

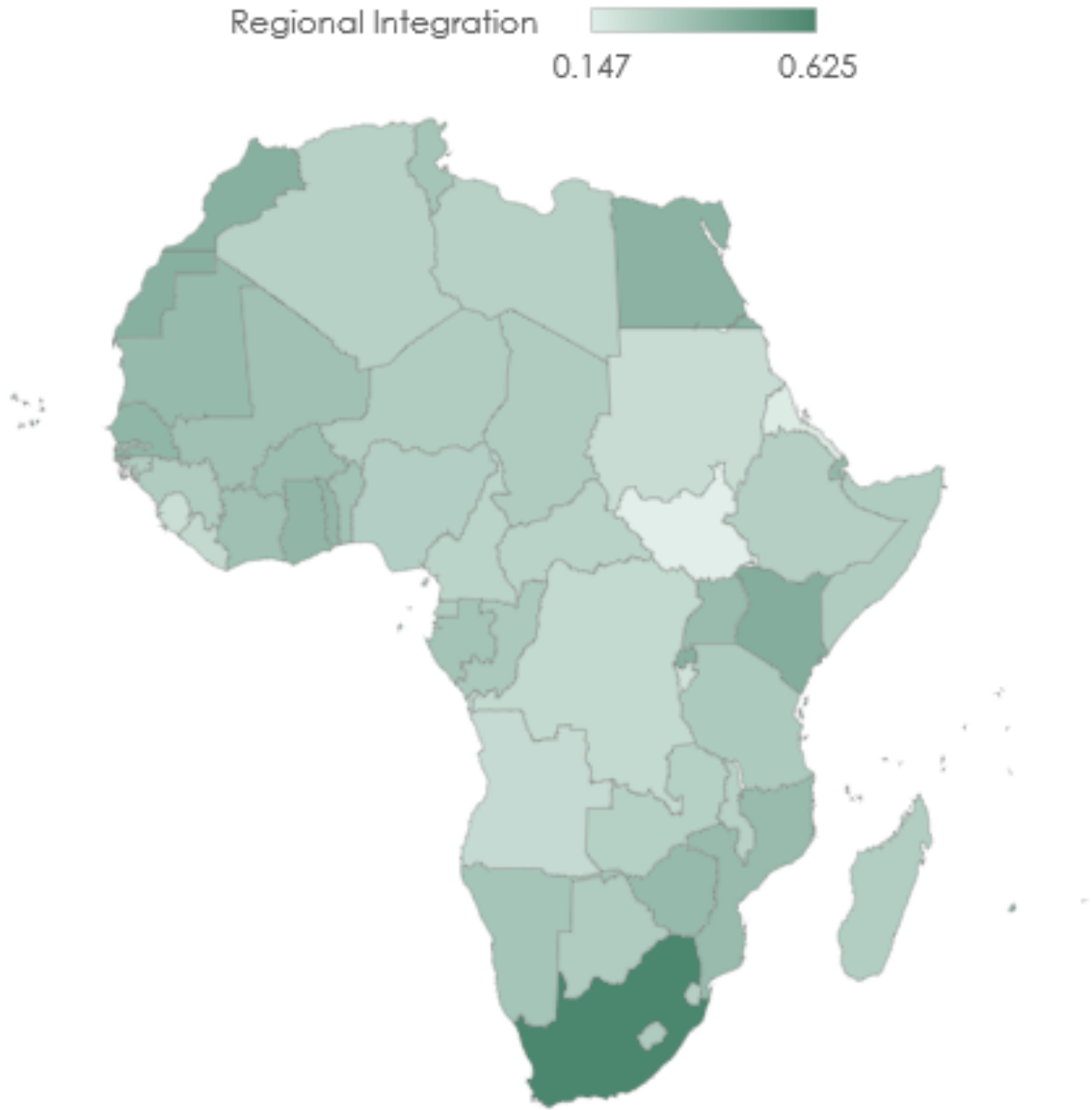


United Nations
Economic Commission for Africa

AFRICA REGIONAL INTEGRATION INDEX (ARII): METHODOLOGICAL NOTE

2019

ARII 2019 – Regional integration in Africa



The more integrated a country is the darker is the shade of green.

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1. Introduction

Regional integration is a complex concept. It is generally conceived as englobing several aspects of economic integration from production to social cross-border linkages that contribute to enhancing economic growth. Moreover, the actual workings of regional integration are far from being homogenous, its mechanism differs from region to region. The advantages it brings along, however, in terms of increased economic activities and growth, are regionwide.

The Africa Regional Integration Index (ARII) 2019 is constructed as a composite index: it is made up of several indicators that reflect the state and efforts towards achieving greater regional integration in Africa. It draws from the economic literature on the subject and the experiences of the different collaborating partners and international institutions to define its conceptual framework. After robust sensitivity analyses and reviews by experts, the final index is composed of 16 indicators grouped into 5 dimensions¹, namely, trade, productive, macroeconomic, infrastructural and free movement of people dimensions.

Although all the indicators used in ARII are relevant, their influence on regional integration may vary. As such, the use of an equal weighting system where all indicators have the same weight is deemed problematic as it can overweigh and/or underweigh some indicators thereby producing biased scores. However, it is a daunting task to assign weights in an objective manner as there exists no consensus in the literature as to which method is the best (Nardo et al., 2005). There are many ways to give weights to indicators including weights obtained through expert judgements also known as budget allocation systems. The latter method is costly and often criticised for unduly adding subjective bias to indexes. Therefore, it is highly recommended to resort to a statistical methodology² that allows the robust computation of weights while maintaining objectivity.

One such technique is principal components analysis (PCA). This methodology has been tested previously in the construction of well-known regional integration indexes and other indexes (Huh & Park, 2017; König, 2015). Its use is motivated by its capacity to derive weights based on the structure of the data and its ability to preserve the variations in the data. Thus, it does not rely on subjective judgements to assign weights. ARII 2019 makes use of PCA to determine the weights of both single indicators and the dimensions. In other words, a two-stage weighting procedure is adopted, i.e., where the single indicators inside each dimension are first assigned weights and then weights are given to the dimensions.

¹ Readers can refer to the ARII 2019 report for more details. The following section of this Note describes the indicators used in each dimension.

² Statistical methodology although objective they may sometimes provide results that go against intuition, this is largely because the quality of data is never perfect. The best weighting methodology would be a combination of expert judgements with statistical methodology.

This methodological note is organized as follows. The following section details the data sources for the variables used in ARII 2019. It also documents the treatment of missing data and any other calculations that were performed. Section 3 describes the normalization procedure and the eligibility tests that are recommended when PCA is used. The weighting procedure, that is, principal components analysis, is documented in section 4; the choice of the number of components together with the aggregation procedure is also described. Section 5 describes the sensitivity analyses that were made to control the validity of the index structure, that is the variables in the dimensions and the credibility of the ranking. Section 6 discusses the empirical results in light of the relevance of the indicators and dimensions. The significance of the weights assigned through PCA is controlled for by computing the index using an alternative methodology that uses equal weights. The following sections report the empirical results for Africa and the 8 RECs: the descriptive statistics, the overall correlation structures, the eligibility tests for the conduct of PCA, the computation of weights, a summary of the weights, a comparison of the weights assigned through PCA and equal weights.

2. Data sources, coverage and treatment of missing data

Overview of dimensions and indicators used in ARII 2019

- | | |
|---------------------------------------|---|
| 1. Trade Integration | <ul style="list-style-type: none"> a. Average tariff on imports b. Share of intra-regional exports over GDP c. Share of intra-regional imports over GDP d. Share of intra-regional trade e. AfCFTA (Only at continental level) |
| 2. Productive Integration | <ul style="list-style-type: none"> a. Share of intra-regional intermediate exports b. Share of intra-regional intermediate imports c. Merchandise trade complementarity index |
| 3. Macroeconomic Integration | <ul style="list-style-type: none"> a. Number of bilateral investment treaties b. Regional convertibility of currency c. Regional inflation differential |
| 4. Infrastructural Integration | <ul style="list-style-type: none"> a. AfDB Composite Infrastructure index b. Proportion of intra-regional flight connections |
| 5. Free Movement of People | <ul style="list-style-type: none"> a. Free Movement of Persons Protocol (Kigali) b. Number of countries that may obtain a visa on arrival c. Number of countries that require a visa |

Detailed description of indicators and variables

Dimension	Trade
Indicator	Level of tariff on imports (intra-regional import)
Data sources	Market Access Map, International Trade Centre (International Trade Centre, 2018)
Variables used	Ad valorem equivalents of applied tariffs at minimum rates
Year coverage	Latest data available. For most countries data date back to 2017, 2016 and 2015 except for Eritrea, Libya and Sierra Leone where data date back to 2006
Country coverage	All except Somalia and South Sudan
Calculation	Bilateral tariff rate (import-weighted) that each country <i>i</i> applied to country <i>j</i> and averaged over all countries in the region
Details	Applied tariffs refer to actual tariffs imposed by the importing country and this is an appropriate measure of actual trade integration. Moreover, these rates also include the preferences that a country may grant to certain trading partners
Treatment of missing data	<ul style="list-style-type: none"> • Data for Somalia is sourced from the Somalian Chamber of Commerce, Industry and Agriculture • Data for South Sudan is obtained from the PWC tax summary https://www.pwc.co.za/en/assets/pdf/tax-summaries/south_sudan_2014.pdf

Dimension	Trade
Indicator	Share of intra-regional goods export (%GDP)
Data sources	UNCTAD, (UN COMTRADE, 2018)
Variables used	Merchandise exports and GDP
Year coverage	Latest available and consistent data (2014, 2015, 2016)
Country coverage	All except South Sudan
Calculation	The ratio of merchandise exports of country <i>i</i> over GDP. Exports and GDP are the averages of 2014-2016 data.
Details	The average of the 3 years is used so as to minimize data discrepancies that often exist for trade data in the African context
Treatment of missing data	Data for South Sudan is retrieved from the UN Comtrade database. However, since there is no data on the exports of South Sudan, South Sudan's exports are imputed by adding up each of its partner's imports. To be consistent, the average of

2014-2016 is used. Moreover, the same classification as UNCTAD, i.e., SITC Rev. 3 is used.

Dimension	Trade
Indicator	Share of intra-regional goods import (%GDP)
Data sources	UNCTAD
Variables used	Merchandise imports and GDP
Year coverage	Latest available and consistent data (2014, 2015, 2016)
Country coverage	All except South Sudan
Calculation	The ratio of merchandise imports of country <i>i</i> over GDP. Imports and GDP are the averages of 2014-2016 data.
Details	The average of the 3 years is used so as to minimize data discrepancies that often exist for trade data in the African context
Treatment of missing data	Data for South Sudan is retrieved from the UN Comtrade database. However, since there is no data on the imports of South Sudan, South Sudan imports are imputed by adding up each of its partner's exports. To be consistent, the average of 2014-2016 is used. Moreover, the same classification as UNCTAD, i.e., SITC Rev. 3 is used.

Dimension	Trade
Indicator	Share of intra-regional goods trade (%total regional trade)
Data sources	UNCTAD
Variables used	Merchandise exports and merchandise imports
Year coverage	Latest available and consistent data (2014, 2015, 2016)
Country coverage	All except South Sudan
Calculation	The sum of country <i>i</i> merchandise exports and imports to all other countries in the region over the total regional merchandise exports and imports. Exports and imports are the averages of 2014-2016.
Details	The average of the 3 years is used so as to minimize data discrepancies that often exist for trade data in the African context
Treatment of missing data	Same as previous

Dimension	Trade
Indicator	AfCFTA
Data sources	African Union (African Union, 2019)
Variables used	Signature and ratification of the AfCFTA

Year coverage	Latest available update up to July 2019 (Niamey Summit)
Country coverage	All
Calculation	Countries are assigned a score of 0 if they did not sign, a score of 1 if they signed and a score of 2 if they ratified the agreement
Details	
Treatment of missing data	Not applicable

Dimension	Productive
Indicator	Share of intra-regional exports of intermediate goods
Data sources	UN Comtrade
Variables used	Intermediate goods exports
Year coverage	Latest available and consistent data (2014, 2015, 2016)
Country coverage	41 + 13 imputations (Chad, Comoros, Dem. Rep. of the Congo, Djibouti, Equatorial Guinea, Eritrea Ethiopia, Gabon, Guinea-Bissau, Liberia and Somalia)
Calculation	The sum of country i intermediate exports to all other countries in the region over the total regional exports. Exports are the average of 2014-2016 data.
Details	Intermediate goods are defined as the sum of the following categories in BEC: 111* Food and beverages, primary, mainly for industry 121* Food and beverages, processed, mainly for industry 21* Industrial supplies not elsewhere specified, primary 22* Industrial supplies not elsewhere specified, processed 31* Fuels and lubricants, primary 322* Fuels and lubricants, processed (other than motor spirit) 42* Parts and accessories of capital goods (except transport equipment) 53* Parts and accessories of transport equipment
Treatment of missing data	Missing data for country i, is imputed by summing up intermediate imports for each country importing from country i for which data are available. The resulting value provide an

underestimate of the intermediate exports of country i (as data is not available for all countries)

Dimension	Productive
Indicator	Share of intra-regional imports of intermediate goods
Data sources	UN Comtrade
Variables used	Intermediate goods imports
Year coverage	Latest available and consistent data (2014, 2015, 2016)
Country coverage	41 + 13 imputations (Chad, Comoros, Dem. Rep. of the Congo, Djibouti, Equatorial Guinea, Eritrea Ethiopia, Gabon, Guinea-Bissau, Liberia and Somalia)
Calculation	The sum of country i intermediate imports to all other countries in the region over the total regional exports. Imports are the average of 2014-2016.
Details	Intermediate goods are defined as above
Treatment of missing data	Missing data for country i, is imputed by summing up intermediate exports for each country exporting to country i for which data are available. The resulting value provides an underestimate of the intermediate imports of country i.

Dimension	Productive
Indicator	Merchandise trade complementarity index Africa / RECs
Data sources	UNCTAD
Variables used	Merchandise exports and merchandise imports
Year coverage	Latest available and consistent data (2014, 2015, 2016)
Country coverage	All except South Sudan
Calculation	<p>As per Michaely (1996), TCI of a country is the sum of the absolute value of the difference between the import shares and the export shares (at 3-digit SITC, Revision 3 level) of the countries or country groups under study, divided by two:</p> $Se_j m_k = 1 - \frac{\sum_i |E_{ij} - M_{ik}|}{2}$ <p> $Se_j m_k$ = the index of trade complementarity of exporter j with importer k i = goods in 3 digit SITC Revision 3 j = exporter k = importer E_{ij} = the share of goods i in country j's total exports to the region </p>

Details	<p>M_{ik} = the share of goods i in country k's total imports from the region</p> <p>Michaely (1996) formula is adapted to the African level and at each REC level to better capture regional integration. TCI measures to what extent the export profile of each African country matches the import profile of the region</p>
Treatment of missing data	South Sudan value is estimated as 1 standard deviation below the average (South Sudan performance on similar variables tends to be below the average).

Dimension	Infrastructure
Indicator	Infrastructure development index
Data sources	AfDB Infrastructure development index , (AfDB, 2016)
Variables used	Overall Infrastructure development index
Year coverage	2016
Country coverage	All
Calculation	As is
Details	
Treatment of missing data	Not applicable

Dimension	Infrastructure
Indicator	Proportion of intra-regional flight connections
Data sources	African Airlines Association (AFRAA, 2018)
Variables used	Flight connections from each country to the remaining countries in the region
Year coverage	2017
Country coverage	All
Calculation	The total number of flight connections from country i to each of the countries in the region over the total number of flight connections in the region
Details	
Treatment of missing data	Not applicable

Dimension	Macroeconomic
Indicator	Number of bilateral investment treaties
Data sources	World Bank, 2017
Variables used	Number of bilateral investment treaties in force
Year coverage	Up to 2017

Country coverage	All
Calculation	The total number of bilateral investment treaties net of those that have not been ratified and/or have been terminated within the region
Details	
Treatment of missing data	Not applicable

Dimension	Macroeconomic
Indicator	Regional convertibility of national currencies
Data sources	National and regional central banks
Variables used	Number of convertible currencies
Year coverage	Latest data up to October 2018
Country coverage	All except Eritrea
Calculation	The number of countries in a region with which a country shares a common currency or with which its currency is convertible as reported by each country's central bank
Details	
Treatment of missing data	Eritrea's value takes the same value as that reported in ARII 2016

Dimension	Macroeconomic
Indicator	Regional inflation differential
Data sources	World Economic Outlook, IMF (International Monetary Fund, 2018)
Variables used	Inflation differential
Year coverage	October 2017
Country coverage	All except Somalia
Calculation	Inflation differential is the difference between country i inflation rate and that of the official target for the region. In the absence of the official target, the minimum positive value for the region is set as a target.
Details	The inflation rate of South Sudan of 380 has been winsorised ³ to 35 so as to reduce the variability of the data but care has been taken so that it remains the highest value.
Treatment of missing data	Somalia's value is imputed from an external source value, https://tradingeconomics.com/somalia/inflation-cpi

Dimension	Free movement of people
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³ Winsorisation, named after the biostatistician Charles P. Winsor, is the transformation of statistical data so as to render extreme values less extreme so as to reduce the effect of spurious outliers

Indicator	Ratification of the Protocol on the Free Movement of Persons
Data sources	African Union
Variables used	Ratification of the Protocol on the Free Movement of Persons, Right of Residence and Right of Establishment (Article 43(2) Treaty establishing the African economic community
Year coverage	Up to July 2019 (Niamey Summit as stopping point)
Country coverage	All
Calculation	The variable takes a value of 1 if the country has ratified the protocol and 0 otherwise
Details	
Treatment of missing data	Not applicable

Dimension	Free movement of people
Indicator	The number of countries which citizens may obtain a visa on arrival
Data sources	African Development Bank, Visa Openness Index 2018 version
Variables used	The number of countries whose citizens may obtain a visa on arrival
Year coverage	2018 (latest data available)
Country coverage	All
Calculation	The variable sums the number of countries whose citizens may obtain a visa on arrival to enter country i.
Details	Rwanda has completely opened up its borders to EAC members but it the Visa Openness database record that the country does not grant visa on arrival. This information was corrected so as not to penalize the country.
Treatment of missing data	Not applicable

Dimension	Free movement of people
Indicator	The number of countries that require a visa
Data sources	African Development Bank, Visa Openness Index 2018 version
Variables used	The number of countries whose citizens require a visa
Year coverage	2018 (latest data available)
Country coverage	All

Calculation

The variable sums the number of countries whose citizens strictly require a visa to enter country i.

Details

Treatment of missing data

Not applicable

6. Normalisation of data and eligibility tests

Min-Max normalisation

ARII is made up of extremely varied indicators measured in different units from the rate of inflation differential to the ratification of the AfCFTA. This renders aggregation of the single indicators into a composite index difficult and comparison between themselves and between RECs not straightforward. Additionally, a common scale is a pre-requisite before applying principal components analysis. Therefore, all the indicators are normalised so that they range between 0 and 1 where 0 denotes the lowest integration level and 1 the highest level. A simple normalisation procedure known as the min-max rescaling procedure is used.

This basic normalisation method is used to avoid influencing the data which is often the case when making use of more sophisticated techniques such as the z-scores (Nardo et al., 2005; Gu, Greensmith, Oates, & Aickelin, 2009). Each indicator q for each country is normalized as follows

$$\frac{q - q_{min}}{q_{max} - q_{min}}$$

where q_{max} and q_{min} are the maximum and minimum values of each indicator q across all countries in the region.

Note that for indicators where the lowest value reflects more integration, for example, a high tariff rate would mean less integration than a low tariff rate, the formula is adjusted as follows

$$1 - \frac{q - q_{min}}{q_{max} - q_{min}}$$

The adjusted formula has been applied to the following indicators:

1. Level of tariff on imports
2. Regional inflation differential
3. Number of countries that require a visa

Eligibility tests

The following tests are performed for each dimension in ARII to ensure that the data are suitable to undergo PCA. They are also performed on the aggregated dimensions.

i. Cronbach Coefficient Alpha

Cronbach's alpha is the most common estimate of the internal consistency of indicators. It is performed to measure the extent to which indicators in each of the five dimensions of ARII are interrelated and, therefore, may measure a single unidimensional phenomenon. However, a high alpha may also be the result of separate clusters that intercorrelate highly even though the clusters themselves do not have a high correlation.

ii. **Bartlett's test of sphericity**

Since PCA is only useful when there is some degree of correlation between the variables, Bartlett's test of sphericity is used to check whether the observed correlation matrix diverges significantly from the identity matrix.

iii. **Kaiser-Meyer-Olkin (KMO)**

Sampling adequacy is ensured by checking the Kaiser-Meyer-Olkin (KMO) index where partial correlation is used to measure the relation between two variables excluding the effects of other variables. A high KMO (usually > 0.5) indicates that PCA is relevant.

4. Weighting and Principal Components Analysis

The different items of a composite index do not necessarily have the same economic significance; therefore, weights are necessary to account for these differences. However, heavy weights on sub-indicators can strongly influence the final scores of countries and they should, therefore, be assigned using a sound methodology (Nardo et al., 2005). Principal components analysis is used to compute non-subjective weights to assign to each indicator and dimensions before building the aggregate index.

There are many ways to assign weights and they all have advantages and disadvantages. However, weights based on statistical models prevail as they require no a priori assumptions. The use of PCA as a weighting scheme is now established in the literature that covers the construction of social indices and, particularly, regional integration indices (Huh & Park, 2017; König, 2015). Often items of composite indicators tend to be correlated, i.e., they measure the same concept, and using an equal weighting scheme will lead to double-counting. Weights given through PCA correct for overlapping information of correlated indicators. The following briefly describes the PCA methodology (Giri, 1996; Jolliffe, 2002).

What is PCA?

PCA is a statistical data reduction technique. Its aim is to reduce the number of observed variables to a resulting set of orthogonal components that maximise the variance in the data. The extracted components reveal the set of variables that are highly correlated, and the latter will have high factor loadings on a specific component. Mathematically, each component P is a linear combination of the original set of variables X_i to X_n and they are sorted in descending order according to the amount of variance they account for in the original set of variables

$$\begin{aligned}P_1 &= a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n \\P_2 &= a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n \\&\vdots \\P_m &= a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n\end{aligned}$$

where a_{mn} represents the weight of the m^{th} principal component for the n^{th} variable. The variance λ of each principal component is given by the eigenvalue of the corresponding eigenvector of the correlation matrix⁴ where $\lambda_1 \geq \lambda_2 \dots \geq \lambda_m$. The first principal component P_1 explains the largest possible variation in the data and the second principal component P_2 explains additional but less variation than the first component and is orthogonal to the first component. Each subsequent component captures additional dimensions but explains a smaller proportion of the variation in the original variables. Since the sum of the eigenvalues equals the number of variables in the data, $\frac{\lambda_m}{n}$ is the proportion of variance explained by the m^{th} component.

Number of components and computation of weights

The term loadings refer to the correlation coefficients between the original variables and the principal components. Factor loadings are squared and normalised and multiplied by the proportion of explained variance of the number of components considered (Huh & Park (2017) for details). The results are aggregated to compute the weights for each indicator in each of the five dimensions.

The number of components that should be retained is quite arbitrary as it often depends on how much random variability is left. However, there are guidelines that have been documented in the literature. The most common methods used are outlined below:

⁴ Principal components can either be based on the correlation or covariance matrix. ARII 2018 uses the former method. As explained in Jolliffe (2002), the use of correlation matrices to define principal components ensures that the results of analysis for different sets of random variables are more directly comparable than for analysis based on covariance matrices. Moreover, principal components that are defined using covariance matrices are sensitive to the units of measurement of the variables and, as such, variables with very large variances will dominate the first few principal components.

- **Scree plot**

The use of the scree plot is one of the simplest ways of determining the appropriate number of components that mostly accounts for the phenomenon under study. It graphs the eigenvalue against the number of components and it is recommended to keep only components that are above the sharp drop-off in the plot (Cattell, 1966).

- **Kaiser criterion**

One of the most popular methods is to drop components whose eigenvalues is less than 1 because the variance they explain is lower than in a single variable (Kaiser, 1960).

- **Variance explained**

Rather than relying on the methods above where the variance explained varies, it is common practice to set a threshold for the amount of variance explained and only keep the number of components that satisfies this criterion.

- **Jolliffe's rule**

It is simply a less strict rule compared to the Kaiser criterion and recommends dropping components with eigenvalues below 0.70.

- **Broken-stick model**

It recommends retaining components that explain more variance than would be expected by randomly dividing the variance into p parts (Peres-Neto, Jackson, & Somers, 2005).

ARII relies on a combination of the first three rules listed above. While the scree plots provide the basis for the number of significant components, it is ensured that the number of components finally retained cumulatively account for more than 70 per cent of the total variance in the data and individually contribute to more than 10 per cent of the variance in the data.

Aggregation scheme

Indicators in a composite index can be aggregated using a linear or a geometric aggregation method. Linear aggregation is an additive method that involves the summation of individual indicators. It ensures full compensability, that is poor performance in some indicators can be compensated by good performance on others. Geometric aggregation is a multiplicative method and it involves partial compensability where countries with higher scores are given more importance.

Given that indicators in ARII have been normalized and are on the same scale and that indicators have already been weighted to reflect their importance, a linear aggregation method is used. The weighted scores for each indicator are summed to obtain grand scores for each dimension. PCA is then applied to the dimensions to obtain dimensional

weights. The weighted dimensions are then linearly aggregated to obtain the final regional integration index.

Pitfalls of PCA

Although lauded with advantages that are convenient for the construction of indexes, such as the maintenance of objectivity and the preservation of the variations that exist in the data, PCA has to be used with caution.

1. As explained above, PCA relies on the correlation of the data. However, correlation may not be a good indicator of the real influence that some variables have on the phenomenon that is being studied.
2. Data revisions and updates completely change the results obtained through PCA as new correlations are explored.
3. PCA is still sensitive to small sample size.
4. Outliers have a major influence on PCA.
5. The importance of individual indicators that may be relevant for policy is masked when using PCA.

5. Sensitivity analysis pre- and post-computations

The recommended eligibility tests have been performed in the conduct of PCA as reported in the previous section. Moreover, a few controls were made post-computations. An alternative method of constructing ARII has been considered, the correlation structure re-analysed and the robustness of the dimensions to variable changes has also been checked.

1. Equal weights versus PCA weights

Rankings have been computed using an equal weighting scheme rather than using weights generated by PCA. This is to test whether the assignment of weights derived from PCA that uses the structure of the data is relevant. The ranks are compared, and their significance is controlled for by performing the Kendall tau rank correlation tests. The results are reported further below.

2. Analysis of overall correlation structure

The variables, indicators and dimensions used in ARII 2019 have been predefined as previously explained by a rigorous review of the literature on the concept of regional integration and its measurement through composite indexes. Insights have been taken from the previous version of the Africa regional integration index, the EU index of integration, the Asia-Pacific regional integration index and the KOF globalization index among others (ARII, 2016; König, 2015; Huh & Park, 2017; Gygli, Haelg, & Sturm, 2018). This information was complemented by reviews and advice from experts, partner institutions and officials from member States and RECs at various stages of this project. As such, the dimensions and variables to be included in each dimension were defined. In order to validate all the information gathered, particularly, to validate variables in their respective dimensions, their correlation structures were examined.

3. Robustness of the dimensions as a result of the removal of single variables

An important step in the definition of the dimensions is to assess whether they remain robust if some variables are included or removed. In essence, the changes in the statistical tests were further controlled as a result of the removal of each of the variables in the dimensions that were considered problematic due to low correlation structures.

Results of sensitivity analysis

Before arriving at the final choice of the 16 final indicators that make up ARII, the index was composed of 18 indicators. However, the results were not satisfactory. ARII suffers from some conceptual issues in terms of both ranking and statistical results. The statistical tests of internal consistency reveal that there were structural issues in both the macroeconomic dimension and the infrastructural dimension. These issues affected the overall validity of the rankings.

The sub-sections below describe the sensitivity analyses⁵ that have been conducted to identify the most optimal set of indicators so as to render ARII more robust while maintaining the validity of the concept of regional integration that echoes the current state of affairs.

Macroeconomic dimension

Step 1

Issue: The investment variable computed as the number of bilateral investment treaties in force has a low correlation in its dimension and it is also negatively correlated with the currency convertibility variable. As shown in Table 1, its scale reliability coefficient, 0.15, is low compared to the acceptable level of 0.5. Moreover, it fails to pass the Bartlett test of sphericity.

Action: Removing the investment variable to check whether there are improvements in the consistency test and the ranking of the dimension.

Result: Table 1, second column, shows little improvement in the Cronbach alpha coefficient measuring scale reliability. Moreover, the p-value for the Bartlett test of sphericity is not significant, i.e., there appears to be no relation between the two variables considered, inflation differential and currency convertibility.

Figure 1 reports considerable changes in the rankings, particularly, the drastic decline in the positions of Egypt and Mauritius. The rank of South Africa's worsens in the macroeconomic dimension. Sierra Leone becomes the second-best integrated country on macroeconomic dimension and Libya remains at an abnormally high rank of seventh.

It appears that the not so realistic position of these countries may be driven by other factors.

Table 1 Statistical tests before and after the removal of the investment variable at the macroeconomic dimension and overall dimensions

<i>Variables used:</i>	Macroeconomic: Inflation Currency Investment	Macroeconomic: Inflation Currency	Dimensions	Dimensions revised
Test scale = mean(unstandardized items)				
Average interitem covariance:	0.0021098	0.0034478	0.0051976	0.0040324
Number of items in the scale:	3	2	5	5
Scale reliability coefficient:	0.1529	0.1859	0.4885	0.4051
Determinant of the correlation matrix	0.968	0.987	0.462	0.509
Bartlett test of sphericity				
Chi-square	1.643	0.69	39.049	34.098

⁵ The sensitivity analyses were conducted before the final adjustment of the data for the following two variables: AfCFTA and number of countries that grant visas on arrival. Since the sensitivity analyses focus on the macroeconomic and infrastructural dimensions where the data was not affected, the results of the sensitivity analyses remain valid.

<i>Degrees of freedom</i>	3	1	10	10
<i>p-value</i>	0.65	0.406	0	0
<i>H0: variables are not intercorrelated</i>				
<i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</i>				
<i>KMO</i>	0.452	0.5	0.505	0.527

Step 2

Issue: Given that the removal of the investment variable does not improve the results, it is suspected that the problem lies in the other variables. It was identified that the inflation differential variable suffers from the presence of outlier which increases the variance in the data and consequently affects the PCA results, and possibly the overall rankings

Action: The inflation variable is winsorised to cater to the extreme value reported for South Sudan inflation rate. This will reduce the variance that was unduly inflated by the outlier.

Result: Statistical test shows some improvement. The scale reliability coefficient increases only to 0.19 which is still far from the accepted benchmark of 0.5 but better than before. The Bartlett test remains insignificant.

However, ranking seems to be more in line with reality. In particular, the positions of Libya and Sierra Leone decline in the macroeconomic dimension. The ranking of South Africa improves from 33rd to 25th.

Table 2 Statistical tests before and after the winsorisation of the inflation variable at the macroeconomic dimension and overall dimensions

	Macroeconomic: <i>Inflation Currency Investment</i>	Macroeconomic: <i>Inflation- Winsorised Currency Investment</i>	Dimensions	Dimensions revised
<i>Test scale = mean(unstandardized items)</i>				
<i>Average interitem covariance:</i>	0.0021098	0.0036542	0.0051976	0.0051159
<i>Number of items in the scale:</i>	3	3	5	5
<i>Scale reliability coefficient:</i>	0.1529	0.1941	0.4885	0.4759
<i>Determinant of the correlation matrix</i>	0.968	0.976	0.462	0.459
<i>Bartlett test of sphericity</i>				
<i>Chi-square</i>	1.643	1.245	39.049	39.369
<i>Degrees of freedom</i>	3	3	10	10
<i>p-value</i>	0.65	0.742	0	0
<i>H0: variables are not intercorrelated</i>				
<i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</i>				
<i>KMO</i>	0.452	0.498	0.505	0.489

Figure 1 Comparing integration rankings with (old) and without (revised) the investment variable for the overall regional and macroeconomic rankings

Country	Regional integration			Macroeconomic dimension		
	Old	Revised	Change	Old	Revised	Change
Algeria	50	51	-1	14	34	-20
Angola	39	44	-5	42	52	-10
Benin	28	22	6	30	20	10
Botswana	27	27	0	45	41	4
Burkina Faso	9	9	0	10	15	-5
Burundi	52	52	0	36	29	7
Cabo Verde	29	25	4	12	8	4
Cameroon	51	48	3	28	18	10
Central African Rep	30	24	6	34	26	8
Chad	23	17	6	32	22	10
Comoros	15	14	1	38	32	6
Côte d'Ivoire	24	20	4	25	14	11
D. Rep. of the Cong	42	40	2	23	11	12
Djibouti	8	8	0	48	45	3
Egypt	14	39	-25	2	53	-51
Equatorial Guinea	45	42	3	29	19	10
Eritrea	54	53	1	53	51	2
Eswatini	31	29	2	51	49	2
Ethiopia	47	49	-2	11	37	-26
Gabon	20	19	1	18	23	-5
Ghana	3	2	1	13	6	7
Guinea	18	16	2	16	12	4
Guinea-Bissau	35	28	7	31	21	10
Kenya	5	5	0	40	30	10
Lesotho	33	33	0	49	46	3
Liberia	36	38	-2	52	50	2
Libya	48	46	2	5	7	-2
Madagascar	34	35	-1	39	36	3
Malawi	32	30	2	37	31	6
Mali	10	13	-3	6	24	-18
Mauritania	7	7	0	8	5	3
Mauritius	17	36	-19	4	40	-36
Morocco	21	34	-13	1	3	-2
Mozambique	4	6	-2	20	28	-8
Namibia	25	26	-1	46	43	3
Niger	22	18	4	24	13	11
Nigeria	37	32	5	15	10	5
Rep. of the Congo	16	15	1	19	25	-6
Rwanda	1	1	0	3	1	2
Sao Tome & Princi	38	31	7	21	9	12
Senegal	13	10	3	17	16	1
Seychelles	41	43	-2	47	44	3
Sierra Leone	43	37	6	9	2	7
Somalia	19	23	-4	41	42	-1
South Africa	2	3	-1	33	35	-2
South Sudan	53	54	-1	54	54	0
Sudan	49	50	-1	35	47	-12
The Gambia	26	21	5	7	4	3
Togo	6	4	2	27	17	10
Tunisia	46	47	-1	22	33	-11
Uganda	11	11	0	44	39	5
Utd Rep. of Tanzan	40	41	-1	26	27	-1
Zambia	44	45	-1	50	48	2
Zimbabwe	12	12	0	43	38	5

Figure 2 Comparing integration rankings before (old) and after (revised) the inflation variable is winsorised for the overall regional and macroeconomic rankings

Country	Regional integration			Macroeconomic dimension		
	Old	Revised	Change	Old	Revised	Change
Algeria	50	48	2	14	13	1
Angola	39	50	-11	42	53	-11
Benin	28	26	2	30	21	9
Botswana	27	25	2	45	37	8
Burkina Faso	9	9	0	10	6	4
Burundi	52	52	0	36	31	5
Cabo Verde	29	28	1	12	8	4
Cameroon	51	47	4	28	19	9
Central African Rep	30	29	1	34	28	6
Chad	23	22	1	32	23	9
Comoros	15	14	1	38	29	9
Côte d'Ivoire	24	23	1	25	17	8
D. Rep. of the Cong	42	46	-4	23	46	-23
Djibouti	8	8	0	48	39	9
Egypt	14	15	-1	2	3	-1
Equatorial Guinea	45	42	3	29	20	9
Eritrea	54	54	0	53	50	3
Eswatini	31	31	0	51	48	3
Ethiopia	47	43	4	11	10	1
Gabon	20	19	1	18	11	7
Ghana	3	5	-2	13	40	-27
Guinea	18	24	-6	16	26	-10
Guinea-Bissau	35	32	3	31	22	9
Kenya	5	4	1	40	38	2
Lesotho	33	33	0	49	45	4
Liberia	36	35	1	52	49	3
Libya	48	51	-3	5	41	-36
Madagascar	34	34	0	39	34	5
Malawi	32	38	-6	37	51	-14
Mali	10	10	0	6	5	1
Mauritania	7	7	0	8	7	1
Mauritius	17	16	1	4	2	2
Morocco	21	18	3	1	1	0
Mozambique	4	6	-2	20	43	-23
Namibia	25	27	-2	46	44	2
Niger	22	21	1	24	14	10
Nigeria	37	40	-3	15	35	-20
Rep. of the Congo	16	17	-1	19	15	4
Rwanda	1	2	-1	3	4	-1
Sao Tome & Princi	38	36	2	21	24	-3
Senegal	13	12	1	17	9	8
Seychelles	41	37	4	47	36	11
Sierra Leone	43	44	-1	9	30	-21
Somalia	19	20	-1	41	32	9
South Africa	2	1	1	33	25	8
South Sudan	53	53	0	54	54	0
Sudan	49	49	0	35	47	-12
The Gambia	26	30	-4	7	12	-5
Togo	6	3	3	27	18	9
Tunisia	46	41	5	22	16	6
Uganda	11	13	-2	44	42	2
Utd Rep. of Tanzan	40	39	1	26	27	-1
Zambia	44	45	-1	50	52	-2
Zimbabwe	12	11	1	43	33	10

Step 3

Issue: Winsorisation seems to have improved to some extent the result, but it is still not at the acceptable level. The correlation structure remains low

Action: Nevertheless, STEP 1 can be repeated using the winsorised variable, that is, removing the investment variable to check whether there are improvements in the consistency test and the ranking of the dimension.

Result: At the macroeconomic dimension, the scale reliability coefficient increases to 0.20 but is still below acceptable level as shown in Table 3. The scale reliability coefficient for the dimensions consequently decreased. The Bartlett test for the macroeconomic dimension reveals once again that the variables in this dimension are not related.

As suspected, the rankings show no apparent improvements as depicted in Figure 3. The sharp decline in the positions of Morocco, South Africa and Mauritius do not match expectations.

Table 3 Statistical tests with and without the investment variable at the macroeconomic dimension and overall dimensions (winsorised data)

	Macroeconomic: Inflation- Winsorised Currency Investment	Macroeconomic: Inflation-Winsorised Currency	Dimensions	Dimensions revised
<i>Test scale = mean(unstandardized items)</i>				
Average interitem covariance:	0.0036542	0.0058471	0.0051976	0.0051159
Number of items in the scale:	3	2	5	5
Scale reliability coefficient:	0.1941	0.2035	0.4885	0.4759
Determinant of the correlation matrix	0.976	0.987	0.462	0.459
Bartlett test of sphericity				
Chi-square	1.245	0.667	39.049	39.369
Degrees of freedom	3	1	10	10
p-value	0.742	0.414	0	0
H0: variables are not intercorrelated				
Kaiser-Meyer-Olkin Measure of Sampling Adequacy				
KMO	0.498	0.5	0.505	0.489

Figure 3 Comparing integration rankings with (old) and without (revised) the investment variable (winsorised inflation data) for the overall regional and macroeconomic rankings

Regional integration				Macroeconomic dimension			
Country	Old	Revised	Change	Country	Old	Revised	Change
Rwanda	2	1	1	Morocco	1	2	-1
Togo	3	2	1	Mauritius	2	27	-25
South Africa	1	3	-2	Egypt	3	48	-45
Kenya	4	4	0	Rwanda	4	1	3
Ghana	5	5	0	Mali	5	17	-12
Mauritania	7	6	1	Burkina Faso	6	7	-1
Mozambique	6	7	-1	Mauritania	7	3	4
Djibouti	8	8	0	Cabo Verde	8	4	4
Burkina Faso	9	9	0	Senegal	9	8	1
Senegal	12	10	2	Ethiopia	10	41	-31
Zimbabwe	11	11	0	Gabon	11	16	-5
Mali	10	12	-2	The Gambia	12	11	1
Uganda	13	13	0	Algeria	13	34	-21
Comoros	14	14	0	Niger	14	5	9
Niger	21	15	6	Rep. of the Congo	15	20	-5
Rep. of the Congo	17	16	1	Tunisia	16	26	-10
Chad	22	17	5	Côte d'Ivoire	17	6	11
Gabon	19	18	1	Togo	18	9	9
Côte d'Ivoire	23	19	4	Cameroon	19	10	9
Guinea	24	20	4	Equatorial Guinea	20	12	8
Benin	26	21	5	Benin	21	13	8
Somalia	20	22	-2	Guinea-Bissau	22	14	8
Cabo Verde	28	23	5	Chad	23	15	8
Central African Rep	29	24	5	Sao Tome & Princi	24	19	5
The Gambia	30	25	5	South Africa	25	38	-13
Botswana	25	26	-1	Guinea	26	22	4
Guinea-Bissau	32	27	5	Utd Rep. of Tanzan	27	23	4
Namibia	27	28	-1	Central African Rep	28	21	7
Morocco	18	29	-11	Comoros	29	24	5
Mauritius	16	30	-14	Sierra Leone	30	18	12
Sao Tome & Princi	36	31	5	Burundi	31	30	1
Eswatini	31	32	-1	Somalia	32	37	-5
Lesotho	33	33	0	Zimbabwe	33	28	5
Madagascar	34	34	0	Madagascar	34	40	-6
Equatorial Guinea	42	35	7	Nigeria	35	29	6
Liberia	35	36	-1	Seychelles	36	32	4
Seychelles	37	37	0	Botswana	37	33	4
Utd Rep. of Tanzan	39	38	1	Kenya	38	31	7
Egypt	15	39	-24	Djibouti	39	35	4
Nigeria	40	40	0	Ghana	40	25	15
Sierra Leone	44	41	3	Libya	41	45	-4
Malawi	38	42	-4	Uganda	42	39	3
Tunisia	41	43	-2	Mozambique	43	49	-6
D. Rep. of the Cong	46	44	2	Namibia	44	42	2
Cameroon	47	45	2	Lesotho	45	43	2
Zambia	45	46	-1	D. Rep. of the Cong	46	36	10
Ethiopia	43	47	-4	Sudan	47	51	-4
Algeria	48	48	0	Eswatini	48	44	4
Angola	50	49	1	Liberia	49	46	3
Sudan	49	50	-1	Eritrea	50	47	3
Libya	51	51	0	Malawi	51	50	1
Burundi	52	52	0	Zambia	52	52	0
South Sudan	53	53	0	Angola	53	53	0
Eritrea	54	54	0	South Sudan	54	54	0

Step 4

Issue: The removal of the investment variable does not improve the statistical tests.

Action: Removing the variable regional convertibility of currency to check for its impact on the test results and on the macroeconomic dimension.

Result: Statistical test deteriorates. The scale reliability coefficient becomes close to zero; this indicates the poor relationship between the variable inflation and investment. The removal of the currency variable is not recommended.

Table 4 Statistical tests with and without the currency variable at the macroeconomic dimension and overall dimensions (winsorised data)

	Macroeconomic: <i>Inflation- Winsorised Currency Investment</i>	Macroeconomic: <i>Inflation- Winsorised Investment</i>	Dimensions	Dimensions revised
<i>Test scale = mean(unstandardized items)</i>				
<i>Average interitem covariance:</i>	0.0036542	0.0001716	0.0051976	0.0058734
<i>Number of items in the scale:</i>	3	2	5	5
<i>Scale reliability coefficient:</i>	0.1941	0.0069	0.4885	0.5035
<i>Determinant of the correlation matrix</i>	0.976	1	0.462	0.478
<i>Bartlett test of sphericity</i>				
<i>Chi-square</i>	1.245	0.001	39.049	37.329
<i>Degrees of freedom</i>	3	1	10	10
<i>p-value</i>	0.742	0.98	0	0
<i>H0: variables are not intercorrelated</i>				
<i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</i>				
<i>KMO</i>	0.498	0.5	0.505	0.547

Step 5

Issue: Given the above results, for completeness, the problem may be lying in the inflation variable.

Action: Removing the inflation variable to check for its impact on the test results and on the macroeconomic dimension.

Result: Statistical test deteriorates. Thus, the resulting ranking is not reported.

Table 5 Statistical tests with and without the inflation variable at the macroeconomic dimension and overall dimensions (winsorised data)

	Macroeconomic: <i>Inflation-Winsorised Currency Investment</i>	Macroeconomic: <i>Currency Investment</i>
<i>Test scale = mean(unstandardized items)</i>		
<i>Average interitem covariance:</i>	0.0036542	0.004944
<i>Number of items in the scale:</i>	3	2
<i>Scale reliability coefficient:</i>	0.1941	0.1916
<i>Determinant of the correlation matrix</i>	0.976	0.989
<i>Bartlett test of sphericity</i>		
<i>Chi-square</i>	1.245	0.583
<i>Degrees of freedom</i>	3	1
<i>p-value</i>	0.742	0.445
<i>H0: variables are not intercorrelated</i>		
<i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</i>		
<i>KMO</i>	0.498	0.5

Infrastructural dimension

Step 1

Issue: The statistical tests at the infrastructural dimension show some structural issues. It has a low scale reliability coefficient pointing to the poor internal consistency of the variables in the dimension. The low KMO indicates that PCA may not be very useful in defining weights. The variable SAATM seems to be the problem at hand given its negative correlation with the variable infrastructure index.

Action: Removing the SAATM variable to check whether there are improvements in the consistency test and the ranking of the dimension.

Table 6 Statistical tests with and without the SAATM variable at the infrastructural dimension and overall dimensions

	Infrastructure: Infrastructure Connections Electricity SAATM	Infrastructure: Infrastructure Connections Electricity	Dimensions	Dimensions revised **
<i>Test scale = mean(unstandardized items)</i>				
<i>Average interitem covariance:</i>	0.00415	0.00385	0.0051159	0.0049669
<i>Number of items in the scale:</i>	4	3	5	5
<i>Scale reliability coefficient:</i>	0.159	0.2479	0.4759	0.4868
<i>Determinant of the correlation matrix</i>	0.776	0.913	0.459	0.354
<i>Bartlett test of sphericity</i>				
<i>Chi-square</i>	12.921	4.671	39.369	52.459
<i>Degrees of freedom</i>	6	3	10	10
<i>p-value</i>	0.044	0.198	0	0
<i>H0: variables are not intercorrelated</i>				
<i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</i>				
<i>KMO</i>	0.359	0.482	0.489	0.46
** Macroeconomic dimension includes Inflation (winsorised). Investment, currency variables				

Results: The scale reliability coefficient increases both at the infrastructural dimension and at overall dimensions level as shown in Table 6 above. However, at the infrastructural dimension, the Bartlett test statistic loses its significance pointing to possible incongruencies in variables in the dimension.

Ranking on the infrastructural dimension appears to be in line with expectations. There is a sharp decline in the ranks of Central African Rep., Liberia, Sierra Leone and Chad by 25 positions. Contrarily the positions of Seychelles, Tunisia, Libya, Mauritius and Algeria improved considerably.

Overall regional integration ranking tends to reflect the current state of integration. The position of Namibia improves by 13 ranks upwards while that of Mali declines from 10th to 18th position.

Step 2

Issue: The removal of the SAATM variable in the infrastructural dimension improves the scale reliability coefficient, however, the Bartlett's test of sphericity becomes insignificant because of the low correlation in the dimension.

Action: Removing both the electricity and SAATM variables to check whether there are improvements in the consistency test.

Result: The scale reliability coefficient improves considerably on the infrastructural dimension and slightly on the overall dimension. The sphericity test becomes significant as reported in Table 7.

There are considerable reshuffling of the rankings following the removal of the two variables, particularly at the top and bottom of the list: Seychelles, Tunisia, Mauritius, Libya and Algeria gain more than 20 places upwards. Contrarily, Central African Republic, Liberia, Sierra Leone, Niger and Chad lose 24 places and more. Eswatini suffers the most dropping from 5th to 40th position; this is because it is a top importer of electricity which is not accounted for anymore. Overall, the new regional ranking is in line with expectations.

Table 7 Statistical tests with and without the SAATM variable and Electricity variable at the infrastructural dimension and overall dimensions

	Infrastructure: Infrastructure Connections Electricity	Infrastructure: Infrastructure Connections	Dimensions	Dimensions revised **
Test scale = mean (unstandardized items)				
Average interitem covariance:	0.00385	0.01177	0.0051159	0.005863
Number of items in the scale:	3	2	5	5
Scale reliability coefficient:	0.2479	0.4199	0.4759	0.5115
Determinant of the correlation matrix	0.913	0.902	0.459	0.352
Bartlett test of sphericity				
Chi-square	4.671	4.308	39.369	52.759
Degrees of freedom	3	1	10	10
p-value	0.198	0.038	0	0
H0: variables are not intercorrelated				
Kaiser-Meyer-Olkin Measure of Sampling Adequacy				
KMO	0.482	0.5	0.489	0.462
** Macroeconomic dimension includes Inflation (winsorised). Investment, currency variables				

Figure 4 Comparing integration rankings with (old) and without (revised) the SAATM variable for the overall regional and infrastructural rankings

Regional integration				Infrastructural dimension			
Country	Old	Revised	Change	Country	Old	Revised	Change
South Africa	1	1	0	Namibia	9	1	8
Rwanda	2	2	0	South Africa	1	2	-1
Togo	3	3	0	Botswana	2	3	-1
Kenya	4	4	0	Morocco	21	4	17
Mauritania	7	5	2	Egypt	3	5	-2
Djibouti	8	6	2	Seychelles	27	6	21
Ghana	5	7	-2	Tunisia	28	7	21
Mozambique	6	8	-2	Libya	29	8	21
Senegal	12	9	3	Mauritius	30	9	21
Uganda	13	10	3	Kenya	4	10	-6
Mauritius	16	11	5	Eswatini	5	11	-6
Comoros	14	12	2	Algeria	31	12	19
Morocco	18	13	5	Gabon	6	13	-7
Namibia	27	14	13	Ethiopia	8	14	-6
Somalia	20	15	5	Côte d'Ivoire	7	15	-8
Burkina Faso	9	16	-7	Cameroon	33	16	17
Zimbabwe	11	17	-6	Cabo Verde	32	17	15
Mali	10	18	-8	Zambia	34	18	16
Egypt	15	19	-4	Togo	13	19	-6
Cabo Verde	28	20	8	Zimbabwe	10	20	-10
The Gambia	30	21	9	Senegal	35	21	14
Gabon	19	22	-3	Nigeria	12	22	-10
Rep. of the Congo	17	23	-6	Ghana	11	23	-12
Botswana	25	24	1	Benin	14	24	-10
Lesotho	33	25	8	Utd Rep. of Tanzania	36	25	11
Guinea-Bissau	32	26	6	Mozambique	16	26	-10
Côte d'Ivoire	23	27	-4	Rwanda	15	27	-12
Madagascar	34	28	6	Mali	17	28	-11
Niger	21	29	-8	Comoros	38	29	9
Chad	22	30	-8	The Gambia	37	30	7
Guinea	24	31	-7	Uganda	39	31	8
Seychelles	37	32	5	Burkina Faso	18	32	-14
Benin	26	33	-7	Lesotho	44	33	11
Sao Tome & Principe	36	34	2	Djibouti	40	34	6
Tunisia	41	35	6	Sao Tome & Principe	41	35	6
Malawi	38	36	2	Angola	42	36	6
Eswatini	31	37	-6	Malawi	43	37	6
Utd Rep. of Tanzania	39	38	1	Equatorial Guinea	45	38	7
Central African Rep.	29	39	-10	Sudan	46	39	7
Equatorial Guinea	42	40	2	Rep. of the Congo	19	40	-21
Zambia	45	41	4	Madagascar	47	41	6
Liberia	35	42	-7	Guinea	20	42	-22
D. Rep. of the Congo	46	43	3	Mauritania	48	43	5
Algeria	48	44	4	D. Rep. of the Congo	49	44	5
Cameroon	47	45	2	Burundi	50	45	5
Nigeria	40	46	-6	Niger	22	46	-24
Sudan	49	47	2	Guinea-Bissau	51	47	4
Ethiopia	43	48	-5	Central African Rep.	23	48	-25
Angola	50	49	1	Liberia	24	49	-25
Libya	51	50	1	Sierra Leone	25	50	-25
Sierra Leone	44	51	-7	Chad	26	51	-25
Burundi	52	52	0	Somalia	52	52	0
South Sudan	53	53	0	Eritrea	53	53	0
Eritrea	54	54	0	South Sudan	54	54	0

Figure 5 Comparing integration rankings with (old) and without (revised) both the SAATM and Electricity variables for the overall regional and infrastructural rankings

Country	Regional integration			Country	Infrastructural dimension		
	Old	Revised	Change		Old	Revised	Change
South Africa	1	1	0	South Africa	1	1	0
Kenya	4	2	2	Egypt	3	2	1
Rwanda	2	3	-1	Seychelles	27	3	24
Mauritius	16	4	12	Morocco	21	4	17
Ghana	5	5	0	Tunisia	28	5	23
Togo	3	6	-3	Mauritius	30	6	24
Djibouti	8	7	1	Libya	29	7	22
Morocco	18	8	10	Kenya	4	8	-4
Mauritania	7	9	-2	Algeria	31	9	22
Senegal	12	10	2	Ethiopia	8	10	-2
Mozambique	6	11	-5	Côte d'Ivoire	7	11	-4
Egypt	15	12	3	Cabo Verde	32	12	20
Uganda	13	13	0	Zimbabwe	10	13	-3
Comoros	14	14	0	Zambia	34	14	20
Zimbabwe	11	15	-4	Nigeria	12	15	-3
Burkina Faso	9	16	-7	Gabon	6	16	-10
Cabo Verde	28	17	11	Cameroon	33	17	16
Mali	10	18	-8	Ghana	11	18	-7
Somalia	20	19	1	Botswana	2	19	-17
Seychelles	37	20	17	Senegal	35	20	15
Tunisia	41	21	20	Namibia	9	21	-12
Côte d'Ivoire	23	22	1	Utd Rep. of Tanzania	36	22	14
The Gambia	30	23	7	Rwanda	15	23	-8
Gabon	19	24	-5	Benin	14	24	-10
Rep. of the Congo	17	25	-8	Comoros	38	25	13
Guinea-Bissau	32	26	6	The Gambia	37	26	11
Madagascar	34	27	7	Uganda	39	27	12
Sao Tome & Principe	36	28	8	Mali	17	28	-11
Guinea	24	29	-5	Djibouti	40	29	11
Namibia	27	30	-3	Sao Tome & Principe	41	30	11
Chad	22	31	-9	Togo	13	31	-18
Lesotho	33	32	1	Angola	42	32	10
Utd Rep. of Tanzania	39	33	6	Malawi	43	33	10
Niger	21	34	-13	Burkina Faso	18	34	-16
Benin	26	35	-9	Equatorial Guinea	45	35	10
Malawi	38	36	2	Mozambique	16	36	-20
Equatorial Guinea	42	37	5	Sudan	46	37	9
Botswana	25	38	-13	Rep. of the Congo	19	38	-19
Central African Rep.	29	39	-10	Madagascar	47	39	8
Zambia	45	40	5	Eswatini	5	40	-35
Algeria	48	41	7	Guinea	20	41	-21
Nigeria	40	42	-2	Mauritania	48	42	6
Libya	51	43	8	D. Rep. of the Congo	49	43	6
Cameroon	47	44	3	Burundi	50	44	6
Eswatini	31	45	-14	Guinea-Bissau	51	45	6
Liberia	35	46	-11	Lesotho	44	46	-2
D. Rep. of the Congo	46	47	-1	Central African Rep.	23	47	-24
Ethiopia	43	48	-5	Liberia	24	48	-24
Angola	50	49	1	Sierra Leone	25	49	-24
Sudan	49	50	-1	Niger	22	50	-28
Sierra Leone	44	51	-7	Chad	26	51	-25
Burundi	52	52	0	Somalia	52	52	0
South Sudan	53	53	0	Eritrea	53	53	0
Eritrea	54	54	0	South Sudan	54	54	0

Step 3

Issue: The removal of both the electricity and SAATM variables tend to improve the scale reliability coefficient on the infrastructural dimension. It is, however, pertinent to test how the combination of other variables affects the robustness of the dimension.

Action: Test how the combination of the other variables affects the scale reliability coefficient and Bartlett test.

Result: As reported in Table 8 Statistical tests showing various combinations of variables there is no improvement in the scale reliability coefficient.

Table 8 Statistical tests showing various combinations of variables

Variables used:	<i>Infrastructure</i>	<i>Infrastructure</i>	<i>Infrastructure</i>	<i>Infrastructure</i>	<i>Infrastructure</i>			
	Connections	Connections	Connections	Connections	Connections	Connections	Connections	Connections
	Electricity	Electricity		SAATM	Electricity	Electricity	Electricity	SAATM
	Original	v1	v2	v3	v4	v5	v6	v7
Test scale = mean(unstandardized items)								
Average interitem covariance:	0.00415	0.00385	0.01177	0.00610	0.00974	0.00640	0.00749	0.17941
Number of items in the scale:	4	3	2	3	3	2	3	2
Scale reliability coefficient:	0.159	0.2479	0.4199	0.1457	0.2388	0.0876	0.1754	0.2068
Determinant of the correlation matrix	0.776	0.913	0.902	0.792	0.906	0.994	0.97	0.979
Bartlett test of sphericity								
Chi-square	12.921	4.671	4.308	11.908	5.043	0.3	1.58	1.117
Degrees of freedom	6	3	1	3	3	1	3	1
p-value	0.044	0.198	0.038	0.008	0.169	0.584	0.664	0.291
H0: variables are not intercorrelated								
Kaiser-Meyer-Olkin Measure of Sampling Adequacy								
KMO	0.359	0.482	0.5	0.381	0.463	0.5	0.47	0.5

Discussion of the results of the sensitivity analysis

The various sensitivity analyses carried out show how the tests vary with the different combination of variables on the macroeconomic and infrastructural dimensions.

The macroeconomic dimension benefitted from the winsorisation of the inflation differential variable and overall ranking shows improvement. Nevertheless, the dimension suffers from very poor correlation among its variables and sensitivity analyses failed to provide a combination of variables that passes the statistical tests. This result points to the incongruency in the dimension that regroups variables that are not measuring the same concept. It would have been best to revise the variables used in this dimension or re-allocate them to other dimensions. However, because no other exhaustive variables are available at this stage, the three variables are retained but the inflation differential variable is winsorised.

The infrastructural dimension benefitted to some extent from the removal of the SAATM variable as the scale reliability coefficient improves. It benefitted even further when both the SAATM and the electricity trade variables were removed so that the Bartlett test also becomes significant. Thus, these two variables were removed. The AfDB composite index in the infrastructural dimension is itself capturing various key components of infrastructure including electricity, and transport and communication. These two variables account to some extent for the two variables previously removed, thus, ensuring comprehensiveness of the dimension.

6. Overview of final empirical results

The relevance of indicators in their dimensions

In general, indicators in their dimensions are correlated and statistical tests performed on the overall dimensions show acceptable results. However, there are some issues at individual dimensions levels that should be addressed in future editions of the index.

The scale reliability coefficients tend to be low for some dimensions. The macroeconomic dimension has the lowest scale reliability coefficients for many regions, for instance, for Africa and CEN-SAD (See Table 27 and Table 30). The infrastructural dimension for the ECOWAS region also suffers from a low scale reliability coefficient. These results reveal that not all the indicators in these dimensions are measuring the same underlying concept they are supposed to reflect.

The trade integration dimension also has a low scale reliability coefficient, for instance, it is only 0.45 for Africa and 0.37 for COMESA ((See Table 27 and Table 31). It is suspected that the indicator AfCFTA is acting as noise as it is only reflecting an institutional arrangement status and not measuring actual trade integration as compared to the

other indicators in the dimension. In fact, removing the AfCFTA as an indicator improves the scale reliability coefficient. Results are not reported here.

An analysis of the correlation structures as shown in the tables in section 8 reveal low correlations. In the case of Africa, as depicted in Table 18, there are very few cells on the diagonals that are highlighted green, that is, that have a high positive correlation (greater than 0.3). In the macroeconomic dimension, two cells are red-coloured pointing to the negative correlation between its variables. This evidences that the variables included in this dimension are not well-related and should not in principle be grouped together. This issue should be addressed in subsequent editions of ARII to arrive at a more robust conceptual framework.

The latter problem persists even for the RECs: all the variables on the macroeconomic dimensions are negatively correlated for CEN-SAD as shown in Table 21. ECOWAS also suffers from the same flaw, see Table 20. Low correlation is also a feature of the free movement of people dimension for SADC and the smaller communities, EAC and AMU as shown in Table 25 and Table 26 respectively.

Most dimensions at the African level pass the Bartlett's test of sphericity except for the infrastructural and macroeconomic dimension as evidenced in Table 27; the p-values on these dimensions are insignificant. On the contrary, most dimensions at the RECs level fail to pass the test. Moreover, the free movement of people dimension appears to have some specification problems as it reveals collinearity when we consider the tests performed for AMU and ECOWAS.

The KMO tests at the dimensional level are more or less around 0.5 for Africa. However, the results for the trade dimension is lowest indicating that there is poor coherence amongst its indicators. AMU and EAC also suffer from very weak KMOs for the trade dimensions.

On a positive note, generally speaking, the tests performed on the aggregated dimensions have better performances revealing that the 5 dimensions together, trade, productive, macroeconomic, infrastructure and free movement of people, are contributing to measure regional integration. This result does not hold for the small REC AMU.

The significance of the weights assigned through PCA

Table 45 reports all the weights that have been assigned to indicators and dimensions using PCA. The details of the computation of the weights are reported in the section Empirical results: PCA and weightings. As is evident, PCA assigned different weights to the same indicators and dimensions for different regions. This is because the structure of the data is different for different regions.

At the African level, the macroeconomic dimension is assigned the highest weight while the free movement of people dimension has the lowest weight. The macroeconomic dimension has more variance which explains its weight. In general, the free movement of people dimension has less variability as such it has the lowest weight. The productive dimension also has a low weight; it is relatively more related to the trade dimension, thus less significant overall. Contrarily, the trade dimension has the highest weight for ECOWAS while its macroeconomic dimension has the lowest weight.

To cross-check the validity of the results, rankings of countries are computed using an equal weighting system (using the final structure of ARII with 16 indicators) rather than using weights assigned through PCA. The results are reported in Figure 6 and show no drastic change in rankings. The most obvious changes are Morocco and Egypt that lose nine positions with the equal weights ranking (due to their low performance on the free movement of people dimension) and Somalia that gains 8 positions. Statistical tests are performed on the two sets of results both at the overall regional integration level and at the level of each dimension to determine whether they are statistically different. The non-parametric statistical test Kendall tau reveals that there is no statistical difference between the PCA-weighted and equal-weighted rankings as revealed in Figure 8.

However, it should be noted that when comparison of the rankings using PCA weights and equal weights was done using the previous ARII structure with 18 indicators, the results were different, revealing considerable changes in the ranking of some countries as is evident by the longer red bars (negative change) and blue bars (positive change). For instance, Ivory Coast gains eight places with equal weight and is positioned 16th. The Gambia loses six places while Nigeria gains six.

It can be concluded that PCA weights were compensating for some of the discrepancies that exist in the data and dimensions. It is therefore especially useful when the structure of the index is not well-defined due to poor data quality. It provides results that reflect the current state of regional integration. Therefore, the use of PCA is warranted.

When the conceptual framework is better defined, as in the case of ARII 2019 after modifications have been made following sensitivity analysis, PCA results tend to be closer to those using equal weights. The use of variables that are all explaining the same underlying concept provides no room for giving more importance to one variable over another.

Empirical results: Descriptive statistics

Description of variables abbreviation:

Variable name	Description
Tariff	Average intra-regional import tariffs
Trade	Share of intra-regional trade (over regional trade)
Exports	Share of intra-regional exports over GDP
Imports	Share of intra-regional imports over GDP
ACFTA	AfCFTA
Intermediates import	Share of intra-regional intermediate exports
Intermediates export	Share of intra-regional intermediate imports
TCI	Merchandise trade complementarity index
Inflation	Regional inflation differential
Investment	Number of bilateral investment treaties in force
Currency	Regional convertibility of currency
AfDB Infrastructure	AfDB Composite Infrastructure index
Connections	Number of intra-regional flight connections
Required	Number of countries that require a visa
Arrival	Number of countries that may obtain a visa on arrival
Protocol	Free movement of persons protocol (Kigali)
Trade_d	Aggregated trade dimension
Productive_d	Aggregated productive dimension
Macro_d	Aggregated macroeconomic dimension
Infrastruc~d	Aggregated infrastructural dimension
Movement_d	Aggregated free movement of people dimension

Table 9 Descriptive statistics - Africa

Trade dimension	Obs	Mean	Std Dev.	Min	Max
<i>Tariff</i>	54	0.83	0.20	0	1
<i>Trade</i>	54	0.06	0.14	0	1
<i>Exports</i>	54	0.17	0.19	0	1
<i>Imports</i>	54	0.11	0.17	0	1
<i>ACFTA</i>	54	0.65	0.35	0	1
Productive dimension	Obs	Mean	Std Dev.	Min	Max
<i>Intermediates imports</i>	54	0.12	0.17	0	1
<i>Intermediates exports</i>	54	0.08	0.17	0	1
<i>TCI</i>	54	0.38	0.18	0	1
Macroeconomic dimension	Obs	Mean	Std Dev.	Min	Max
<i>Inflation</i>	54	0.79	0.23	0	1
<i>Currency</i>	54	0.26	0.22	0	1
<i>Investment</i>	54	0.12	0.21	0	1
Infrastructural dimension	Obs	Mean	Std Dev.	Min	Max
<i>AfDB Infrastructure</i>	54	0.25	0.24	0	1
<i>Connections</i>	54	0.19	0.17	0	1
Free movement of people	Obs	Mean	Std Dev.	Min	Max
<i>Required</i>	54	0.49	0.37	0	1
<i>Arrival</i>	54	0.27	0.37	0	1
<i>Protocol</i>	54	0.56	0.50	0	1
Aggregated Dimensions	Obs	Mean	Std Dev.	Min	Max
<i>Trade_d</i>	54	0.38	0.12	0.11	0.73
<i>Productive_d</i>	54	0.20	0.13	0.05	1.00
<i>Macro_d</i>	54	0.40	0.13	0.02	0.81
<i>Infrastructure_d</i>	54	0.22	0.17	0.01	0.90
<i>Movement_d</i>	54	0.44	0.31	0.01	1.00

Table 10 Descriptive statistics - SADC

<i>Trade dimension</i>	Obs	Mean	Std. Dev.	Min	Max
<i>Tariff</i>	16	0.88	0.27	0	1
<i>Trade</i>	16	0.16	0.24	0	1
<i>Exports</i>	16	0.24	0.25	0	1
<i>Imports</i>	16	0.24	0.28	0	1
<i>Productive dimension</i>	Obs	Mean	Std. Dev.	Min	Max
<i>Intermediates imports</i>	16	0.38	0.37	0	1
<i>Intermediates exports</i>	16	0.15	0.24	0	1
<i>TCI</i>	16	0.25	0.23	0	1
<i>Macroeconomic dimension</i>	Obs	Mean	Std. Dev.	Min	Max
<i>Inflation</i>	16	0.78	0.30	0	1
<i>Currency</i>	16	0.32	0.31	0	1
<i>Investment</i>	16	0.16	0.29	0	1
<i>Infrastructural dimension</i>	Obs	Mean	Std. Dev.	Min	Max
<i>AfDB Infrastructure</i>	16	0.26	0.31	0	1
<i>Connections</i>	16	0.17	0.24	0	1
<i>Free movement of people</i>	Obs	Mean	Std. Dev.	Min	Max
<i>Required</i>	16	0.80	0.28	0	1
<i>Arrival</i>	16	0.27	0.37	0	1
<i>Protocol</i>	16	0.44	0.51	0	1
<i>Aggregated Dimensions</i>	Obs	Mean	Std. Dev.	Min	Max
<i>Trade_d</i>	16	0.34	0.18	0.01	0.59
<i>Productive_d</i>	16	0.24	0.23	0.06	0.99
<i>Macro_d</i>	16	0.42	0.18	0.09	0.72
<i>Infrastructure_d</i>	16	0.21	0.23	0.02	0.89
<i>Movement_d</i>	16	0.49	0.23	0.22	1.00

Table 11 Descriptive statistics - ECOWAS

Trade dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Tariff</i>	15	0.921	0.26	0	1
<i>Trade</i>	15	0.266	0.30	0	1
<i>Exports</i>	15	0.295	0.30	0	1
<i>Imports</i>	15	0.353	0.30	0	1
Productive dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>Intermediates imports</i>	15	0.14	0.25	0	1
<i>Intermediates exports</i>	15	0.14	0.25	0	1
<i>TCI</i>	15	0.41	0.31	0	1
Macroeconomic dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>Inflation</i>	15	0.552	0.21	0	1
<i>Currency</i>	15	0.133	0.35	0	1
<i>Investment</i>	15	0.831	0.31	0	1
Infrastructural dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>AfDB Infrastructure</i>	15	0.305	0.24	0	1
<i>Connections</i>	15	0.292	0.26	0	1
Free movement of people					
	Obs	Mean	Std. Dev.	Min	Max
<i>Required</i>	15	1.000	0.00	1	1
<i>Arrival</i>	15	1.000	0.00	1	1
<i>Protocol</i>	15	0.200	0.41	0	1
Aggregated Dimensions					
	Obs	Mean	Std. Dev.	Min	Max
<i>Trade_d</i>	15	0.438	0.16	0.20	0.77
<i>Productive_d</i>	15	0.220	0.20	0.00	0.72
<i>Macro_d</i>	15	0.469	0.18	0.25	0.86
<i>Infrastructure_d</i>	15	0.298	0.17	0.07	0.66
<i>Movement_d</i>	15	0.733	0.14	0.67	1.00

Table 12 Descriptive statistics – CEN-SAD

Trade dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Tariff</i>	29	0.78	0.27	0	1
<i>Trade</i>	29	0.21	0.26	0	1
<i>Exports</i>	29	0.19	0.26	0	1
<i>Imports</i>	29	0.24	0.27	0	1
Productive dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Intermediates imports</i>	29	0.12	0.19	0	1
<i>Intermediates exports</i>	29	0.11	0.20	0	1
<i>TCI</i>	29	0.46	0.26	0	1
Macroeconomic dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Inflation</i>	29	0.47	0.32	0	1
<i>Currency</i>	29	0.13	0.24	0	1
<i>Investment</i>	29	0.78	0.24	0	1
Infrastructural dimension	Obs	Mean	Std. Dev.	Min	Max
<i>AfDB Infrastructure</i>	29	0.27	0.26	0	1
<i>Connections</i>	29	0.34	0.25	0	1
Free movement of people	Obs	Mean	Std. Dev.	Min	Max
<i>Required</i>	29	0.61	0.36	0	1
<i>Arrival</i>	29	0.28	0.38	0	1
<i>Protocol</i>	29	0.62	0.49	0	1
Aggregated Dimensions	Obs	Mean	Std. Dev.	Min	Max
<i>Trade_d</i>	29	0.38	0.16	0.03	0.78
<i>Productive_d</i>	29	0.26	0.15	0.03	0.62
<i>Macro_d</i>	29	0.44	0.15	0.19	0.94
<i>Infrastructure_d</i>	29	0.30	0.21	0.06	0.80
<i>Movement_d</i>	29	0.51	0.31	0.00	1.00

Table 13 Descriptive statistics - COMESA

Trade dimension	Obs	Mean	Std Dev.	Min	Max
<i>Tariff</i>	21	0.856	0.287	0	1
<i>Trade</i>	21	0.301	0.295	0	1
<i>Exports</i>	21	0.322	0.263	0	1
<i>Imports</i>	21	0.289	0.284	0	1
Productive dimension	Obs	Mean	Std Dev.	Min	Max
<i>Intermediates imports</i>	21	0.202	0.238	0	1
<i>Intermediates exports</i>	21	0.246	0.299	0	1
<i>TCI</i>	21	0.507	0.292	0	1
Macroeconomic dimension	Obs	Mean	Std Dev.	Min	Max
<i>Inflation</i>	21	0.117	0.217	0	1
<i>Currency</i>	21	0.155	0.240	0	1
<i>Investment</i>	21	0.778	0.294	0	1
Infrastructural dimension	Obs	Mean	Std Dev.	Min	Max
<i>AfDB Infrastructure</i>	21	0.311	0.316	0	1
<i>Connections</i>	21	0.322	0.250	0	1
Free movement of people	Obs	Mean	Std Dev.	Min	Max
<i>Required</i>	21	0.319	0.382	0	1
<i>Arrival</i>	21	0.549	0.414	0	1
<i>Protocol</i>	21	0.286	0.463	0	1
Aggregated Dimensions	Obs	Mean	Std Dev.	Min	Max
<i>Trade_d</i>	21	0.445	0.166	0.15	0.95
<i>Productive_d</i>	21	0.328	0.212	0.07	0.83
<i>Macro_d</i>	21	0.365	0.148	0.12	0.67
<i>Infrastructure_d</i>	21	0.317	0.180	0.07	0.66
<i>Movement_d</i>	21	0.385	0.361	0.00	1.00

Table 14 Descriptive statistics - ECCAS

Trade dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Tariff</i>	11	0.55	0.39	0	1
<i>Trade</i>	11	0.28	0.31	0	1
<i>Exports</i>	11	0.27	0.32	0	1
<i>Imports</i>	11	0.22	0.33	0	1
Productive dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>Intermediates imports</i>	11	0.19	0.30	0	1
<i>Intermediates exports</i>	11	0.36	0.37	0	1
<i>TCI</i>	11	0.41	0.30	0	1
Macroeconomic dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>Inflation</i>	11	0.75	0.29	0	1
<i>Currency</i>	11	0.00	0.00	0.00	0.00
<i>Investment</i>	11	0.58	0.28	0	1
Infrastructural dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>AfDB Infrastructure</i>	11	0.48	0.32	0	1
<i>Connections</i>	11	0.27	0.32	0	1
Free movement of people					
	Obs	Mean	Std. Dev.	Min	Max
<i>Required</i>	11	0.42	0.31	0	1
<i>Arrival</i>	11	0.09	0.30	0	1
<i>Protocol</i>	11	0.82	0.40	0	1
Aggregated Dimensions					
	Obs	Mean	Std. Dev.	Min	Max
<i>Trade_d</i>	11	0.36	0.22	0.08	0.89
<i>Productive_d</i>	11	0.32	0.22	0.08	0.87
<i>Macro_d</i>	11	0.68	0.25	0.00	0.92
<i>Infrastructure_d</i>	11	0.37	0.26	0.00	0.83
<i>Movement_d</i>	11	0.47	0.25	0.06	1.00

Table 15 Descriptive statistics - IGAD

Trade dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Tariff</i>	8	0.78	0.34	0	1
<i>Trade</i>	8	0.37	0.41	0	1
<i>Exports</i>	8	0.36	0.41	0	1
<i>Imports</i>	8	0.24	0.33	0	1
Productive dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Intermediates imports</i>	8	0.27	0.33	0	1
<i>Intermediates exports</i>	8	0.25	0.44	0	1
<i>TCI</i>	8	0.47	0.36	0	1
Macroeconomic dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Inflation</i>	8	0.33	0.36	0	1
<i>Currency</i>	8	0.25	0.46	0	1
<i>Investment</i>	8	0.73	0.32	0	1
Infrastructural dimension	Obs	Mean	Std. Dev.	Min	Max
<i>AfDB Infrastructure</i>	8	0.48	0.41	0	1
<i>Connections</i>	8	0.48	0.34	0	1
Free movement of people	Obs	Mean	Std. Dev.	Min	Max
<i>Required</i>	8	0.50	0.42	0	1
<i>Arrival</i>	8	0.45	0.39	0	1
<i>Protocol</i>	8	0.75	0.46	0	1
Aggregated Dimensions	Obs	Mean	Std. Dev.	Min	Max
<i>Trade_d</i>	8	0.44	0.17	0.23	0.74
<i>Productive_d</i>	8	0.32	0.34	0.04	0.91
<i>Macro_d</i>	8	0.42	0.19	0.25	0.85
<i>Infrastructure_d</i>	8	0.48	0.31	0.04	1.00
<i>Movement_d</i>	8	0.54	0.37	0.06	1.00

Table 16 Descriptive statistics - EAC

Trade dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Tariff</i>	6	1.000	0.000	1	1
<i>Trade</i>	6	0.473	0.432	0	1
<i>Exports</i>	6	0.393	0.363	0	1
<i>Imports</i>	6	0.448	0.415	0	1
Productive dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Intermediates imports</i>	6	0.482	0.361	0	1
<i>Intermediates exports</i>	6	0.458	0.449	0	1
<i>TCI</i>	6	0.360	0.434	0	1
Macroeconomic dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Inflation</i>	6	0.500	0.408	0	1
<i>Currency</i>	6	0.820	0.402	0	1
<i>Investment</i>	6	0.000	0.000	0	0
Infrastructural dimension	Obs	Mean	Std. Dev.	Min	Max
<i>AfDB Infrastructure Connections</i>	6	0.572	0.361	0	1
	6	0.537	0.372	0	1
Free movement of people	Obs	Mean	Std. Dev.	Min	Max
<i>Required</i>	6	0.833	0.408	0	1
<i>Arrival</i>	6	0.500	0.474	0	1
<i>Protocol</i>	6	0.667	0.516	0	1
Aggregated Dimensions	Obs	Mean	Std. Dev.	Min	Max
<i>Trade_d</i>	6	0.440	0.270	0.117	0.829
<i>Productive_d</i>	6	0.434	0.374	0.003	0.910
<i>Macro_d</i>	6	0.660	0.362	0.000	0.991
<i>Infrastructure_d</i>	6	0.555	0.339	0.000	1.000
<i>Movement_d</i>	6	0.664	0.191	0.410	1.000

Table 17 Descriptive statistics - AMU

Trade dimension	Obs	Mean	Std. Dev.	Min	Max
<i>Tariff</i>	5	0.579	0.427	0	1
<i>Trade</i>	5	0.557	0.448	0	1
<i>Exports</i>	5	0.306	0.408	0	1
<i>Imports</i>	5	0.488	0.428	0	1
Productive dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>Intermediates imports</i>	5	0.445	0.418	0	1
<i>Intermediates exports</i>	5	0.407	0.386	0	1
<i>TCI</i>	5	0.496	0.428	0	1
Macroeconomic dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>Inflation</i>	5	0.743	0.423	0	1
<i>Currency</i>	5	0.400	0.365	0	1
<i>Investment</i>	Constant				
Infrastructural dimension					
	Obs	Mean	Std. Dev.	Min	Max
<i>AfDB Infrastructure</i>	5	0.633	0.382	0	1
<i>Connections</i>	5	0.384	0.392	0	1
Free movement of people					
	Obs	Mean	Std. Dev.	Min	Max
<i>Required</i>	5	0.333	0.471	0	1
<i>Arrival</i>	5	0.200	0.447	0	1
<i>Protocol</i>	5	0.200	0.447	0	1
Aggregated Dimensions					
	Obs	Mean	Std. Dev.	Min	Max
<i>Trade_d</i>	5	0.481	0.198	0.253	0.790
<i>Productive_d</i>	5	0.449	0.330	0.000	0.796
<i>Macro_d</i>	5	0.571	0.310	0.167	0.998
<i>Infrastructure_d</i>	5	0.509	0.325	0.000	0.906
<i>Movement_d</i>	5	0.222	0.349	0.000	0.833

Empirical results: Correlation structures

Green High correlation >.3 Red Negative correlation <.3

Table 18 Pearson Correlation Coefficients-Africa

		Free Movement			Productive			Trade					Macroeconomic			Infrastructure	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Required	1.00															
2	Arrival	0.90	1.00														
3	Protocol	0.13	0.09	1.00													
4	Intermediates import	-0.14	-0.22	-0.32	1.00												
5	Intermediates export	-0.15	-0.22	-0.27	0.75	1.00											
6	TCI	0.08	0.07	-0.02	0.22	0.28	1.00										
7	Trade	-0.09	-0.15	-0.25	0.79	0.93	0.43	1.00									
8	Tariff	-0.05	-0.10	-0.04	0.15	0.12	-0.19	0.14	1.00								
9	Exports	0.06	-0.11	-0.18	0.41	0.16	-0.23	0.15	0.11	1.00							
10	Imports	-0.08	-0.15	0.01	0.25	-0.03	-0.42	-0.06	0.18	0.66	1.00						
11	ACFTA	0.04	-0.10	0.35	0.03	0.06	0.01	0.15	0.14	0.19	0.01	1.00					
12	Currency	0.09	-0.02	0.17	-0.22	-0.08	-0.06	-0.10	-0.04	-0.23	-0.25	0.30	1.00				
13	Inflation	0.30	0.19	-0.09	-0.06	-0.11	0.02	-0.03	-0.08	0.10	0.01	0.31	0.11	1.00			
14	Investment	-0.18	-0.15	-0.31	0.09	0.14	0.14	0.16	-0.03	-0.15	-0.22	-0.06	-0.11	0.00	1.00		
15	Infrastructure	-0.02	-0.03	-0.47	0.29	0.31	0.28	0.35	0.09	0.09	-0.11	-0.08	-0.13	0.07	0.58	1.00	
16	Connections	-0.04	-0.10	-0.27	0.69	0.68	0.38	0.76	0.04	0.08	-0.21	0.21	-0.04	0.08	0.32	0.28	1.00

Table 19 Pearson Correlation Coefficients - SADC

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Required	1.000														
2	Arrival	0.446	1.000													
3	Protocol	-0.358	-0.057	1.000												
4	Intermediates import	-0.053	-0.463	-0.247	1.000											
5	Intermediates export	-0.141	-0.372	-0.186	0.620	1.000										
6	TCI	0.040	-0.103	-0.218	0.310	0.803	1.000									
7	Trade	-0.091	-0.384	-0.289	0.721	0.972	0.778	1.000								
8	Tariff	0.224	-0.402	-0.462	0.302	0.179	0.090	0.234	1.000							
9	Exports	-0.006	-0.485	-0.245	0.266	0.060	-0.228	0.135	0.387	1.000						
10	Imports	-0.045	-0.412	0.053	0.265	-0.167	-0.406	-0.031	0.323	0.610	1.000					
11	Currency	0.293	0.164	0.314	-0.063	0.056	0.222	0.007	-0.226	-0.388	-0.368	1.000				
12	Inflation	0.490	0.223	-0.511	-0.001	0.071	-0.127	0.116	0.063	0.212	0.195	-0.226	1.000			
13	Investment	0.303	-0.017	-0.269	-0.038	0.207	0.370	0.199	0.227	-0.236	-0.336	0.254	0.192	1.000		
14	Infrastructure	0.255	0.094	-0.484	0.053	0.347	0.430	0.360	0.258	-0.066	-0.204	-0.323	0.384	0.405	1.000	
15	Connections	0.063	-0.266	-0.209	0.626	0.961	0.845	0.952	0.215	-0.029	-0.212	0.151	0.073	0.332	0.386	1.000

Table 20 Pearson Correlation Coefficients - ECOWAS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Required
2 Arrival
3 Protocol	.	.	1.000	.	.	.	.	.	.	.	.	.	.	.	.
4 Intermediates import	.	.	0.031	1.000	.	.	.	.	.	.	.	.	.	.	.
5 Intermediates export	.	.	-0.157	0.161	1.000	.	.	.	.	.	.	.	.	.	.
6 TCI	.	.	0.020	0.594	0.229	1.000	.	.	.	.	.	.	.	.	.
7 Trade	.	.	-0.022	0.746	0.720	0.499	1.000	.	.	.	.	.	.	.	.
8 Tariff	.	.	0.159	0.168	0.128	0.215	0.194	1.000	.	.	.	.	.	.	.
9 Exports	.	.	0.243	0.399	-0.081	0.413	0.186	0.278	1.000	.	.	.	.	.	.
10 Imports	.	.	0.377	0.156	-0.306	-0.286	0.015	-0.537	-0.053	1.000	.	.	.	.	.
11 Currency	.	.	-0.127	-0.092	0.081	-0.453	0.065	-0.494	-0.036	0.481	1.000	.	.	.	.
12 Inflation	.	.	0.136	0.120	-0.612	0.018	-0.460	0.016	0.351	0.125	-0.356	1.000	.	.	.
13 Investment	.	.	0.294	-0.062	-0.088	-0.091	-0.119	0.125	-0.131	0.070	-0.032	0.208	1.000	.	.
14 Infrastructure	.	.	-0.208	0.016	0.078	0.099	0.023	0.219	-0.129	-0.376	0.162	-0.251	-0.132	1.000	.
15 Connections	.	.	0.119	0.882	0.366	0.606	0.849	0.203	0.537	0.104	0.029	-0.142	-0.044	-0.049	1.000

Table 21 Pearson Correlation Coefficients – CEN-SAD

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Required	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2 Arrival	0.725	1.000	.	.	.	.	.	.	.	.	.	.	.	.	.
3 Protocol	0.246	0.173	1.000	.	.	.	.	.	.	.	.	.	.	.	.
4 Intermediates import	-0.031	-0.228	-0.263	1.000	.	.	.	.	.	.	.	.	.	.	.
5 Intermediates export	-0.116	-0.258	-0.401	0.356	1.000	.	.	.	.	.	.	.	.	.	.
6 TCI	-0.163	-0.112	0.062	0.018	0.129	1.000	.	.	.	.	.	.	.	.	.
7 Trade	-0.098	-0.292	-0.410	0.775	0.779	0.031	1.000	.	.	.	.	.	.	.	.
8 Tariff	-0.057	-0.200	-0.002	0.103	0.096	-0.270	0.165	1.000	.	.	.	.	.	.	.
9 Exports	0.379	0.072	0.039	0.405	0.052	-0.094	0.258	0.198	1.000	.	.	.	.	.	.
10 Imports	0.210	-0.213	0.035	0.242	-0.124	-0.285	0.134	0.040	0.283	1.000	.	.	.	.	.
11 Currency	0.042	-0.320	-0.139	0.115	0.180	-0.290	0.173	0.265	0.283	0.494	1.000	.	.	.	.
12 Inflation	0.491	0.289	0.191	0.016	-0.374	-0.031	-0.207	-0.015	0.348	0.129	-0.071	1.000	.	.	.
13 Investment	-0.403	-0.195	-0.282	0.096	0.146	-0.072	0.286	-0.056	-0.166	-0.138	-0.023	-0.076	1.000	.	.
14 Infrastructure	-0.360	-0.191	-0.501	0.103	0.275	-0.159	0.331	0.037	-0.120	-0.303	0.020	-0.315	0.679	1.000	.
15 Connections	-0.031	-0.270	-0.327	0.762	0.540	0.038	0.844	0.018	0.422	0.155	0.202	-0.038	0.448	0.384	1.000

Table 22 Pearson Correlation Coefficients - COMESA

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Required	1.000														
2 Arrival	0.760	1.000													
3 Protocol	0.472	0.646	1.000												
4 Intermediates import	-0.120	-0.147	-0.009	1.000											
5 Intermediates export	-0.252	-0.287	0.097	0.716	1.000										
6 TCI	0.306	0.324	0.236	0.196	0.266	1.000									
7 Trade	-0.213	-0.243	-0.057	0.831	0.797	0.426	1.000								
8 Tariff	0.022	-0.166	-0.230	0.118	0.015	-0.228	0.125	1.000							
9 Exports	0.308	-0.061	-0.009	0.510	0.331	0.237	0.368	0.270	1.000						
10 Imports	0.365	0.320	0.234	0.269	-0.115	0.217	0.003	-0.232	0.270	1.000					
11 Currency	0.242	0.264	0.377	-0.057	-0.148	0.182	-0.027	0.048	0.076	0.368	1.000				
12 Inflation	0.491	0.346	0.176	-0.545	-0.454	0.188	-0.367	-0.111	-0.113	-0.102	0.169	1.000			
13 Investment	-0.454	-0.242	-0.305	-0.088	0.119	0.053	0.278	-0.043	-0.397	-0.369	-0.144	-0.061	1.000		
14 Infrastructure	-0.086	-0.357	-0.328	-0.116	0.198	0.073	0.114	0.045	-0.004	-0.294	-0.205	-0.039	0.457	1.000	
15 Connections	-0.037	-0.042	0.131	0.398	0.274	0.244	0.628	-0.023	0.104	-0.044	0.184	0.048	0.214	-0.204	1.000

Table 23 Pearson Correlation Coefficients - ECCAS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Required	1														
2 Arrival	0.631	1													
3 Protocol	0.110	0.149	1												
4 Intermediates import	0.103	-0.133	-0.548	1											
5 Intermediates export	-0.129	0.148	-0.221	0.492	1										
6 TCI	0.274	0.059	0.034	0.209	-0.174	1									
7 Trade	0.146	-0.110	-0.093	0.593	0.531	0.219	1								
8 Tariff	-0.179	-0.337	0.503	-0.439	-0.060	0.219	0.062	1							
9 Exports	0.416	0.382	-0.092	0.287	0.532	0.090	0.737	-0.127	1						
10 Imports	0.015	-0.210	0.270	-0.146	-0.191	-0.175	0.161	0.019	0.158	1					
11 Currency	0.650	0.496	0.360	0.106	0.138	0.020	0.144	-0.303	0.300	0.240	1				
12 Inflation	0.422	0.063	-0.225	0.067	0.214	-0.087	0.206	-0.080	0.370	0.238	0.530	1			
13 Investment													1		
14 Infrastructure	0.010	0.178	-0.002	-0.116	0.082	0.428	-0.108	-0.039	0.244	0.261	0.152	0.209		1	
15 Connections	0.138	-0.111	-0.452	0.733	0.542	0.505	0.673	-0.135	0.559	-0.153	0.141	0.373		0.351	1

Table 24 Pearson Correlation Coefficients - IGAD

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Required	1														
2 Arrival	0.930	1													
3 Protocol	0.492	0.601	1												
4 Intermediates import	0.269	0.096	0.474	1											
5 Intermediates export	0.341	0.049	0.308	0.769	1										
6 TCI	0.652	0.472	0.304	0.398	0.721	1									
7 Trade	0.103	-0.220	0.086	0.731	0.886	0.362	1								
8 Tariff	-0.283	-0.430	-0.327	0.052	0.266	0.246	0.296	1							
9 Exports	0.631	0.448	0.243	0.395	0.510	0.584	0.458	0.435	1						
10 Imports	0.509	0.646	0.326	0.012	-0.262	-0.046	-0.389	-0.825	-0.269	1					
11 Currency	-0.213	-0.248	0.000	0.179	0.013	-0.376	0.215	0.045	-0.223	0.167	1				
12 Inflation	0.565	0.353	-0.203	-0.002	0.342	0.539	0.288	0.050	0.617	-0.112	-0.612	1			
13 Investment	-0.616	-0.601	-0.333	-0.250	-0.286	-0.724	0.104	-0.036	-0.243	-0.429	0.000	-0.056	1		
14 Infrastructure	0.405	0.262	0.396	0.333	0.638	0.702	0.464	0.471	0.788	-0.520	-0.461	0.510	-0.164	1	
15 Connections	0.264	0.044	0.007	0.022	0.463	0.194	0.580	-0.081	0.314	-0.200	-0.048	0.575	0.336	0.394	1

Table 25 Pearson Correlation Coefficients - EAC

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Required	1														
2 Arrival	-0.258	1													
3 Protocol	-0.316	-0.204	1												
4 Intermediates import	0.398	-0.520	0.507	1											
5 Intermediates export	0.499	-0.948	0.242	0.639	1										
6 TCI	0.378	-0.878	0.447	0.556	0.935	1									
7 Trade	0.497	-0.874	0.427	0.741	0.970	0.956	1								
8 Tariff								1							
9 Exports	0.530	-0.690	0.446	0.888	0.807	0.805	0.886		1						
10 Imports	-0.017	0.892	-0.011	-0.177	-0.760	-0.649	-0.616		-0.296	1					
11 Currency	0.600	0.344	-0.316	-0.088	-0.093	-0.186	-0.067		-0.179	0.308	1				
12 Inflation	1.000	-0.253	-0.335	0.399	0.490	0.361	0.485		0.526	-0.013	0.594	1			
13 Investment													1		
14 Infrastructure	0.776	-0.385	0.305	0.554	0.647	0.708	0.754		0.725	-0.063	0.436	0.758		1	
15 Connections	0.707	-0.545	-0.023	0.425	0.726	0.579	0.701		0.443	-0.486	0.591	0.696		0.708	1

Table 26 Pearson Correlation Coefficients - AMU

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Required	1														
2 Arrival	-0.395	1													
3 Protocol	-0.395	1.000	1												
4 Intermediates import	-0.154	-0.595	-0.595	1											
5 Intermediates export	-0.331	-0.588	-0.588	0.249	1										
6 TCI	0.025	-0.648	-0.648	0.940	0.191	1									
7 Trade	-0.377	-0.695	-0.695	0.752	0.815	0.697	1								
8 Tariff	0.801	-0.758	-0.758	0.064	0.234	0.285	0.156	1							
9 Exports	-0.471	-0.419	-0.419	0.809	0.463	0.572	0.757	-0.270	1						
10 Imports	-0.395	0.669	0.669	-0.005	-0.567	-0.238	-0.395	-0.845	0.246	1					
11 Currency															
12 Inflation	-0.722	0.340	0.340	0.400	-0.061	0.403	0.297	-0.583	0.275	0.289		1			
13 Investment	0.4841	-0.1021	-0.1021	0.3667	-0.6275	0.5654	-0.1824	0.2925	-0.1964	-0.0145		0.2371	1		
14 Infrastructure	0.618	-0.928	-0.928	0.473	0.348	0.495	0.428	0.772	0.329	-0.499		-0.585	0.1573	1	
15 Connections	-0.428	-0.548	-0.548	0.857	0.570	0.668	0.865	-0.129	0.981	0.064		0.281	-0.1609	0.409	1

Empirical results: Eligibility tests

Table 27 Statistical test results - Africa

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.007	0.012	0.004	0.004	0.054	0.006
Number of items in the scale:	5	3	3	3	3	5
Scale reliability coefficient:	0.450	0.674	0.194	0.248	0.571	0.500
Determinant of the correlation matrix	0.454	0.396	0.976	0.913	0.192	0.378
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	39.838	47.334	1.245	4.671	84.36	49.091
Degrees of freedom	10	3	3	3	3	10
p-value	0	0	0.742	0.198	0	0
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.449	0.545	0.498	0.482	0.502	0.461

Table 28 Statistical test results - SADC

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.019	0.042	0.009	0.028	0.037	0.014
Number of items in the scale:	4	3	3	2	3	5
Scale reliability coefficient:	0.611	0.758	0.252	0.544	0.471	0.694
Determinant of the correlation matrix	0.481	0.183	0.826	0.851	0.688	0.199
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	9.38	22.351	2.524	2.182	4.925	20.204
Degrees of freedom	6	3	3	1	3	10
p-value	0.153	0	0.471	0.14	0.177	0.027
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.59	0.471	0.378	0.5	0.477	0.637

Table 29 Statistical test results - ECOWAS

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.165	0.025	0.016	0.003		0.007
Number of items in the scale:	4	3	3	2		5
Scale reliability coefficient:	0.490	0.601	0.401	0.094		0.624
Determinant of the correlation matrix	0.601	0.613	0.834	0.998		0.203
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	6.034	5.959	2.208	0.03		18.346
Degrees of freedom	6	3	3	1		10
p-value	0.419	0.114	0.53	0.862		0.049
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.49	0.541	0.495	0.5		0.622

Table 30 Statistical test results – CEN-SAD

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.008	0.007	0.003	0.025	0.059	0.011
Number of items in the scale:	4	3	3	2	3	5
Scale reliability coefficient:	0.464	0.337	0.103	0.554	0.606	0.630
Determinant of the correlation matrix	0.809	0.858	0.988	0.854	0.446	0.401
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	5.483	4	0.316	4.226	21.157	23.319
Degrees of freedom	6	3	3	1	3	10
p-value	0.484	0.261	0.959	0.04	0	0.01
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.596	0.497	0.482	0.5	0.532	0.597

Table 31 Statistical test results - COMESA

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.0102	0.0293	0.0075	0.0161	0.1084	0.0061
Number of items in the scale:	4	3	3	2	3	5
Scale reliability coefficient:	0.369	0.647	0.287	0.332	0.825	0.404
Determinant of the correlation matrix	0.656	0.453	0.95	0.958	0.246	0.343
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	7.52	14.41	0.93	0.79	25.49	18.74
Degrees of freedom	6	3	3	1	3	10
p-value	0.276	0.002	0.818	0.375	0	0.044
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.42	0.54	0.54	0.50	0.63	0.431

Table 32 Statistical test results - ECCAS

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.0188	0.0182	0.0449	0.0359	0.0300	0.0129
Number of items in the scale:	4	3	2	2	3	5
Scale reliability coefficient:	0.4387	0.3828	0.692	0.5194	0.5112	0.5897
Determinant of the correlation matrix	0.413	0.648	matrix has zero values on diagonal	0.877	0.589	0.309
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	6.93	3.54		1.12	4.33	8.81
Degrees of freedom	6	3		1	3	10
p-value	0.328	0.316		0.291	0.228	0.55
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.47	0.38		0.50	0.52	0.55

Table 33 Statistical test results - IGAD

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.021	0.046	0.011	0.030	0.051	0.012
Number of items in the scale:	4	3	3	2	3	5
Scale reliability coefficient:	0.613	0.773	0.292	0.545	0.587	0.662
Determinant of the correlation matrix	0.374	0.202	0.746	0.85	0.685	0.145
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	11.638	19.447	3.568	2.031	4.601	22.193
Degrees of freedom	6	3	3	1	3	10
p-value	0.071	0	0.312	0.154	0.203	0.014
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.556	0.554	0.352	0.5	0.588	0.431

Table 34 Statistical test results - EAC

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.0979	0.1244	0.0974	0.0952	0.0222	0.0453
Number of items in the scale:	3	3	2	2	3	5
Scale reliability coefficient:	0.8177	0.8835	0.7449	0.8288	0.2526	0.8084
Determinant of the correlation matrix	0.071	0.073	0.648	0.499	0.758	0.001
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	8.40	8.28	1.52	2.44	0.88	18.32
Degrees of freedom	3	3	1	1	3	10
p-value	0.039	0.04	0.218	0.119	0.831	0.05
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.39	0.61	0.50	0.50	0.36	0.26

Table 35 Statistical test results - AMU

	Trade	Productive	Macroeconomic	Infrastructure	Movement	Dimensions
Test scale = mean (unstandardized items)						
Average interitem covariance:	0.3523	0.0801	0.0366	0.0612	0.1222	0.0470
Number of items in the scale:	4	3	2	2	3	5
Scale reliability coefficient:	0.4879	0.7295	0.3801	0.5808	0.8115	0.832
Determinant of the correlation matrix	0.004	0.107	0.832	0.739	.	0
Bartlett test of sphericity (H0: variables are not intercorrelated)						
Chi-square	10.16	4.84	0.46	0.65	.	.
Degrees of freedom	6	3	1	3	.	10
p-value	0.118	0.184	0.498	884	.	.
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.23	0.51	0.50	0.40	.	.

Empirical results: PCA and weightings

Table 36 Results of PCA and weights derived for indicators and dimensions - Africa

Component	Eigenvalue	Difference	Proportion	Cumulative	Eigenvectors					Loadings					Weights
					Variable	Comp1	Comp2	Comp3	Unexplained	Variable	Comp1	Comp2	Comp3	Unexplained	
Comp1	1.781	0.572	0.356	0.356	Tariff	0.313	0.351	0.851	0.036	Tariff	0.417	0.386	0.801	Tariff	0.249
Comp2	1.209	0.323	0.242	0.598	Trade	0.183	0.633	-0.137	0.440	Trade	0.244	0.696	-0.129	Trade	0.144
Comp3	0.886	0.045	0.177	0.775	Exports	0.655	-0.171	-0.253	0.143	Exports	0.875	-0.188	-0.238	Exports	0.221
Comp4	0.841	0.557	0.168	0.943	Imports	0.612	-0.407	0.059	0.130	Imports	0.817	-0.447	0.055	Imports	0.224
Comp5	0.283	.	0.057	1.000	ACFTA	0.255	0.531	-0.435	0.375	ACFTA	0.340	0.584	-0.409	ACFTA	0.161
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp 1	Comp 2	Comp 3		
Comp1	1.894	1.030	0.631	0.631	Intermedia-M	0.651	-0.306	0.117		Intermedia-M	0.896	-0.284		Intermedia-M	0.320
Comp2	0.864	0.622	0.288	0.919	Intermedia-X	0.665	-0.213	0.124		Intermedia-X	0.915	-0.198		Intermedia-X	0.318
Comp3	0.242	.	0.081	1.000	TCI	0.367	0.928	0.001		TCI	0.505	0.863		TCI	0.362
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp 1	Comp 2			
Comp1	1.157	0.161	0.386	0.386	Inflation	0.519	0.683	0.224		Inflation	0.558	0.682		Inflation	0.360
Comp2	0.997	0.150	0.332	0.718	Currency	0.703	0.002	0.428		Currency	0.756	0.002		Currency	0.266
Comp3	0.846	.	0.282	1.000	Investment	-0.487	0.730	0.195		Investment	-0.523	0.729		Investment	0.374
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Unexplained				Comp 1				
Comp1	1.284	0.266	0.428	0.428	Infrastruc-e	0.707	0.358			Infrastruc-e	0.801			Infrastructure	0.500
Comp2	1.018	0.319	0.339	0.767	Connections	0.707	0.358			Connections	0.801			Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp 1	Comp 2			
Comp1	1.921	0.945	0.640	0.640	Required	0.700	-0.091	0.051		Required	0.970	-0.090		Required	0.327
Comp2	0.976	0.874	0.325	0.966	Arrival	0.696	-0.137	0.051		Arrival	0.965	-0.135		Arrival	0.328
Comp3	0.103	.	0.034	1.000	Protocol	0.161	0.986	0.000		Protocol	0.224	0.975		Protocol	0.345
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Comp3	Unexplained		Comp 1	Comp 2	Comp 3		
Comp1	1.950	0.867	0.390	0.390	Trade_d	0.224	-0.521	0.729	0.118	Trade_d	0.313	-0.542	0.700	Trade_d	0.223
Comp2	1.083	0.161	0.217	0.607	Productive_d	0.571	-0.258	-0.093	0.284	Productive_d	0.798	-0.268	-0.089	Productive_d	0.181
Comp3	0.922	0.119	0.184	0.791	Macro_d	0.254	0.790	0.369	0.072	Macro_d	0.355	0.823	0.354	Macro_d	0.235
Comp4	0.803	0.561	0.161	0.952	Infrastruc-d	0.647	0.161	0.014	0.157	Infrastruc-d	0.903	0.167	0.013	Infrastruc-d	0.213
Comp5	0.242	.	0.048	1.000	Movement_d	-0.375	0.109	0.568	0.415	Movement_d	-0.524	0.113	0.546	Movement_d	0.148

Table 37 Results of PCA and weights derived for indicators and dimensions - SADC

	Eigenvectors									Loadings				Weights
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2			
Comp1	1.929	0.862	0.482	0.482	Tariff	0.505	0.284	0.422		Tariff	0.702	0.293		Tariff 0.193
Comp2	1.068	0.433	0.267	0.749	Trade	0.198	0.864	0.128		Trade	0.275	0.893		Trade 0.291
Comp3	0.635	0.267	0.159	0.908	Exports	0.615	-0.149	0.247		Exports	0.854	-0.154		Exports 0.251
Comp4	0.368	.	0.092	1.000	Imports	0.572	-0.389	0.207		Imports	0.795	-0.402		Imports 0.265
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2			
Comp1	2.178	1.475	0.726	0.726	Intermedia~M	0.494	0.468			Intermedia~M	0.729			Intermedia~M 0.244
Comp2	0.703	0.583	0.234	0.960	Intermedia~X	0.652	0.074			Intermedia~X	0.962			Intermedia~X 0.425
Comp3	0.120	.	0.040	1.000	TCI	0.575	0.281			TCI	0.848			TCI 0.330
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2			
Comp1	1.260	0.071	0.420	0.420	Inflation	-0.255	0.795	0.167		Inflation	-0.287	0.866		Inflation 0.340
Comp2	1.189	0.638	0.396	0.816	Currency	0.780	-0.168	0.201		Currency	0.875	-0.183		Currency 0.326
Comp3	0.551	.	0.184	1.000	Investment	0.572	0.584	0.183		Investment	0.642	0.636		Investment 0.334
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2			
Comp1	1.387	0.775	0.694	0.694	Infrastruc~e	0.707	0.306			Infrastruc~e	0.833			Infrastructure 0.500
Comp2	0.613	.	0.306	1.000	Connections	0.707	0.306			Connections	0.833			Connections 0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2			
Comp1	1.601	0.656	0.534	0.534	Required	0.690	0.022	0.239		Required	0.872	0.021		Required 0.299
Comp2	0.944	0.489	0.315	0.848	Arrival	0.556	0.625	0.137		Arrival	0.703	0.607		Arrival 0.339
Comp3	0.455	.	0.152	1.000	Protocol	-0.464	0.780	0.080		Protocol	-0.588	0.758		Protocol 0.362
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2			
Comp1	2.391	1.052	0.478	0.478	Trade_d	0.459	-0.390	0.294		Trade_d	0.709	-0.452		Trade_d 0.189
Comp2	1.338	0.722	0.268	0.746	Productive_d	0.556	0.167	0.224		Productive_d	0.859	0.193		Productive_d 0.208
Comp3	0.616	0.208	0.123	0.869	Macro_d	0.087	0.723	0.282		Macro_d	0.135	0.837		Macro_d 0.193
Comp4	0.408	0.160	0.082	0.951	Infrastruc~d	0.497	0.400	0.196		Infrastruc~d	0.768	0.463		Infrastruc~d 0.216
Comp5	0.247	.	0.049	1.000	Movement_d	-0.476	0.370	0.276		Movement_d	-0.736	0.428		Movement_d 0.194

Table 38 Results of PCA and weights derived for indicators and dimensions - ECOWAS

Component	Eigenvalue	Difference	Proportion	Cumulative	Eigenvectors				Unexplained	Loadings				Weights	
					Variable	Comp1	Comp2	Comp3		Comp1	Comp2	Comp3			
Comp1	1.685	0.572	0.421	0.421	Tariff	0.675	-0.142	-0.047	0.208	Tariff	0.876	-0.149	-0.042	Tariff	0.220
Comp2	1.112	0.308	0.278	0.699	Trade	0.286	0.666	-0.665	0.013	Trade	0.372	0.702	-0.597	Trade	0.274
Comp3	0.805	0.407	0.201	0.900	Exports	0.395	0.504	0.735	0.020	Exports	0.513	0.532	0.659	Exports	0.272
Comp4	0.398	.	0.100	1.000	Imports	-0.553	0.531	0.124	0.158	Imports	-0.718	0.560	0.111	Imports	0.234
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2			
Comp1	1.70211	0.805905	0.5674	0.5674	Intermedia~M	0.6484	-0.3229	0.1909		Intermedia~M	0.8459	-0.3057		Intermedia~M	0.311
Comp2	0.8962	0.494505	0.2987	0.8661	Intermedia~X	0.3657	0.9264	0.003248		Intermedia~X	0.4772	0.877		Intermedia~X	0.384
Comp3	0.401695	.	0.1339	1	TCI	0.6677	-0.1938	0.2075		TCI	0.8711	-0.1835		TCI	0.305
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2			
Comp1	1.426	0.454	0.475	0.475	Currency	-0.609	0.501	0.228		Currency	-0.727	0.494		Currency	0.322
Comp2	0.972	0.371	0.324	0.800	Investment	0.384	0.864	0.064		Investment	0.458	0.852		Investment	0.390
Comp3	0.601	.	0.201	1.000	Inflation	0.695	-0.038	0.310		Inflation	0.830	-0.038		Inflation	0.288
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2			
Comp1	1.049	0.099	0.525	0.525	Infrastruc~e	-0.707	0.707	0.000		Infrastruc~e	-0.724	0.690		Infrastructure	0.500
Comp2	0.951	.	0.475	1.000	Connections	0.707	0.707	0.000		Connections	0.724	0.690		Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2			
														Required	0.333
														Arrival	0.333
														Protocol	0.333
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2			
Comp1	2.298	0.923	0.460	0.460	Trade_d	0.537	0.348	0.170		Trade_d	0.814	0.408		Trade_d	0.226
Comp2	1.375	0.650	0.275	0.735	Productive_d	0.592	-0.109	0.179		Productive_d	0.897	-0.127		Productive_d	0.224
Comp3	0.725	0.378	0.145	0.880	Macro_d	-0.208	0.577	0.443		Macro_d	-0.315	0.677		Macro_d	0.152
Comp4	0.347	0.092	0.069	0.949	Infrastruc~d	0.561	-0.077	0.268		Infrastruc~d	0.851	-0.090		Infrastruc~d	0.199
Comp5	0.255	.	0.051	1.000	Movement_d	0.056	0.727	0.267		Movement_d	0.084	0.852		Movement_d	0.200

Table 39 Results of PCA and weights derived for indicators and dimensions – CEN-SAD

Component	Eigenvalue	Difference	Proportion	Cumulative	Eigenvectors		Comp1	Comp2	Comp3	Unexplained	Loadings			Weights		
					Variable	Variable					Comp1	Comp2	Comp3			
Comp1	1.559	0.586	0.390	0.390	Tariff	Tariff	0.399	0.709	0.517	0.047	Tariff	0.498	0.699	0.465	Tariff	0.285
Comp2	0.973	0.164	0.243	0.633	Trade	Trade	0.509	0.199	-0.797	0.043	Trade	0.635	0.196	-0.717	Trade	0.286
Comp3	0.809	0.150	0.202	0.835	Exports	Exports	0.609	-0.129	0.108	0.396	Exports	0.761	-0.128	0.097	Exports	0.181
Comp4	0.659	.	0.165	1.000	Imports	Imports	0.459	-0.665	0.292	0.173	Imports	0.573	-0.656	0.263	Imports	0.248
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Variable	Comp1	Comp2	Unexplained	Unexplained	Comp1	Comp2	Comp3	Comp3	Weights	
Comp1	1.384	0.396	0.461	0.461	Intermedia-M	Intermedia-M	0.661	-0.340	0.281		Intermedia-M	0.778	-0.338		Intermedia-M	0.303
Comp2	0.989	0.361	0.330	0.791	Intermedia-X	Intermedia-X	0.701	-0.036	0.318		Intermedia-X	0.825	-0.036		Intermedia-X	0.287
Comp3	0.627	.	0.209	1.000	TCI	TCI	0.266	0.940	0.029		TCI	0.313	0.935		TCI	0.409
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Variable	Comp1	Comp2	Unexplained	Unexplained	Comp1	Comp2	Comp3	Comp3	Weights	
Comp1	1.093	0.070	0.364	0.364	Currency	Currency	0.445	0.733	0.235		Currency	0.465	0.741		Currency	0.362
Comp2	1.023	0.139	0.341	0.705	Investment	Investment	0.497	-0.681	0.256		Investment	0.520	-0.688		Investment	0.351
Comp3	0.884	.	0.295	1.000	Inflation	Inflation	-0.745	-0.016	0.393		Inflation	-0.779	-0.017		Inflation	0.287
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Variable	Comp1	Comp2	Unexplained	Unexplained	Comp1	Comp2	Comp3	Comp3	Weights	
Comp1	1.384	0.768	0.692	0.692	Infrastruc-e	Infrastruc-e	0.707	0.707	0.000		Infrastruc-e	0.832	0.555		Infrastructure	0.500
Comp2	0.616	.	0.308	1.000	Connections	Connections	0.707	-0.707	0.000		Connections	0.832	-0.555		Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Variable	Comp1	Comp2	Unexplained	Unexplained	Comp1	Comp2	Comp3	Comp3	Weights	
Comp1	1.831	0.933	0.610	0.610	Required	Required	0.674	-0.183	0.139		Required	0.912	-0.174		Required	0.316
Comp2	0.898	0.627	0.299	0.910	Arrival	Arrival	0.658	-0.292	0.131		Arrival	0.891	-0.277		Arrival	0.319
Comp3	0.271	.	0.090	1.000	Protocol	Protocol	0.336	0.939	0.002		Protocol	0.455	0.890		Protocol	0.366
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Variable	Comp1	Comp2	Comp3	Unexplained	Unexplained	Comp1	Comp2	Comp3	Comp3	Weights
Comp1	2.110	0.921	0.422	0.422	Trade_d	Trade_d	0.446	0.289	0.648	0.146	Trade_d	0.647	0.315	0.580	Trade_d	0.208
Comp2	1.189	0.387	0.238	0.660	Productive_d	Productive_d	0.324	-0.652	0.435	0.120	Productive_d	0.471	-0.711	0.390	Productive_d	0.215
Comp3	0.802	0.300	0.160	0.820	Macro_d	Macro_d	0.394	0.635	-0.131	0.178	Macro_d	0.573	0.693	-0.118	Macro_d	0.200
Comp4	0.502	0.106	0.100	0.921	Infrastruc-d	Infrastruc-d	0.573	-0.058	-0.192	0.275	Infrastruc-d	0.832	-0.063	-0.172	Infrastruc-d	0.177
Comp5	0.397	.	0.079	1.000	Movement_d	Movement_d	-0.461	0.291	0.581	0.180	Movement_d	-0.670	0.318	0.520	Movement_d	0.200

Table 40 Results of PCA and weights derived for indicators and dimensions - COMESA

					Eigenvectors						Loadings					Weights
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp 1	Comp2	Comp3	Unexplained		Comp 1	Comp 2	Comp 3			
Comp1	1.533	0.299	0.383	0.383	Tariff	0.407	-0.592	0.533	0.087		Tariff	0.504	-0.658	0.476	Tariff	0.256
Comp2	1.234	0.435	0.309	0.692	Trade	0.573	-0.031	-0.749	0.048		Trade	0.709	-0.034	-0.670	Trade	0.267
Comp3	0.799	0.365	0.200	0.892	Exports	0.690	0.175	0.226	0.192		Exports	0.854	0.194	0.202	Exports	0.227
Comp4	0.434	.	0.109	1.000	Imports	0.176	0.786	0.322	0.108		Imports	0.218	0.873	0.288	Imports	0.250
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp 1	Comp2	Unexplained			Comp 1	Comp 2				
Comp1	1.843	0.966	0.614	0.614	Intermedia-M	0.651	-0.311	0.134			Intermedia-M	0.884	-0.291		Intermedia-M	0.318
Comp2	0.877	0.597	0.292	0.907	Intermedia-X	0.667	-0.200	0.144			Intermedia-X	0.906	-0.188		Intermedia-X	0.315
Comp3	0.280	.	0.093	1.000	TCI	0.362	0.929	0.002			TCI	0.491	0.870		TCI	0.367
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp 1	Comp2	Unexplained			Comp 1	Comp 2				
Comp1	1.254	0.315	0.418	0.418	Currency	0.657	0.051	0.456			Currency	0.736	0.049		Currency	0.248
Comp2	0.940	0.134	0.313	0.731	Investment	-0.507	0.768	0.123			Investment	-0.568	0.745		Investment	0.400
Comp3	0.806	.	0.269	1.000	Inflation	0.558	0.638	0.227			Inflation	0.625	0.619		Inflation	0.352
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp 1	Comp2	Unexplained			Comp 1	Comp 2				
Comp1	1.204	0.409	0.602	0.602	Infrastructure	-0.707	0.707	0.000			Infrastructure	-0.776	0.631		Infrastructure	0.500
Comp2	0.796	.	0.398	1.000	Connections	0.707	0.707	0.000			Connections	0.776	0.631		Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp 1	Unexplained				Comp 1					
Comp1	2.260	1.721	0.753	0.753	Required	0.575	0.254				Required	0.864			Required	0.330
Comp2	0.538	0.336	0.179	0.933	Arrival	0.621	0.130				Arrival	0.933			Arrival	0.385
Comp3	0.202	.	0.067	1.000	Protocol	0.534	0.356				Protocol	0.803			Protocol	0.285
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp 1	Comp2	Comp3	Unexplained		Comp 1	Comp 2	Comp 3			
Comp1	1.817	0.453	0.364	0.364	Trade_d	0.631	-0.169	0.117	0.222		Trade_d	0.851	-0.197	0.122	Trade_d	0.181
Comp2	1.364	0.261	0.273	0.636	Productive_d	0.657	0.011	0.179	0.181		Productive_d	0.885	0.013	0.188	Productive_d	0.191
Comp3	1.103	0.695	0.221	0.857	Macro_d	-0.226	0.669	0.394	0.125		Macro_d	-0.304	0.782	0.414	Macro_d	0.204
Comp4	0.408	0.101	0.082	0.939	Infrastructure-d	0.336	0.693	-0.085	0.133		Infrastructure-d	0.453	0.809	-0.089	Infrastructure-d	0.202
Comp5	0.307	.	0.061	1.000	Movement_d	-0.083	-0.210	0.890	0.054		Movement_d	-0.111	-0.246	0.935	Movement_d	0.221

Table 41 Results of PCA and weights derived for indicators and dimensions - ECCAS

	Eigenvectors								Loadings					Weights	
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.80191	0.770091	0.4505	0.4505	Tariff	-0.0493	0.9356	0.09245		Tariff	-0.06615	0.9504		Tariff	0.320
Comp2	1.03182	0.105304	0.258	0.7084	Trade	0.6774	0.0891	0.165		Trade	0.9093	0.09048		Trade	0.295
Comp3	0.926514	0.686753	0.2316	0.9401	Exports	0.6829	-0.1431	0.1386		Exports	0.9167	-0.1453		Exports	0.304
Comp4	0.239761	.	0.0599	1	Imports	0.269	0.3103	0.7703		Imports	0.3611	0.3152		Imports	0.081
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.49327	0.374751	0.4978	0.4978	Intermedia~M	0.7173	0.2434	0.1655		Intermedia~M	0.8765	0.2574		Intermedia~M	0.320
Comp2	1.11852	0.730309	0.3728	0.8706	Intermedia~X	0.6943	-0.3292	0.159		Intermedia~X	0.8484	-0.3482		Intermedia~X	0.322
Comp3	0.38821	.	0.1294	1	TCI	0.0592	0.9124	0.0637		TCI	0.07232	0.9649		TCI	0.358
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.53032	1.06064	0.7652	0.7652	Inflation	0.7071	0.2388			Currency	0.8747			Currency	0.500
Comp2	0.469678	.	0.2348	1	Currency	0.7071	0.2388			Inflation	0.8747			Inflation	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.35089	0.701788	0.6754	0.6754	Infrastruc~e	0.7071	0.7071	0		Infrastruc~e	0.8219	0.5697		Infrastructure	0.500
Comp2	0.649106	.	0.3246	1	Connections	0.7071	-0.7071	0		Connections	0.8219	-0.5697		Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.68006	0.728262	0.56	0.56	Required	0.6788	-0.2164	0.1813		Required	0.8799	-0.2111		Required	0.311
Comp2	0.9518	0.583661	0.3173	0.8773	Arrival	0.6866	-0.1519	0.1861		Arrival	0.8899	-0.1482		Arrival	0.309
Comp3	0.368139	.	0.1227	1	Protocol	0.2605	0.9644	0.000759		Protocol	0.3376	0.9409		Protocol	0.380
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Comp3	Unexplained		Comp1	Comp2	Comp3		
Comp1	2.0468	0.640347	0.4094	0.4094	Trade_d	0.4511	0.125	0.7761	0.07756	Trade_d	0.6454	0.1482	0.6957	Trade_d	0.217
Comp2	1.40646	0.602941	0.2813	0.6907	Productive_d	0.5763	-0.2901	0.0032	0.2017	Productive_d	0.8245	-0.3441	0.002853	Productive_d	0.188
Comp3	0.803516	0.364415	0.1607	0.8514	Macro_d	0.338	0.5465	-0.5197	0.1291	Macro_d	0.4835	0.6482	-0.4659	Macro_d	0.205
Comp4	0.439101	0.134979	0.0878	0.9392	Infrastruc~d	0.5898	-0.1865	-0.3129	0.1604	Infrastruc~d	0.8438	-0.2212	-0.2805	Infrastruc~d	0.197
Comp5	0.304122	.	0.0608	1	Movement_d	0.048	0.7528	0.1722	0.1744	Movement_d	0.06869	0.8928	0.1543	Movement_d	0.194

Table 42 Results of PCA and weights derived for indicators and dimensions - IGAD

Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2				
Comp1	2.3597	1.4358	0.5899	0.5899	Tariff	0.5675	-0.4043	0.0889			Tariff	0.8718	-0.3886		Tariff	0.277
Comp2	0.9239	0.3406	0.2310	0.8209	Trade	0.4281	0.5609	0.2769			Trade	0.6576	0.5391		Trade	0.220
Comp3	0.5833	0.4502	0.1458	0.9667	Exports	0.4349	0.5583	0.2657			Exports	0.6681	0.5366		Exports	0.224
Comp4	0.1331	.	0.0333	1.0000	Imports	-0.5527	0.4586	0.0849			Imports	-0.8490	0.4408		Imports	0.279
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Unexplained				Comp1					
Comp1	2.2717	1.6686	0.7572	0.7572	Intermedia-M	0.5535	0.3041				Intermedia-M	0.8342			Intermedia-M	0.306
Comp2	0.6030	0.4778	0.2010	0.9582	Intermedia-X	0.6382	0.0748				Intermedia-X	0.9619			Intermedia-X	0.407
Comp3	0.1253	.	0.0418	1.0000	TCI	0.5352	0.3494				TCI	0.8066			TCI	0.286
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2				
Comp1	1.6146	0.6146	0.5382	0.5382	Currency	0.7042	-0.0908	0.1911			Currency	0.8948	-0.0909		Currency	0.309
Comp2	1.0000	0.6146	0.3333	0.8715	Investment	0.0642	0.9959	0.0016			Investment	0.0816	0.9959		Investment	0.382
Comp3	0.3854	.	0.1285	1.0000	Inflation	-0.7071	0.0000	0.1927			Inflation	-0.8985	0.0000		Inflation	0.309
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2				
Comp1	1.3940	0.7880	0.6970	0.6970	Infrastruc-e	0.7071	0.7071	0.0000			Infrastruc-e	0.7071	0.7071		Infrastructure	0.500
Comp2	0.6060	.	0.3030	1.0000	Connections	0.7071	-0.7071	0.0000			Connections	0.7071	-0.7071		Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Unexplained				Comp1					
Comp1	2.3678	1.7961	0.7893	0.7893	Required	0.6036	0.1374				Required	0.9287			Required	0.364
Comp2	0.5717	0.5112	0.1906	0.9798	Arrival	0.6269	0.0696				Arrival	0.9646			Arrival	0.393
Comp3	0.0605	.	0.0202	1.0000	Protocol	0.4927	0.4252				Protocol	0.7581			Protocol	0.243
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained			Comp1	Comp2				
Comp1	2.5920	1.2062	0.5184	0.5184	Trade_d	0.5380	0.1970	0.1960			Trade_d	0.8662	0.2319		Trade_d	0.202
Comp2	1.3858	0.8149	0.2772	0.7956	Productive_d	0.5558	0.0161	0.1988			Productive_d	0.8949	0.0190		Productive_d	0.201
Comp3	0.5709	0.2584	0.1142	0.9098	Macro_d	-0.1504	0.7772	0.1042			Macro_d	-0.2421	0.9150		Macro_d	0.225
Comp4	0.3125	0.1737	0.0625	0.9722	Infrastruc-d	0.4690	0.3893	0.2197			Infrastruc-d	0.7551	0.4583		Infrastruc-d	0.196
Comp5	0.1388	.	0.0278	1.0000	Movement_d	0.3987	-0.4531	0.3034			Movement_d	0.6419	-0.5334		Movement_d	0.175

Table 43 Results of PCA and weights derived for indicators and dimensions - EAC

					Eigenvectors				Loadings					Weights	
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Unexplained			Comp1					
														Tariff	0
Comp1	2.23087	1.50534	0.7436	0.7436	Trade	0.6584	0.03281			Trade	0.9835			Trade	0.434
Comp2	0.725528	0.681923	0.2418	0.9855	Exports	0.5872	0.2307			Exports	0.8771			Exports	0.345
Comp3	0.0436054	.	0.0145	1	Imports	-0.4708	0.5056			Imports	-0.7031			Imports	0.222
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	2.43337	1.92594	0.8111	0.8111	Intermedia-M	0.5082	0.8549	0.0006436		Intermedia-M	0.7928	0.609		Intermedia-M	0.340
Comp2	0.507434	0.448239	0.1691	0.9803	Intermedia-X	0.6178	-0.2776	0.03204		Intermedia-X	0.9638	-0.1977		Intermedia-X	0.329
Comp3	0.0591953	.	0.0197	1	TCI	0.6	-0.4383	0.02651		TCI	0.9359	-0.3122		TCI	0.331
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Unexplained			Comp1					
Comp1	1.59952	1.19903	0.7998	0.7998	Inflation	0.7071	0.2002			Inflation	0.8943			Inflation	0.500
Comp2	0.400485	.	0.2002		Currency	0.7071	0.2002			Currency	0.8943			Currency	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.708	1.41599	0.854	0.854	Infrastruc-e	0.7071	0.7071	0		Infrastruc-e	0.9241	0.3821		Infrastructure	0.500
Comp2	0.292004	.	0.146	1	Connections	0.7071	-0.7071	0		Connections	0.9241	-0.3821		Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.32543	0.129112	0.4418	0.4418	Required	-0.7663	-0.1836	0.1813		Required	-0.8823	-0.2008		Required	0.325
Comp2	1.19632	0.718066	0.3988	0.8406	Arrival	0.2323	0.8142	0.1354		Arrival	0.2675	0.8905		Arrival	0.343
Comp3	0.478252	.	0.1594	1	Protocol	0.5989	-0.5508	0.1616		Protocol	0.6895	-0.6024		Protocol	0.332
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	2.95818	1.75952	0.5916	0.5916	Trade_d	0.5256	-0.2353	0.1166		Trade_d	0.9039	-0.2576		Trade_d	0.213
Comp2	1.19866	0.4359	0.2397	0.8314	Productive_d	0.4814	-0.5045	0.00951		Productive_d	0.8279	-0.5523		Productive_d	0.238
Comp3	0.762763	0.685505	0.1526	0.9839	Macro_d	0.3756	0.5125	0.268		Macro_d	0.6459	0.5611		Macro_d	0.176
Comp4	0.0772579	0.0741195	0.0155	0.9994	Infrastruc-d	0.5512	0.0591	0.09698		Infrastruc-d	0.9481	0.06468		Infrastruc-d	0.217
Comp5	0.0031384	.	0.0006	1	Movement_d	0.2172	0.6512	0.3521		Movement_d	0.3737	0.7129		Movement_d	0.156

Table 44 Results of PCA and weights derived for indicators and dimensions - AMU

					Eigenvectors				Loadings				Weights		
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	2.0086	0.2421	0.5021	0.5021	Tariff	0.6587	-0.1099	0.1072		Tariff	0.9335	-0.1461		Tariff	0.236
Comp2	1.7665	1.5465	0.4416	0.9438	Trade	0.2594	0.6878	0.0291		Trade	0.3676	0.9142		Trade	0.257
Comp3	0.2200	0.2149	0.0550	0.9987	Exports	-0.1503	0.7175	0.0453		Exports	-0.2130	0.9536		Exports	0.253
Comp4	0.0050	.	0.0013	1.0000	Imports	-0.6901	-0.0026	0.0433		Imports	-0.9781	-0.0035		Imports	0.253
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	2.0341	1.1261	0.6780	0.6780	Intermedia~M	0.6812	-0.1715	0.0293		Intermedia~M	0.9716	-0.1634		Intermedia~M	0.330
Comp2	0.9080	0.8501	0.3027	0.9807	Intermedia~X	0.2886	0.9564	0.0001		Intermedia~X	0.4116	0.9113		Intermedia~X	0.340
Comp3	0.0579	.	0.0193	1.0000	TCI	0.6728	-0.2365	0.0285		TCI	0.9596	-0.2254		TCI	0.330
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.2371	0.4743	0.6186	0.6186	Inflation	0.7071	0.7071	0.0000		Inflation	0.7865	0.6176		Inflation	0.500
Comp2	0.7629	.	0.3814	1.0000	Investment	0.7071	-0.7071	0.0000		Investment	0.7865	-0.6176		Investment	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.4094	0.8188	0.7047	0.7047	Infrastruc~e	0.7071	0.7071	0.0000		Infrastruc~e	0.8395	0.5434		Infrastructure	0.500
Comp2	0.5906	.	0.2953	1.0000	Connections	0.7071	-0.7071	0.0000		Connections	0.8395	-0.5434		Connections	0.500
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	1.7994	0.6270	0.5998	0.5998	Required	0.7298	0.1579	0.0125		Required	0.9789	0.1710		Required	0.332
Comp2	1.1724	1.1442	0.3908	0.9906	Arrival	0.6593	-0.4200	0.0110		Arrival	0.8844	-0.4547		Arrival	0.333
Comp3	0.0282	.	0.0094	1.0000	Protocol	0.1809	0.8937	0.0048		Protocol	0.2426	0.9677		Protocol	0.335
Component	Eigenvalue	Difference	Proportion	Cumulative	Variable	Comp1	Comp2	Unexplained		Comp1	Comp2				
Comp1	2.7799	1.5764	0.5560	0.5560	Trade_d	0.5835	0.0510	0.0505		Trade_d	0.9728	0.0559		Trade_d	0.238
Comp2	1.2035	0.2626	0.2407	0.7967	Productive_d	0.5758	0.1203	0.0611		Productive_d	0.9600	0.1319		Productive_d	0.236
Comp3	0.9409	0.8651	0.1882	0.9848	Macro_d	0.0860	0.6787	0.4251		Macro_d	0.1434	0.7445		Macro_d	0.144
Comp4	0.0758	0.0758	0.0152	1.0000	Infrastruc~d	0.5661	-0.2956	0.0041		Infrastruc~d	0.9438	-0.3243		Infrastruc~d	0.250
Comp5	0.0000	.	0.0000	1.0000	Movement_d	0.0151	0.6595	0.4759		Movement_d	0.0252	0.7235		Movement_d	0.132

Weights assigned through PCA

Table 45 Weights of indicators and dimensions for Africa and RECs

Indicators	Weights by region								
	Africa	SADC	ECOWAS	CEN-SAD	COMESA	ECCAS	IGAD	EAC	AMU
Tariff	0.249	0.165	0.220	0.285	0.256	0.320	0.277	0.000	0.236
Trade	0.144	0.292	0.274	0.286	0.267	0.295	0.220	0.434	0.257
Exports	0.221	0.268	0.272	0.181	0.227	0.304	0.224	0.345	0.253
Imports	0.224	0.276	0.234	0.248	0.250	0.081	0.279	0.222	0.253
ACFTA	0.161	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Intermediates import	0.320	0.247	0.311	0.303	0.318	0.320	0.306	0.340	0.330
Intermediates export	0.318	0.407	0.384	0.287	0.315	0.322	0.407	0.329	0.340
TCI	0.362	0.346	0.305	0.409	0.367	0.358	0.286	0.331	0.330
Inflation	0.360	0.338	0.288	0.287	0.352	0.500	0.309	0.500	0.500
Currency	0.266	0.327	0.322	0.362	0.248	0.500	0.382	0.500	0.000
Investment	0.374	0.335	0.390	0.351	0.400	0.000	0.309	0.000	0.500
AfDB Infrastructure Index	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Connections	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Required									
Arrival	0.327	0.307	0.333	0.316	0.330	0.311	0.364	0.325	0.332
Protocol	0.328	0.354	0.333	0.319	0.385	0.309	0.393	0.343	0.333
Dimensions	Weights by region								

Trade	0.22 3	0.20 4	0.226	0.208	0.181	0.217	0.20 2	0.21 3	0.23 8
Productive	0.18 1	0.19 4	0.224	0.215	0.191	0.188	0.20 1	0.23 8	0.23 6
Macroeconomic	0.23 5	0.17 3	0.152	0.200	0.204	0.205	0.22 5	0.17 6	0.14 4
Infrastructural	0.21 3	0.19 4	0.199	0.177	0.202	0.197	0.19 6	0.21 7	0.25 0
Free Movement	0.14 8	0.23 5	0.200	0.200	0.221	0.194	0.17 5	0.15 6	0.13 2

Rankings using PCA weights vs Equal weights - African level

Figure 6 Comparing rankings using PCA and equal weights

Country	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking
South Africa	1	1	0	4	3	1	1	1	0	25	29	-4	1	1	0	45	45	0
Kenya	2	2	0	18	13	5	7	7	0	38	38	0	8	8	0	10	10	0
Rwanda	3	3	0	13	14	-1	33	33	0	4	2	2	23	23	0	6.5	6.5	0
Mauritius	5	11	-6	33	35	-2	32	31	1	2	3	-1	6	6	0	29	25.5	3
Ghana	8	4	4	10	9	1	16	17	-1	40	33	7	18	18	0	8	8	0
Togo	9	5	4	20	20	0	25	26	-1	18	15	3	31	31	0	6.5	6.5	0
Morocco	4	13	-9	39	39	0	8	8	0	1	1	0	4	4	0	48	48	0
Djibouti	10	6	4	12	15	-3	21	22	-1	39	42	-3	29	29	0	2	2	0
Mauritania	13	7	6	29	27	2	51	51	0	7	6	1	42	42	0	4	4	0
Senegal	7	8	-1	9	7	2	15	16	-1	9	9	0	20	20	0	14	14	0
Mozambique	14	9	5	22	29	-7	14	13	1	43	41	2	36	36	0	5	5	0
Egypt	6	15	-9	21	19	2	10	10	0	3	4	-1	2	2	0	47	47	0
Uganda	15	10	5	15	12	3	18	18	0	42	44	-2	27	27	0	9	9	0
Comoros	20	16	4	51	52	-1	39	40	-1	29	30	-1	25	25	0	2	2	0
Zimbabwe	12	14	-2	5	5	0	17	15	2	33	36	-3	13	13	0	17	18	-1
Burkina Faso	16	17	-1	14	16	-2	27	25	2	6	7	-1	34	34	0	16	16.5	-0.5
Mali	18	20	-2	17	17	0	40	38	2	5	5	0	28	28	0	21	21	0
Cabo Verde	22	21	1	43	43	0	41	43	-2	8	8	0	12	12	0	19	19	0
Somalia	31	23	8	54	54	0	24	24	0	32	35	-3	52	52	0	2	2	0
Seychelles	11	12	-1	32	34	-2	42	42	0	36	39	-3	3	3	0	12	12	0
Côte d'Ivoire	17	22	-5	6	6	0	6	6	0	17	14	3	11	11	0	40	40	0
Tunisia	24	26	-2	52	51	1	4	3	1	16	25	-9	5	5	0	39	39	0
The Gambia	19	19	0	8	8	0	43	44	-1	12	10	2	26	26	0	20	20	0
Gabon	23	24	-1	26	24	2	38	39	-1	11	11	0	16	16	0	33	32	1
Rep. of the Congo	27	27	0	11	11	0	54	54	0	15	13	2	38	38	0	22	22	0
Guinea-Bissau	35	30	5	46	46	0	31	32	-1	22	19	3	45	45	0	18	15	3
Madagascar	37	31	6	38	40	-2	46	46	0	34	37	-3	39	39	0	12	12	0
Namibia	25	28	-3	2	2	0	9	9	0	44	45	-1	21	21	0	46	46	0
Guinea	33	32	1	27	25	2	47	47	0	26	26	0	41	41	0	23	23	0
Sao Tome & Principe	26	25	1	24	22	2	12	14	-2	24	24	0	30	30	0	34.5	34.5	0
Chad	32	33	-1	28	28	0	26	27	-1	23	21	2	51	51	0	26	27.5	-1.5
Lesotho	29	37	-8	3	4	-1	53	53	0	45	46	-1	46	46	0	25	25.5	-0.5
Niger	36	35	1	19	18	1	50	50	0	14	12	2	50	50	0	24	24	0
Utd Rep. of Tanzania	28	29	-1	35	36	-1	20	19	1	27	28	-1	22	22	0	30	27.5	2.5
Benin	21	18	3	31	31	0	35	35	0	21	18	3	24	24	0	12	12	0
Malawi	42	36	6	30	30	0	29	28	1	51	51	0	33	33	0	15	16.5	-1.5
Botswana	34	40	-6	7	10	-3	13	11	2	37	40	-3	19	19	0	43.5	43	0.5
Equatorial Guinea	30	34	-4	25	23	2	36	36	0	20	17	3	35	35	0	37	37	0
Central African Rep.	45	41	4	47	47	0	30	30	0	28	27	1	47	47	0	27.5	29.5	-2
Zambia	41	39	2	16	26	-10	5	5	0	52	52	0	14	14	0	38	38	0
Algeria	43	44	-1	50	49	1	23	21	2	13	22	-9	9	9	0	50.5	50.5	0
Nigeria	38	38	0	34	33	1	2	2	0	35	31	4	15	15	0	41	41	0
Libya	44	43	1	36	37	-1	34	34	0	41	34	7	7	7	0	54	54	0
Eswatini	39	42	-3	1	1	0	48	48	0	48	48	0	40	40	0	43.5	43	0.5
Cameroon	46	46	0	48	48	0	11	12	-1	19	16	3	17	17	0	49	49	0
Liberia	47	49	-2	45	45	0	22	23	-1	49	49	0	48	48	0	27.5	29.5	-2
Ethiopia	40	45	-5	23	21	2	52	52	0	10	20	-10	10	10	0	52	52	0
D. Rep. of the Congo	48	47	1	42	41	1	45	41	4	46	43	3	43	43	0	32	32	0
Angola	49	48	1	37	38	-1	3	4	-1	53	53	0	32	32	0	34.5	34.5	0
Sudan	50	50	0	53	53	0	19	20	-1	47	47	0	37	37	0	36	36	0
Sierra Leone	51	51	0	40	32	8	37	37	0	30	23	7	49	49	0	42	43	-1
Burundi	52	52	0	41	42	-1	44	45	-1	31	32	-1	44	44	0	50.5	50.5	0
South Sudan	54	53	1	44	44	0	49	49	0	54	54	0	54	54	0	31	32	-1
Eritrea	53	54	-1	49	50	-1	28	29	-1	50	50	0	53	53	0	53	53	0

Figure 7 Comparing rankings using PCA and equal weights (ARII 18 variables)

Country	Regional integration			Trade integration			Productive integration			Macroeconomic integration			Infrastructural integration			Free movement of people		
	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking	PCA weights	Equal weights	Change in ranking
Rwanda	1	2	-1	13	13	0	33	33	0	3	2	1	15	15	0	6.5	6.5	0
South Africa	2	1	1	3	3	0	1	1	0	33	34	-1	1	1	0	45	45	0
Ghana	3	3	0	8	8	0	16	17	-1	13	13	0	11	11	0	8	8	0
Mozambique	4	5	-1	18	20	-2	14	13	1	20	20	0	16	16	0	5	5	0
Kenya	5	4	1	15	12	3	7	7	0	40	40	0	4	4	0	10	10	0
Togo	6	6	0	19	19	0	25	26	-1	27	26	1	13	12	1	6.5	6.5	0
Mauritania	7	8	-1	22	22	0	51	51	0	8	8	0	48	48	0	4	4	0
Djibouti	8	7	1	14	14	0	21	22	-1	48	48	0	40	40	0	2	2	0
Burkina Faso	9	12	-3	29	29	0	27	25	2	10	10	0	18	18	0	13	14.5	-1
Mali	10	13	-3	16	15	1	40	38	2	6	6	0	17	17	0	19	19	0
Uganda	11	10	1	12	11	1	18	18	0	44	44	0	39	39	0	9	9	0
Zimbabwe	12	9	3	9	10	-1	17	15	2	43	43	0	10	9	1	15	16	-1
Senegal	13	14	-1	7	7	0	15	16	-1	17	16	1	35	35	0	12	12	0
Egypt	14	11	3	20	18	2	10	10	0	2	3	-1	3	2	1	47	47	0
Comoros	15	15	0	51	51	0	39	40	-1	38	38	0	38	37	1	2	2	0
Rep. of the Congo	16	18	-2	10	9	1	54	54	0	19	19	0	19	19	0	20	20	0
Mauritius	17	17	0	28	28	0	32	31	1	4	4	0	30	29	1	27	23.5	3
Guinea	18	19	-1	21	21	0	47	47	0	16	15	1	20	20	0	21	21	0
Somalia	19	23	-4	54	54	0	24	24	0	41	41	0	52	52	0	2	2	0
Gabon	20	21	-1	40	40	0	38	39	-1	18	17	1	6	5	1	29	30	-1
Morocco	21	20	1	32	33	-1	8	8	0	1	1	0	21	21	0	48	48	0
Niger	22	26	-4	17	17	0	50	50	0	24	23	1	22	22	0	22	22	0
Chad	23	24	-1	23	23	0	26	27	-1	32	31	1	26	26	0	24	25.5	-1
Côte d'Ivoire	24	16	8	5	5	0	6	6	0	25	25	0	7	8	-1	40	40	0
Namibia	25	22	3	2	2	0	9	9	0	46	46	0	9	14	-5	46	46	0
The Gambia	26	32	-6	25	25	0	43	44	-1	7	7	0	37	38	-1	18	18	0
Botswana	27	25	2	6	6	0	13	11	2	45	45	0	2	3	-1	42.5	43	-0
Benin	28	27	1	26	26	0	35	35	0	30	29	1	14	13	1	36.5	36	0
Cabo Verde	29	29	0	41	41	0	41	43	-2	12	11	1	32	33	-1	17	17	0
Central African Rep.	30	30	0	45	45	0	30	30	0	34	33	1	23	23	0	25.5	27.5	-2
Eswatini	31	28	3	1	1	0	48	48	0	51	51	0	5	7	-2	42.5	43	-0
Malawi	32	33	-1	24	24	0	29	28	1	37	37	0	43	43	0	14	14.5	-0
Lesotho	33	37	-4	4	4	0	53	53	0	49	49	0	44	46	-2	23	23.5	-0
Madagascar	34	34	0	34	34	0	46	46	0	39	39	0	47	47	0	11	11	0
Guinea-Bissau	35	35	0	43	44	-1	31	32	-1	31	30	1	51	51	0	16	13	3
Liberia	36	36	0	44	43	1	22	23	-1	52	52	0	24	24	0	25.5	27.5	-2
Nigeria	37	31	6	47	48	-1	2	2	0	15	14	1	12	10	2	41	41	0
Sao Tome & Principe	38	38	0	38	38	0	12	14	-2	21	21	0	41	41	0	32.5	32.5	0
Angola	39	39	0	31	32	-1	3	4	-1	42	42	0	42	42	0	32.5	32.5	0
Utd Rep. of Tanzania	40	41	-1	49	49	0	20	19	1	26	32	-6	36	36	0	28	25.5	2
Seychelles	41	43	-2	27	27	0	42	42	0	47	47	0	27	27	0	36.5	36	0
D. Rep. of the Congo	42	45	-3	35	35	0	45	41	4	23	22	1	49	49	0	30	30	0
Sierra Leone	43	44	-1	33	31	2	37	37	0	9	9	0	25	25	0	44	43	1
Zambia	44	40	4	11	16	-5	5	5	0	50	50	0	34	34	0	38	38	0
Equatorial Guinea	45	47	-2	39	39	0	36	36	0	29	28	1	45	44	1	35	36	-1
Tunisia	46	42	4	50	50	0	4	3	1	22	24	-2	28	28	0	39	39	0
Ethiopia	47	46	1	37	37	0	52	52	0	11	12	-1	8	6	2	52	52	0
Libya	48	48	0	30	30	0	34	34	0	5	5	0	29	30	-1	54	54	0
Sudan	49	49	0	53	52	1	19	20	-1	35	35	0	46	45	1	34	34	0
Algeria	50	50	0	48	47	1	23	21	2	14	18	-4	31	31	0	50.5	50.5	0
Cameroon	51	51	0	46	46	0	11	12	-1	28	27	1	33	32	1	49	49	0
Burundi	52	52	0	36	36	0	44	45	-1	36	36	0	50	50	0	50.5	50.5	0
South Sudan	53	53	0	42	42	0	49	49	0	54	54	0	54	54	0	31	30	1
Eritrea	54	54	0	52	53	-1	28	29	-1	53	53	0	53	53	0	53	53	0

Figure 8 Statistical test comparing rankings using PCA and equal weights

```
. ktau rI_eq rI

Number of obs =      54
Kendall's tau-a =      0.8658
Kendall's tau-b =      0.8658
Kendall's score =    1239
SE of score =    134.041

Test of Ho: rI_eq and rI are independent
Prob > |z| =      0.0000 (continuity corrected)

. ktau rTrade_d_eq rTrade_d

Number of obs =      54
Kendall's tau-a =      0.9357
Kendall's tau-b =      0.9357
Kendall's score =    1339
SE of score =    134.041

Test of Ho: rTrade_d_eq and rTrade_d are independent
Prob > |z| =      0.0000 (continuity corrected)

. ktau rProductive_d_eq rProductive_d

Number of obs =      54
Kendall's tau-a =      0.9720
Kendall's tau-b =      0.9720
Kendall's score =    1391
SE of score =    134.041

Test of Ho: rProductive_d_eq and rProductive_d are independent
Prob > |z| =      0.0000 (continuity corrected)

. ktau rMacro_d_eq rMacro_d

Number of obs =      54
Kendall's tau-a =      0.9064
Kendall's tau-b =      0.9064
Kendall's score =    1297
SE of score =    134.041

Test of Ho: rMacro_d_eq and rMacro_d are independent
Prob > |z| =      0.0000 (continuity corrected)

. ktau rInfrastructure_d_eq rInfrastructure_d

Number of obs =      54
Kendall's tau-a =      1.0000
Kendall's tau-b =      1.0000
Kendall's score =    1431
SE of score =    134.041

Test of Ho: rInfrastructure_d_eq and rInfrastructure_d are independent
Prob > |z| =      0.0000 (continuity corrected)

. ktau rMovement_d_eq rMovement_d

Number of obs =      54
Kendall's tau-a =      0.9755
Kendall's tau-b =      0.9859
Kendall's score =    1396
SE of score =    133.915 (corrected for ties)

Test of Ho: rMovement_d_eq and rMovement_d are independent
Prob > |z| =      0.0000 (continuity corrected)
```

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Annex: Evolution in the choice of variables and dimensions

There were six dimensions proposed in the initial version of ARII 2019. In addition to the five dimensions that make up the final ARII 2019, there was also a social dimension that included 3 variables: mean years of schooling, gender equality and net migration within RECs. The inclusion of a social dimension was motivated by consultative meetings at the conceptual phase of the integration index: the rationale behind a social dimension is that for regional integration to be successful, favourable social arrangements have to be in place. The dimension was included, and results disseminated for initial validation. However, the dimension was subsequently removed as the variables in this dimension lack a regional component.

The rationale behind each dimension is well-documented in the ARII report and not reproduced here. Only changes that were made in the construction of the index are briefly outlined.

The variable AfCFTA was added to the trade dimension in the course of the making of ARII. The establishment of a free trade area is a stepping-stone in the advancement of regional integration. A country's adherence to this agreement is an important signal to stakeholders as to its economic future. Although, constantly changing, the variable was included and updated numerous times as more countries ratified the agreement.

The infrastructural dimension went through several changes. The variable net electricity trade (source from the Africa Energy Commission report) was initially included but a robust sensitivity analysis recommended its removal in order to improve the overall validity of the dimension.

The cost of mobile roaming was also included in initial computations of the infrastructural dimension. Such a variable is highly significant for regional integration; modernization of African economies but removed because of the low quality of the data and its incompleteness.

The variable Single African Air Transport Market is an initiative aiming at opening the African skies and there are currently 28 countries that signed the agreement. It was initially included but failed to pass the statistical tests. This is comprehensible as what really matters for integration is the implementation of such an agreement.

Disclaimer

This *Methodological Note* has been prepared to accompany the ARII 2019 report and to explain the methodology used and to facilitate the interpretation of the empirical results obtained. The interpretations of the results and findings expressed herein are those of the author and do not necessarily reflect the views of the United Nations Economic Commission for Africa and its partners. Nor do they represent opinions of its officials or member States.

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