Public expenditure and optimal size of state In Cameroon from 1982 To 2023: the Armey Curve

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PUBLIC EXPENDITURE AND OPTIMAL SIZE OF STATE IN CAMEROON FROM 1982 TO 2023: THE ARMEY CURVE

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ABSTRACT:
The objective of this article is to determine the optimal threshold of public expenditure or optimal size of the State, necessary for economic growth in Cameroon over the period 1982 to 2023. The hypotheses on the conditionality of the optimal allocation of said expenditure at a threshold, and on the presence of a non-linear relationship between the macroeconomic variables of the study, were issued. It is indeed a quadratic relationship whose estimation is based on the calculation of a critical threshold, and the analysis in this case leads on using the method of Vedder and Gallaway (1998), also known as the Armey curve. Its main result is that total public expenditure in Cameroon since 2008 is above the optimal threshold of 16% of GDP, for which the effects would be beneficial on growth. The study recommends reducing public expenditure in non-growth sectors and channeling it to infrastructure investments capable of inducing private investment.

KEYWORDS: Public expenditure, optimal size, Armey curve, growth.
JEL Code: C22; H50.

1. INTRODUCTION

Cameroon is part, at the sub-regional level, of the CEMAC[1] economic and monetary zone. Within monetary unions, countries cannot use monetary policy to act on the economy, because it is common to the whole; only budgetary policy, of which public expenditure represents the preferred but not exclusive transmission channel (Blancheton, 2020), constitutes the main adjustment tool available to States for responding to the various asymmetric shocks that can affect economies.

The discussion of the relationship between government expenditure and growth is not new in the history of economic thought. It was at the heart of the thinking of classical economists, such as Adam Smith, who saw State interventionism as a source of market imbalance. For the Keynesian current, on the other hand, the State must intervene in the economy to overcome market failures. More recently, however, the same discussion will continue in the context of new growth theories, with Barro (1990) in particular, who presents an endogenous growth model where public expenditure plays a major role in growth.

In Cameroon, an increase in public expenditure was observed between 1982 and 1986, then between 1995 and 2023. These increased respectively from 412 to 876 billion FCFA[2], then from 550 to 6,274 billion FCFA (according to the World Bank national accounts data and national budget laws). These phases were marked by positive variations in GDP (Gross Domestic Product), rising respectively from 4,597 to 6,420 billion FCFA, then from 6,922 to 29,073 billion FCFA. Indeed, Cameroon has generally conducted an expansionary budgetary policy which led to an increase in public expenditure over the study period (1982-2023), with the exception of the years 1988 to 1993 marked by the recession accompanied by the structural adjustment, where public expenditure decreased according to the aforementioned sources from 630 to 487 billion FCFA, cumulatively with the drop in GDP from 4,981 to 3,746 billion FCFA.

[1] Economic and Monetary Community of Central Africa.
[2] African Financial Community Franc (for West Africa) / African Financial Cooperation Franc (for Central Africa).

In reality, there would be an optimal amount of public expenditure or optimal size of government, defined as *"the level of expenditure that has the greatest positive and significant impact on economic growth. Beyond this amount, any additional public expenditure is a source of economic loss"* (Nubukpo, 2007). Barro (1990) will suggest the concept of the optimal size of the State, to reconcile the positive and negative effects that result from State intervention in economic activity. It establishes that one can determine an optimal public expenditure. At this point, an additional monetary unit of public expenditure costs more in productivity than it yields. Following it, Vedder and Gallaway (1998) put forward the hypothesis of a non-linear relationship between public expenditure and growth, which makes it possible to consider that there is an optimal threshold or size of the State, from which spending would be conducive to growth.

This communication has as its main concern the question of the impact of optimal public expenditure on growth in Cameroon. The objective is to determine the optimal level or rate of public expenditure necessary for growth. To achieve this, we assume the presence of a non-linear relationship between said macroeconomic quantities (Fouopi & al., 2014).

In economic literature the necessity for government size increase is supported by the following two arguments (Sulkhan, 2017): first, known as "Wagner law" according to which public revenue growth coefficient of government expenditure elasticity coefficient is more than 1 (one), which leads to an increase in the size of government (Sachs & Larrain, 1993); second, "Baumol cost disease" according to which government expenditures increase because salaries of state employees grow more than their productivity (Mutascu & Milos, 2009).

Barro (1988) will conclude that the growth of GDP and savings are positively linked to that of productive public expenditure in relation to GDP, up to a certain threshold before decreasing thereafter. This relationship has been popularized by the Barro curve, used to determine the optimal size of public expenditure. Subsequently, the existence of an optimal size of public expenditure represented by a curve in the shape of an inverted "U", will be widely spread by Barro (1989), Armey (1995), Rahn and Fox (1996) and Scully (1998, 2003) under the term BARS curve (in reference to the initials of their names).

Armey (1995), drawing inspiration Kuznets (1955, 1963) and Laffer (1981, 2004) curves, will construct a curve based on the principle that, at public expenditures below a certain critical threshold, the production of a certain quantity of public goods or services (usually deemed to provide positive externalities conducive to the development of private sector) not being guaranteed, the level of the national product or the growth rate of the GDP is consequently reduced. At the same time, when the stock of public expenditure is very high, the impact of the State on economic activity is excessive, which disadvantages the private sector (Figure one). Vedder and Gallaway (1998) using this (Armey) curve, calculated the optimal share of government expenditure in GDP for the United States of America (USA), Canada and European countries (United Kingdom, Italy, Sweden and Denmark).

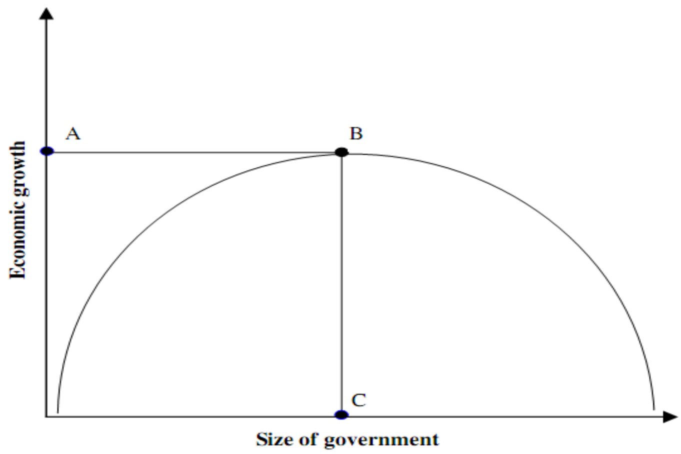

Fig. 1 *Armey curve (Armey, 1995)*
Source: Sulkhan (2017).

According to Armey curve, increasing government expenditures stimulate economic growth, firstly, higher rate (A) to the point when economic growth rate is at its maximum (B), on certain conditions government size (C)[3], after this point increasing the size of government reduces the rate of economic growth due to the fact that government expenditure are finessed by the tax, changes in tax policy reacting negatively by economic agents, which has negative influence on aggregate demand and macroeconomic equilibrium (Sulkhan, 2017).

Like Vedder and Gallaway (1998), Chen and Lee (2005) assume a non-linear relationship between public expenditure and growth. They consider that governments with low levels of public expenditure provide essential services such as the guarantee of individual property and the provision of public goods; while governments at very high levels of public expenditure go so far as to crowd out private sector investment. For these different cases, regime-switching models are currently the preferred approach for econometric work in individual time series, relating to the presence of non-linearity between macroeconomic variables. Two methods of analysis can be used: the approach by threshold regime-switching models [TAR (Threshold AutoRegressive model)], proposed by Tong (1978), and Tong & Lim (1980); and the method of Vedder and Gallaway (1998). This last approach, also known as the Armey curve, is the one that is subject of our study. The data are annual and essentially come from the statistics of the finance laws of Republic of Cameroon, and from the World Bank database. In this respect, we have annual series of public expenditure and GDP growth rates. The period considered goes from 1982 to 2023. The data is subject to statistical and econometric processing. The data are subject to statistical and econometric processing, based on time series modeling whose estimates are established by the Ordinary Least Squares (OLS) method of Legendre (1805) and Gauss (1809, 1855), and by the Generalized Method of Moments (GMM) of Hansen (1982).

The remainder of our discussion is structured as follows: the second and third sections focus on methodological approaches to public expenditure and the optimal size of government, respectively in terms of empirical specification and econometric estimation. The interpretations of the results are presented in the fourth section, then we conclude our reflection and formulate some policy recommendations in the fifth and final section.

2. PUBLIC EXPENDITURE AND OPTIMAL SIZE OF STATE: EMPIRICAL SPECIFICATION OF NON-LINEARITY USING THE ARMEY CURVE

Our model is inspired by the work of Vedder and Gallaway (1998), who managed to establish the presence of a non-linear relationship between the size of government expenditure and growth in USA, using the Armey curve. There are different ways of defining it precisely, one of which consists of relating public expenditure (G) as a percentage of GDP (G/GDP which we denote G_Y), in relation to total real production (Y). It is a quadratic relationship: which means that the influence of public expenditure is positive provided that it is contained within suitable limits, while a very high level of public expenditure slows down economic growth (Walid, 2013). The Armey curve can therefore be presented in a simple quadratic way, as follows:

$$Y = \alpha_0 + \alpha_1 (G_Y) - \alpha_2 (G_Y)^2 \qquad (1)$$

The positive sign on the linear term G, is designed to show the beneficial effects of government expenditure on output, while the negative sign for the squared term means that the variable measures any negative effects associated with increasing the level of public expenditure or size of government. Since the squared term increases in value faster than the linear term, the presence of negative effects of government expenditure will eventually outweigh the positive effect (Vedder & Gallaway, 1998).

Human and capital resources increase over time, so one would expect that over time production would increase. To control for this factor, we introduce the time variable (T) into equation (1), setting the first year examined, 1982, with the value one, the year 1983 with the value two, and so on, until the value 42 for the last year examined (2023). In addition, production varies according to the economic cycle. We would expect output to be below the time trend of GDP in years when the unemployment rate (U), is high. Vedder and Gallaway (1998) therefore develop the following equation:

$$Y = \alpha_0 + \alpha_1 G_Y - \alpha_2 G_Y{}^2 + \alpha_3 T - \alpha_4 U \qquad (2)$$

Our path is to use the definition of the Armey curve to the Cameroonian economy. To this end, we add a specific variable: equation (2) is then completed by GDP lagged by one period [GDP(-1)], defined to express expectations on the product. Sometimes the effect of an explanatory variable on an explained

[3] (C) Represents the optimal size of government.

variable is not instantaneous, the explained variable may respond with a delay.

The model to be estimated is the following:

$$Y_t = \beta_0 + \beta_1 G_{Yt} + \beta_2 G_{Yt}^{2} + \beta_3 T_t + \beta_4 U_t + \beta_5 GDP(-1)_t + \varepsilon_t \quad (3)$$

And the table one (See appendix), represents the evolution of the variables of the model.

3. PUBLIC EXPENDITURE AND OPTIMAL SIZE OF STATE: ECONOMETRIC ESTIMATE

The methodological approach, the econometric estimation and the diagnostic tests of the residuals constitute the articulations of this section.

3.1. Methodological approach

Table Two (See appendix) presents the descriptive statistics relating to the different variables of the model. Reading it, the lowest ratio of public expenditure to GDP is 6.03%, and the highest is 23.9%. As for their average over the period, it is 14.72%.

Our methodological approach, in accordance with our theoretical model inspired by the work of Vedder and Gallaway (1998), is based on a time series modeling whose estimates are established by the Ordinary Least Squares (OLS) method of Legendre (1805) and Gauss (1809, 1855), and by the Generalized Method of Moments (GMM) of Hansen (1982). We estimate a non-linear equation between public expenditure relative to GDP and economic growth.

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3.2. Econometric estimation

3.2.1. Study of the stationarity of the variables

The study of the stationarity of variables relates to the Augmented Dickey-Fuller (ADF) unit root test, to verify the stationarity of the processes at the significance level of 5%. The results obtained in Table Three (See appendix), indicate that the processes Y_t, G_{Yt}, G_{Yt}^2, and U_t admit unit roots in level: they are stationarized by the difference filter (Bourbonnais, 2015).

Looking at Table Four (See appendix), the processes Y_t, G_{Yt}, G_{Yt}^2, and U_t are stationary in first differences [$D(Y_t)$; $D(G_{Yt})$; $D(G_{Yt}^2)$; $D(U_t)$]. This means that the shocks at period *t-1* will have permanent and non-transitory effects on the trajectory of GDP, public expenditure, and the unemployment rate at period *t*.

3.2.2. Estimates and results

The results of estimating equation (3) using OLS regression analysis are shown in the following Table Five (See appendix). The coefficients of the regression model are significant at the 5% significance level if and only if the values of the Student statistic are greater than 1.96 in absolute values. In this regard, all the independent variables except the unemployment rate[4] are significant at the 5% level.

The expected signs of the variables G_{Yt} and G_{Yt}^2 are opposite, which qualifies the non-linear relation well. To this end, the influence of public expenditure is positive on growth when it is contained within acceptable limits, while a very high level of expenditure slows down this economic growth (Walid, 2013). In other words, public expenditure in Cameroon has a positive effect on economic growth on the one hand, and a harmful or negative effect on the other in the event of excessive expenditure.

[4] The insignificant unemployment rate coefficient with a negative sign could be explained by the fact that labor compensation and employment-friendly policies are partly dependent on public expenditure. The unemployment rate usually has a negative influence on growth.

The determination of the optimal level of public expenditure that maximizes real GDP growth is given by canceling the first derivative of equation (3) of our model to be estimated (Dione, 2016):

$$\frac{\partial Y}{\partial G} = 0 \rightarrow \beta_1 + 2\,\beta_2 G = 0 \rightarrow \beta_1 = -\,2\,\beta_2 G \rightarrow G = -\,\frac{\beta_1}{2\beta_2} \qquad (4)$$

The results obtained from equation (4) by the OLS and GMM method are summarized in the table six below:

Table 6: *Optimal size of public expenditure as % of GDP*

	Optimal public expenditure (G*)	
Estimation methods	OLS	GMM
Results	16,89 %	16,89 %
R^2	0,9772	0,9772

Source: Our calculations based on data from the finance laws from 1982 to 2023, and from GDF-World Bank. NB: OLS = Ordinary Least Squares; GMM = Generalized Method of Moments.

The optimal size of the State obtained by the OLS and GMM methods is the same: 16.89% of public expenditure reported to GDP.

These results are subject to model validation prior to their interpretation.

3.3. Residual diagnostic tests

3.3.1. Residual autocorrelation test

Consider the simple and partial autocorrelation functions (ACF), of model residuals on Table Seven (See appendix).

The probabilities associated with statistics Ljung-Box's Q (Q-Stat) are all greater than 0.05. The process is therefore without memory (sequence of random variables independent of each other), which means that the residuals are not autocorrelated.

3.3.2. Residual homoscedasticity test

Reading Table Eight (See appendix), the correlogram of the squared residuals does not indicate any term significantly different from 0 (critical probabilities all greater than 0.05), the homoscedasticity of the residuals is therefore checked [the variance of the error is constant: the risk of the amplitude error is the same regardless of the period (Bourbonnais, 2015)]. Residuals are a white noise process.

3.3.3. Serial correlation test

Reading Table Nine (See appendix), the critical probability associated with the Chi-Square: 0.5040 is greater than 0.05. We cannot reject the null hypothesis, there is no evidence of correlation between the series residuals.

3.3.4. Model stability

We use the CUSUM (Cumulative Sum) significance test. The trend of the CUSUM curve on Figure two (See appendix), is within the significance intervals at the 5% level. The model is therefore globally stable in its structural form, and we can conclude that the regression coefficients are stable.

The various diagnostic tests mentioned above allow the validation of the representation of our model to be estimated in equation (3). It is now a question of interpreting the results obtained.

4. INTERPRETATIONS

The results obtained in Tables Five and Six allow a certain number of interpretations to be made.

The coefficient of determination $R^2 = 0.9772$, expresses that 97.72% of the variability of GDP growth can be explained linearly by the exogenous variables. Such an adequacy of the estimated model equation is satisfactory.

The results of Tables Five and Six are similar to those of the work of Vedder and Gallaway (1998) who put forward the hypothesis that there would be a non-linear relationship between the public expenditures of the American State and the growth of real GDP over the period 1947-1997. The impact of government expenditure on growth would differ depending on the level of the ratio of government expenditure to GDP, and there would be a threshold value beyond which government expenditure would be less and less productive. For Vedder and Gallaway (1998), too much government (what they call the size of the State) stifles entrepreneurship and reduces the rate of economic growth. They say in simple terms, that a small government seems to promote growth, while a large government reduces it.

Our estimates using the OLS and GMM methods give us an optimal size of the State of 16.89% of government expenditure relative to GDP. These results are higher than the average public expenditure of 14.72% over the study period. In other words, Cameroon would be on average in the upward sloping part of the Armey curve according to the approach of Vedder and Gallaway (1998).

However, as shown in Table One, we find that from the year 2008 until the year 2023, the ratio of government expenditure to GDP has steadily increased well beyond the threshold optimum of 16.89%. All things that would explain the negative sign of the coefficient of public expenditure G_{Yt} (see Table Five), which means that any increase of one percentage point in government expenditure on GDP, would lead to a loss of 880 billion FCFA on wealth produced, for a gain of only 26 billion FCFA. Cameroon since 2008 would then be in the negatively sloping part of the Armey curve. This would mean that higher government expenditure (as a percentage of total output) is associated with a relative decline in real output levels.

5. CONCLUSION AND RECOMMENDATION

In this study, it was a question of assessing the optimal allocation of public expenditure for economic growth over the period 1982 to 2023. Our examination focused on the presence of a non-linear relationship (quadratic relationship) between the macroeconomic variables mentioned above, due to the existence of threshold effects which required the determination of the optimal size of public expenditure by the approach of the Armey curve of Vedder and Gallaway (1998). The results show that since 2008, public expenditure in Cameroon has exceeded the optimal size of the State estimated at the threshold of 16% of GDP, which would lead to possible losses in the wealth produced.

As a recommendation, the Cameroonian government could reduce its expenditure in non-growth sectors, and channel it to infrastructure investments capable of bringing about private investment, for example, in order to provide the productive fabrics with the best capacities to face the both internal and external competition : it is the function of allocating resources (i.e. their allocation to the various possible uses), which consists for the State in not relying solely on the mechanisms of market to ensure the allocation of productive resources (Beitone & al., 2019).

The results of the analysis of the relationship between optimal public expenditure and economic growth have a number of subtleties. As rightly pointed out Vedder and Gallaway (1998), we do not always arrive at results confirming the existence of the optimal size of the State, according to the categories of expenditure or according to the periods of observation. Following them, Bikai and Kouam (2018) recall the criticism linked to the plurality of possible thresholds that can lead to the non-linearity of the relationship between public expenditure and growth. We believe that other avenues of research focusing on threshold regime-switching models could be oriented towards richer and broader panel data analyses. /-

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APPENDIX

Table 1: *Evolution of the series (from 1982 to 2023) in billions of FCFA*

Years	GDP (Y)	G_{Yt} in %	$G_{Yt}{}^2$	T_t	U_t
1982	4,597	8.90	79.21	1	*5.27
1983	5,697	8.67	75.17	2	*5.27
1984	7,021	9.24	85.38	3	*5.27
1985	7,801	9.63	92.74	4	*5.27
1986	6,420	13.60	184.96	5	*5.27
1987	5,452	15.70	246.49	6	*5.27
1988	4,981	12.60	158.76	7	*5.27
1989	5,237	10.50	110.25	8	*5.27
1990	4,197	11.65	135.72	9	*5.27
1991	4,183	11.90	141.61	10	7.50
1992	3,803	16.12	259.85	11	7.60
1993	3,746	13.00	169.00	12	7.80
1994	7,483	6.03	36.36	13	7.80
1995	6,922	7.90	62.41	14	7.90
1996	7,393	8.60	73.96	15	8.10
1997	8,817	10.12	102.41	16	7.90
1998	9,333	11.16	124.55	17	7.80
1999	10,176	10.70	114.49	18	7.70
2000	12,193	9.60	92.16	19	7.60
2001	13,117	9.46	89.49	20	7.50
2002	12,981	10.68	114.06	21	6.70
2003	11,443	12.04	144.96	22	5.90
2004	11,139	12.07	145.68	23	5.10
2005	11,386	12.90	166.41	24	4.40
2006	11,711	13.06	170.56	25	3.70
2007	11,194	15.45	238.70	26	3.10
2008	10,728	19.15	366.72	27	3.40
2009	11,604	17.60	309.76	28	3.80
2010	12,562	18.60	345.96	29	4.10
2011	12,369	19.80	392.04	30	4.00
2012	14,020	19.40	376.36	31	3.80
2013	14,240	20.90	436.81	32	3.70
2014	15,051	21.80	475.24	33	3.50
2015	19,043	20.05	402.00	34	3.60
2016	19,953	20.15	406.02	35	3.60
2017	20,243	20.90	436.81	36	3.60
2018	20,130	23.90	571.21	37	3.60
2019	23,240	20,86	435.14	38	3.67
2020	23,470	21,09	444.79	39	3.99
2021	24,950	20,98	440.16	40	4.14
2022	27,220	20,57	423.12	41	3.78
2023	29,073	21,58	465.70	42	3.70

Source: Author based on data from finance laws from 1982 to 2023, and from GDF (Global Development Finance) **-** World Bank. NB: Y_t = real GDP; G_{Yt} = Public expenditure relative to GDP (in %); T_t = Temporal variable; U_t = Unemployment rate (in %); * 5.27 is the average of U_t from 1991 to 2023, because before 1991 this statistic was not given.

Table 2: *Descriptive statistics of the series (from 1982 to 2023)*

Statistics	Y_t	G_{Yt}	G_{Yt}^2	T_t	U_t	$GDP(-1)_t$
Mean	12,055.21	14.72	241.50	21.50	5.27	11,640.15
Median	11,290	13.03	169.78	21.50	5.27	11,194
Maximum	29,073	23.90	571.21	42.00	8.10	27,220
Minimum	3,746	6.03	36.36	1.00	3.10	3,746
Standard deviation	6,756	5.01	153.24	12.26	1.68	6,275.24
Comments	42	42	42	42	42	41

Source: Author based on data from finance laws from 1982 to 2023, and from GDF-World Bank.
NB: Y_t = real GDP; G_{Yt} = Public expenditure relative to GDP (in %); T_t = Temporal variable; U_t = Unemployment rate (in %); $GDP(-1)_t$ = GDP lagged one period.

Table 3: *Results of Augmented Dickey-Fuller (ADF) tests on level variables*

VARIABLES	ADF: Probabilities associated with t-statistics	ADF: Null hypothesis: admits a unit root	Probabilities associated with the TREND	Probabilities associated with the Constant	Delays
Y_t (*real GDP*)	0.9999	Do not reject[5]	/	/	00
G_{Yt} (*Public expenditure relative to GDP*)	0.8223	Do not reject	/	/	00
G_{Yt}^2 (*Square of public expenditure relative to GDP*)	0.7677	Do not reject	/	/	00
U_t *(Unemployment rate)*	0.4186	Do not reject	/	/	01

Source: Our calculations based on data from the finance laws from 1982 to 2023, and from GDF-World Bank.
NB: t-statistic = student statistic.

[5] Because of the uncertainty associated with type II error in significance testing, statisticians often recommend using the phrase “do not reject H0” instead of “accept H0”.

Table 4: *Results of the Augmented Dickey-Fuller (ADF) test on the processes Y_t, G_{Yt}, G_{Yt}^2, and U_t in first differences (D)*

VARIABLES	ADF		Probabilities associated with the TREND	Probabilities associated with the Constant	Delays
	Probabilities associated with t-statistics	**Null hypothesis:** admits a unit root			
D(Y_t)	0.0000	Rejection	/	/	00
D(G_{Yt})	0.0000	Rejection	/	/	00
D(G_{Yt}^2)	0.0000	Rejection	/	/	00
D(U_t)	0.0040	Rejection	/	/	01

Source: Our calculations based on data from the finance laws from 1982 to 2023, and from GDF-World Bank. NB: t-statistic = student statistic; Y_t = real GDP; G_{Yt} = Public expenditure relative to GDP (in %); U_t = Unemployment rate (in %).

Table 5: *Regression analysis for real GDP in Cameroon from 1982 to 2023*

Regression statistics	Regression coefficient	t -statistic
C (Constant)	6,474.1940	2.3559
G_{Yt} (Public expenditure relative to GDP)	**-** 880.6163	-2.9353
G_{Yt}^2 (Square of public expenditure relative to GDP)	26.0678	2.6208
T_t (Time variable)	78.0980	1.9575
U_t (Unemployment rate)	- 52.3565	-0.3203
GDP(-1)$_t$ (GDP lagged one period)	0.9465	13.7809
R^2 (Determination coefficient)	0.9772	
Durbin Watson	2.0623	

Source: Our calculations based on data from the finance laws from 1982 to 2023, and from GDF-World Bank. NB: t-statistic = student statistic.

Table 7: *Correlogram of model residuals*

Sample: 1982 2023
Included observations: 41

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.041	-0.041	0.0744	0.785
		2	-0.150	-0.152	1.0903	0.580
		3	-0.021	-0.035	1.1109	0.774
		4	0.031	0.006	1.1570	0.885
		5	-0.072	-0.080	1.4092	0.923
		6	0.009	0.006	1.4135	0.965
		7	0.127	0.110	2.2539	0.944
		8	-0.056	-0.049	2.4240	0.965
		9	0.015	0.051	2.4364	0.983
		10	0.051	0.044	2.5826	0.990
		11	-0.134	-0.135	3.6414	0.979
		12	-0.092	-0.075	4.1599	0.980
		13	0.036	-0.017	4.2432	0.988
		14	-0.033	-0.086	4.3134	0.993
		15	0.144	0.172	5.7263	0.984
		16	0.023	0.001	5.7630	0.990
		17	-0.043	-0.022	5.8961	0.994
		18	0.012	0.082	5.9080	0.997
		19	-0.185	-0.233	8.6486	0.979
		20	-0.310	-0.363	16.700	0.672

Source: Author based on data from the finance laws from 1982 to 2023 and from GDF-World Bank.

Table 8: *Correlogram of squared residuals*

Sample: 1982 2023
Included observations: 41

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.003	-0.003	0.0004	0.984
		2	-0.134	-0.134	0.8138	0.666
		3	0.178	0.181	2.2877	0.515
		4	0.172	0.159	3.6946	0.449
		5	-0.072	-0.028	3.9481	0.557
		6	-0.146	-0.148	5.0148	0.542
		7	0.022	-0.055	5.0396	0.655
		8	0.011	-0.030	5.0457	0.753
		9	-0.071	-0.004	5.3237	0.805
		10	-0.085	-0.042	5.7390	0.837
		11	-0.023	-0.042	5.7706	0.888
		12	0.163	0.161	7.3861	0.831
		13	-0.045	-0.018	7.5161	0.874
		14	-0.100	-0.052	8.1667	0.880
		15	0.081	0.006	8.6140	0.897
		16	0.009	-0.070	8.6194	0.928
		17	-0.089	-0.047	9.1952	0.934
		18	-0.034	-0.000	9.2831	0.953
		19	-0.014	-0.052	9.2986	0.968
		20	0.164	0.208	11.555	0.931

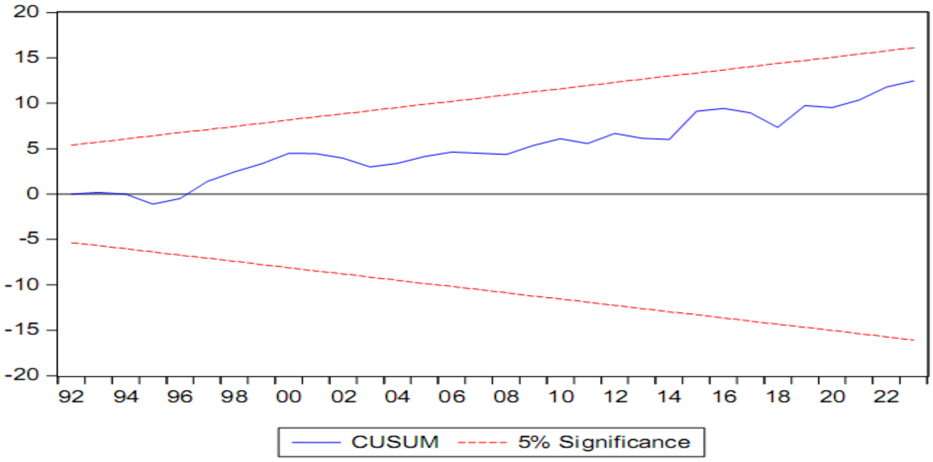
Source: Author based on data from the finance laws from 1982 to 2023 and from GDF-World Bank.

Table 9: *Breusch - Godfrey test*

Breusch-Godfrey Serial Correlation LM Test: *Null hypothesis: absence of correlation between the series up to 02 lags*			
F-statistic	0.5705	Prob. F(2.21)	0,5707
Obs*R-squared	1.3703	Prob. Chi- Square(2)	0,5040
Equation test:			
Dependent Variable: RESID			
Method: Least Squares			

Source: Author based on data from the finance laws from 1982 to 2023 and from GDF-World Bank.

Fig. 2 *Model Stability Test*



Source: Author based on data from the finance laws from 1982 to 2023 and from GDF-World Bank.