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Growth of Public Expenditure and Gross Domestic Product (GDP) of Tanzania

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Abstract
The paper examines the interrelations between public expenditure and GDP using regression modelling, with data covering the period from 1966 to 2012. Augmented Dickey-Fuller and Phillips-Perron tests were conducted to determine if the time series of the variables were stationary. These models were further supplemented by the use of a Distributed Lag Model (DLM) to evaluate the degree and direction of interrelations between GDP and public expenditure. The findings provide empirical evidence supporting and validating the DLM, revealing that the growth of public expenditure is more influenced by current GDP rather than lagged public expenditure. However, the adjustment of actual to desired changes in public expenditure is slow and limited, spreading over a long period, reflecting the inefficiency and lethargic response of bureaucracy to change. This implies that public expenditure, particularly on investment, is spread over projects with longer gestation periods in areas such as health, education, transport, and communication. As the government embarks on an industrialization strategy, it is crucial to diversify spending to include not only long-term investment projects but also immediate consumption and social welfare programs. By implementing a strategic spending plan that addresses both short-term and long-term needs, the government can promote sustained economic growth and development. This approach will help build a more resilient economy, ensuring that immediate benefits are realized while also laying the groundwork for future economic progress.

Keywords: Public expenditure, GDP, Simultaneous Equation Model and Distributed Lag Model

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Introduction

Public expenditure comprises both consumption and investment. Public expenditure, particularly expenditure on public enterprises, has emerged as a key driver of economic growth in many economies. In modern economies irrespective of their development status, public expenditure plays pivotal roles in promotion of welfare and enhancement of production and growth of the economy. Even in capitalist economies, regulation and controls came to play decisive role during the Second World War. However, in developing and planned economies, public expenditure has been used as an instrument of economic growth, achievement of self-reliance and promotion of social welfare (Myrdal, 1955).

Besides, in case of developing countries, poverty of the people and underdevelopment of the country are envisaged to constitute a vicious circle. The growth of the economy in these countries requires industrialization to reduce over-dependence on primary production. To break the vicious cycle of underdevelopment, external public intervention is required, transforming it into a virtuous cycle of prosperity and development (Myrdal, 1955). Public intervention is needed to come out of Smith's trap of "*laissez faire*". The public authority should not only initiate the process of development but also nurture it over a long period of time until the economy reaches the mature stage where market can take care of the process of growth without much public intervention. Besides, modern states are no more the ruling states, they are the welfare states. Thus, public authority should also be the promoter and protector of people's welfare. Therefore, public expenditure is needed not only for pushing the economy onto its long-term growth path but also for keeping it moving from the lower to each successive higher development stage. This makes public expenditure grow incessantly across time. Thus, public expenditure in general, and public investment in productive and welfare-promoting activities in particular, are considered major factors of economic growth, especially in developing economies (Prakash and Chowdhury, 1995).

This theory of state-led development has been underlying the public operations in developing countries like Tanzania for a long time. However, its policy implications and the theoretical foundation have been challenged by the re-emergence of market friendly neo-classical economists led by the figures such as

Haberler Gottfried, Milton Friedman and David Shapiro. This study examines the interrelation between public expenditure and growth of GDP in the Tanzanian economy from 1966 to 2012. A simultaneous econometric model was developed for this purpose and applied to the data from Tanzania. Findings support the premise. A separate model was used to evaluate different behaviours of economies of Tanzania. However, the period covered by the study is characterized by two policy shifts. The first shift occurred long back when Tanzania attained political independence from the British rule in 1961. The second occurred in 1986 when the economy of Tanzania was opened up and adopted liberalisation, privatisation and globalisation (LPG) as the state policy.

Literature Review

Theoretical Background

The theory and policy of public expenditure are directly related to the theory of the state. The concept and theory of the state have been evolved since the inception of civilisation. With the changing theory, there has been a continuous multiplication of state's roles and functions.

The theories of state and their philosophical views are divided into two groups: (i) Theory of minimal government intervention and minimal public expenditure; and (ii) Theories supporting maximal government and maximum public expenditure.

Classical economists like Adam Smith (1723–1790), Thomas Robert Malthus (1766–1834), David Ricardo (1772–1823), and John Stuart Mill (1806–1873) advocated for minimal government intervention in economic affairs, resulting in minimal public expenditure. This minimal public expenditure implied limited roles and functions of the government, primarily focused on essential areas such as defense, maintenance of public law and order, and the administration of justice. Smith and other classical economists advocated the policy of free enterprise and market-oriented economy which discouraged significant government intervention. The other classical economists who followed Smith argued that the economy of any state works best if left to function on its own in accordance with the signals released by the market. This stance opposed government intervention, particularly in the form of restrictions and regulations on economic affairs. Consequently, public expenditure remained small, primarily

confined to essential functions such as defense and the administration of justice. This resulted in the widespread anger and opposition against the philosophy of laissez faire.

Emergence of New Philosophy and Theory

The emergence of new philosophy and economic theory which emerged as the concept of ruling state was replaced by the welfare state, where the government's roles and functions shifted to not only governing but also ensuring the wellbeing of its citizens. This shift required an expansion of government roles and functions, leading to increased public expenditure. This transformation finds theoretical support in Wagner's Law and the Keynesian Hypothesis, marking a watershed moment in the theoretical backing of public expenditure.

Adolph Wagner (1883) proposed the "law on the increasing expansion of public expenditure in general and state activities in particular", suggesting that it leads to an increase in the size and control of bureaucracy over the economy. Wagner argued that greater public expenditure promotes economic growth. According to Wagner's law, as the economy develops over time, the activities and functions of the government increase. As the economy grows, administrative and protective functions of the government come to be substituted for private activities, there is an increased need for social and cultural goods and services, and government intervention becomes necessary to manage and finance natural monopolies and ensure the smooth operation of market forces (Bird, 1971). Critics of the Wagner's Law argue that he does not specify the criteria for measuring public expenditure growth, such as absolute public expenditure, public expenditure relative to GDP, or the public sector's size relative to the economy (Prakash and Chowdhury, 1995, p. 30). However, Musgrave (1959) opined that Wagner's law refers to the size of the public sector relative to the size of the economy. It is the size of the public sector which reflects the level of public expenditure.

Emergence of socialist governments in many countries in the wake of Bolshevik revolution in USSR and the worldwide great depression in late twenties and early thirties of the 20th century transformed the theory and philosophy of the state's roles and functions which directly related to public expenditure. The socialist revolution replaced the market demand based production for profit by planned

system of production for the achievement of objectives and targets of development and growth. The public ownership of means of production and resultant transformation of priorities and scale of production for accelerated maximal growth were substituted for the production for maximisation of private profit; this resulted in astronomical growth of public expenditure across the globe. Planning was used as a tool to industrialisation-based economic development and social transformation. Social welfare came into the centre stage of policy and the objective of economic growth with equity and justice for the creation of an egalitarian society became the driving force (Prakash and Chowdhury, 1995). All these changes led to the astronomical rise in public expenditure as a proportion of GDP.

Keynesian theory advocated for government intervention to stimulate effective demand by public expenditure to dampen the demand recession/depression in the economy (Keynes, 1936). He envisaged public expenditure as the tool to fill the income-consumption gap. As marginal increase in consumption tends to be less than the increase in marginal income, public investment is required to fill the gap between marginal income and marginal consumption. However, the income-consumption gap is generally left uncovered by the private investment, which is guided solely by profits and the marginal efficiency of capital; thus, Keynes stressed that an increase in public spending promotes economic growth by instilling a purchasing power into the economy. According to Keynes, an increase in public spending can be a useful tool to promote an aggregate demand for a sluggish economy (Njoku et al., 2014). However, it may bring crowding-out effect on private sector.

Keynes considered the public expenditure as an exogenous factor that can be used as an important policy mechanism to propel economic growth. The Keynesian framework indicated that causality runs from public spending to economic growth. Although the theory has fallen out of favour since 1970s, it still influences policy discussions, particularly on whether or not changes in public spending have transitory and/or permanent economic effects (Srinivasan, 2013). For instance, some policymakers use the Keynesian analysis to argue that higher or lower levels of public expenditure may fuel or diminish economic growth (Mitchell, 2005; Mungroo et al., 2013).

Keynes further argued that the public expenditure can boost economic growth either through the consumption multiplier or investment-based accelerator effects, since the aggregate demand function comprises both consumption and investment expenditure. In fact, incremental output/income resulting from a given public and/or private consumption expenditure becomes available to generate the subsequent aggregate demand until 15 to 17 rounds of the cycle are completed, though each successive round shall be subject to diminishing magnitudes of consumption, investment and income (Prakash and Sharma, 2013). While the public expenditure on administration and welfare promotes the economic growth through multiplier, public expenditure on a capital investment promotes economic growth via what Hicks called an accelerator. However, Hicks argument is that income, irrespective of its genesis or source, is allocated for both consumption and investment, though the marginal propensity to consume (MPC) and the marginal propensity to save (MPS) may differ from round to round (Prakash and Sharma, 2013).

Empirical Review of Literature

Results from various empirical studies on the relationship between public expenditure and economic growth in both developed and developing countries differ widely. Some studies find public consumption spending to have a negative impact on growth (Grier and Tullock, 1989; Barro, 1990). However, Devarajan et al. (1996) found a positive impact of public spending on health, transport, and communication on economic growth using a sample of 14 OECD countries. Public expenditure on education was found to have no impact on economic growth.

It should be noted that the interrelations between income and expenditure on education are characterized by a lead-lag structure. If this is not incorporated into the analysis, the results can be misleading, as shown in previous studies (Prakash, 1977; Prakash and Chowdhury, 1995). One clear inference from the above discussion is that both the magnitude and composition of public expenditure are crucial in its relationship with economic growth. Though numerous studies on aggregate public expenditure have been conducted, only a few of them are based on the analysis of public expenditure in key sectors of a particular country's economy.

Studying 62 countries, Lin (1994) found that non-productive government expenditure has no effect on economic growth in the advanced countries, but it has a positive impact in less developed countries (LDCs). Lin also highlighted ways to increase the growth effect of public expenditure. These include the provision of public goods and infrastructure, social services, and targeted interventions such as export subsidies. This study also furnishes rationale for treating public spending to be of paramount importance in developing countries. Vedder and Gallaway (1998) lend support for the findings of Lin and they showed the reasons that make government expenditure the major determinant of economic growth in developing countries. They inferred that an increase in public expenditure may not have its intended beneficial effect in developing countries, given their high levels of public debts.

They also argued that public spending promotes economic growth by enhancing the capital stock, advancing technology, and improving the quality of human resources and literacy (for the interrelation between literacy and growth, see Sharma and Ajeet, 2010; Prakash, Buragohain and Gupta, 1993). The role of government in developing countries is crucial in correcting market failures and promoting economic growth through fiscal policies, which include taxation and public expenditure. Fiscal instruments have proven more effective in stimulating growth in many developing countries than monetary instruments. One reason is that most of these countries still have predominantly non-monetised segments in their economies. Gupta et al. (2005) and Jaroensathapornkul (2010) also provided empirical evidence to support the thesis that fiscal policy plays an important role in catalysing economic growth and development in developing countries.

Classical theory emphasises balanced or surplus budgets, viewing excessive public spending and fiscal deficits as indicators of public imprudence. However, the advent of neo-development economics has advocated for deficit budgeting to be covered by public borrowings. The underlying idea is that public debt and fiscal deficits can promote growth, provided the resources raised are invested in productive investment (Prakash and Chowdhury, 1995). This approach implicitly suggests that public expenditure promotes economic growth and generates employment.

In contrast to the above views, neoclassical economists emphasize supply-side economics based on market mechanisms, minimizing government's roles and functions. This leads them to consider fiscal policies, especially public expenditure, not only as ineffective but also counterproductive to growth. A key aspect of their logic is the crowding-out effect of public expenditure on private investment. As public expenditure increases, public goods substitute private goods, resulting in lower private spending on consumption (including education, health, transportation, and other goods and services) as well as investment. If governments borrow extensively domestically to fund its expenditure, pressure on the credit market leads to higher interest rates, which hamper private investment and raise investment costs, potentially exacerbating inflationary pressures (Abu-Bader and Abu-Qarn, 2003).

Moreover, the short-run ineffectiveness of public expenditure on items such as health, education, irrigation, and physical infrastructure like dams, electricity plants, roads, and railroads involve long lead-lags in completion and reaching critical breakeven points, which may obscure or cloud the long-run growth effects of public expenditure. However, public prudence does not always guide public spending, especially in democratic polities, where populism often plays a decisive role in determining the direction of public expenditure. Populist fiscal measures tend to result in unproductive public expenditure financed through fiscal deficits and public debts. This often leads to high inflationary pressures, prompting high-interest rate policies for regulation. High inflation saps household purchasing power, leading to demand recessions, while high-interest rates dampen private investment (Diamond, 1989). This negatively affects the private sector and, consequently, economic growth. The argument needs supplementation by a structural approach to analyse the growth effects of private and public investment in a comparative framework (Prakash, 1994).

Ditimi (2011) used multivariate co-integration time series model and inferred that public spending on various socio-economic sectors and agriculture positively affects the economic growth. However, the public expenditure on education, health, transport and communication had no significant effect on economic growth. The above review reveals that empirical results relating to relation between public expenditure and economic growth have been inconclusive; most of the studies reveal that the aggregate public expenditure

positively affects growth; some studies controvert this finding; and the country and sector specific studies highlight the differentials of growth effects of the public expenditure on sectoral growth. However, these studies have not taken the difference in short and long run growth effects into consideration. All the same, these studies furnish the back-drop of the study in hand. The study in hand focuses on determination of: growth of GDP and Per Capita GDP during the period from 1966 to 2012; the impact of change in policy and impact of change in other determinant(s) of growth of GDP/Per Capita GDP; growth of public expenditure; and interrelations between GDP and the public expenditure.

Hypotheses

Hypothesis 1: *The current GDP depends on lagged GDP, public expenditure and private consumption in the preceding period.*

Hypothesis 2: *The current public spending depends on the previous public spending and the current GDP.*

Models and Methods of Data Analysis

The study formulates macro-econometric model of growth and interrelation between public expenditure, private consumption and GDP. The simple Keynes' income identity, given hereunder, is modified in this study.

$$Y_t = C_t + I_t \quad \text{.....(1)}$$

Y refers to income produced in the given period, *C* stands for consumption and *I* denotes investment. Keynes did not distinguish between private and public investment, or private and public consumption. Therefore, relation 1 is modified as follows to incorporate 'private consumption expenditure' and 'public expenditure' as predetermined variables. Public expenditure comprises the following elements:

$$PE_t = PEC_t + PI_t + PWA_t \quad \text{.....(2)}$$

PE stands for the total public expenditure, *PEC* for the total public consumption expenditure, *PI* for the total public investment, *PWA* for the public expenditure on social welfare and administration, while t stands for time in a financial year. Both relation 1 and 2 are definitional identities; relation 1 is not a part of the model.

The following two functional relations together with equation 2 constitute the model:

$$GDP_t = f(GDP_{t-1}, PE_{t-1}, PVCE_{t-1}) \quad \text{.....(3)}$$

$$PE_t = f(PE_{t-1}, GDP_t) \quad \text{.....(4)}$$

PVCE refers to private consumption expenditure. Inclusion of this variable as the predetermined variable of the system is designed to capture the consumption multiplier effect on the growth of GDP, which shall also capture the induced investment-based accelerator effect on the economic growth. As the Marginal Propensity to Consume (MPC) is less than one, only a fraction of incremental income, emanating from a growth process, is spent on consumption. The other fraction of incremental income becomes available for investment induced by a consumption multiplier. However, the public expenditure comprises all three parts specified in relation 2. The functional relations 3 and 4 are Distributed Lag Models (DLM) with a *partial adjustment specification*. This means that the actual change in GDP or PE is only a fraction of the desired change.

Partial Adjustment Hypothesis

Distributed lag model is the generalised form of auto-regressive models and this study uses its derivative of the adjustment process. According to Nerlove (1958), the distributed lag model is a generalised form of auto-regressive models and this study uses its derivative of the adjustment process. Nerlove provides a specification which is an alternative to Koyck's model (Koyck, 1954). It is assumed that there is an optimal or long-run equilibrium/desired value of GDP_t, specified as GDP_t^*. GDP_t^* is specified as a linear function of public expenditure as follows:

$$GDP_t^* = \alpha_0 + \alpha_1 PE_t + \mu_t \quad \text{.....(5)}$$

$$PE_t^* = \beta_0 + \beta_1 GDP_t + \nu_t \quad \text{.....(6)}$$

$$(GDP_t - GDP_{t-1}) = \lambda(GDP_t^* - GDP_{t-1}) \quad \text{.....(7)}$$

$$(PE_t - PE_{t-1}) = \gamma(PE_t^* - PE_{t-1}) \quad \text{.....(8)}$$

$0 \le \lambda \le 1$; and $0 \le \gamma \le 1$.

It is assumed that the actual change in GDP and PE represents only a fraction of the desired change. Coefficients λ and γ denote the adjustment of observed

values to the desired value of the variable under consideration. A coefficient of one indicates no lag in the adjustment of the actual to desired value, while a coefficient of 0 implies no adjustment. Thus, the higher the value of the adjustment coefficient, the quicker the adjustment of the actual to desired value.

In practice, the adjustment from actual to desired change occurs gradually over several periods due to factors such as inertia, ignorance, imperfect foresight, bottlenecks, constraints, resistance to change, and uncertainty associated with expectations, all of which impede the realization of the desired level of change. Since the values of GDP_t^* and PE_t^* are unobserved, they are removed from the system. The values of GDP_t^* and PE_t^* are substituted in 5 and 6 from equations 7 and 8 respectively, which yield the following twin relations:

$$GDP_t = \lambda\alpha_0 + (1-\lambda)GDP_{t-1} + \lambda\alpha_1 PE_{t-1} + \lambda\mu_t$$

$$GDP_t = \Pi_0 + \Pi_1 GDP_{t-1} + \Pi_2 PE_{t-1} + \nu_t \quad \text{.....(9)}$$

and

$$PE_t = \gamma\beta_0 + (1-\gamma)PE_{t-1} + \lambda\beta_1 GDP_t + \gamma\varepsilon_t$$

$$PE_t = \Pi_3 + \Pi_4 PE_{t-1} + \Pi_5 GDP_t + \omega_t \quad \text{.....(10)}$$

where: $\Pi_0 = \lambda\alpha_0$, $\Pi_1 = (1-\lambda)$, or $\lambda = 1 - \Pi_1$, $\Pi_2 = \lambda\alpha_1$, $\nu_t = \lambda\mu_t$; and

$\Pi_3 = \gamma\alpha_0$, $\Pi_4 = (1-\gamma)$, or $\gamma = 1 - \Pi_4$, $\Pi_5 = \gamma\alpha_1$, $\omega_t = \gamma\varepsilon_t$ .....(A)

The reduced form equations are exactly identified. Reduced form parameters may be estimated by Maximum Likelihood, GLS or OLS. Structural parameters shall be derived from the estimates of reduced the form parameters as per relations specified in set A.

Impact of Policy on Growth

To capture the growth effect of change in policy, another equation is formulated as an alternative to relation 10:

$$GDP_t = f(GDP_{t-1}, PE_{t-1}, D) \quad \text{.....(11)}$$

D stands for policy dummy. It is assigned a value 1 after the change in policy and value 0 before the change in policy. Use of a binary dummy variable captures the impact of change in policy from one period to another. The coefficient of the dummy represents a difference in the value of intercepts for the two periods.

If equation 11 is taken into consideration, the model will include equations 10 and 11, while equation 9 will be excluded from the alternative model. This part of the model is treated as a separate specification. The identification status

remains unchanged in that equation 11 is exactly identified, but equation 10 is now over-identified. These are alternative model specifications.

Identification of Functional Relations

The system comprises one definitional and two functional relations. The model includes only five variables in functional relations, three of which are lagged and hence predetermined. The remaining variables (GDP_t and PE_t) are endogenous and are determined within the model. Relation 3 excludes one of the five variables ($PVCE_{t-1}$). This satisfies the condition of exact identification of the equation, as explained below:

i. The number of variables excluded from equation 3 is equal to the number of equations minus one: 2 - 1 = 1.
ii. The number of variables excluded from equation 4 is 2, which is greater than the number of equations minus one: 2 > 1. Therefore, equation 4 is over-identified.

Equation 3 can be estimated by Ordinary Least Squares (OLS), Indirect Least Square (ILS) or Maximum Likelihood (ML) since all these estimates tend to coincide with each other in case of exactly identified equations. However, equation 4 will have to be estimated by Two Stage Least Square (TSLS), since OLS estimates of GDP_t shall be used as values of the predetermined variable in this relation. In such cases, the coefficient of multiple determination becomes difficult to interpret as its meaning is unclear (See Wallis, 1971).

Growth Curve

The following growth curve with or without policy dummy is employed for analysing the growth of the variables of the system:

$$\ln Y_t = \alpha_0 + \alpha_1 X + \mu_t \quad \text{.....(12)}$$

$$\ln Y_t = \alpha_0 + \alpha_1 X + \alpha_2 D + \mu_t \quad \text{.....(13)}$$

Y refers to the variable growth of which is analysed, X stands for time, while μ refers to random errors. Division of time series data into two parts from 1966-1985 and 1986-2012 also highlights the differential growth during these two parts of the composite period. One growth curve is then fitted to each part of the time series separately.

Unit Root and Co-Integration Tests of Time Series Models

Time series models require an evaluation of the stationary nature of the data series. Regression analysis does not yield genuine and reliable results if the series is non-stationary. Either the time series of each variable in the model must be individually stationary, or the series must be co-integrated. If the random errors of the estimated linear regression model are stationary, the linear combination of the variables is treated as stationary, and all the variables in the regression are said to be integrated of the same order. In this study, Augmented Dickey-Fuller and Phillips-Perron unit root tests are applied to the series of each variable separately to determine if they are stationary. The Engle-Granger test of co-integration is used to supplement the unit root tests.

The Augmented Dickey-Fuller Test

Unlike the standard Dickey-Fuller test, the Augmented Dickey-Fuller (ADF) test captures the serial correlation associated with error terms. The ADF test adjusts the DF test by accounting for the lagged difference terms of the dependent variable (y_t) in each equation to ensure that the error term is not serially correlated (Brooks, 2008). The following versions of the Random Walk Model (RWM) are used, and the Augmented Dickey-Fuller unit root test is applied to them:

$$\Delta y_{it} = \delta y_{it-1} + \sum_{i=1}^{n} \phi_i \Delta y_{t-i} + U_t \quad \text{.....(14)}$$

$$\Delta y_{it} = \gamma_0 + \delta y_{it-1} + \sum_{i=1}^{n} \phi_i \Delta y_{t-i} + U_t \quad \text{.....(15)}$$

$$\Delta y_{it} = \gamma_0 + \delta y_{it-1} + \gamma_1 T + \sum_{i=1}^{n} \phi_i \Delta y_{t-i} + U_t \quad \text{.....(16)}$$

Where: $\rho = 1 + \delta$ and ϱ are the root of the equation, n is the optimal number of lags, U_t is assumed to be white noise with 0 mean and constant variance σ_μ^2

The ADF test is based on the significance of the coefficient of y_{t-1} as shown in equations 14 to 16. The hypothesis of stationarity is estimated by examining whether the value of δ is exactly smaller than 0. The null hypothesis taken in this test of Dickey-Fuller (DF) is that there is unit root: $H_0 : \rho = 1$ and it is experimented against the alternative hypothesis: $H_1 : \rho < 1$. The test is carried

out by calculating the equation of first order differences of y_t, that is Δy_t as a function of y_{t-1}, y_{t-1} subtracted from both sides of the equation.

The Phillips-Perron Unit Root Test

Unlike DF and ADF tests, the Phillips-Perron test assumes that error terms are independently and identically distributed (Phillips and Perron, 1988). It uses some non-parametric methods to correct serial correlation and heteroskedasticity in the error terms by modifying DF test statistics without adding lags of first differences of regressand (Gujarati, 2003). This test uses the same critical values as those of DF and ADF since they have the same asymptotic distribution and test whether $\delta=0$. The equation for PP test is given below:

$$\Delta y_t = \beta + \delta y_{t-1} + \varepsilon_t \quad \text{.....(17)}$$

Empirical Results

Empirical results are reported sequentially and hierarchically.

Growth Curves without Policy Dummy

OLS estimates of growth curves are presented in Table 1. The growth curve fits the data of Gross Domestic Product (GDP), Gross Domestic Product per capita, Public Revenue, Public Expenditure, Population, Public Expenditure per capita, and Share of Public Expenditure in GDP. The proportion of the total variation explained by the function ranges from 44.49% for per capita GDP to 99.5% for population, while the coefficient of multiple correlation is also significant in all these cases. However, the proportion of total variation in public expenditure per unit of public revenue is only 2.36, and the coefficient is not statistically significant. This may indicate that the growth of public expenditure is not in tune with the growth of public revenue. The values of intercepts and slope coefficients in all functions, except for that of public expenditure per unit of public revenue, are significant. Thus, the growth curve does not properly fit the data of public expenditure per unit of public revenue. This implies that systematic factors embodied in time explain the growth of all the variables except public expenditure per unit of public revenue. Public expenditure per unit of public revenue seems to be governed more by random factors than by systematic factors, consistent budgetary decisions, or fiscal policy.

Table 1: OLS Estimates of Growth Curves without Dummy Variable

Variable	Intercept	Slope	R^2	F	P*	CAGR (%)
$lnGDP_t$	14.8134 (470.4984)	0.0363 (31.8099)	0.957	1011.871	1.73E-32	3.6997
ln(GDP/Po	12.3491 (374.7584)	0.008003 (6.6958)	0.499	44.833	2.88E-08	0.8036
$lnPR_t$	6.1237 (75.3474)	0.2081 (70.5735)	0.991	4980.618	9.89E-48	23.1281
$lnPE_t$	6.3831 (85.5407)	0.2104 (77.7441)	0.993	6044.147	1.32E-49	23.4215
$lnPOP_t$	0.0296 (291.765)	2.4219 (98.1756)	0.995	9638.444	3.85E-54	3.0002
ln(PE/PR)	0.2594 (4.1258)	0.0024 (1.0436)	0.0236	1.089	0.3022	0.2383
ln(PE/Pop)	3.9612 (49.7850)	0.1809 (62.6696)	0.989	3927.483	1.97E-45	19.8264
*Values of t are reported in parenthesis.						

Source: Author's Compilation

Growth Curves with Policy Dummy

This section examines OLS estimates of growth curves with a policy dummy as an additional determinant of economic growth. Results are shown in Table 2. In the set of growth curves with the dummy as an additional explanatory factor, the coefficient of the dummy may be interpreted as the parameter of shift in the location of the growth curve.

The results in Table 2 indicate that growth curves with the dummy as an additional determinant fit the data better than growth curves without the policy dummy, as the coefficient of determination has increased in all cases except one. All the slope coefficients are significant at the 5% significance level. Both GDP and per capita GDP have been growing positively and significantly throughout the period of observation despite the change in policy. Additionally, variables relating to public finances of Tanzania and population have also been growing positively and significantly with the growth of GDP.

However, the effect of the policy of globalization differs between economic and financial variables. The policy change has significantly affected four out of eight variables under study, as the coefficient of the dummy is significant only in these four cases. While the change in policy has significantly and positively affected the growth of public revenue, it has negatively impacted the growth of GDP, per capita GDP, and public expenditure per unit of public revenue. The policy reforms appear to have slowed down the growth of these variables. Conversely, the change in policy has not significantly affected the growth of population, public expenditure, public expenditure per capita, and public expenditure per unit of GDP. This implies that public expenditure has not been touched by the change in policy, highlighting the need for reforms.

The important aspects of the growth of the Tanzanian economy revealed by the growth curves include several key points. First, GDP has grown more rapidly than the population, resulting in positive growth of per capita income. Second, public revenue has increased at nearly five times the rate of GDP growth. This implies that the government has captured a significant proportion of the increased incomes of the people to meet the growth requirements of the economy and the welfare needs of the population. It suggests that the government of Tanzania remains committed to promoting growth and welfare through public policy interventions. Lastly, public expenditure has grown even more rapidly than public revenue. The growth of public expenditure justifies the rapid growth of public revenue. In fact, the growth of per capita public expenditure has almost matched the rate of growth of total public revenue. These inferences are also supported by the geometric means reported in the last column of the table, which contains year-on-year growth rates of these variables.

Table 2: Growth Curves with Dummy as an Additional Determinant of Growth

Variable	Intercept	Slope	Dummy	R^2	F	P*	CAGR (%)	Geometric mean
lnGDPt	14.7735 (530.790)	0.0435* (23.4389)	-0.228* (-4.486)	0.971	731.05	1.75E-34	4.4411	3.5110
lnGDP/POP	12.3105 (409.33)	0.0149* (7.4392)	-0.221* (-4.021)	0.634	38.05	2.54E-10	1.5014	1.4717
lnPR	6.2139 (82.2322)	0.1919* (38.1346)	0.5162* (3.7378)	0.993	3215.1	2.04E-48	21.1598	18.4182
lnPE	6.3762 (80.1318)	0.2117* (39.9369)	-0.0395 (-0.271)	0.9926	2959.9	1.24E-47	23.5736	24.1042
lnPOP	2.4225 (273.587)	0.0295* (49.9427)	0.0034 (0.2094)	0.995	4716.8	4.66E-52	2.9893	2.8122
lnPE/PR	0.1623 (3.3110)	0.0197* (6.0430)	-0.556* (-6.204)	0.479	20.24	5.85E-07	1.9923	6.6333
lnPE/POP	3.9537 (46.6006)	0.1822* (32.2435)	-0.0428 (-0.276)	0.989	1923.4	1.5E-43	19.9868	15.6211
lnPE/GDP	-3.7922 (-48.2281)	0.1682* (32.1183)	0.1887 (1.3135)	0.990	2075.8	2.85E-44	18.3190	15.1931
* means significant at 5% level (two tail) The Critical value for 88 degrees of freedom at 5% significance level is 1.960								

Source: Author's Compilation

Augmented Dickey-Fuller and Phillips-Perron Tests for Unit Root Results

Results of Augmented Dickey-Fuller and Phillips-Perron tests of unit root are reported in Table 3. All variables except population and investment are found to be non-stationary at level. This is through comparing the computed test statistics for both tests and critical values at 1% and 5% probability.

Table 3: Augmented Dickey-Fuller and Phillips-Perron Tests

	Augmented Dickey-Fuller				Phillips-Perron			
	Level		First Difference		Level		First Difference	
Variables	Intercept	Intercept and Trend	Intercept	Intercept and Trend	Intercept	Intercept and trend	Intercept	Intercept and trend
Ln(FSD/GDP)	-2.643	-2.632	-6.883*	-6.803*	-2.537	-2.525	-8.657*	-8.527*
lnGDP	2.120	0.371	-3.32**	-4.010**	2.376	0.561	-3.249*	-4.001*
Ln(GDP/Pop)	1.698	0.679	-3.44**	-4.075**	2.184	0.706	-3.43**	-4.12**
Ln(PE/GDP)	-1.2292	-1.5621	-7.621*	-7.532*	-2.336	-2.702	-9.112*	-9.003*
Ln(PE/POP)	-1.6243	-0.4607	-8.624*	-6.480*	-1.582	-1.508	-8.570*	-8.565*
LnPCE	1.0833	-0.6939	-5.215*	-5.491*	0.682	-0.956	-5.287*	-5.491*
LnPE	1.2504	0.1121	-6.699*	-7.170*	1.654	0.367	-6.747*	-7.172*
LNFSD	-1.0172	-1.8577	-5.728*	-5.680*	-1.035	-1.825	-5.723*	-5.672*
LNINF	-2.2930	-2.3369	-7.515*	-7.423*	-2.269	-2.314	-7.786*	-7.676*
LNPOP	-2.1438	-4.773*	-	-	-2.382	-4.712*	-	-
LNINV	-3.746*	-4.212*	-	-	-3.746*	-4.212*	-	-
The critical values are -3.58 and -2.93 at 1% and 5% respectively when the regression has a constant term and -4.15 and -3.50 at 1% and 5% when the regression has a constant and trend term; * and ** indicate significance level at 1% and 5% respectively.								

Source: Author's Compilation

Because of the existence of the unit root at levels, the variables are subjected to first difference except population and investment which are stationary at order 0 I(0). Both ADF and PP test statistics have been estimated with constant and constant and trend. Results indicate that all variables are stationary at the first differences or integrated at I(1).

Estimates of Distributed Lag Model of GDP as a Function of PE

The approach of step-wise regression approach is used to identify the contribution of lagged value of the dependent variable and its major determinant separately as well as jointly. First, the OLS estimate of GDP as a function of public expenditure is reported hereunder:

$$GDP_t = \underset{t=2.7181}{1414789} + \underset{t=13.6142}{3.7651} PE_{t-1}, R^2 = 0.8046, F = 185.346, F^* = 1.45E-17 \quad \text{.....(18)}$$

The equation shows that lagged public expenditure explains as much as 80.5% of the total change in GDP over the years. The coefficient of lagged expenditure is not only high but statistically significant. However, the significance of the intercept indicates that some excluded variables from the equation are exercising substantial influence on inter-temporal changes in real GDP of Tanzania. Therefore, lagged GDP in accordance with DLM is incorporated as an additional determinant in the above function. The OLS estimates of DLM equation 19 are reported below:

$$GDP_t = \underset{t=-6.324}{-246618} + \underset{t=0.1518}{0.0063} PE_{t-1} + \underset{t=101.107}{1.0822} GDP_{t-1}, R^2 = 0.992, F = 25612.98, F^* = 7.21E-67 \quad \text{.....(19)}$$

The above equation reveals that the proportion of the total variation of GDP explained by this function is 19.2% more than that of the earlier function, and the coefficient of multiple determination, like that of the previous function, is highly significant statistically. It indicates that the lagged GDP is not a superfluous determinant of its current value. It is as if the GDP of the preceding period sets the benchmark for the future growth of the economy, making the growth process cumulative in nature. However, the coefficient attached to the lagged public expenditure has turned from significant in the preceding function to not significant in this one. This change is attributable to the high degree of multicollinearity between lagged GDP and lagged public expenditure. If the public expenditure in the preceding period affects the current period GDP, λ is also likely to influence the preceding period GDP to a larger or smaller extent. The coefficient of adjustment of the current change to the desired change in GDP is negative and as small as -0.0822, appearing statistically 0. Since the coefficient of observed to desired change must satisfy the condition $0 \leq \lambda \leq 1$, that it cannot be negative, its non-significance suggests that multicollinearity has reduced its value to 0 statistically.

This section has evaluated the significance of the absolute difference between the estimated value of $\Pi_2 = 1.0822$ and the unity. The value of t indicates that

the difference is statistically insignificant. Therefore, it is inferred that $\lambda=0$ means that there occurs no adjustment of the observed to the desired change in the short run. However, the long run impact of the public expenditure is extremely large virtually verging towards infinity ($\Pi_1/\lambda=0.0063/0$). This is due to the composition and nature of public expenditure. The public administration component of public expenditure influences GDP growth indirectly and remotely, with its impact on GDP growth being imperceptible and invisible as the purchasing power transferred to public employees is spread thinly over an extremely large number of individuals, whose propensities to consume and save vary greatly. In contrast, public expenditure on welfare measures such as health and education takes a long time to become a base for income generation. Public expenditure on GDP growth, represented by investment in infrastructure and similar lines of production, may not yield high returns and involves long lead times in completion. Therefore, the growth effect of such expenditure, by its very nature, affects GDP growth slowly and only after a considerable period of time.

Distributed Lag Model of Public Expenditure

In this analysis, step-wise regression is also used to identify and exclude variables that are highly collinear, thereby improving the stability and interpretability of the model. Specifically, the Ordinary Least Squares (OLS) estimate of public expenditure, modeled as a function of GDP, has been calculated. The results of this estimation are reported below:

$$PE_t = \underset{t=0.0707}{9487.591} + \underset{t=13.6142}{0.2142GDP_t}, R^2=0.8046, F=185.346, F^*=1.45E\text{-}17 \quad \text{.....(20)}$$

The above equation shows that the current GDP explains 80.5% of the total inter-temporal change in the public expenditure. Both the coefficient of determination and the regression coefficients are significant. Besides, the intercept is not significant in this case, suggesting that there is little possibility of any excluded variable(s) becoming a significant determinant of public expenditure. Nevertheless, the OLS estimate for the distributed lag model is reported below.

$$PE_t = \underset{t=-0.9293}{-74427.708} + \underset{t=2.9551}{0.0560GDP_t} + \underset{t=9.5213}{0.8323PE_{t-1}}, R^2=0.936, F=312.25, F^*=2.48E\text{-}26 \quad \text{.....(21)}$$

The explanatory power of the distributed lag model is nearly 8% higher than that of the preceding function. Both the coefficient of multiple determination and the regression coefficients are statistically significant. The intercept continues to

be not significant. The coefficient of adjustment is, however, very low, having a value of γ=0.1677. The short run response of the public expenditure to a unit change in the current GDP is only 0.06. In contrast, the long run response is 0.056/0.1677=0.334. The low value of coefficient of adjustment of the actual to the desired change in the public expenditure implies that the adjustment process is slow and the magnitude is low with the result that the adjustment is spread over extremely long periods. Public investment appears to be allocated to projects with longer gestation periods, such as those in health, education, transport, and communication. This has already been explained earlier. The estimate of the structural equation of the public expenditure is reported below:

$$PE_t = -443814.61 + 0.1677PE_{t-1} + 0.3339GDP_t \quad (22)$$

Thus, a unit rise in the public expenditure of the preceding period leads to an increase of 0.17, while the unit increase in the current GDP makes the public expenditure rise by 0.334 units. Changes in both the determinants make public expenditure rise by approximately 0.50 units in the long run equilibrium/desired level of the public expenditure. Therefore, the changes in the twin determinants shift public the expenditure curve/plane upward to the right.

Amount of Adjustment Completed in Each Period

The period wise adjustment in the public expenditure in response to the change in GDP is shown in Table 4.

Table 4: Adjustment Completed Each Period

Period	Adjustment Completed	Cumulative Adjustment	Remaining Adjustment
Initial	0.0	0.0	1.0
I.	0.1677	0.1677	0.8323
II.	0.1396	0.3073	0.6927
III.	0.1162	0.4235	0.5765
IV.	0.0967	0.5202	0.4798
V.	0.0805	0.6007	0.3993
VI.	0.0321	0.6328	0.3672
XV.	0.0142	0.9296	0.0704

Source: Author's Compilation

In fact, the completion of 92.96% of the desired change in the public expenditure takes as long as 15 years; only 63.28% of the desired change in the public expenditure occurs in six years. Thus, the mutual adjustment between the public expenditure and the GDP is a long-drawn process. Empirical evidence,

taken as a whole, lends credence to the validity of the distributed lag model with a partial adjustment specification. Long lead times involved in the adjustment reflects the well-known inefficiency and lethargic responses of the bureaucracy to respond to the needs of change. This is an addition to spending on the projects involving long investment periods.

Conclusions

This paper examined the impact of public expenditure growth on GDP growth in Tanzania. The main findings of the study are as follows: Both GDP and public expenditure in Tanzania have been growing consistently over the years, with public expenditure growing ahead of the economy. There is conclusive evidence that the growth of public expenditure, both in absolute and relative terms, has exceeded that of GDP growth. The policy of liberalisation, privatisation and globalisation has significantly affected economic growth. In the short run, GDP growth is explained more significantly by lagged GDP than by lagged public expenditure. Public expenditure growth is explained more by current GDP than by lagged public expenditure. However, slightly more than 50% of the long-run inter-temporal changes in public expenditure are jointly explained by current GDP and lagged public expenditure. Nonetheless, the adjustment of actual to desired changes in public expenditure is low and slow, resulting in a lengthy adjustment process. These long lead times reflect the well-known inefficiency and lethargic responses of bureaucracy to the need for change. Additionally, public investment appears to be allocated to projects with longer gestation periods, such as those in health, education, transport, and communication.

The public administration component of public expenditure affects GDP growth in an indirect and remote way. Its impact on GDP growth is barely noticeable because the purchasing power distributed to public employees is spread across a large number of individuals. This means the overall effect is weakened, as these employees have very different spending and saving habits. Consequently, the economic stimulus provided by public administration spending does not translate into a significant or direct boost to GDP growth, making its influence more difficult to detect and measure.

The study was associated with some limitations, particularly the lack of data on disaggregated components of public expenditure, such as manufacturing,

economic and general public services, and other services in Tanzania. Although these variables are important for the study, they had to be excluded due to data unavailability. Future research could include these variables if the necessary data becomes available, thereby extending the study.

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