Journal of Business and Environmental Sciences
Volume: 3 (1): Page: 94-111
https://doi.org/10.21608/JCESE.2024.254571.1048
ISSN: 2974-3117
E-ISSN: 2974-3125

Research article

Estimating the Error Correction Model by Applying It to the Sectors of the Gross Domestic Product of the Republic Of Sudan (1960-2020s)

Yousif Jaffar Albashir Osman [1], Mohamed Elamin A.Allatif [2], Intisar Yousif Ahmed[3]*

[1] Department of Agricultural Economic, College of Agricultural Studies, Sudan University of Science and Technology, Sudan; yousifgafer976@gmail.com

[2] Department of Agricultural Economic, College of Agricultural Studies, Sudan University of Science and Technology, Sudan;

[3] Department of Agricultural Economic, College of Agricultural Studies, Sudan University of Science and Technology, Sudan; intisarsust@yahoo.com

* **Correspondence:** intisarsust@yahoo.com.

Abstract: The study addressed time series data issues, investigating the long-term relationship between GDP components, the agricultural sector, and other economic sectors. It utilized desorption and economic model estimation to depict the short-term dynamic relationship and estimate long-term equilibrium parameters. Causality and co-integration of time series data, particularly concerning the gross domestic product (GDP) of agro-industrial and service sectors in dollars, were explored. Using time series data from 1960 to 2020, Granger causality tests and an Error Correction model were applied via E-Views for analysis. Findings indicated a 10% decline in the agricultural sector's contribution led to an 8% decrease in GDP. Similarly, reductions of 10% in the service and industrial sectors resulted in GDP declines of 25% and 62%, respectively. Speed error correction in the GDP equation was statistically significant at 1%. Typically, 74% of GDP imbalances in the long run were corrected within a year, with correction speeds for contributing sectors (agriculture, industry, and services) at 19%, 2%, and 1%, respectively. The results affirmed causal relationships between GDP and the service and agriculture sectors, as well as intimate causal relations between agriculture and industry and services. Lastly, the study recommended enhancing agricultural sector development through flexible investment support policies grounded in efficient and sustainable technology, emphasizing attention to both the agricultural and industrial sectors to improve GDP contributions, meet potential exports, and satisfy local demand.

Keywords: Time series data problems; GDP components; Agricultural sector; Causality and co-integration; Economic model estimation

APA Citation: Osman, Y. J. A., Allatif, M. E. A. & Ahmed, I. Y. (2024). Estimating the Error Correction Model by Applying It to the Sectors of the Gross Domestic Product of the Republic Of Sudan (1960-2020s). Journal of Business and Environmental Sciences, 3(1), 94-111.

Received: 10 December 2023; **Revised**: 30 December 2023; **Accepted:** 11 January 2024; **Online:** 21 January 2023

The Scientific Association for Studies and Applied Research (SASAR)
https://jcese.journals.ekb.eg/

1. Introduction

The nature of data play a key role in formulation of economic variables especially time series data, if the feature of the variables was characterized by common integration phenomenon. The most suitable interpretation of relationship between models are error correction. If model variables are not characterized by this property, its form do not become valid to explain the behavior of this phenomenon and consequently using of such models to reconcile short-run and long-run behavior of economic relations will not be adequate. The economic variables are supposed to be heading in long run towards a state of stability in the economy which called. In this situation the model results may deviate from its path vector for many reasons, therefore, considering such results will produce misleading recommendations. Thus, using of ordinary least square estimation is highly required which were adopted by study to examine the contribution and the relationship between economic sectors (agriculture, industry and services) in the GDP of Sudan. (Abdul Kader, 2007).

No stationary (trended) time-series data can be regarded as potentially a major problem for empirical econometrics. It is well known that trends, either stochastic or deterministic, may cause spurious regressions, uninterruptable student-t values and other statistics, goodness of fit measures which are 'too high' and, as a rule, make regression results rather difficult to evaluate. However, most macroeconomic time-series are subject to some Types of trend. Some researchers have suggested a remedy, namely to difference a series successively until stationary is achieved. Nevertheless, it has been proved that 'differencing' results in a loss of some valuable long-run information in the data (Cheung, 1993).

The study aimed to treat time series data problems and find out the relationship between components of GDP and contribution of agricultural sector and other economic sectors in long run, through the desorption and estimation of economic model to reflect the dynamic relationship between them in short run with an estimation of equilibrium parameters in long run. The study also tried to examine the direction of causality and co-integration of time series data and the gross domestic of agro-industrial and service in dollars. The study depended basically on time series data from secondary source for the period (1960-2020).Granger causality test and Error Correction model were applied to analyze the data using a program of economic performances (E-Views). The results revealed that the decline in the contribution of agricultural sector by 10% lead to lower GDP by 8%. However, the decline in the contribution of the service and industrial sectors each by 10% lead to lower GDP by (25% and 62%), respectively. Results also confirmed that speed error correction of GDP equation was statistically significant at 1%. Typically, 74% of imbalance of GDP in the long run has been corrected in year, while the error correction speed in the sectors that contributing to GDP (agriculture, industry and services) of imbalance was corrected by (19%, 2% and 1 %) respectively. The results approved the causal relation between GDP and services and agriculture sectors. Similarly, intimately causal relation between agriculture and industry and services were also reported.

Finally, the study suggested some recommendations that expect to enhance the development of agricultural sector through flexible investment support policies based on the use of efficient and sustainable technology. Moreover, considerable attention should be given to the agriculture and industrial sectors. This would not only improve the contribution of the sectors to GDP but would also help meet potential exports and satisfy the local demand.

A real breakthrough in the time-series econometrics came with the concept of 'co-integration' in the early 1980s. The concept was first introduced by Granger (1981). Afterwards, Engle and Granger (1987), provided a firm theoretical base for representation, testing, estimating and modeling of co-integrated no stationary time-series variables. Since then, there has been an explosion of research on co-integration and related fields. Co-integration analysis allow us to use no stationary data so that spurious results are avoided It also provides applied econometricians an effective formal framework for testing and estimating long-run models from actual time-series data (Engle, 1987).

2. Research problem and questions

Economic variables such as quantities and prices were very important for economic sectors and GDP data. However, in last years it was seriously influenced by problem of instability especially in time series data, which results in obtaining a regression manifest itself in form of relations as indicated as follows:

1. Identify high coefficient of determination (R2)
2. Transactions with a statistically significant decline high.
3. The presence of chain link shown autocorrelation statistic was first class.

This is due to time that the data is often left out direction that reflects special circumstances affecting all variables factor making them change in the same In spite of the lack of a real relationship between them, research problem lies in presence of an unbalanced relationship between agricultural sector and gross domestic product, as well as between agricultural sector and other sectors (service and industry).

3. Research Objectives

The study aimed to achieve the following objectives:

1- To treat problem of instability of time series data for gross domestic product and other economic sectors in Sudan.

2- To estimate true form of time series data, which describes relationship between constituent sectors of GDP in Sudan?

4. Research hypotheses

1- Time series of different sectors contributed stably to gross domestic product in Sudan.

2- There is intimately relationship between contribution of agricultural sector and other sectors such a services and industry to GDP in Sudan.

5. Materials and Method

5.1 Data Description and Study Area

The research was based primarily on secondary data, from 1960 to 2020, obtained from the reports of the Central Bank of Sudan, and aims to estimate the contribution of the agriculture, industry and services sectors to the GDP of Sudan.

5.2 Methods of Analysis

Unit root test, Johansen tests for co-integration, error correction model, and the multiple regression models were used to discover and to assess the relation between variables using EVIEWS 11 statistical package.

5.3 Descriptive Statistics Test

To test normality series, a descriptive statistics test is run using the Jarque–Bera statistics indicator. If Jarque Bera statistics is less than .05 level, the H0 is rejected (normal distribution), significant that the series shows non-normal distribution. Accordingly, the series is theoretical to be changed to logarithm form.

5.4 Unit Root Test

To test for a unit root in each series, we employ the augmented Dickey-Fuller (ADF) methodology (see Dickey-Fuller, 1981). The ADF test is estimated by the following regression:

$$\Delta Y_t = a_0 + zt + a_1 Y_{t-1} + + \sum_{i=1}^{p} a_i \Delta Y_{t-1} + \varepsilon_t$$

Z = ADF coefficient to be estimated; t = time selected; Π = Constant; Π = trend.

Testing H0: X has a unit root (non stationary), against H1: X (Stationary).

The t statistic of ADF coefficient is compared with the t statistic of test critical values. If the series is stationary, acceptance of H1 of ADF statistic is bigger than the critical t value (Emam et al., 2018). EVIEWS 9 program (which was used in this study) normally adopts 1% and 5% level of significance.

- Null hypothesis of unit root (time series are not stationary) (H: P = 0)
- Alternative hypothesis of unit root (time series are stationary) (H: P ≠ 0)

5.5 Specification of Lag

A maximum lag number is identified and considered in the co-integration test. Different standards can be used in choosing the lag orders: Akaike information criterion (AIC) is the most widely used model (Emam et al., 2018). AIC is the best model in lag selection when dealing small samples (less than 60; Liew, 2004).

5.6 Johansen Tests for Co-Integration

Johansen tests, namely Eigen value and trace tests are used for testing co-integration. For both tests, the null hypothesis of no integration was examined against co-integration. However, the two tests are different in alternative hypothesis. Hence, the maximum Eigen value examines the biggest Eigen value in relation to the following largest value which is zero. The test statistics is specified by the next equation (Emam et al., 2018):

$$LR\ (r0,\ r0+1) = -T\ln\ (1 - \lambda r0+1)$$

LR (r0, r0Π1) is the likelihood ratio statistic to test whether rank (Π) = r0 against the alternative hypothesis that ranks (Π) = r0 + 1.

The trace test examines whether the rank of matrix Π is equal to r0, in particular, tests the null hypothesis rank (Π) = r0, against the alternative hypothesis r0 < rank (Π) ⩽ n, n represents the maximum number of co-integrating vectors (Baig & Straquadine, 2014). (Emam et al., 2018).

5.7 VECM

The ECM explores the degree of short-run dynamics of equilibrium and the implications of short-run performance, one or more variables changes to return stability, where short-run equilibrium variation is required to preserve long-run relations (Dhungel, 2014).

6. Results and Discussion

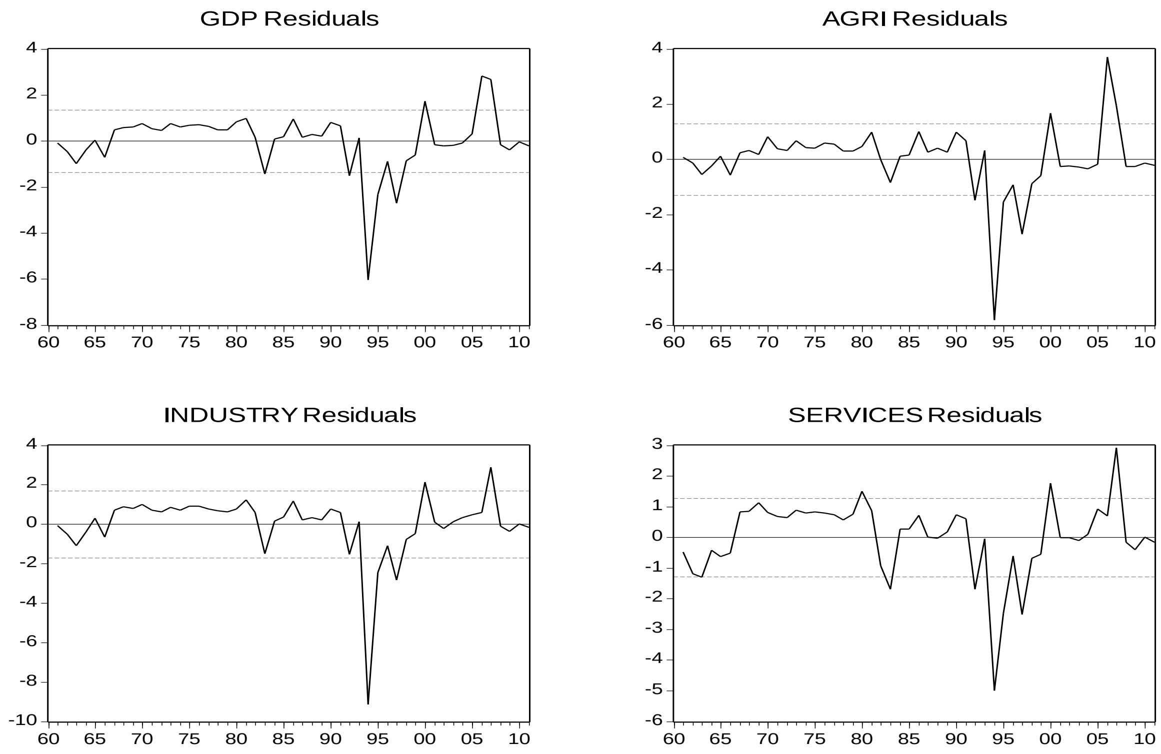
6.1 Description of data stability

The description of the data showed that the data was not normally distance. According, natural logarithm was applied to solve this problem.

6.2 Normality of the data

To avoid the critical problem of economic such as men variance of disturbance error is zero and constant homoscedastic some tests his normality, multi collinearly were conducted in all study analysis .as result of tests and alteration of natural logarithm the data become normally distributed.

Graph (1): Normally distributed



Source: Depicted from own data, 1960-2020

6.3 Test unit root

- Null hypothesis of unit root (time series are not stationary) (H: P = 0)
- Alternative hypothesis of unit root (time series are stationary) (H: P $\neq$ 0)

Test unit root GDP

We take at the levels (no unit roots) of the series in GDP and then we run the unit root test, the value of statistics t-calculated (3.29) less than t-critical value (3.54). All reported values are distributed p-values (1%) under null of unit root or no co-integration. We reject alternative hypothesis (Table 1). We take test unit root at first differences, t-calculated value greater (7.84) than t-critical value (3. 54) the unit root at first difference tests indicate that there is time series data GDP are stationary. We proceed to test for causality direction using Error Correction model for, accepted alternative hypothesis (Table 2).

Table (1): Test unit root GDP at level

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		3.29	0.0195
Test critical values:	1% level	3.54	
	5% level	2.91	
	10% level	2.59	

Source: Depicted from own data, 1960-2020

Table (2): Test unit root GDP after first differences

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	7.84	0.0000

Test critical values: 1% level	3.54	
5% level	2.91	
10% level	2.59	

*MacKinnon (1996) one-sided p-values.

Source: Depicted from own data, 1960-2020

Test unit root agriculture sector

We take unit root depending on test Dickey Fuller to see stability or stationary series of whether or not review of data (Table 3) shows that it contains the unit root they are not stationary at level where t-calculated value (3.35) less than t-critical value (3.54) We reject alternative hypothesis. After taking first differences t-calculated value greater (7.89) than t-critical value (3.54) we accepted alternative hypothesis that mean the time series data of agricultural is stationary (Table 4).

Table 3: Test unit root agricultural at level

Null Hypothesis: AGRICULTU has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

	t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic	3.35	0.0167
Test critical values: 1% level	3.54	
5% level	2.91	
10% level	2.59	

*MacKinnon (1996) one-sided p-values.

Source: Depicted from own data, 1960-2020

Table 4: Test unit root agricultural after first differences

Null Hypothesis: D(AGRICULTU) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

	t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic	7.89	0.0000
Test critical values: 1% level	3.54	
5% level	2.91	
10% level	2.59	

*MacKinnon (1996) one-sided p-values.

Source: Depicted from own data, 1960-2020

Test unit root industrial sector

The series analysis important to make sure stability time series industrial sector, test unit root at level t-calculated (3.24) less than t-critical value (3.54). That means the series not stationary (Table 5) .We reject alternative hypothesis. But stabilized after first differences have found t-calculated value greater (8.13) than t-critical value (3. 54) become the series stable after taking first differences us accepted alternative hypothesis (Table 6).

Table 5: Test unit root industry at level

Null Hypothesis: INDUSTRY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		3.24	0.0222
Test critical values:	1% level	3.54	
	5% level	2.91	
	10% level	2.59	

*MacKinnon (1996) one-sided p-values.

Source: Depicted from own data, 1960-2020

Table 6: Test unit root industrial after first differences

Null Hypothesis: D(INDUSTRY) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		8.13	0.0000
Test critical values:	1% level	3.54	
	5% level	2.91	
	10% level	2.59	

Source: Depicted from own data, 1960-2020

Test unit root services sector

Review the results related to unit root in (Table 7) shows is test unit root services, they are unstable when at level because t-calculated less (2.9) than t-critical (3.5), us reject alternative hypothesis. But stationary after taking first differences because t-calculated value (7.6) greater than t-critical (3.5) we accept alternative hypothesis (Table 8).

Table 7: Test unit root services sector at level

Null Hypothesis: SERVICE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.97	0.0428
Test critical values:	1% level	3.54	
	5% level	2.91	
	10% level	2.59	

*MacKinnon (1996) one-sided p-values.

Source: Depicted from own data, 1960-2020

Table 8: Test unit root after first differences

Null Hypothesis: D(SERVICE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		7.63	0.0000
Test critical values:	1% level	3.54	
	5% level	2.91	
	10% level	2.59	

*MacKinnon (1996) one-sided p-values.

Source: Depicted from own data, 1960-2020

Causal relation

Results in Table (9) test causality: causal relationship in one direction between agriculture and GDP was significance at level of (0.010) indicating that agriculture has curial influence on GDP.

Table 9: Test causal relation

Pairwise Granger Causality Tests
Sample: 1960 2020
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
AGRICULTU does not Granger Cause GDP	59	47.7583	1.E-12
GDP does not Granger Cause AGRICULTU		49.8955	5.E-13
INDUSTRY does not Granger Cause GDP	59	3.78999	0.0288
GDP does not Granger Cause INDUSTRY		3.64951	0.0326
SERVICE does not Granger Cause GDP	59	13.3038	2.E-05
GDP does not Granger Cause SERVICE		14.5258	9.E-06
INDUSTRY does not Granger Cause AGRICULTU	59	6.87703	0.0022
AGRICULTU does not Granger Cause INDUSTRY		6.65091	0.0026
SERVICE does not Granger Cause AGRICULTU	59	17.1303	2.E-06
AGRICULTU does not Granger Cause SERVICE		21.1421	2.E-07
SERVICE does not Granger Cause INDUSTRY	59	69.7994	1.E-15
INDUSTRY does not Granger Cause SERVICE		77.9518	1.E-16

Also relationship in one direction between services and GDP was reported. This means that gross domestic product is affected by services sector at significance level of (0.010). There is relationship in one direction between industry and agriculture, agriculture and services was significance at level of (0.047) (0.0001) respectively. Relationship between industry and services was not significance at level of (0.641959), services sector completely independent from industry and vice versa.

Study of Co-integration

Study of co-integration between sectors and GDP Johannes test results showed integration and long-run relationship between GDP and sectors in table (10).

Table 10: Test the co-interacting

Johansen Co-Integration Test Results: Trace Statistic (Lag Interval in First Differences)

Hypothesized **No. of CE(s)**	**Eigen value**	Trace **Statistic**	0.05 **Critical Value**	**Prob.****
None *	0.995730	582.5395	47.85613	0.0001
At most 1 *	0.986825	266.0820	29.79707	0.0001
At most 2	0.141091	14.97666	15.49471	0.0597
At most 3 *	0.100689	6.155326	3.841466	0.0131

Source Data were collected and analyzed.

Note: Trace statistic test shows two co-integrating equations at the .05 level. CE = co-integrating equation.

**Rejection of the null hypothesis at 5% level of significance; * represent 5% level of significance.

Johansen Co-Integration Test Results: Max-Eigen Statistic (Lag Interval in First Differences).

Hypothesized **No. of CE(s)**	**Eigen value**	Max-Eigen **Statistic**	0.05 **Critical Value**	**Prob.****
None *	0.995730	316.4575	27.58434	0.0001
At most 1 *	0.986825	251.1053	21.13162	0.0001
At most 2	0.141091	8.821333	14.26460	0.3013
At most 3 *	0.100689	6.155326	3.841466	0.0131

Source Data were collected and analyzed

Note: Max Eigen value tests show no co-integrating equation(s) at the .05 level. CE = co-integrating equation.

*Represent 5% level of significance.

Table (10) common test based on test characteristic values and test the impact between GDP and various sectors of calculated value effect of (582.5) greater than value for same test at potential level (1%) and (5%) we rejected all reported values are distributed N (0, 1) under null of unit root or no co-integration. are weighted by long run variances, accept alternative hypotheses is co-integration and presence of long-run balance relationship. Balance relationship by following:

Equation (1): $Y = -0.002 + .14x_{1t} - .206x_{2t} + 0.82x_{3t}$

(0.00274) (0.05935) (0.06166) (0.07093)

Y= GDP, X_1= Agriculture, X_2= Industry, X_3 = Service

The model results revealed that the lower contribution of agricultural sector by14% lead to lower GDP by 8%, and decrease in contribution of service sector and industrial by10% lead to lower GDP by 25 % and 62% respectively.

6.4 Estimates of model error correction

Tests indicate that there is a long-run relationship between GDP and other factor for both Associations. We proceed to test using Error Correction model for each sector Table (11).

1- Long-run elasticity's: that the elasticity's of various sectors of agriculture, industry and services (-0.037321) (-0.646265) (-0.274898) respectively statistically significant but negative signal and this is contrary to economic logic because sectors gross domestic product is a dollar that either have a positive or neutral effect, is due to smallness of Sudanese economy, in addition to being the economy open affected by imported inflation and exchange rate.

2- Correction factor: error was corrected in GDP equation of statistical significance equal (740321) that is 74% of the imbalance in long run GDP has been corrected in the year as speed error correction in GDP sectors of agriculture, industry and services (10%, 6% and 13%) imbalance is corrected in the year of sectors in a row and by comparing elasticity's in long and short run, we find that sectors of services and industry flexible in long and short run which means that economy has become economy service-industrial agriculture sector has been resilient in short run and is flexible in long run is attributed to policies on agricultural sector.

Table (11): Error Correction Model

Vector Error Correction Estimates
Date: 03/14/23 Time: 03:07

Sample (adjusted): 1963 2020
Included observations: 58 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
GDP(-1)	1.000000			
AGRICULTU(-1)	-1.859416			
	(0.00630)			
	[-295.067]			
INDUSTRY(-1)	-1.106393			
	(0.01393)			
	[-79.4138]			
SERVICE(-1)	0.202446			
	(0.00671)			
	[30.1543]			
C	47.96851			
Error Correction:	**D(GDP)**	**D(AGRICULTU)**	**D(INDUSTRY)**	**D(SERVICE)**
CointEq1	18.40885	10.84184	6.292294	13.87678
	(5.40670)	(2.51944)	(0.45828)	(0.99000)
	[3.40482]	[4.30328]	[13.7303]	[14.0169]
D(GDP(-1))	-7.989286	-5.159503	-3.810502	-8.903709
	(5.62275)	(2.62011)	(0.47659)	(1.02956)
	[-1.42089]	[-1.96919]	[-7.99532]	[-8.64807]
D(GDP(-2))	0.635896	-0.305020	-1.130027	-2.058877
	(3.05283)	(1.42257)	(0.25876)	(0.55899)
	[0.20830]	[-0.21442]	[-4.36706]	[-3.68320]
D(AGRICULTU(-1))	9.538722	6.969472	6.051072	14.12190
	(10.8510)	(5.05637)	(0.91974)	(1.98688)
	[0.87907]	[1.37835]	[6.57911]	[7.10759]
D(AGRICULTU(-2))	1.773996	1.685230	1.620061	2.214312
	(5.58238)	(2.60130)	(0.47317)	(1.02217)
	[0.31778]	[0.64784]	[3.42385]	[2.16629]
D(INDUSTRY(-1))	-27.98825	-11.33849	1.649913	4.414261

	(9.25810)	(4.31412)	(0.78473)	(1.69521)
	[-3.02311]	[-2.62822]	[2.10253]	[2.60395]
D(INDUSTRY(-2))	-0.635832	0.399797	1.109668	1.775423
	(7.05018)	(3.28527)	(0.59758)	(1.29093)
	[-0.09019]	[0.12169]	[1.85693]	[1.37530]
D(SERVICE(-1))	22.47072	10.23236	1.588141	3.379040
	(2.65480)	(1.23710)	(0.22502)	(0.48611)
	[8.46418]	[8.27127]	[7.05764]	[6.95117]
D(SERVICE(-2))	-4.124877	-1.739796	0.423860	1.947772
	(3.93486)	(1.83358)	(0.33352)	(0.72050)
	[-1.04829]	[-0.94885]	[1.27085]	[2.70338]
C	-392.3252	-187.5660	-58.55672	-134.6726
	(12051.6)	(5615.86)	(1021.51)	(2206.73)
	[-0.03255]	[-0.03340]	[-0.05732]	[-0.06103]
R-squared	0.967146	0.970993	0.989771	0.989947
Adj. R-squared	0.960985	0.965555	0.987853	0.988062
Sum sq. resids	4.04E+11	8.78E+10	2.90E+09	1.36E+10
S.E. equation	91781.15	42768.55	7779.489	16805.69
F-statistic	156.9995	178.5322	516.0473	525.1649
Log likelihood	-739.5858	-695.2968	-596.4467	-641.1199
Akaike AIC	25.84779	24.32058	20.91195	22.45241
Schwarz SC	26.20304	24.67583	21.26720	22.80766
Mean dependent	1.307831	7.435241	6.549121	17.33000
S.D. dependent	464665.5	230440.3	70584.99	153809.2

Determinant resid covariance (dof adj.)	2.08E+29
Determinant resid covariance	9.74E+28
Log likelihood	-2264.916
Akaike information criterion	79.61778
Schwarz criterion	81.18087
Number of coefficients	44

Source Data were collected and analyzed.

- Numbers between parentheses and brackets are t value and probability, respectively.
- Note: VECM = vector error correction model; GDP = Growth Domestic Product; ECM = error correction model; LM = Lagrange Multiplier test.

7. Conclusions

Through foregoing analysis data and test hypotheses, study reached several conclusions:

1- Reject null hypothesis that recognizes the unit root of series data is stable at significance level of 1%, and accept alternative hypothesis at first differences I (1).

2- Causal relationship of one direction between both agriculture and GDP, and between services and GDP were reported. This can be clearly understood by looking to the results of the study that rejecting null hypothesis unbalance relationship and accepting alternative hypothesis that recognizes balance relationship between them.

3- The model results revealed that the lower contribution of agricultural sector by10% lead to lower GDP by 8%, and decrease in contribution of service sector and industrial by10% lead to lower GDP by 25 % and 62% respectively .

4- he study also concluded that error was corrected in GDP equation at significance level of (0.740321) that means 74% of imbalance in long run GDP speed was corrected a year. Moreover, the error of GDP sectors (agriculture, industry and services) were corrected at significance level of (0.19030) (2.203885) and (1.410260) that means (19%, 2% and 1%) of the imbalance of sectors were corrected in the year respectively.

8. Recommendations

1- Improve gross domestic product, there is a need for flexible investment support policies to be introduced for the agricultural sector, based on the use of efficient and sustainable technology. Reconsider its policies on agricultural sector; find disadvantage and work to deal with it.

2- Policymakers should encourage and support farmers to undertake high return agricultural products that distinct to their area and cultivate them to nationally or even globally accepted standards.

3- More attention should be given to the different sectors. This would not only improve the contribution of the sectors to GDP, but would also help meet potential exports and satisfying the local demand.

Further research is urgently needed for deep estimation of the changes and causal relationship between different sectors.

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تقدير نموذج تصحيح الأخطاء عن طريق تطبيقه على قطاعات الناتج المحلي الإجمالي لجمهورية السودان (1960-2020م).

يوسف جعفر البشير عثمان [1]، محمد الأمين عبد اللطيف [2]، إنتصار يوسف أحمد [3]*

[1] قسم الاقتصاد الزراعي، كلية الدراسات الزراعية، جامعة السودان للعلوم والتكنولوجيا؛yousifgafer976@gmail.com

[2] قسم الاقتصاد الزراعي، كلية الدراسات الزراعية، جامعة السودان للعلوم والتكنولوجيا؛

[3] قسم الاقتصاد الزراعي، كلية الدراسات الزراعية، جامعة السودان للعلوم والتكنولوجيا؛intisarsust@yahoo.com

الملخص: تهدف الدراسة إلى معالجة مشاكل بيانات السلاسل الزمنية واكتشاف العلاقة بين مكونات الناتج المحلي الإجمالي والمساهمة في قطاع الزراعة والقطاعات الاقتصادية الأخرى على المدى الطويل، من خلال التصريف وتقدير النموذج الاقتصادي لعكس العلاقة الديناميكية بينها على المدى القصير مع تقدير معلمات التوازن على المدى الطويل. حاولت الدراسة أيضاً فحص اتجاه السببية وتكامل بيانات السلاسل الزمنية والناتج المحلي الإجمالي للصناعات الزراعية والخدمات بالدولار. اعتمدت الدراسة أساساً على بيانات السلاسل الزمنية من مصدر ثانوي للفترة (1960-2020). تم تطبيق اختبار السببية لجرانجر ونموذج التصحيح الخطأ لتحليل البيانات باستخدام برنامج أداء اقتصادي .(E-Views) كشفت النتائج أن انخفاض مساهمة قطاع الزراعة بنسبة 10% يؤدي إلى انخفاض الناتج المحلي الإجمالي بنسبة 8%. ومع ذلك، يؤدي انخفاض مساهمة قطاعي الخدمات والصناعة بنسبة 10% لانخفاض الناتج المحلي الإجمالي بنسبة (25% و62%) على التوالي. أكدت النتائج أيضاً أن سرعة تصحيح الخطأ في معادلة الناتج المحلي الإجمالي كانت ذات دلالة إحصائية عند 1%. في المتوسط، تم تصحيح 74% من عدم التوازن في الناتج المحلي الإجمالي على المدى الطويل في العام، بينما تم تصحيح سرعة تصحيح الأخطاء في القطاعات التي تسهم في الناتج المحلي الإجمالي (الزراعة والصناعة والخدمات) بنسب (19%، 2% و1%) على التوالي. أكدت النتائج وجود العلاقة السببية بين الناتج المحلي الإجمالي وقطاعات الخدمات والزراعة. بالمثل، تم الإبلاغ أيضاً عن وجود علاقة سببية حميمة بين الزراعة والصناعة والخدمات.

أخيرًا، اقترحت الدراسة بعض التوصيات التي من المتوقع أن تعزز تطوير القطاع الزراعي من خلال سياسات دعم الاستثمار المرنة استنادًا إلى استخدام تكنولوجيا فعالة ومستدامة. علاوة على ذلك، ينبغي إيلاء اهتمام كبير للقطاعين الزراعي والصناعي. وهذا لن يحسن فقط مساهمة هذين القطاعين في الناتج المحلي الإجمالي، ولكن سيساعد أيضًا في تلبية الصادرات المحتملة وتلبية الطلب المحلي.

الكلمات الافتتاحية: مشاكل بيانات السلاسل الزمنية، مكونات الناتج المحلي الإجمالي، القطاع الزراعي، السببية والتكامل، تقدير النموذج الاقتصادي.