

# Comparison of Macroeconomic Performances of Sub-Saharan African Countries with TOPSIS Method

## Sahra Altı Afrika Ülkelerinin Makroekonomik Performanslarının TOPSIS Metodu İle Karşılaştırılması

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### Abstract

*This paper aims to compare macroeconomic performances of eight Sub-Saharan African countries with the data of the year 2016 by using TOPSIS (Technique for Order Preference Similarity to Ideal Solution) method. For this purpose, four macroeconomic indicators including GDP growth rate, inflation rate, unemployment rate and current account balance/GDP are used to evaluate the performances of the countries. According to the results of the study, Cote d'Ivoire and Tanzania show the best macroeconomic performances while South Sudan shows the lowest macroeconomic performance.*

*This paper is the first one which evaluates macroeconomic performances of Sub-Saharan Africa using one of the multi-criteria decision-making methods. In this regard, the paper has some policy recommendations for Sub-Saharan African countries.*

**Keywords:** Sub-Saharan Africa, TOPSIS, Macroeconomic Performance, Multi Criteria Decision Making Methods.

### Öz

*Bu çalışma sekiz Sahra Altı Afrika ülkesinin makroekonomik performanslarını 2016 yılı için TOPSIS metodu ile karşılaştırmayı amaçlanmaktadır. Bu amaçla, GSYH büyüme oranı, enflasyon oranı, işsizlik oranı ve cari işlemler açığı/GSYH göstergelerinden oluşan dört adet makroekonomik gösterge ülkelerin makroekonomik performanslarını karşılaştırmak amacıyla kullanılmıştır. Çalışmadan elde edilen sonuçlara göre, Fildişi Sahilleri ve Tanzanya en iyi makroekonomik performansını sergilerken Güney Sudan ise en kötü makroekonomik performansı sergilemiştir.*

*Bu çalışma Sahra Altı Afrika ülkelerinin makroekonomik performanslarını çok kriterli karar verme yöntemi ile değerlendiren ilk çalışma mahiyetindedir. Bu açıdan çalışma, Sahra Altı Afrika ülkeleri için bazı politika önerileri sunmaktadır.*

**Anahtar Kelimeler:** Sahra Altı Afrika, TOPSIS, Makroekonomik Performans, Çok Kriterli Karar Verme Yöntemleri.

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## Introduction

Macroeconomic performances of countries determine the future of many economic and financial factors. Firstly, macroeconomic indicators affect sovereign credit ratings (Chee et. al., 2015; Yildiz and Gunsoy, 2017) and stock market performance (Kyereboah-Coleman and Agyire-Tettey, 2008; Pal and Mittal, 2011). Macroeconomic performances of countries affect investor behavior, capital flows and foreign direct investment inflows (Sharma and Joshi, 2015; Enu et. al., 2013). Secondly, macroeconomic performances affect exchange rates (Akhter and Faruqi, 2015). Thirdly, macroeconomic performances affect the performance of the private sector. For example, macroeconomic indicators affect the profitability of private sector companies (Bekeris, 2012). In this regard, macroeconomic performances of countries affect other economic and financial factors, and sectors such as the private sector. Therefore, the comparison of countries' macroeconomic performances may shed light on the future macroeconomic performances of countries and the macroeconomic positions in their regions. On the other hand, the comparison of macroeconomic performances of countries may support some literature, such as different macroeconomic structures of the large and small countries, and the literature of economic convergence. In this regard, the comparison of macroeconomic performances of countries may provide a basis for economic theories and some economic implications.

As laying emphasis on the comparison of macroeconomic performances, the aim of the study is to compare and evaluate the macroeconomic performances of eight Sub-Saharan African countries for 2016. TOPSIS, which is one of the multi-criteria decision-making methods, is used to compare the macroeconomic performances. Macroeconomic performances are evaluated with the criteria accepted in the literature. For some reasons, TOPSIS method is preferred for the study. One of these reasons is that the analysis steps of the method are relatively easy. The other is that the method creates an ideal solution from alternatives and evaluates all alternatives according to their distances from the ideal solution. In addition, another reason is assigning importance ratings to the evaluation criteria in this method (Ela et. al., 2018:134).

The paper consists of six parts. After the introduction, macroeconomic developments in Sub-Saharan Africa are presented in Section 1. In Section 2, a literature review on which macroeconomic performances are evaluated by multi-criteria decision-making methods is included. In Section 3, the data and methodology used in the analysis are given in detail. In Section 4, analysis and findings are presented and, concluding remarks follow in the last section.

## 1. Macroeconomic Developments in Sub-Saharan Africa

Many countries in Sub-Saharan Africa have shown high annual growth rates through high oil and commodity prices and positive external conditions. However, many countries have faced economic disruptions since 2015. In this regard, Sub-Saharan Africa had a bad year concerning economic performance in 2016 due to low oil and commodity prices and drought.

In 2016, unfavorable domestic conditions in some countries, such as insecurity and drought, rising borrowing costs and low oil and commodity prices, affected the macroeconomic performance of the region. GDP growth slowed markedly to 1.2 percent in 2016, down from 3.0 percent in 2015. The slowdown was especially strong among commodity and oil exporters such as Nigeria, South Africa and Republic of the Congo. Additionally, low commodity and oil prices affect the current account balance and trade conditions negatively in oil and commodity exporter countries in general. On the other hand, low prices had a positive impact on net energy and oil importers in terms of current account balance. As for inflation, the nominal exchange rate depreciation, compounded by the effect of drought on food supply and removal of fuel aids, contributed to a rise in inflation in commodity exporters. Low oil and commodity prices decreased the inflation in oil and commodity exporters such as Kenya and Tanzania. Drought in some countries caused food price inflation in many countries such as Zambia and Zimbabwe. Although economic performance deteriorated in many countries in Sub-Saharan Africa, unemployment stabilized at 7.3 percent. However, unemployment rates were uneven among countries. For example, due to the slowdown in the South African economy, the unemployment rate reached more than 25 percent in 2016 (World Bank, 2016).

## 2. Literature Review

Comparing the macroeconomic performances of countries is a new research topic in the economic literature. The number of studies comparing the macroeconomic performance of countries using TOPSIS method has increased recently. In this context, some of the researches in the literature are as follows.

Altay Topcu and Oralhan (2017) analyzed 35 OECD countries for the period of 2010-2015 using ELECTRE, PROMETHEE and TOPSIS methods. They determined six macroeconomic indicators (decision criteria) to compare the macroeconomic performances of countries. The indicators were income per capita, export and import volumes, inflation rate, GDP growth

rate and employment rate. They found that The United Kingdom had the best macroeconomic performance and Chile was the last in the ranking.

Eyuboglu (2017) compared and evaluated the macroeconomic performances of Turkish World countries for the period of 2004-2013 with AHP and TOPSIS methods and used four decision criteria which were GDP growth rate, current account balance/GDP rate, inflation rate, and unemployment rate. As a result of the study, it was found that Azerbaijan, Turkmenistan and Uzbekistan showed the best macroeconomic performances.

Sevgin and Kundakci (2017) analyzed 28 EU countries using MOORA and TOPSIS for the year 2013 and used six decision criteria which were sovereign debt/GDP ratio, budget deficit/GDP ratio, export/import rate, inflation rate, GDP/population ratio and unemployment rate. According to the result obtained, Luxembourg, Sweden and Denmark ranked among the top three in terms of macroeconomic performances and Slovenia, Greece and Turkey ranked among the last three.

Masca (2017) ranked 28 EU countries with TOPSIS method according to their macroeconomic performance for the year 2015. By using six macroeconomic indicators as decision criteria which were general government deficit-surplus/GDP, long-term interest rates, inflation rates, general government gross debt/GDP, gross fixed capital formation/GDP, it was found that Sweden had the best performance and Greece had the lowest performance.

Cihan and Salur (2017) analyzed the macroeconomic performances of the BRICS countries and Turkey for the period of 2004-2014 with TOPSIS method. They used six decision criteria which were GDP growth, inflation rate, unemployment rate, budget deficit (surplus)/GDP and current account balance/GDP rates. They found that Azerbaijan was the country with the best performance among the BRICS countries and Turkey.

Eyuboglu (2016) compared the macroeconomic performances of 10 developing countries for the period of 2003-2013 with TOPSIS method and used four decision criteria which were current account balance/GDP rate, inflation rate, unemployment rate and GDP growth rate. According to the findings of the study, it was founded that China and Malaysia showed the best macroeconomic performances.

Goktolga et. al. (2015) compared the macroeconomic performances of five Asian countries for the period of 2003-2013 with TOPSIS method and used six decision criteria which were GDP growth rate, per capita GDP, export rate, import rate, inflation rate and unemployment rate. According to the findings of the study, it was founded that in all years except 2006, 2009 and 2013, Kazakhstan showed the best macroeconomic performance.

Urfalioglu and Genc (2013) analyzed 32 countries consisting of the EU countries and the EU candidate countries for 2012 with TOPSIS, PROMETHEE and WSA methods. They used six decision criteria which were GDP growth, income per capita, inflation rate, export and import volume and employment rate. They found that Ireland had the best performance according to ELECTRE method; Germany had the best performance according to TOPSIS method and Sweden had the best performance according to PROMETHEE method.

Genc and Masca (2013) ranked the macroeconomic performances of 28 EU countries and Turkey for 2015 using TOPSIS and PROMETHEE methods. They used long-term interest rates, general government gross debt/GDP, GDP growth rate, general government deficit-surplus/GDP, unemployment rate and inflation rates as decision criteria. They found that Latvia had the best performance according to TOPSIS method and Estonia had the best performance according to PROMETHEE method. According to both methods, Portugal was found as the country with the worst performance.

Dincer (2011) analyzed 30 countries consisting of the EU countries and the EU candidate countries for the year 2012 using TOPSIS and WSA methods. Five decision criteria which were GDP per capita, inflation rate, export and import volume as a percentage of GDP and employment rate were used. According to the findings of TOPSIS method, the first three countries with the best performances were Luxembourg, Netherlands and Denmark; the last three were Macedonia, Latvia and Bulgaria. In addition, according to the performance ranking of WSA method, the first six and the last three were the same with TOPSIS method.

Ozden (2011) ranked 29 EU member countries and EU candidates for 2009 according to macroeconomic performances with TOPSIS and ELECTRE methods and used six decision criteria which were sovereign debt as a percentage of GDP, budget balance as a percentage of GDP, export/import ratio, inflation rate, GDP/population ratio and unemployment rate.

Turan et. al. (2010) compared the macroeconomic performances of EU candidate countries and countries with the potential to enter the EU for the period of 2005-2019 with TOPSIS method and used six decision criteria which were GDP growth rate, current account balance/GDP rate, inflation rate and unemployment rate. According to the findings of the study, it was founded that the EU is a political community rather than an economic community.

Ozturk and Bayramoglu (2018) ranked the macroeconomic performances of the EU countries and Turkey for the period of 2006-2016 using TOPSIS method. They used GDP growth rate, per capita GDP, export rate, import rate, inflation rate and

employment rate as decision criteria. They found that in the years that the growth rate of Turkey was higher than in other countries, Turkey took the first place in terms of macroeconomic performance.

Ela et. al. (2018) compared the macroeconomic performances of EU countries and Turkey for the year 2016 with TOPSIS method and used four decision criteria which were current account balance/GDP rate, inflation rate, unemployment rate and GDP growth rate. According to the findings of the study, it was founded that Romania showed the best macroeconomic performance while Turkey showed the worst economic performance.

### 3. Data and Methodology

#### 3.1. Macroeconomic Indicators and Data

In this study, it is used macroeconomic indicators (inflation rate, GDP growth rate, current account balance/GDP rate and unemployment rate) to evaluate the performances of the countries. Inflation rate, GDP growth rate, current account balance/GDP rate and unemployment rate data are obtained from IMF World Outlook Database. Sub-Saharan African countries (Mozambique, Angola, Cote d'Ivoire, Nigeria, South Africa, South Sudan, Tanzania, Zambia) are selected according to their distinctive features:

Oil exporter countries: Nigeria, South Sudan.

Non-energy mineral exporters: South Africa, Zambia.

Oil importers: Cote d'Ivoire, Tanzania.

Commodity exporters: Angola, Mozambique.

Macroeconomic indicators (the definitions are based on IMF explanations) used in this study and their effects on the macroeconomic performances are as follows (Table 1):

**GDP Growth Rate:** It shows the annual percentage changes in GDP. Higher growth rate is considered as higher macroeconomic performance because higher GDP growth rate refers higher income.

**Inflation Rate:** It shows the annual percentages of changes in consumer prices. High inflation rate makes price disorder and decreases purchasing power; therefore, higher inflation is considered as lower macroeconomic performance.

**Unemployment Rate:** According to TURKSTAT definition, it shows the ratio of the unemployed population to the labor force. Unemployment causes some of the resources in the economy to remain idle, and it is also a factor that prevents economic growth. Therefore, higher unemployment rate is considered as lower macroeconomic performance.

**Current Account Balance/GDP:** The result of a country's trade in goods and services with the outside world is called the current balance. Current account deficit means lower GDP growth. Additionally, current account deficit affects exchange rates negatively. Therefore, current account deficit is considered as lower macroeconomic performance and current account surplus is considered as higher macroeconomic performance.

**Table 1. Macroeconomic Performance Evaluation Criteria and Their Targets**

Evaluation Criteria	Target
GDP Growth Rate	Maximum
Inflation Rate	Minimum
Unemployment Rate	Minimum
Current Account Balance/GDP	Maximum

Table 2 shows the macroeconomic indicator data for the countries used in the analysis for 2016. This table also forms the decision matrix of TOPSIS method.

**Table 2. Macroeconomic Indicator Data for 2016**

	GDP Growth Rate (%)	Inflation Rate (%)	Unemployment Rate (%)	Current Account Balance/GDP (%)
Angola	-0.7	34.7	7.7	-3.2
Cote d'Ivoire	8.3	0.7	2.6	-1.1
Mozambique	3.8	19.2	25.2	-39.2
Nigeria	-1.6	15.7	13.4	0.7
South Africa	0.6	6.3	26.7	-3.3
South Sudan	-13.8	379.8	11.6	1.8
Tanzania	7	5.2	2.2	-4.5
Zambia	3.7	17.9	7.8	-4.5

### 3.2. TOPSIS Method

TOPSIS (Technique for Order Preference Similarity to Ideal Solution) developed by Hwang and Yoon (1981) is a multicriteria decision making method based on the distances from the ideal solution. This method allows relative ordering of alternatives according to certain criteria. The most preferable alternative should be the nearest to the ideal solution and the farthest to the negative-ideal solution.

#### Step 1:

The decision matrix consisting of alternatives and criteria is created. Alternatives and criteria form the rows and columns, respectively (Hwang and Yoon, 1981).

$$D = \begin{bmatrix} x_{11} & \dots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \dots & x_{mn} \end{bmatrix} \quad \begin{array}{l} m: \text{alternative} \\ n: \text{criterion} \end{array} \quad (1)$$

#### Step 2:

The decision matrix is normalized to evaluate the criteria with different units. R is the normalized decision matrix (Hwang and Yoon, 1981).

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \quad \begin{array}{l} i = 1, \dots, m \\ j = 1, \dots, n \end{array} \quad (2)$$

$$R = \begin{bmatrix} r_{11} & \dots & r_{1n} \\ \vdots & \ddots & \vdots \\ r_{m1} & \dots & r_{mn} \end{bmatrix} \quad (3)$$

#### Step 3:

The normalized matrix is multiplied by the criterion weights. Criterion weights represent the importance ratings given by the decision makers to the criteria. The sum of the criterion weights must be equal to 1. V is the weighted normalized decision matrix (Hwang and Yoon, 1981).

$$V = \begin{bmatrix} w_1 r_{11} & \dots & w_n r_{1n} \\ \vdots & \ddots & \vdots \\ w_1 r_{m1} & \dots & w_n r_{mn} \end{bmatrix} = \begin{bmatrix} v_{11} & \dots & v_{1n} \\ \vdots & \ddots & \vdots \\ v_{m1} & \dots & v_{mn} \end{bmatrix} \quad (4)$$

#### Step 4:

Ideal (A<sup>+</sup>) and negative-ideal (A<sup>-</sup>) solution values are obtained for each criterion according to benefit or cost situation. Ideal solution represents the relatively best alternative while negative-ideal solution represents the relatively worst alternative (Hwang and Yoon, 1981).

$$A^+ = \left\{ \left( \max_i v_{ij} \mid j \in J \right), \left( \min_i v_{ij} \mid j \in J' \right) \mid i = 1, \dots, m \right\} = \{v_1^*, v_2^*, \dots, v_n^*\} \quad (5)$$

$$A^- = \left\{ \left( \min_i v_{ij} \mid j \in J \right), \left( \max_i v_{ij} \mid j \in J' \right) \mid i = 1, \dots, m \right\} = \{v_1^-, v_2^-, \dots, v_n^-\} \quad (6)$$

$$J = \{j = 1, 2, \dots, n \mid j \text{ for benefit criteria}\} \quad (7)$$

$$J' = \{j = 1, 2, \dots, n \mid j \text{ for cost criteria}\} \quad (8)$$

Step 5:

The distances of each alternative from ideal and negative-ideal solutions are calculated as (Hwang and Yoon, 1981)

$$S_i^* = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^*)^2} \quad i = 1, 2, \dots, m \quad (\text{for ideal solution}) \quad (9)$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2} \quad i = 1, 2, \dots, m \quad (\text{for negative - ideal solution}) \quad (10)$$

Step 6:

Relative closeness of each alternative to the ideal solution is calculated. Relative closeness ( $C_i^*$ ) value is between 0 and 1. If  $C_i^* = 1$ , the alternative is the ideal solution ( $A^*$ ), and if  $C_i^* = 0$ , it is the negative-ideal solution ( $A^-$ ) (Hwang and Yoon, 1981).

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^+} \quad i = 1, 2, \dots, m \quad (11)$$

Step 7:

Alternatives are ranked according to descending sort based on the relative closeness values. Thus, the relatively best and worst alternatives can be determined (Hwang and Yoon, 1981).

**4. Analysis and Findings**

In this study, macroeconomic performances of eight Sub-Saharan African countries for 2016 are measured and compared using TOPSIS method. Evaluation criteria and weights are taken from Eyuboglu (2017). Accordingly, criterion weights are included in this study as GDP growth rate (0.51), inflation rate (0.29), unemployment rate (0.12) and current account balance/GDP (0.08). Macroeconomic indicator data for 2016 in Table 2 constitutes the decision matrix. The decision matrix is normalized as in Table 3. Table 3 also shows the criterion weights and targets.

**Table 3. Normalized Matrix and Criterion Weights**

Target	max	min	min	max
Weights	0.51	0.29	0.12	0.08
	GDP Growth Rate (%)	Inflation Rate (%)	Unemployment Rate (%)	Current Account Balance/GDP (%)
Angola	-0.04	0.09	0.18	-0.08
Cote d'Ivoire	0.45	0.00	0.06	-0.03
Mozambique	0.21	0.05	0.59	-0.98
Nigeria	-0.09	0.04	0.32	0.02
South Africa	0.03	0.02	0.63	-0.08
South Sudan	-0.75	0.99	0.27	0.04
Tanzania	0.38	0.01	0.05	-0.11
Zambia	0.20	0.05	0.18	-0.11

The normalized matrix is multiplied by the criterion weights and the weighted normalized decision matrix is obtained. According to the weighted normalized decision matrix, ideal and negative-ideal solution values of each criterion is attained as in Table 4.

**Table 4. Ideal and Negative-Ideal Solutions**

Target	max	min	min	max
	GDP Growth Rate (%)	Inflation Rate (%)	Unemployment Rate (%)	Current Account Balance/GDP (%)
Ideal solution (A*)	0.230	0.001	0.006	0.004
Negative-ideal solution (A-)	-0.382	0.288	0.076	-0.078

After finding ideal and negative-ideal solutions, the distances of each alternative from ideal ( $S_i^*$ ) and negative-ideal ( $S_i^-$ ) solutions and relative closeness to the ideal solution ( $C_i^*$ ) are calculated as in Table 5.

**Table 5. Distances from Ideal and Negative-Ideal Solutions and Relative Closeness to The Ideal Solution**

	$S_i^*$	$S_i^-$	$C_i^*$
Angola	0.251	0.456	0.645
Cote d'Ivoire	0.002	0.683	0.996
Mozambique	0.161	0.558	0.776
Nigeria	0.276	0.445	0.617
South Africa	0.224	0.494	0.688
South Sudan	0.676	0.092	0.120
Tanzania	0.037	0.649	0.946
Zambia	0.129	0.563	0.813

For an alternative to be preferable, the distance from ideal solution ( $S_i^*$ ) should be lower, and the distance from the negative-ideal solution ( $S_i^-$ ) should be higher. According to the relative closeness ( $C_i^*$ ) calculated considering this information, Cote d'Ivoire (0.996) is found as the best country among eight Sub-Saharan African countries (Table 5-6).

**Table 6. Final Ranking of Countries**

Ranking	Countries
1	Cote d'Ivoire
2	Tanzania
3	Zambia
4	Mozambique
5	South Africa
6	Angola
7	Nigeria
8	South Sudan

Following Cote d'Ivoire, Tanzania ranks with 0.946 and becomes the second country with the best macroeconomic performance. Zambia with 0.813, Mozambique (0.776), South Africa (0.688), Angola (0.645) and Nigeria (0.617), respectively, come after Cote d'Ivoire and Tanzania. South Sudan (0.12) is the country with the lowest macroeconomic performance.

## Conclusion

In this study, eight Sub-Saharan African countries' macroeconomic performances are evaluated using four fundamental indicators (current account balance/GDP rate, unemployment rate, inflation rate and GDP growth rate). For this purpose, eight Sub-Saharan African countries are analyzed with the data of 2016 using TOPSIS method. According to the findings, countries with the best macroeconomic performance are obtained as Cote d'Ivoire and Tanzania. The reason for this ranking may be Cote d'Ivoire and Tanzania's highest GDP growth rate and the lowest inflation and unemployment rates. Zambia, Mozambique, South Africa, Angola, Nigeria and South Sudan have lower performance than Cote d'Ivoire and Tanzania. The macroeconomic performance of South Sudan is significantly lower than others. The fact that the inflation

rate is extremely high and GDP growth rate is very low can be considered as the cause of this situation. On the other hand, according to country groups, the results show that the oil importer countries have the highest macroeconomic performances while the oil exporter countries have the lowest macroeconomic performance. Also, bigger countries (measured by GDP) such as South Sudan and Nigeria showed lower macroeconomic performances than smaller countries.

It should be considered that the ideal solution and the closeness measure to the ideal solution are relative measures. Different findings can be obtained when different countries are also used. Another issue that needs to be considered is that there are other indicators such as long-term interest rates, export and import volumes, affecting macroeconomic performance. Due to the limitation of data access, the number of countries and indicators used in the study are limited. It would be more appropriate to use various macroeconomic indicators for a more detailed evaluation.

This paper has some policy recommendations for Sub-Saharan African countries. Firstly, according to the results, given that oil prices are low in 2016, two oil-exporter countries, Nigeria and South Sudan are the countries with lowest macroeconomic performances. This situation shows that these countries have vulnerable economies to global economic conditions such as oil prices. Therefore, these two countries should make export diversification. So, they can decrease export and macroeconomic vulnerabilities. In addition to this, one of the reasons South Sudan has the lowest macroeconomic performance is that it has high inflation rate. In this regard, South Sudan should focus on the reasons of the inflation such as monetization of the public deficits and conflicts. Monetizing the public deficits is banned by laws in lots of countries, such as Turkey. Therefore, South Sudan should stop to monetize public deficits to reach low inflation rates. On the other hand, environmental conditions affected the rankings of the countries. In this regard, high inflation rates like in Zambia may be reduced by giving importance to agricultural policy.

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