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The Impact of National Debt on Economic Growth in Liberia: A Vector Error Correction Model

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Abstract: This research investigated empirically the impact of the government of Liberia (GOL) debt on economic growth from 1970 to 2020. The findings from several studies in different regions of the world present mixed result and at times, controversial results on the impact of debt on the health of a country's economy. Its objective was to ascertain whether debt, both domestically and foreign, has an impact on economic growth in Liberia over the period of 50 years. Despite the theoretical foundation that debt stymied economic growth, the result from the analysis prove contrary to existing body of literature relative to the Liberian economy. The paper reviewed several literatures from various sources and regions to build the foundation for this work. The work used annual time series data of National debt (both domestic and foreign) and Gross domestic product (GDP) as well as annual data for revenue and expenditure for the periods under research. Data for national debt and GDP were obtained from the world development index, the World Bank and the international monetary fund while data for government revenue and government expenditure were both obtained from the fiscal outturn from the ministry of finance and development planning in Liberia. The paper established that there exists a long run relationship between national debt and economic growth in Liberia. It also established that there exist a bidirectional relationship between national debt and economic growth in Liberia.

Keywords: Economic Growth (GDP), National Debt, Government Expenditure, Government Revenue

1. Introduction

This paper attempts to understand the impact of national debt on the economy and despite the mixed findings that debt can have several consequences on various economies, this paper showed empirically the specific impact of debt on the growth of the Liberian economy between 1970 and 2020. As mentioned earlier, a country's debt can have negative or positive undertone, based on various indicators. For example, if the debt to GDP ratio exceeds a given threshold, debt is said to have an adverse condition in that economy. Reinhart & Rogoff opined that the ratio of debt to GDP should be at most 90%; and that a country will experience economic growth if the threshold is less than the 90% mark. They asserted that any number above the set threshold will ruined national growth and set the economy into spiral [11]. It is shown also empirically that a threshold of 88.2% for developing countries can produce growth of the economy [8]. In Liberia, the heavily indebted poor countries arrangement (HIPC) alleviated the country's debt in 2008, renewing the country's pledge to follow the mandate of the United Nation's SDG no. 8 which calls for countries to achieve higher economic growth by 2030 [13].

2. Literature Review

There are mixed reactions when it comes to the empirical assessment of national debt on economic growth. Each case is country specific and threshold specific.

It is uncertain to determine from a theoretical standpoint, the effect of debt on national income, both in the short and long run [7, 12]. One of the arguments proffered is that because output is sensitive to demand, national debt can have a positive and significant effect on disposal income, aggregate demand and gross domestic product [2]. This is true especially for short term intervention such as intervention on infrastructure and other basic social services like road constructions, electrification and water provision installations. Jobs creations and disposal income generation

are visible in the short run when these activities are being undertaken. However, the situation is not so rosy in the long run if public debt accrues to finance the deficit budget. This is so because if the decrease in national savings is not fully offset by increase in private savings, it could eventually lead to decrease in total volume of investment, which in turn, will have a negative effect on gross domestic product, which will lower capital stock, increase in interest rate and finally reduce labor productivity [4].

There is another aspect in the literature that tends to depart from the conventional short and long run debate. The works by Aschauer and Devarajan, Swaroop & Zou for example argued that the impact of debt in the long run on the economy is the function on the productiveness of the debt [5, 3].

Given these divergent of views, one can clearly see that the relationship between public or national debt on economic growth is far from conclusive (see [10] or the technical Appendix in [6].

3. Analytical Framework / Methodology and Regression Analysis and Results

Economic analysis, especially ones of a time series nature must be thoroughly examined and appropriate model develop. The very first step involve in running regression is to identify which variable is listed first. This is often referred to as ordering of variables. Once that is completed, the regression begins by testing stationarity of the variables to see if it has unit roots or whether it is stationary or non - stationary. Unit roots test are essential. The seminar work by Nelson & Plosser ushered in the concept of unit roots in macroeconomics time series [9]. Below is the table 1, presenting unit roots tests for all the variables in the model.

As countries race to fulfil the United Nations sustainable development goals (SDGs) which amongst others things indicate that countries should be on a positive path for economic growth by 2030 set up under number 8 of the SDG [14], the economic question then become how can countries, especially developing and least developed countries achieve such paradigm shift in the absence of adequate resources and competing priorities? The answer of course lies in the resource envelop of each country. Under flexible condition, countries address their development plans through their budget framework. Taxation and borrowing are but the two routes taken to achieve and undertake their development programs, apart from bi-lateral and other forms of multi-lateral grants arrangements. However, since taxes are a disincentive to the tax payer as it dispossess people of purchasing power and according to [1] imposing excessive burden on the public by increasing the cost of living and thereby reducing the purchasing power of people. The question of how to invest in critical infrastructure in order to be in compliance with the United Nations' SDGs is of critical relevance in addressing and alleviating poverty in Liberia. Since there are insufficient studies done in relation of the impact of debt on economic growth in Liberia, this paper will establish the baseline to further research on examining the consequences of debt on growth in the Liberian economy.

One thing though that is certain is that as research continues in understanding the impact of debt on the economic performance of countries, intriguing results may add to the body of literature already available.

Table 1. *UNIT ROOT TEST RESULTS (ADF).*

UNIT ROOT TEST RESULTS TABLE (ADF)					
Null Hypothesis: the variable has a unit root					
	At Level				
		DEBT	GDP	GE	GR
With Constant	t-Statistic	-2.3927	-0.5625	-0.5543	-4.6849
	Prob.	*0.1490*	*0.8693*	*0.8712*	*0.0004*
		n0	n0	n0	***
With Constant & Trend	t-Statistic	-2.3770	-1.5056	-1.3435	-4.7838
	Prob.	*0.3866*	*0.8142*	*0.8651*	*0.0017*
		n0	n0	n0	***
Without Constant & Trend	t-Statistic	-1.1602	0.4021	0.6816	-2.9936
	Prob.	*0.2211*	*0.7958*	*0.8598*	*0.0035*
		n0	n0	n0	***
	At First Difference				
		d(DEBT)	d(GDP)	d(GE)	d(GR)
With Constant	t-Statistic	-3.0781	-3.7178	-5.7763	-7.9218
	Prob.	*0.0348*	*0.0067*	*0.0000*	*0.0000*
		**	***	***	***
With Constant & Trend	t-Statistic	-3.1021	-3.7134	-5.7036	-7.8363
	Prob.	*0.1172*	*0.0307*	*0.0001*	*0.0000*
		n0	**	***	***
Without Constant & Trend	t-Statistic	-3.0975	-3.5496	-5.6531	-8.0042
	Prob.	*0.0026*	*0.0007*	*0.0000*	*0.0000*
		***	***	***	***

Notes:
a: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant
b: Lag Length based on SIC
c: Probability based on MacKinnon (1996) one-sided p-values.

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3.1. Johanssen Cointegration Test

Testing for economic relationship between and amongst variables are important parameters for economic analysis.

In this regression, we will use the Johanssen cointegration test to identify long run relationship between or amongst the variables.

The hypothesis for the Johanssen test is given as:

H0: no cointegrating equation (null hypothesis) and

H1: the H0 is not true

All variables are at their levels form and not first difference as a condition precedent for conducting the Johanssen cointegration test. Below is the result from the test and we can see that the null hypothesis is to be rejected for the fact that there is one cointegrating equation at the 5% level of significance. The results showed that there are at most 3 cointegrating equations. The same result can be said from the Max-Eigen statistic where the Max-Eigen statistic for the null hypothesis is greater than the critical value at 5% suggesting that we can reject the null hypothesis that there is no cointegration amongst the variables.

Table 2. *Cointegration Result.*

Date: 11/26/20 Time: 20:26				
Sample (adjusted): 1972 2020				
Included observations: 49 after adjustments				
Trend assumption: Linear deterministic trend				
Series: DEBT GDP GE GR				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.569327	56.31380	47.85613	0.0066
At most 1	0.180751	15.03584	29.79707	0.7778
At most 2	0.094132	5.266828	15.49471	0.7799
At most 3	0.008587	0.422586	3.841466	0.5156
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.569327	41.27796	27.58434	0.0005
At most 1	0.180751	9.769016	21.13162	0.7660
At most 2	0.094132	4.844242	14.26460	0.7614
At most 3	0.008587	0.422586	3.841466	0.5156
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
DEBT	GDP	GE	GR	
-2.15E-10	2.07E-09	-7.09E-09	2.45E-09	
6.42E-10	1.55E-09	-4.80E-09	-8.48E-11	
5.81E-10	-1.77E-09	6.04E-09	2.10E-10	
7.73E-11	1.08E-09	6.01E-11	7.75E-12	
Unrestricted Adjustment Coefficients (alpha):				
D(DEBT)	-18940977	-95585428	-14000976	-7407856.
D(GDP)	17887116	25917092	-352910.2	-9947315.
D(GE)	27846300	14233488	-17868985	-1522497.
D(GR)	-3.78E+08	54573572	-70671594	-4151430.
1 Cointegrating Equation(s):		Log likelihood	-3987.996	
Normalized cointegrating coefficients (standard error in parentheses)				
DEBT	GDP	GE	GR	
1.000000	-9.611505	32.95599	-11.40338	
	(2.02526)	(6.31495)	(1.48556)	
Adjustment coefficients (standard error in parentheses)				
D(DEBT)	0.004078			
	(0.00799)			
D(GDP)	-0.003851			
	(0.00409)			

D(GE)	-0.005995		
	(0.00241)		
D(GR)	0.081310		
	(0.01391)		
2 Cointegrating Equation(s):		Log likelihood	-3983.112
Normalized cointegrating coefficients (standard error in parentheses)			
DEBT	GDP	GE	GR
1.000000	0.000000	0.656593	-2.399936
		(1.43329)	(0.85152)
0.000000	1.000000	-3.360493	0.936737
		(0.22462)	(0.13345)
Adjustment coefficients (standard error in parentheses)			
D(DEBT)	-0.057248	-0.187656	
	(0.02311)	(0.08836)	
D(GDP)	0.012777	0.077266	
	(0.01256)	(0.04802)	
D(GE)	0.003137	0.079727	
	(0.00742)	(0.02836)	
D(GR)	0.116323	-0.696746	
	(0.04335)	(0.16575)	
3 Cointegrating Equation(s):		Log likelihood	-3980.690
Normalized cointegrating coefficients (standard error in parentheses)			
DEBT	GDP	GE	GR
1.000000	0.000000	0.000000	5.079002
			(2.16346)
0.000000	1.000000	0.000000	-37.34104
			(11.9742)
0.000000	0.000000	1.000000	-11.39052
			(3.56477)
Adjustment coefficients (standard error in parentheses)			
D(DEBT)	-0.065387	-0.162875	0.508419
	(0.03041)	(0.10685)	(0.35730)
D(GDP)	0.012572	0.077891	-0.253396
	(0.01656)	(0.05818)	(0.19454)
D(GE)	-0.007251	0.111354	-0.373847
	(0.00947)	(0.03328)	(0.11130)
D(GR)	0.075238	-0.571660	1.990706
	(0.05634)	(0.19796)	(0.66196)

3.2. Vector Error Correction Model (VECM)

Now after establishing the presence of a relationship (both long run and short run relationship amongst the variables, we can now run the error correction for the model. The 4 variable - model for our error correction is given below as:

$$\Delta LNDEBTt = a\_0+\sum\_(i=1)^n\alpha i\Delta LNDEBTt=1 + \sum\_(i=1)^n \lambda i\ \Delta LNGDPt-1 +\sum\_(i=1)^n\varphi i\Delta LNGEt-1 + \sum\_(i=1)^n\Gamma i\Delta LNGRt-1 +\sigma Zt-1 +\varepsilon t$$

Where all variables in the model are considered endogenous and GE is government expenditure and GR is government revenue; εt is the residual or white noise while Zt-1 is the error correction term and its coefficient σ is the speed of adjustment which measures the speed at which debt will return to equilibrium after a change in economic growth (GDP). All variables are the log transformation of the raw data. The result below in table 3 needs to be expanded in order to find the long run causality and short run causality, hence we need to run the system for the p-value.

Table 3. *Vector Error Correction Estimates.*

Vector Error Correction Estimates	
Date: 11/27/20 Time: 13:04	
Sample (adjusted): 1973 2020	
Included observations: 48 after adjustments	
Standard errors in () & t-statistics in []	
Cointegrating Eq:	CointEq1
LNDEBT(-1)	1.000000
LNGDP(-1)	-0.006380
	(0.65014)
	[-0.00981]
LNGE(-1)	-3.490027
	(0.91538)
	[-3.81267]

LNGR(-1)	4.447693			
	(0.78251)			
	[5.68391]			
C	-37.95216			
Error Correction:	D(LNDEBT)	D(LNGDP)	D(LNGE)	D(LNGR)
CointEq1	-0.034261	-0.064511	-0.292847	-0.387416
	(0.03252)	(0.02327)	(0.09954)	(0.08448)
	[-1.05344]	[-2.77252]	[-2.94211]	[-4.58581]
D(LNDEBT(-1))	0.420371	0.007146	-0.068908	-0.129261
	(0.15988)	(0.11438)	(0.48931)	(0.41530)
	[2.62933]	[0.06248]	[-0.14083]	[-0.31125]
D(LNDEBT(-2))	0.011993	-0.108770	0.140236	0.158469
	(0.15923)	(0.11392)	(0.48732)	(0.41362)
	[0.07532]	[-0.95481]	[0.28777]	[0.38313]
D(LNGDP(-1))	-0.069731	0.175161	0.009610	-0.006838
	(0.22320)	(0.15969)	(0.68312)	(0.57980)
	[-0.31241]	[1.09690]	[0.01407]	[-0.01179]
D(LNGDP(-2))	0.082179	0.146773	2.586713	2.374021
	(0.21316)	(0.15250)	(0.65237)	(0.55370)
	[0.38553]	[0.96244]	[3.96510]	[4.28756]
D(LNGE(-1))	0.003587	-0.098311	-0.609272	-0.323809
	(0.11635)	(0.08324)	(0.35610)	(0.30224)
	[0.03083]	[-1.18102]	[-1.71097]	[-1.07137]
D(LNGE(-2))	-0.008613	-0.062157	-0.644367	-0.457970
	(0.10274)	(0.07350)	(0.31442)	(0.26687)
	[-0.08384]	[-0.84566]	[-2.04936]	[-1.71610]
D(LNGR(-1))	0.000408	0.167886	0.523745	0.447399
	(0.12680)	(0.09072)	(0.38807)	(0.32937)
	[0.00322]	[1.85069]	[1.34963]	[1.35834]
D(LNGR(-2))	0.027312	0.169807	0.674252	0.530419
	(0.10906)	(0.07802)	(0.33377)	(0.28329)
	[0.25044]	[2.17635]	[2.02011]	[1.87237]
C	0.024085	0.027529	-0.045654	-0.071462
	(0.03953)	(0.02828)	(0.12097)	(0.10267)
	[0.60935]	[0.97349]	[-0.37740]	[-0.69601]
R-squared	0.226764	0.432416	0.396688	0.526382
Adj. R-squared	0.043629	0.297988	0.253799	0.414209
Sum sq. resids	2.533911	1.296967	23.73419	17.09758
S.E. equation	0.258228	0.184745	0.790306	0.670773
F-statistic	1.238237	3.216717	2.776188	4.692598
Log likelihood	2.485436	18.55910	-51.20623	-43.33471
Akaike AIC	0.313107	-0.356629	2.550259	2.222279
Schwarz SC	0.702940	0.033204	2.940093	2.612113
Mean dependent	0.044250	0.043601	0.058534	0.039443
S.D. dependent	0.264053	0.220496	0.914887	0.876403
Determinant resid covariance (dof adj.)		0.000120		
Determinant resid covariance		4.72E-05		
Log likelihood		-33.37767		
Akaike information criterion		3.224069		
Schwarz criterion		4.939337		
Number of coefficients		44		

Since our focus is to observe the impact of national debt on economic growth, only two variables of interest are relevant for this paper, which are national debt (DEBT) and economic growth (GDP). Therefore, we observe the p-value for debt and is given by table 5.

Our focus is on the speed of adjustment towards long run equilibrium, captured in the model as C1. The economic implications for C1 is that by rule, it has to be negative and statistically significant in order to have any economic meaning. The result above showed that indeed c1 is negative (-0.034261). By being negative, it tells us if there is a departure in one direction, the correction will have to be pulled back in the other direction so as to ensure that the equilibrium is retained. Hence, the interpretation of the result from the speed of adjustment, σ, showed that 3.4% of long run equilibrium is corrected in each period. It also tells us that debt Granger causes economic growth in the Liberian economy.

We now observe the other variable of interest which is economic growth and its impact on national debt in the

Liberian economy. Table 4 shows the system equation for economic growth below:

Table 4. *System Equation.*

Dependent Variable: D(LNDEBT)				
Method: Least Squares (Gauss-Newton / Marquardt steps)				
Date: 11/27/20 Time: 13:12				
Sample (adjusted): 1973 2020				
Included observations: 48 after adjustments				
D(LNDEBT) = C(1)*(LNDEBT(-1) - 0.00638014053879*LNGDP(-1) - 3.49002650672*LNGE(-1) + 4.44769324256*LNGR(-1) - 37.9521608773) + C(2)*D(LNDEBT(-1)) + C(3)*D(LNDEBT(-2)) + C(4) *D(LNGDP(-1)) + C(5)*D(LNGDP(-2)) + C(6)*D(LNGE(-1)) + C(7) *D(LNGE(-2)) + C(8)*D(LNGR(-1)) + C(9)*D(LNGR(-2)) + C(10)				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.034261	0.032523	-1.053441	0.2988
C(2)	0.420371	0.159878	2.629327	0.0123
C(3)	0.011993	0.159230	0.075319	0.9404
C(4)	-0.069731	0.223205	-0.312411	0.7564
C(5)	0.082179	0.213159	0.385528	0.7020
C(6)	0.003587	0.116353	0.030827	0.9756
C(7)	-0.008613	0.102736	-0.083838	0.9336
C(8)	0.000408	0.126799	0.003220	0.9974
C(9)	0.027312	0.109058	0.250436	0.8036
C(10)	0.024085	0.039527	0.609346	0.5459
R-squared	0.226764	Mean dependent var		0.044250
Adjusted R-squared	0.043629	S.D. dependent var		0.264053
S.E. of regression	0.258228	Akaike info criterion		0.313107
Sum squared resid	2.533911	Schwarz criterion		0.702940
Log likelihood	2.485436	Hannan-Quinn criter.		0.460425
F-statistic	1.238237	Durbin-Watson stat		2.015007
Prob(F-statistic)	0.301676			

Again, the result above show that σ, which is the speed of adjustment captured as c11 (-0.064511) is negative and statistically significant and therefore has economic interpretation in the model. The economic meaning for the system equation for economic growth suggests that there is a 6.5% of long run equilibrium being corrected in each period. It further explains that economic growth Granger Causes national debt.

In conclusion, the interpretation of the error correction model shows that there is a bidirectional relationship between national Debt and economic growth in the Liberian economic meaning national debt Granger causes economic growth and economic growth Granger causes national debt. In essence, as the Liberian economy grows, it accrues national debt in order to facilitate such growth, and as the national grows, it has to follow economic growth since the relationship is in both directions.

Table 5. *System equation showing p-values.*

Dependent Variable: D(LNGDP)				
Method: Least Squares (Gauss-Newton / Marquardt steps)				
Date: 11/27/20 Time: 13:38				
Sample (adjusted): 1973 2020				
Included observations: 48 after adjustments				
D(LNGDP) = C(11)*(LNDEBT(-1) - 0.00638014053879*LNGDP(-1) - 3.49002650672*LNGE(-1) + 4.44769324256*LNGR(-1) - 37.9521608773) + C(12)*D(LNDEBT(-1)) + C(13)*D(LNDEBT(-2)) + C(14)*D(LNGDP(-1)) + C(15)*D(LNGDP(-2)) + C(16)*D(LNGE(-1)) + C(17)*D(LNGE(-2)) + C(18)*D(LNGR(-1)) + C(19)*D(LNGR(-2)) + C(20)				
	Coefficient	Std. Error	t-Statistic	Prob.
C(11)	-0.064511	0.023268	-2.772525	0.0086
C(12)	0.007146	0.114382	0.062477	0.9505
C(13)	-0.108770	0.113918	-0.954810	0.3457
C(14)	0.175161	0.159688	1.096899	0.2796
C(15)	0.146773	0.152501	0.962440	0.3419
C(16)	-0.098311	0.083242	-1.181021	0.2449
C(17)	-0.062157	0.073501	-0.845662	0.4030
C(18)	0.167886	0.090716	1.850685	0.0720
C(19)	0.169807	0.078023	2.176354	0.0358
C(20)	0.027529	0.028279	0.973493	0.3365
R-squared	0.432416	Mean dependent var		0.043601
Adjusted R-squared	0.297988	S.D. dependent var		0.220496

S.E. of regression	0.184745	Akaike info criterion	-0.356629
Sum squared resid	1.296967	Schwarz criterion	0.033204
Log likelihood	18.55910	Hannan-Quinn criter.	-0.209310
F-statistic	3.216717	Durbin-Watson stat	2.193660
Prob(F-statistic)	0.005422		

4. Conclusion

The research adds to existing body of literature and has established another argument to existing debates of the impact of debt on economic growth. This paper has shown that for the case of Liberia, a heavily indebted poor country and second poorest nation on earth [14], public debt has indeed cause economic growth. However, it will be interesting that despite the findings of debt facilitating growth, Liberia still remains one of the poorest countries and that growth of the economy has not translated to improved standard of living. This paper therefore lay the foundation for future works concerning such delicate matters.

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