Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.6, No.10, 2015

Evaluation of the Equilibrium Level in Economic Growth under Influence of External Debt

Adam H. Yagoob [1, 2*] Qian Zhengming [3]
1.School of Economics, Department of Statistics & Planning; Xiamen University, Room No. 607, Cia Qingjie Building 361005 Xiamen, Fujian, China
2.Ministry of Finance & National Economy of Sudan, Nile St P.O. Box: 298, Khartoum, Sudan
3.School of Economics, Department of Statistics & Planning Xiamen University, 361005 Xiamen, Fujian P.R. China
* E-mail of the corresponding author: izedein@hotmail.com

Abstract
This paper is an attempt to develop Cointegration and Error Correction Model (ECM) that evaluates the effect of external debt sustainability on economic growth of Sudan; then, compares the long run relationship between external debt and economic growth. The compatibility of the two methods together will be assessed in comparing the results. The data retrieved from World Development Indicators (WDI) of The World Bank for the period 1978-2011. The empirical results showed that trade openness, inflation, capital formation and measures of external debt sustainability have a significant impact on the economic growth of Sudan. Furthermore, this result is confirmed by the estimates of both Johansen Cointegration and Engle Granger error correction method. However, the later showed that initially, effect of the changes in the explanatory variables on economic growth is above the equilibrium. The equilibrium level is achieved extremely slowly as the speed of adjustment in economic growth is found to be a fraction of zero.
Keywords: Sudan, Economic Growth, Cointegration, External Debt, Error Correction, Sustainability

1. Introduction

A debate on the significance of using Cointegration and Error Correction Mechanism as empirical tools stated among researchers and policy makers, a question arises on the applicability of these two methods for stationary data. Arguments given in favor of error correction mechanism included; the origin of this method, which dates back before the Cointegration method was introduced. Hence, error correction mechanism was favored to be a flexible method, applicable on both stationary and the non-stationary data (Williams, 1992). The argument often found among the authors, that Cointegration implies error correction and error correction in turn implies Cointegration. For stationary data, error correction seems unsuitable according to the Smith and Durr. Early error correction mechanisms modelled such data that was almost certainly cointegrated (Durr, 1992, Alogoskoufis and Smith, 1991). An unresolved debate on the acceptability of stationary data in error correction model continued since 1993, these controversial debates improved the understandings of the researcher of the ways of development in the association of theory with the time series models. Error correction models do not only provide a suitable modelling strategy, but also allow the estimation of short-term as well as long-term effects. Analysts thus; consider the inclusion of longer equilibrium forces, along with the short-term shocks in the analysis of dynamic effects. Either there are tortured arguments for Cointegration or loss of the power of error correction models, to most of the economists given the paucity of true Cointegration relationships in economics data. In this paper, Cointegration and error correction models are developed that can assess the effect of external debt sustainability on the economic growth. Hence a tool is provided that can be used to analyse the dynamics of the relationship between foreign debt and economic growth of a country. The different stages of the history of economic and financial conditions of almost every nation; contain a stage where the country borrows. The stages begin with the time when a country is a net borrower, and then time starts when the country becomes mature borrower and the country stand at the position of new creditor, which might lead to a time when the country becomes a mature borrower. Changes in institutional development, economic structure, performance, magnitude, scope and size are accumulated in attaining each of these stages.

2. How Does External Debt Impact Economic Growth?

All the main sources in a country that can be utilized to stimulate growth are affected by debt as, indicated in the discussions regarding policy and theory. Two arguments are particularly found to support the theory; that debt impacts the economic growth through capital accumulation. They suggest that lower accumulation of capital leads to non-linear impact of foreign debt on the process of economic development and expansion. First argument is a concept of overhang debt, which implies that the accumulation of capital stock slows down because investors are discouraged to invest in a country, rapidly increasing indebtedness. Investors are discouraged due to the anticipation that; an increasingly borrowing government will impose progressive and aggressive taxes to repay the debt. The second argument is the anticipation of investors about the proportion of

debt to be serviced with the domestic resources. This anticipation makes the investors hold back their investment; in the increasingly indebted country. Other than low accumulation of capital stock, lower growth in factor productivity; driven by high indebtedness is also regarded as, an obstacle in the economic growth of indebted country. For example, such costly and difficult policies, which majorly facilitate and provide enormous profits to the foreign creditors, are less likely; to be favored by the government. This protective behaviour of indebted government; further worsens the business environment and opportunities to enhance the productivity and efficiency of investment in the economy. Incentives for efficient use of resources and improvement in technology are likely; to be hindered in an indebted economy. There exist high levels of debt related to instabilities and uncertainties in indebted economies. Long run productivity growth is driven from such investment that involves high risks and is a long-term, rather than the short-term investment that provides quick returns. The uncertain economic environment of indebted countries is inappropriate for long-term investments involving high risks. Thus, slower growth in productivity is contributed by reduced efficiency of investment projects and misallocation of resources. Those who advocate foreign aid, often argue that; education, health, infrastructure, energy, and other social services are inefficiently and sometimes not at all provided in highly indebted low income countries. Anticipated increase in marginal taxes adversely; impacts the investment decision; one of which is the acquisition of human capital. Therefore, high level of debt slows down the process of economic growth through low accumulation of human capital. On the other hand, the long run impact of debt on human capital accumulation has been made the detection of this channel exceedingly difficult.

3. Literature on Error Correction Models

Error correction models of dynamic econometric equations impose testable and strong non-linear restrictions. Also, there is no obviation of the need of modelling the process of expectations formation, if the dynamic econometric equations are represented as error correction models (Alogoskoufis and Smith, 1991). Whenever ECMs are treated as mere re-parameterization of vector autoregression or dynamic linear regression models, it results in ignorance from the modelling of expectations and the non-linear restrictions except in some special cases. De Boef (2001) discussed the applicability of two common estimation methods namely, generalized error correction and Engle-Granger two step estimator. The author discussed the findings of social scientists, who evaluated the equilibrium relationships between different social indicators. Hence, the author advocated the use of ECM into infer long-run relationships between the social and economic indicators (De Boef, 2001). Applied side of any domain hence, utilize this statistical tool to evaluate the long run as well as short run relationships. Arabi (2002) also employed the same techniques in studying the economy of Sudan, but discussed the indicators other than foreign debt. Specifically, the study focused on the theories of a closed economy and the object is to develop a model to be used in economic policy making, when the economy is assumed to be a closed economy (Arabi Khalafalla, 2002). Engle Granger two step method is popular among the authors for the estimation of ECMs. An example is the study of Janes (2012), which focuses on developing a single equation microeconomic ECM (Janes, 2012), through this approach, a short-term as well as long-term effect between key performance indicators (KPIs) is evaluated. The findings provided some valuable recommendations for the analysts interested in exploring the microeconomic time series data to forecast. Several ratios like external debt to Gross National Income (GNI), debt to GDP, external debt service to export earnings are often used to measure the sustainability of foreign borrowing (Ajayi and Khan, 2000), however these ratios also needed to be sustainable and measuring their sustainability; cannot be determined, only this fact realized that; the drastic increase in stock of external debt to a high level, can reduce the usefulness of these ratios. An example of situation where acquisition of foreign fund is undesirable; is an increase in the burden of debt servicing that exceeds the debt bearing capacity of indebted country. In such situation export expansion must substitute foreign assistance. In the absence of export expansion, the country will have to bear the debt burden, far higher than the country's capacity to bear as; meeting the debt services will require more borrowing. Crowd out effect in public investment as an impact of debt is explained through; the relationship between the debt stock and payment for debt servicing. This crowding out effect works as a channel for the negative impact of debt on the economic growth and development of borrowing nation (Cohen, 1997, Clements et al., 2003). This channel works through reducing the public investments as, debt repayment and service payments soak up the resources. A liquidity crisis that induced by the debt, result in reducing the government expenditure attributes and damage to the growth process in the borrowing country. Liquidity crisis that results in reduced public expenditure, may lead a cut-off in the development expenses and public investment in the social sector. Many functional sectors are impacted in this context as often, they are fuelled by the public investment and thus, the liquidity crisis is considered to be of considerable importance when, discussing the damaging effects of external debt (Fosu, 2007).

Macroeconomic instability and tax disincentive; are the debt overhang effects, of accumulated debt stock; that reduces economic performance. Macroeconomic instability is related to the anticipated inflation, possible monetary expansion, depreciation in the exchange rate and exceptional financing resulting in uncertainly and rise in fiscal deficit. By debt disincentive, it is meant that; the anticipation of large taxes in future

income to cover the increasing debt burden in present, discourage the investments (Claessens et al., 1996). Private investment is also found to be negatively; impacted by external debt as results in the study by Iyoha, affirmed the debt overhang effect and crowding-out effect of debt servicing. The author presented empirical justification that; how these two damaging effects of debt servicing, leads to low level of private investment in the borrowing country. Efficient utilization external financing is found to be the key factor that drives the rise in economic development process (Iyoha, 1997). It happens that a country experiences growth in economic condition, as long as the external resources are efficiently utilized, but as soon as the acquisition of foreign loan become inefficient, process of economic growth slows down. Development of capital markets, restructuring the programs of sustained export promotion and privatization; are preventive measures for the severe impact of external debt on public and private investments, whose prime factors are global interest rates, balance of payments and fiscal expenditure (Audu, 1997). Recognizing the impacts of increasing external debt states that; integration within and across the African countries with regional groupings is de-accelerated by the reliance of Africa on northern countries, for hard currencies and heavy indebtedness. For a given level of indebtedness in the future, the current level of investment is curbed by the high debt servicing in the present, which is another aspect of liquidity crisis resulting from external debt (Classens et al. 1996). Apart the liquidity crisis, moral hazard effect is also identified as, a damaging consequence of external debt. According to Arnone et al. , Moral hazard is evident in countries with poor macroeconomic policies and high levels of external debt (Arnone et al., 2005).

4. Methodology

Real Gross Domestic Product (RGDP) is used as; an indicator of economic growth, external debt outstanding and debt services were also used as indicators of borrowing. Economic growth is measured by growth rate of RGDP (i.e.Yt–Yt-1/Yt-1). Data of total debt service is in current U.S. dollars measured as the sum of repayments (charges and repurchases) to IMF, interest paid on short-term debt and principle repayments and interest actually paid on long-term debt in foreign currency. Economic growth model is effective always, whenever any variable is studied for its impact on economic growth in a country. Therefore the model specification includes a well-established framework of economic growth. The procedure includes test of stationary (unit root test) and Johansen Cointegration test. After obtaining significant results of these two tests, an error correction model is estimated. Error correction model is used to evaluate the equilibrium in economic growth of Sudan under the influence of external debt. Model specification follows the investigation of external debt effects on economic growth by Pattillo (Pattillo et al., 2011). Equation (1) estimates the effect of external debt on economic growth of Sudan.

$$RGDPt = f(TOT, INFL, GCF, DSR, TDS, ED)t \quad (1)$$

Where RGDPt = Real GDP at time t, TOT = Terms of Trade, INFL = Rate of Inflation, GCF = Gross Capital Formation as a ratio of GDP, DSR = Debt Service as a ratio of export earnings, TDS = Total Debt Service to GDP ratio, ED = Stock of External Debt to GDP ratio.

A prior sign of GCF is positive while, of DSR, TDS, and ED is negative. Other variables are not provided prior signs, and their nature remains to be seen by the regression results. Equation (1) is transformed into log linear form so that; the estimated coefficients depict elasticity. The log linear model is as in equation (2),

$$LRGDPt = \alpha + \beta 1\ LTOTt + \beta 2\ LINFLt + \beta 3\ LGCFt + \beta 4\ LDSRt + \beta 5\ LTDSt + \beta 6\ LEDt + \mu t \quad (2)$$

Where L stands for log and all the coefficients are values of elasticity. α is the average annual growth of GDP. All the βs shows the elasticity of GDP growth to the corresponding indicators, or in other words the percentage change in growth of real GDP for one percent increase in the corresponding regressor. μ is the error term that is assumed to be White Noise, this means that the mean value of error terms is zero while, the variance is constant. Mathematically,

$$E(\mu) = 0,$$
$$Var(\mu) = \sigma$$

Also, the error terms are assumed to follow a normal distribution. Symbolically,

$$\mu \sim N(0, \sigma)$$

The long run aspects of decision making are ignored in equation (2) as there is no term capturing time effect. This issue addressed in the theory of Cointegration in a form of error correction term (ECT). This term is actually the residual term of equation (2), which is the deviation of the control variable form its long run equilibrium value. To obtain long ruin equilibrium, some short run forecasts are necessary. An ECM provides these short run forecasts. Hence, the methodology employed in this paper is incomplete without specification of a general ECM. Equation (3) is the error correction representation of the Cointegration equation (2).

$$\Delta LRGDPt = \alpha + \beta 1\ \Delta LTOTt\text{-}1 + \beta 2\ \Delta LINFLt\text{-}1 + \beta 3\ \Delta LGCFt\text{-}1 + \beta 4\ \Delta LDSRt\text{-}1 + \beta 5\ \Delta LTDSt\text{-}1 + \beta 6\ \Delta LEDt\text{-}1 + \beta 7\ ECTt\text{-}1 + \varepsilon t \ldots \quad (3)$$

Where, ECT is actually the error term (μ) in the Cointegration equation obtained in in equation (2). Δ represents the first difference of the series, notice the subscripts (t-1), which show that the independent variables

hold lag values. In ECM, sign of β7 shows whether economic growth is above or below the equilibrium level and the estimate of β7 show the percentage of equilibrium level of economic growth that can be achieved in one year.

4.1 Augmented Dickey Fuller Test (Test of Stationary Series)

We perform a unit root test on each variable in our model using the Augmented Dickey- Fuller (ADF) test. Let Yt be a time series, then following hypothesis can be formulated to test the existence of unit root in Yt.

$$\Delta Yt = \alpha + \gamma t + \beta Yt\text{-}1 - \theta 1 \Delta Yt\text{-}1 + \mu t \quad (4)$$

H0: (α, γ, β) = (α, 0, 0)... υ... H1: (α, γ, β) ≠ (α, 0, 0)

The joint hypothesis γ = β = 0 is tested performing F-test. If the null hypothesis is not rejected, the next step is to test β = 0 using t-statistics. Following is the estimation equation,

$$\Delta Yt = \alpha + + \beta Yt\text{-}1 - \theta 1 \Delta Yt\text{-}1 + \mu t \quad (5)$$

H0: (α, β) = (0, 0)... υ... H1: (α, β) ≠ (0, 0)

Rejection of H0 requires the series contain a unit root and should contain a drift term. The above described form uses the values of Y and hence, it is called the level form. If the Y is replaced by its first difference or second difference, then the model becomes first or second difference form respectively. If there a unit root exist in the series at the first difference form, the series is regarded as a series integrated of order 1, such a series can be transformed into stationary series by taking the first difference. When the series is transformed into a stationary series; variance in the values of the stationary series is constant over time. In his manner, the researcher can get rid of the problems that often arise in non-stationary series. The regression estimates of non-stationary series turn out to be spurious. After testing for unit roots, we proceed to test for Cointegration (long run relationship between variables). The method considers Johansen and Juselius's (1990) definition of Cointegration. Johansen's Cointegration procedure was used to test for the possibility of at least one cointegrating vector between variables in the model developed for the economy of Sudan in this research.

4.2 Johansen's Cointegration Test

Johansen's Cointegration test starts with the estimation of the following autoregressive model of order k,

$$LRGDPt = \alpha + \beta 0\ LRGDPt\text{-}1 + ... + \beta k\ LRGDPt\text{-}k + \varepsilon t \quad ... \quad (6)$$

Where, order of integration of LRGDP is one, or we can say than LRGDPt = I(1) and εt are a vector of innovations. Another notion for equation 6 is

$$\Delta LRGDPt = \alpha + \Pi\ LRGDP\ t\text{-}1 + \Sigma \Gamma i\ \Delta Yt\text{-}i + \varepsilon t \quad (7)$$

Where,

$$\Pi = \Sigma\ \beta i - I \text{ and } \Gamma i = -\Sigma\ \beta i \quad (8)$$

Two different statistics for tests are used here namely; Trace statistic and maximum Eigen value statistic obtained using the following formula,

$$Jtrace = -T\ \Sigma\ \ln(1-\lambda i) \quad (9)$$

$$Jmax = -T\ \ln(1-\lambda r+1) \quad (10)$$

Where, T is the sample size and λi are the ith largest canonical correlation.

4.3 Engle Granger Error Correction Method

At first a static (long-run) model is estimated and it's lagged residuals

$$ECTt\text{-}1 = LRGDPt\text{-}1 - \alpha - \Sigma \beta i\ Xit\text{-}1 \quad (11)$$

Where Xi be the set of all explanatory variables, enter the first difference equation with a minus sign

$$\Delta\ LRGDPt = \alpha 0 + \Sigma \alpha i \Delta Xit\text{-}1 - \gamma\ (LRGDPt\text{-}1 - \alpha - \Sigma \beta i\ Xit\text{-}1) + \varepsilon t \quad (3.12)$$

In the second step, the estimated coefficient γ measures the speed of adjustment. It is worthy to mention that the error correction term means that if the lagged dependent variable greater than the disequilibrium the current one will be decreased in the subsequent period.

5. Results and Discussion

Time series are stationary if there does not exist a unit root in the series. For this purpose, ADF test is used to check the existence of unit root in the series. Following are the results of ADF at level form.

Table 1: ADF test at level form

Null Hypothesis	Student's t-statistic	Probability
RGDP has a unit root	6.860882	0.0912
INFL has a unit root	-1.917547	0.3201
TOT has a unit root	-1.449674	0.5447
GCF has a unit root	0.039774	0.9551
DSR has a unit root	-2.773733	0.0741
TDS has a unit root	-1.448579	0.5448
ED has a unit root	-2.529680	0.1208

Critical values for the Student's t-statistic are as following

Table 2: ADF Test critical values

	Test critical values
1% level	-3.724070
5% level	-2.986225
10% level	-2.632604

As none of the t-statistics in the results of ADF test is significant, every time series in the model are non-stationary; hence, estimates of OLS might be spurious because the mean and variance of the series are non-constant in the presence of unit root. To test whether the regression estimates are spurious or not, the researcher aims at identifying Cointegration between the series. Cointegration between two time series exists if the time series are stationary at first difference. Therefore, ADF test is again applied to the series but for the first difference form. Following are the results of ADF test.

Table 3: ADF test at first difference form

Null Hypothesis	Student's t-statistic	Probability
D(RGDP) has a unit root	-7.636960	0.0000
D(INFL) has a unit root	-7.496670	0.0000
D(TOT) has a unit root	-5.684134	0.0001
D(GCF) has a unit root	-4.935389	0.0004
D(DSR) has a unit root	-8.020119	0.0000
D(TDS) has a unit root	-6.895719	0.0000
D(ED) has a unit root	-3.160637	0.0330

As the test statistics are all significant, each of the series included in the model are stationary at first difference level. Now the test of Cointegration is applicable on the series included in the model. The null hypothesis of no Cointegration relationship between the time series and the null hypothesis of at least one Cointegration relationship are tested; using Trace statistics and Maximum Eigenvalue statistics. Table 4and table 5 represent the results of Cointegration test through Trace statistics and results of Cointegration test through maximum Eigen value statistics, respectively.

Table 4: Cointegration Test using Trace statistics

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None *	0.924131	197.6743	125.6154	0.0000
At most 1 *	0.855895	122.8906	95.75366	0.0002
At most 2	0.573957	66.71145	69.81889	0.0863
At most 3	0.502248	41.96818	47.85613	0.1596
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Table 5: Cointegration Test using Eigen value statistics

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.
None *	0.924131	74.78365	46.23142	0.0000
At most 1 *	0.855895	56.17918	40.07757	0.0004
At most 2	0.573957	24.74327	33.87687	0.4026
At most 3	0.502248	20.23195	27.58434	0.3253
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Hence, there exist more than one or at least two Cointegration relationships between the time series

variables included in the model. This result shows that the estimates of parameters, when estimated in Cointegration equation are not spurious. Following are estimates of the model developed in this paper, obtained in the form of Cointegration equation.

Table 6: Cointegration coefficients

Normalized cointegrating coefficients (standard error in parentheses)						
LOG(RGDP)	LOG(ABS(TOT))	LOG(INFL)	LOG(GCF)	LOG(DSR)	LOG(TDS)	LOG(ED)
1.000000	2.789170	3.197275	0.061306	-3.958703	6.104162	4.349115
	(0.25061)	(0.71566)	(1.44571)	(0.68714)	(0.49618)	(1.59670)

As the model is a log-linear model, estimated coefficients represent the elasticity of change in real GDP to change in the independent variables. According to the Cointegration coefficients in table 6, Real GDP growth increases by approximately three percent for one percent increase in terms of trade while; one percent rise in the rate of inflation also increases the real GDP by slightly, more than three percent. If there is a one percent increase in the ratio of gross capital formation to the GDP then, it brings a rise in real GDP by only 0.06 %. Debt service as a percentage of exports earnings has a negative impact on the real GDP as one can see that the Cointegration coefficient of DSR is negative. A decline of approximately 4% is experienced in the real GDP if, the debt services as a percentage of GDP rise by one percent. Interestingly, total debt service to GDP ratio and stock of external debt to GDP ratio has a positive impact on the real GDP as shown by their positive signs in the Cointegration results. Slightly more than six percent increase in real GDP is led by a one percent increase in the ratio of total debt services to GDP and a slightly more than 4% increase in real GDP is led by a one percent rise in the stock of external debt to GDP ratio.

Moreover, Error Correction Model is developed in the form of equation (3) is estimated using Engle-Granger error correction method. According to this method the residuals obtained from the Cointegration estimate in table 3 are inserted as ECT in lagged form. Table 7 is the estimated ECM model.

Table 7: Engle Granger Estimation of Error Correction Model

Error Correction Model				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(ABS(TOT(-1))))	2.004102	0.254738	2.865711	0.0146
D(LOG(INFL(-1)))	3.023706	0.716083	3.473956	0.0025
D(LOG(GCF(-1)))	0.110661	1.330786	3.594564	0.0013
D(LOG(DSR(-1)))	-3.019934	0.518491	4.078030	0.0009
D(LOG(TDS(-1)))	6.009310	0.519334	-3.481510	0.0042
D(LOG(ED(-1)))	4.153895	0.097531	2.577911	0.0272
ECT(-1)	2.42E-12	4.84E-13	5.004124	0.0000
R-squared	0.651645	Mean dependent var		0.046579
Adjusted R-squared	0.642346	S.D. dependent var		0.045159
S.E. of regression	0.037175	Akaike info criterion		-3.579002
Sum squared resid	0.035931	Schwarz criterion		-3.304177
Log likelihood	63.26403	Hannan-Quinn criter.		-3.487905
Durbin Watson stat	2.268447			

More than 60 % of the long run and short run changes in the real GDP growth are explained by changes in the explanatory variables included in the ECM as, R-squared is 0.65 and adjusted R-squared is 0.64. The major problem that the times series mostly face is the problem of autocorrelation between the residuals that increase the bias in the estimates. One measure of autocorrelation in the series is Durbin-Watson. Generally, the critical value of Durbin Watson for no autocorrelation is 2. In the output of ECM Durbin Watson is 2.26 which implies that the estimates are not likely to be biased. The effect of each explanatory variable on the control variable is close to the effect evaluated in the Cointegration equation using Johansen Cointegration method. As the model is in logarithmic form, the interpretation of the coefficients is in terms of percentage changes. One percent increase in terms of trade of Sudan with the trading countries brings 2 % change in the GDP growth in long run. One percent increase in inflation increases and one percent increase in the debt servicing decreases GDP growth by approximately 3% in the long run. Long run effect of capital formation on the GDP growth is positive, but only 0.11% though, it is significant at; 0.001 level of significance. It is apparent in that an increase is observed in the GDP growth as total debt stock increases in the long run. The effect of total debt stock is stronger than any other explanatory variable included in the study. All the explanatory variables included in the study have a significant impact on the GDP growth of Sudan in the long run. Coefficient of error correction term

ECT is almost zero. However, this coefficient is significant as t-stat is 5 with P-value 0.00 which is less than the minimum acceptable P-value 0.05 for 95% confidence interval. Hence, GDP growth of Sudan does not reach the equilibrium level in one year. A very small fraction of the equilibrium is achieved every year. GDP growth moves slowly towards the equilibrium level and hence, effect of the changes in external debt stock and external debt servicing keep appearing in the form of affected economic growth to many years. The positive sign of the coefficient of ECT shows that, in the short run, GDP growth is above the equilibrium level; therefore, initially, a small change in external debt stock seems to bring large change in the GDP growth, but with the passage of time, these effects subside very slowly.

6. Conclusion

Often the detection of unit root in economic time series is due to the finite size of the series; but economic theory denies the likelihood of non-stationarity in every economic time series. A common mistake that statisticians do is considering the existence of unit root as; an empirical property while, it is rather a theoretical property, even if time series with a unit root is not likely to be faced, it is often the case that the stationary data have long cycles and the data are under the influence of both short run and long run effects of many indicators. These possibilities are ignored in most of the applied works. In the analytical section of this paper, it is clearly observed that ECM is appropriate for non-stationary data at first level and at the second level. Results of the Engle Granger error correction are found to be similar to that of Johansen Cointegration. There is no significant difference between the estimates of Cointegration and estimates of ECM. Even additional theoretical tractability is provided by the ECM as the long run dynamics are not lumped together with short run dynamics, in this approach ECM allows the formulation and testing of discrimination between short run process and long run process.

This paper investigates the relationship among the debt service and economic growth using Cointegration and ECM. Trade liberalization, inflation, and investment are also included in the study as modifier confounding variables to capture the effect of extraneous variables. A log linear model is developed in this study to identify the impact of stock of external debt and external debt service on the economic growth of Sudan. Results found that economic growth of Sudan is initially above the equilibrium level when there are changes in the external debt stock and external debt sustainability. The process of economic growth in the country reaches the equilibrium level very slowly as the speed of adjustment (coefficient of ECT) is found to be a very small.

References

AJAYI, S. I. & KHAN, M. S. 2000. *External debt and capital flight in Sub-Saharan Africa. International Monetary Fund Institute* [Online]. Washington D.C: International Monetary Fund Institute. Available: http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=449498.

ALOGOSKOUFIS, G. & SMITH, R. 1991. On Error Correction Models: Specification, Interpretation, Estimation. *Journal of Economic Surveys,* 5**,** 97-128.

ARABI KHALAFALLA, A. M. 2002. The Application of Two Gap Analysis to the Sudan Economy. *Scientific Journal of Sudan Academy for Science*.

ARNONE, M., BANDIERA, L. & PRESBITERO, A. F. 2005. External Debt Sustainability Theory and Empirical Evidenc.

AUDU, M. A. 1997. *Islam and Edo State,* Abuja, Nigeria, Hazab Printers.

CLAESSENS, S., DETRAGIACHE, E., KANBUR, R. & WICKBAM, P. 1996. Analytical Aspects of the Debt Problems of Heavily Indebted Countries. *The world Bank,* Policy Research Working Paper No.1618.

CLEMENTS, B. J., BHATTACHARYA, R. & NGUYEN, T. Q. 2003. *External debt, public investment, and growth in low-income countries* [Online]. Washington, D.C.: International Monetary Fund, Fiscal Affairs Dept. Available: http://site.ebrary.com/id/10302967.

COHEN, D. 1997. *Growth and external debt : a new perspective on the African and Latin American tragedies,* London, Centre for Economic Policy Research.

DE BOEF, S. 2001. Modeling Equilibrium Relationships:Error Correction Models with
Strongly Autoregressive Data. *Political Analysis Political Analysis,* 9**,** 78-94.

DURR, R. H. 1992. An Essay on Cointegration and Error Correction Models. *polianalysis Political Analysis,* 4**,** 185-228.

FOSU, A. K. 2007. *The external debt-servicing constraint and public expenditure composition evidence from African economies* [Online]. Helsinki, Finnland: UNU World Inst. for Development Economics Research (UNU/WIDER).

IYOHA, M. A. 1997. *An econometric study of debt overhang, debt reduction, investment, and economic growth in Nigeria,* Ibadan, Nigeria, National Centre for Economic Management & Administration (NCEMA).

JANES, A. 2012. Error correction model for the service company. *Knowledge and Learning: Global Empowerment; Proceedings of the Management, Knowledge and Learning International Conference 2012***,** 373-381.

PATTILLO, C., POIRSON, H. & RICCI, L. A. 2011. External Debt and Growth. *Review of Economics and Institutions,* 2.

WILLIAMS, J. T. 1992. What Goes Around Comes Around: Unit Root Tests and Cointegration. *Political Analysis Political Analysis,* 4**,** 229-235.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar