COINTEGRATION ANALYSIS ON UNEMPLOYMENT AND MACROECONOMIC VARIABLE AMONG SELECTED AFRICAN COUNTRIES (A DYNAMIC PANEL APPROACH)

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ABSTRACT: Unemployment in Nigeria and the entire sub-Saharan countries is viewed as part of major problem hindering development in Africa. Unemployment and its determinant have been widely discussed in literatures and have continued to attract the attention of researchers especially applied econometricians. The constant increase of unemployment in Africa necessitated this study.
This study examined the effect of some selected macroeconomic variable on unemployment among 26 African countries using cointegration analysis. The panel unit root test shows that the entire variable contains a unit root at the level stage, while the first differences of the variables are all stationary. The result of Johansen cointegration test revealed that there is a long run relationship which exists between the selected macroeconomic variables and unemployment.
We therefore employed the dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS) to obtaining the coefficient of the long run. The result of the DOLS indicates that at 5% level of significance the gross domestic product and the foreign direct investment have a negative and positive impact on unemployment respectively while exchange rate is not significant at the long run. Similarly, the result of the FMOLS is in consistence with the DOLS. However, we will rely on the DOLS for our inference since it performs better than FMOLS according to recent literatures.
KEYWORDS: Panel unit root, Johansen Cointegration test, dynamic ordinary least square, dynamic panel models, fully modified ordinary least square (FMOLS).

1. INTRODUCTION

Unemployment is an issue among the underdeveloped and developing countries; no country can be economically successful if the rate of unemployment is drastically increasing and that is why it has been of great concern to policy makers because its plays a major role as an indicator of well-being of labor market and can be used to evaluate the state of an economy. Unemployment arises from the economic structure of a country, and it arises from different reasons depending on whether it is an underdeveloped or developing country. There is no standard definition of unemployment as various countries adopt definitions to suit their local priorities. Practically all countries use the International labor organization definition, or a variant of it to compute unemployment. International labor Organization (ILO) defined Unemployment as total number of adults (aged 16 years or older) willing and able to work and who are actively looking for work and have not found a job.
Unemployment affects crime, economic welfare, misery and social instability [8]. The harm that has been caused by unemployment both to the individual and country at large are enormous, in Nigeria specifically there has been an increasing number of youth migrations mainly to American, Asian and European Countries seeking for greener pastures and this is because of the increase rate of unemployment within the sub-Sharan countries.

2. REVIEW OF LITERAURE

Apparently some authors have worked on unemployment and its determinant across African such as [10] examined the effect of selected macroeconomic variables on unemployment rate in Nigeria using cointegration test. The results revealed a long run relationship between unemployment and chosen macroeconomic variables. The results of the vector error correction model (VECM) show that real GDP at lag 2 and current exchange rate positively affect Unemployment. Moreover, unemployment at lag 1, money supply at lag 2 Exchange rate at lag 2, current lending and its first lag negatively affects Unemployment. These results are robust to the satisfaction of various diagnostic test including residual normality assumptions, correction for autocorrelation and white heteroscedasticity.
[5])investigates the response of unemployment to selective macroeconomics shocks for the period of 2000 – 2010 Q1 it finds that positive to growth, growth in export and inflations reduce unemployment. On the other hand, shocks to exchange rate, interbank interest rate and money supply increase unemployment.

Ayoola and Femi [1] examined Countries GDP with dependent variable and 6 independent variables used in this study include: Total Investment (totinv), Inflation (inf), Population (popl), current account balance (cab), volume of imports of goods and services (vimgs), and volume of exports of goods and services (vexgs). The results of their investigation showed that total investment, population and volume of exports of goods and services strongly affect the economic growth. It was noticed that population of these selected countries positively affect the GDP while total investment and volume of exports negatively affect GDP. On the contrary, inflation, current account balance and volume of imports of goods and services' contribution to the GDP are insignificant.

In [2], the Author investigate macroeconomic determinants of the unemployment for India, China and Pakistan for the period 1980 to 2009. The investigation was conducted through cointegration, granger causality and regression analysis. The variables selected for the study are unemployment, inflation, gross domestic product, exchange rate and the increasing rate of population. The result of the regression analysis showed significant impact of the entire variable for all three countries. GDP of Pakistan showed positive relation with unemployment rate. The granger causality showed that bidirectional causality does not exist between any of the three variables for all countries. Cointegration result explored that long-term relationship do exist among the variable and they finally recommended that the distribution of income needs to be improved for Pakistan in order to have a positive impact of growth on the employment rate.

In this paper we focused on the panel data cointegration on unemployment using some selected macroeconomic variables such as Gross Domestic Product, Foreign Direct Investment and Exchange rate for 26 African countries. We want to investigate if there exist a long run relationship between unemployment and the selected variable using cointegration technique. Also, we want to estimate the long run coefficient using the dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS) because it has been the two most reliable approach of cointegration regression. This paper is structured as follows: Section 2 descries the recent literatures related to our research of study and the source of data. Section 3 presents the Models and Methodology used. Section 4 presents the empirical results and discussion while the last section concludes the paper.

2.1 SOURCE AND DISCRIPTION OF DATA

The data for this study is a secondary data and was obtained from the world database indicator (WDI), the variables considered are unemployment (UNEM), gross domestic product (GDP), foreign direct investment (FDI) and Exchange rate (EXR) for the following 26 African countries; Angola, Benin, Botswana, Burkina Faso, Cameroon, Congo Dem. Rep., Congo, Rep., Cote d'Ivoire, Egypt, Equatorial Guinea, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Malawi, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Tunisia, Uganda, Zambia from 1991-2017. Unemployment (UNEM) is assumed to be the dependent variable on the course of obtaining the cointegration regression where GDP, FDI and EXR are the independent variable.

3. METHODOLOGY

Dynamic Panel Models: Economic correlation most times exhibits some degree of dynamic behavior. Hence to be able to observe these features we make use of dynamic panel data (DPD) model. The dynamic behaviors are characterized by the existence of lagged dependent variable among the regressors. Therefore

$$y_{it} = \delta y_{i,t-1} + x'_{it}\beta + u_{it} \quad (1)$$

$$x_{it} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1T} \\ x_{21} & x_{22} & \dots & x_{2T} \\ x_{31} & x_{32} & \dots & x_{3T} \end{bmatrix}$$

$$y_{it} = \begin{bmatrix} y_{11} \\ y_{12} \\ \vdots \\ y_{NT} \end{bmatrix}; \qquad u_{it} = \begin{bmatrix} u_{11} \\ u_{12} \\ \vdots \\ u_{NT} \end{bmatrix}$$

δ Is a scalar, given equation (1) above there are two sets of specific effects namely the individual specific effects and time specific effects. If only one set of specific effects is included in the regression, such is referred to as one-way error components model. However, if both sets of specific effects are included, we refer to the model as two-way error components model.

Equations (2), (3) and (4) show decomposition of u_{it} into one-way and two-way error components given $y_{it} = \delta y_{i,t-1} + x'_{it}\beta + u_{it}$

$$u_{it} = \lambda_i + \varepsilon_{it} \quad (2)$$
$$u_{it} = \alpha_t + \varepsilon_{it} \quad (3)$$
$$u_{it} = \lambda_i + \alpha_t + \varepsilon_{it} \quad (4)$$

where λ_i and α_t denote the observed individual and time specific effect, respectively. To estimate dynamic panel data model it raises quite a few issues with fixed, random and generalized least squares this is because the presence of lagged dependent variable is correlated with the disturbance term since (y_{it-1} as a function of u_{it}).

The solution to this is to use the generalized method of moment (Greene). Here we are interested in using cointegration technique which is also appropriate for long panels

3.1. PANEL COINTEGRATION

Cointegration arises when the variables been considered are not stationary. This technique is used to analyze the joint movement of non-stationary economic variable and their departure from equilibrium overtime. It expresses the relationships that exist between two or more non-stationary series for which the stochastic relationships are bounded ([SY11]).

3.2. PANEL UNIT ROOT

The test for unit root in time series is now common among applied researchers and has become a vital part of econometrics course. Panel unit root tests have become a fast-growing area of research with a view to improving the alleged low power of individual unit root tests particularly in small samples. To start with let us consider the following autoregressive (AR) process for panel data.

$$y_{it} = \rho_i y_{i,t-1} + \lambda_i K_{it} + \varepsilon_{it} \quad (5)$$

were ρ_i is the AR coefficient and the error term u_{it} is assumed to be independent and identically distributed (i.i.d). K_{it} which includes the individual effect, such as constant and linear time trend which captures cross sectional heterogeneity

3.2.1. Levin, Lin and Chu Test (LLC)

LLC argued that individual unit root test has limited power against alternative hypothesis with highly persistent deviation from stability or equilibrium. This is always consistent in small samples. The LLC propose a more power panel unit root test than performing individual unit test for each cross section.
The null hypothesis for this test suggests that each individual time series contains a unit against the alternative of no unit root. The maintained hypothesis is that

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{j=1}^{n} \beta_{ij} \Delta y_{i,t-J} + \delta_i K_{it} + \varepsilon_{it} \quad (6)$$

There are also limitations to the LLC test such that the test depends upon the independence assumptions across the cross-sectional unit and it is not applicable if cross sectional correlation is detected. Also, the assumption that all the cross sections have a unit root or not is limiting. This test is often recommended for moderate sized panels, especially for $N > 10 \leq 250$ and $T > 25 \leq 250$.

3.2.2. Im, Pesaran and Shin Test (IPS)

The restrictive nature of the LLC Test which assumes that ρ is homogenous was extended by Im et al (2013) allowing heterogeneity in the AR coefficient (ρ) and proposes an alternative testing procedure by averaging individual unit root test statistic. Im et al suggest an average of ADF test when u_{it} is serially correlated with the different serial correlation properties among the cross-sectional unit. In a situation the lag order is always zero ($\rho_i = 0$) for all i then the IPS provides critical values for i for all different number of cross sectional unit N, series length T and Dickey fuller regression containing intercept only or intercept and linear trend. However, in the case where the lag order may be non zero for some cross sectional units, IPS shows that a properly standardized $\bar{t}$ has an asymptotic $N(0,1)$ distribution.

3.2.3. ADF AND PP FISHER CHI-SQUARE

([MS11] [9]) suggest the use of nonparametric Fisher tests. This test is a combination of the probability limit value of unit root tests from each cross-section rather than average test statistics. Fisher test are usually carried out using individual ADF or Phillip-Perron unit root tests and their asymptotic distribution follow a chi-square (P-test).

3.3. COINTEGRATION TEST

([Joh88] [7]) proposes two different approaches, one of them is like the likelihood ratio trace statistic and the second one is the eigen-values statistic in other to detect the presence of cointegration vectors in a non-stationary series. The trace statistic and maximum Eigen statistic can be shown below as equation 6 and 7 respectively.

$$\alpha_{trace}(r) = -T \sum_{i=r+1}^{n} In(1 - \hat{\alpha_i}) \quad (7)$$
$$\alpha_{max}(r, r+1) = -TIn(1 - \alpha_{r+1}) \quad (8)$$

Where T is the sample size, n=4 variables which is unemployment, GDP, FDI and Exchange rate. α_i is the ith largest canonical correlation between residuals from the four-dimensional differentiating process.

4. DISCUSSIONS OF RESULTS

We utilized LLC, IPS, Fisher ADF and PP Chi-Square Panel unit root test in other to examine integration properties of the UNEM, GDP, FDI and EXC_R across countries. Since the LLC test statistic is restrictive because it assumes that all cross-sectional units contain or do not contain a unit root. Hence focusing on a less restrictive IPS, Fisher ADF and PP Chi-Square test statistics can lead to more accurate results about the integration properties of

the variables. IPS, Fisher ADF and PP Chi-Square test result in levels and first difference are presented in Table 1.

The result in the Table 1 clearly indicates that all the variables are integrated of the same order both at the level and first difference stage. At the level stage the variables contain a unit root whereas after the first difference it was found to be stationary.

4.1. COINTEGRATION RESULT

For the panel cointegration test between our variable of interest we employed the fishers Johansen cointegration methodology which makes use of the trace test and max-Eigen test in other to investigate if there is cointegration and also to obtain the number of cointegration equations. The below Table 2 displays the result.

Table 1: Panel unit root test

Variables	LLC Test	IPS Test	ADF Fisher Chi Square	PP Fisher Chi Square	I(d=Order)
Unemployment	-0.48336 [0.3144]	0.91424 [0.8194]	62.9204 [0.1427]	36.4036 [0.9504]	**I(0)**
Exchange Rate	3.32700 [0.9996]	2.91521 [0.9982]	69.2920 [0.0547]	44.1744 [0.7714]	**I(0)**
Gross Domestic Product	3.09847 [0.9990]	7.32304 [1.0000]	11.3089 [1.0000]	7.08199 [1.0000]	**I(0)**
Foreign Direct Investment	-1.90202 [0.2860]	-1.3292 [0.0919]	64.9356 [0.1074]	78.6018 [0.1000]	**I(0)**
1st DFFERNCE OF THE SERIES					
Unemployment	-0.79422 [0.2135]	-5.26756 [0.0000]	135.736 [0.0000]	258.634 [0.0000]	**I(1)**
Exchange Rate	-7.18180 [0.0000]	-8.44012 [0.0000]	186.180 [0.0000]	268.770 [0.0000]	**I(1)**
Gross Domestic Product	-7.03561 [0.0000]	-9.68839 [0.0000]	194.514 [0.0000]	291.704 [0.0000]	**I(1)**
Foreign Direct Investment	-10.9494 [0.0000]	-15.5022 [0.0000]	317.081 [0.0000]	540.285 [0.0000]	**I(1)**

Table 2: Panel cointegration test

JOHANSEN FISHER COINTEGRATION TEST					
Series	**No of CE**	**Trace Test**	**Prob**	**Max-Eigen Test**	**Prob**
Unemployment, Gross Domestic Product and Exchange Rate	None	685.60	0.0000	510.40	0.0000
Unemployment, Gross Domestic Product and Exchange Rate	At Most 1	278.20	0.0000	218.20	0.0000
Unemployment, Gross Domestic Product and Exchange Rate	At Most 2	120.90	0.0000	105.00	0.0000
Unemployment, Gross Domestic Product and Exchange Rate	At Most 3	88.52	0.0012	88.52	0.0012

Table 2 present the result of Johansen cointegration test. The result confirms the existence of long-run relationship among UNEM, GDP, FDI and EXR. Therefore, we reject the null of no cointegration at 5% level of significance. Thus, there is evidence of a long run relationship among the variables. Specifically, trace and Max-Eigen test indicates three cointegrating equation at 5% critical value.

Since the panel cointegration does not support the use of ordinary least (OLS) in the estimation of the coefficient of the long-term relationship that exists among the variable, we therefore proceed with an alternative approach. The [4] recommended the dynamic ordinary least squares (DOLS) as an alternative and efficient method to panel cointegration estimation. Similarly, we can estimate the long-term relationship that exist among variables

using the fully modified ordinary least squares but from recent literatures the Dynamic ordinary least squares have been proven to be more efficient.
Table 3 bellow shows the result of the dynamic ordinary least squares which indicate that at 5% level of significance the gross domestics' product has a negative association to unemployment while the foreign direct investment has a positive association to unemployment.

Table 3: Dynamic Ordinary Least Squares

Dependent Variable: D(UNEM) **Method: Panel dynamic Least square (DOLS)**				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob-Value**
Goss Domestic Product	-1.70E-11	5.06E-12	-3.354773	0.0009
Foreign Direct Investment	7.24E-10	2.16E-10	3.357192	0.0009
Exchange Rate	-7.27E-05	0.000355	-0.204993	0.8377
R-squared	0.951984			
R-Adjusted	0.917135			

Table 4: Fully Modified Ordinary Least Squares

Dependent Variable : UNEM **Method: Fully modified dynamic Least square (FMOLS)**				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob-Value**
Goss Domestic Product	-8.75E-11	1.77E-11	-4.929245	0.0000
Foreign Direct Investment	6.70E-10	3.20E-10	2.092610	0.0368
Exchange Rate	-0.057452	0.052647	-1.091281	0.2756
R-squared	-0.7883683			
R-Adjusted	-0.8229189			

Table 4 above shows the result of the fully modified ordinary least squares which indicate that at 5% level of significance the gross domestics' product has a negative association to unemployment while the foreign direct investment has a positive association to unemployment.
It is obvious that in Tables 3 and 4 the foreign direct investment at 5% level of significance is statistically not significant and hence has no association with unemployment at the long run.

5. CONCLUSION NAND SUGGESTION

Firstly, we obtained the result of the panel unit root test and it shows that unemployment, gross domestic product, foreign direct investment and exchange rate are non-stationary at the level stage. However, the test was carried out again using the first difference of all the variables and was found to be stationary. The result of the Johansen Fishers panel cointegration tests support that there is a panel long run equilibrium relationship among the unemployment, gross domestic product, foreign direct investment and exchange rate move together in the long run.
Secondly the result of the panel DOLS show that 1% increase in gross domestic product, foreign direct investment will cause a change of -1.70E-11 and 7.24E-10 on unemployment, respectively. However, at the long run, exchange rate does not have a significant impact to unemployment.
Having obtained the above result we therefore suggest that the Government and all the relevant agencies concerned in making economic policy among the African countries we considered should pay more attention to Gross Domestics Product, Foreign direct investment in other to tremendously reduce the rate of unemployment rate within their respective country.

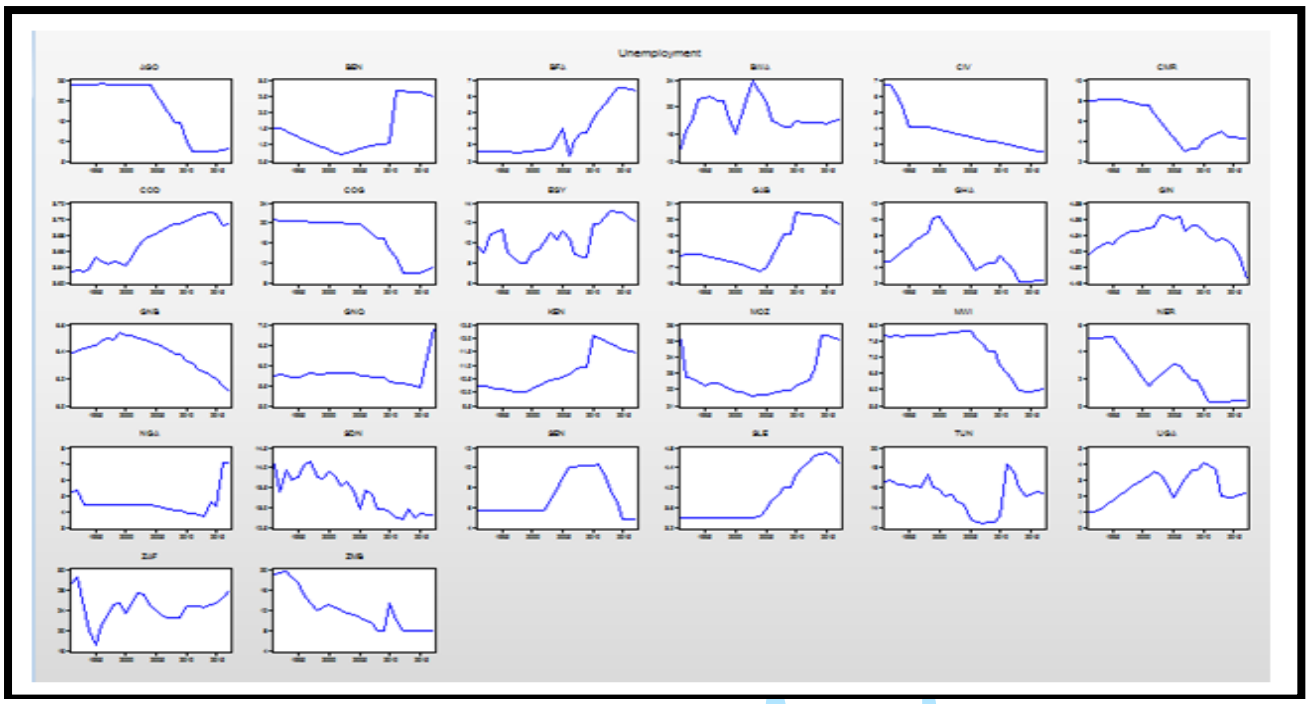

Fig. 1: Graph showing the time plot of unemployment for 26 African countries

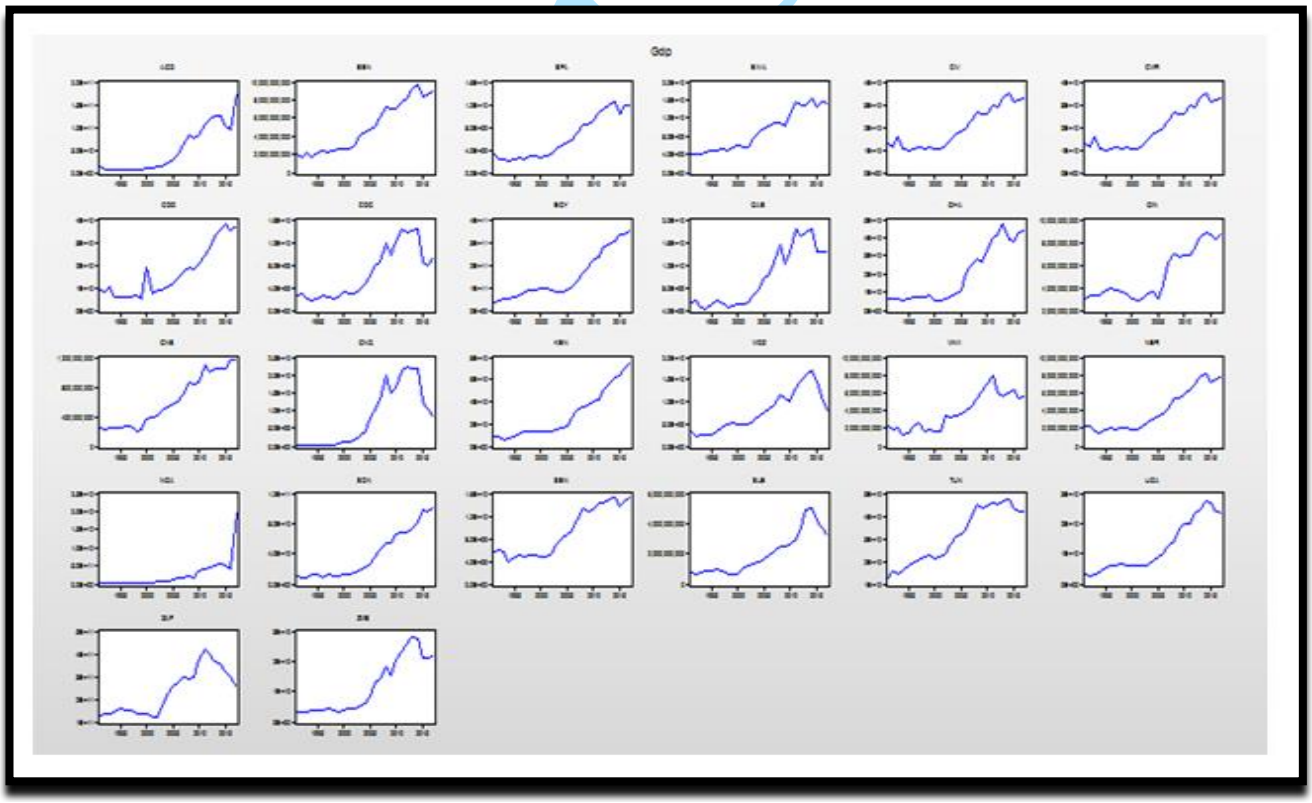

Fig. 2: Graph showing the time plot of Gross domestic product 26 African countries

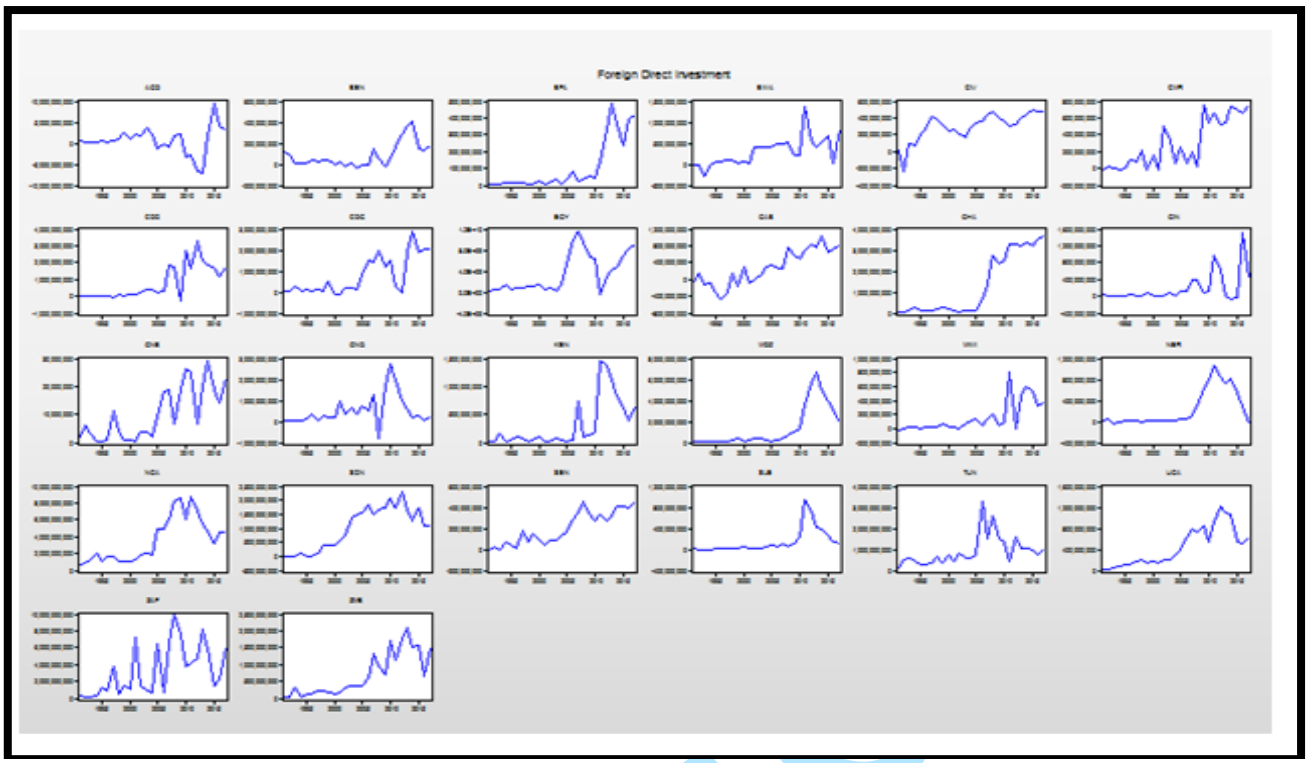

Fig. 3: Showing the time plot foreign direct investment for the 26 African countries

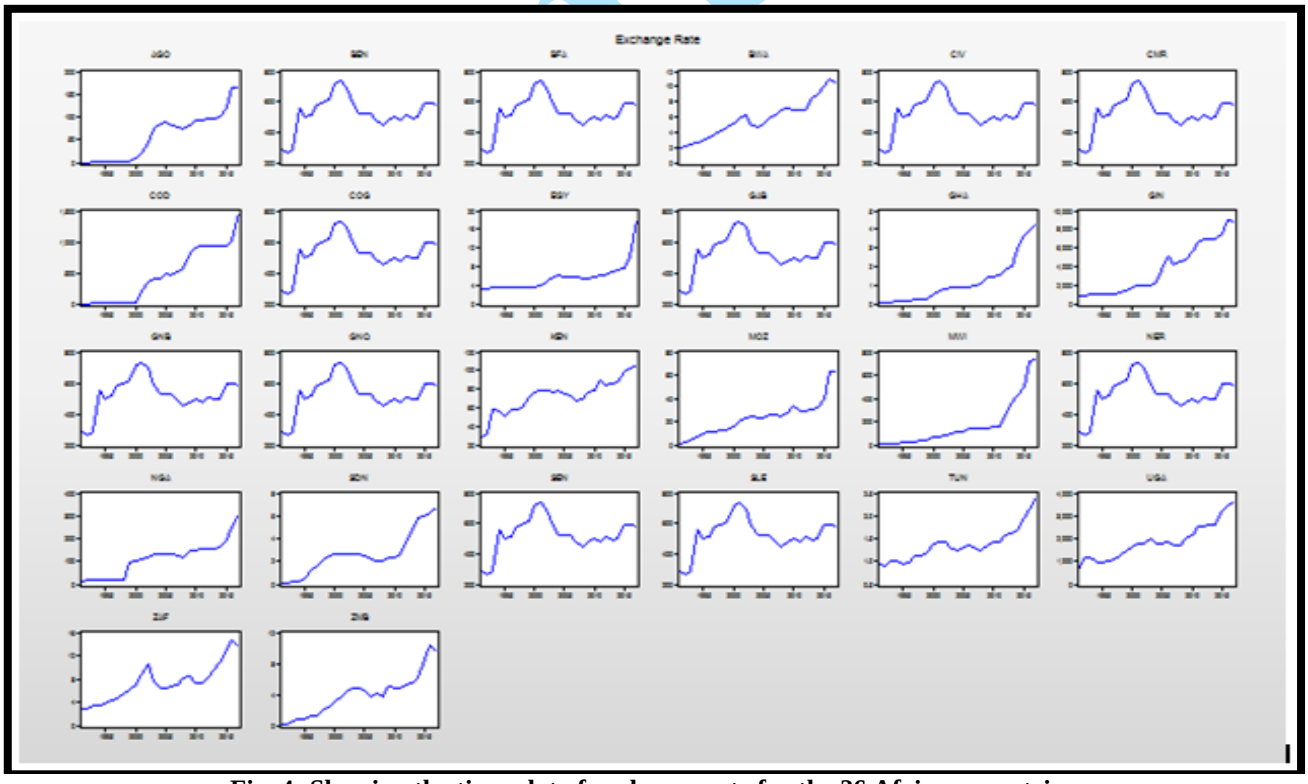

Fig. 4: Showing the time plot of exchange rate for the 26 African countries

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