	1.58
UVI55930	Other transport equipment	1,56	1,36	1,72	1,16	0.70