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Interactions of Gross Domestic Product, External Debt and Government Expenditure: Evidence From International Development Association Countries [A Panel-VAR Approach]

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Abstract

The study employed a Panel Vector Autoregressive (PVAR) model to examine the relationships among three macroeconomic variables- Gross Domestic Product, Total External Debt Stocks, and Gross National Expenditure - in International Development Association (IDA) member countries. Data from three different time frames - 1991-2019 (29 countries), 1994-2018 (35 countries), and 2008-2018 (39 countries) – was analyzed, and the lags of endogenous variables were used as instruments to address endogeneity issues in the dynamic model. The variables were transformed into growth rates to ensure stationarity and were estimated using the Generalized Method of Moments (GMM). The results were reported after removing both panel-specific and time-specific fixed effects. The study found a positive relationship between Total External Debt Stocks growth and Gross Domestic Product growth, which became more significant with the increase in the sample timeframe. The findings showed that a 100% increase in Total External Debt growth would lead to a 4-7% increase in Gross Domestic Product growth. The positive relationship was confirmed by the transmission of shocks from Total External Debt growth to Gross Domestic Product growth, but it lasted only for two periods and quickly returned to an equilibrium state. The relationship between Gross National Expenditure growth and the other variables was not conclusively established due to its lack of consistent and stable behavior with the other variables. The Stata package "pvar" was employed for data analysis and inferential conclusions.

Keywords: endogeneity, external debt, generalized method of moment, government expenditure, gross domestic product, impulse response function, instrumental variables, panel vector autoregression

1. Introduction

In finance, the use of debt capital by corporations is viewed as both a risk factor that increases financial vulnerability and a leverage tool for capitalizing on profitable opportunities. The optimal balance between these two outcomes is still a subject of discussion among academics, policy makers, practitioners, and researchers. In the similar vein, nations also use external debt for various purposes, such as mitigating the effects of trade deficits, reducing budget deficit pressures, addressing humanitarian or disaster needs, funding infrastructure investments, and financing development projects. However, the dynamics of external debt usage are more complex for nations and occur in a broader context.

According to World Bank's 2021 report, there has been a marked increase in the total external debt stock of countries across different regions and economic groups. In the decade 2009-2019, the total external debt stock reported for all low- and middle- income countries more than doubled, from $3.618 Trillion to $8.139 Trillion (with an annual growth rate of 8.45%). During the same period, the East Asia and Pacific region reported a 3.6-fold increase in its total external debt stock, rising from $0.829 Trillion to $2.995 Trillion (13.71% p.a.). The total external debt in Europe and Central Asia increased 1.36 times, going from $1.076 Trillion to $1.464 Trillion (3.13% p.a.). In Latin America and the Caribbean, the total external debt increased 2.14-fold, from $0.899 Trillion to $1.927 Trillion (7.92% p.a.). The total external debt in Middle East and North Africa increased 1.86-fold, from $0.183 Trillion to $0.340 Trillion (6.39% p.a.). In South Asia, the total external debt increased 2.16 times, from $0.366 Trillion to $0.789 Trillion (7.98% p.a.). Similarly, the total external debt in Sub-Saharan Africa increased 2.35 times, rising from $0.266 Trillion to $0.625 Trillion (8.92% p.a.). While the growth rate of

external debt varied across regions, with East Asia and the Pacific reporting the highest annual growth rate at 13.71 percent, and Europe and Central Asia reporting the lowest at 3.13 percent, these figures show that external debt is a widely used funding source for the countries around the world.

Despite its use by economies to achieve development goals, excessive or unconstrained use of external debt can result in adverse economic consequences. Theories such as the Debt Overhang Hypothesis, the Crowding-Out Effect, the Liquidity Constraint Hypothesis, and the Debt Laffer Curve Theory warn of these consequences (Senadza, Fiagbe, & Quartey, 2017). Both Neoclassical and Keynesian economics view external debt as a double-edge sword for economic growth, depending on its scale, appropriateness, and use (AL-Tamimi & Jaradat, 2019). Given the persistent use of external debt by economies, questions about its effectiveness and consequences arise, and it is important to provide valid answers to these questions. These questions include whether external debt promotes or hinders economic growth, the cost-benefit relationship, and whether the stagnation of an economy is an inherent cost of using external debt. Furthermore, these questions become even more pressing in the light of recent economic turmoil experienced by the countries such as Sri Lanka, Zambia, Ukraine, Pakistan, Ethiopia, Ghana, Argentina, Tunisia, El Salvador, Tajikistan, Suriname, Ecuador, Mozambique, Nigeria, Egypt, Kenya, Gabon, etc. (Jones, 2022).

Empirical research on the relationship between external debt and economic growth has yielded varying results. Some studies have found a negative relationship between external debt and economic growth (Ayadi & Ayadi, 2008; Azam, Emirullah, Prabhakar, & Khan, 2013; Babu, Kiprop, Kalio, & Gisore, 2014; Çifligu, 2018), while others have reported a positive relationship (Kasidi & Said, 2013; Uzun, Karakoy, Kabadayi, & Emsen, 2012; Mohamed, 2018).Additionally, some studies have identified a nonlinear relationship between external debt and economic growth (Shkolnyk & Koilo, 2018; Osinubi & Olaleru, 2006; Dauda, Ahmad, & Azman-Saini, 2013; Checherita & Rother, 2010), while others found no relationship (Oumarou, 2021).

The aim of this paper is to study the interaction between External Debt, Gross Domestic Product, and Government Expenditure in International Development Association (IDA) countries over three separate time frames: 1991-2019 (29 countries), 1994-2018 (35 countries), and 2008-2018 (39 countries). The main objective of the research is to determine the overall association between External debt and Gross Domestic Product.

2. Literature Review

The neoclassical theory asserts that external debt can have both positive and negative effects on economic growth. Debt can provide access to foreign capital and technology, but too much debt can lead to debt service payments and hinder growth. If a country's income grows faster than its debt, it is likely to repay it and avoid a crisis, but if income grows slower, the country may face difficulty and a debt crisis. The Keynesian theory concurs with the neoclassical theory, but it places greater emphasis on the role of the government in striking a balance between borrowing for investment and preserving its ability to repay debt. Governments can attain this balance though effective management of fiscal and monetary policies.

There are various other theories that attempt to explain the relationship between external debt and economic growth. The "Debt Overhang Hypothesis" claims that high levels of debt can act as a hindrance to the economy, causing individuals or firms to be reluctant to take on new debt or investments due to existing debt obligations. The "Crowding-Out Effect" refers to the situation where government borrowing for investment crowds out private sector investment, leading to a reduction in overall investment in the economy. The "Liquidity Constraint Hypothesis" suggests that high levels of external debt can constrain liquidity and hinder a country's ability to drive economic growth through increased investment and spending. The "Debt Laffer Curve Theory" suggests that there is an optimal level of debt beyond which further increase in debt may actually reduce economic growth, rather than increase it.

In this section, we will examine some empirical studies that explored the relationship between external debt and economic growth (Gross Domestic Product):

Iyoha (1999) examined the relationship between external debt and economic growth in Sub-Saharan African countries during the period 1970-1994. Simulations and simultaneous equation models found the "Debt Overhang" and "Crowding-Out" effect, where a large stock of external debt and heavy debt service payments depressed investment in Sub-Saharan Africa.

Were (2001) analyzed the relationship between external debt and economic growth in Kenya using 26 years of data ranging from 1970 to 1995. The study found that the accumulation of external debt had a negative impact on both economic growth and private investment.

Schclarek and Ramon-Ballester (2005) studied the relationship between external debt and economic growth in

20 Latin American countries from 1970-2002. They used a dynamic system Generalized Method of Moments (GMM) estimator and spline regression to analyze the data. The study found that lower external debt levels were associated with higher growth rates.

Osinubi and Olaleru (2006) studied the relationship between external debt and economic growth in Nigeria using spline regression and co-integration tests. The study analyzed data from 1970 to 2003 and confirmed the nonlinear (Debt Laffer Curve) effect of external debt on economic growth in Nigeria. Similarly, Checherita and Rother (2010) confirmed this non-linear relationship in their study of Euro Area.

Shah and Pervin (2012) analyzed data from Bangladesh from 1974 to 2010 to investigate the relationship between external debt and economic growth. The study used co-integration test and error correction mechanism (ECM) model to reach its conclusions. The study found that external debt had a positive effect on the growth of GDP, while debt servicing had a negative effect.

Shabbir (2013) studied the relationship between external debt and economic growth in 70 developing countries for the period of 1976-2011. A linear panel data model consisting of fixed effect and random effects were used for empirical investigations. The study found that an increase in external debt reduced the fiscal space available for servicing external debt liabilities, thus dampening economic growth.

Mahmoud (2015) analyzed 30 years of data, ranging from 1997 to 2005, to study the relationship between external debt and economic growth in the Mauritanian economy. The study used OLS regression and Johansen's co-integration analysis and found a negative relationship between the two variables.

Onakoya and Ogunade (2017) found a negative relationship between external debt and economic growth in Nigeria by analyzing data from 1981 to 2014. They used Autoregressive Regressive Distributed Lag (ARDL) model to infer the results.

Matuka and Asafo (2018) analyzed data from 1970 to 2017 to study the relationship between external debt and economic growth in Ghana. Their analysis, based on co-integration and Vector Error Correction Model (VECM), inferred the existence of "Crowding-Out", "Debt Overhang", and "Non-Linear" effects of external debt on the economic growth of Ghana.

Oumarou (2021) analyzed data from 1970 to 2019 in the context of Niger and used methods such as Vector Auto Regression (VAR) and Variance Decomposition Analysis to draw conclusions. The study found that external debt had no impact on economic growth.

3. Empirical Study Methodology

3.1 Empirical Model

Abrigoand Love (2016) developed a Stata package called "pvar" to handle homogeneous panel VAR models within a generalized method of moments (GMM) framework. We obtained the methodological procedures for model selection, estimation, and inference from this package. The general equation of a k-variate homogeneous panel VAR model of order p with panel specific fixed effects is given by:

$$Y_{it} = Y_{it-1} A_1 + Y_{it-2} A_2 + \cdots + Y_{it-p+1} A_{p-1} + Y_{it-p} A_p + X_{it} B + u_i + e_{it} \quad (1)$$

$$i \in \{1,2,3,\cdots,N\} \quad t \in \{1,2,3,\cdots,T_i\}$$

where Y_{it} is a *(1xk)* vector of dependent variables; X_{it} is a *(1xl)* vector of exogenous covariates; and u_i and e_{it} are *(1xK)* vectors of dependent variable-specific panel fixed-effects and idiosyncratic errors, respectively. The *(kxk)* matrices $A_1, A_2, \cdots, A_{p-1}, A_p$ and the *(lxk)* matrix B are parameters to be estimated. Innovations are assumed to have following characteristics: $E(e_{it}) = 0$, $E(e_{it}' e_{it}) = \Sigma$, and $E(e_{it}' e_{is}) = 0$ for all $t>s$.

The methodological workflow of the study follows the guidelines set by Abrigo and Love (2016). Before estimating equation (1), essential preliminary tests are performed on the variables, and any non-stationary variables are transformed into stationary variables. The panel VAR model in equation (1) is estimated using the generalized method of moments (GMM). When GMM estimation incorporates the lags of endogenous variable at levels as the instrumental variables of the differenced endogenous variables, the problem of endogenity inherent in a dynamic panel model like equation (1) is resolved, and the panel-specific fixed effects are removed. Similarly, the methods of lag selection, model stability, and inferential measures are appropriately reported. Different empirical studies that used panel VAR models were helpful in understanding concepts, drawing insights, and implementing the "pvar" package more efficiently (Canova & Ciccarelli, 2013; Lof & Malinen, 2014; Aziz & Dahalan, 2015; Cazacu, 2015; Bayraktar- Sa˘glam & Böke, 2017; Jacobs, Ogawa, Sterken, & Tokustu, 2020; Koengkan, 2019; Özsolak & Kum, 2021).

3.2 Data and Variables

The study examines three endogenous variables without any exogenous variables. Therefore, in equation (1), the exogenous variable "X_{it}" equals 0, and specifically, the term "X_{it} B" is zero. The three endogenous variables are *"Gross Domestic Product"*, *"External Debt Stocks"*, and *"Gross National Expenditure"* denoted by *"gdp"*, *"exdebt"*, and *"govexp"* respectively. The growth rates of these variables are denoted by *"ggdp"*, *"gexdebt"*, and *"ggovexp"* respectively. Secondary data on these indicators were downloaded from the "*World Development Indicator*" databank, which is maintained on the website of the World Bank. Table 1 provides the long definitions of these indicators. The descriptive statistics of the indicators across countries are provided in Appendix A and are reported in billions of US dollars.

Table 1. Definition of variables

Indicators	Long Definition
GDP (current US$)	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.
External Debt Stocks, Total (DOD, Current US$)	Total external debt is debt owed to nonresidents repayable in currency, goods, or services. Total external debt is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt. Short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt. Data are in current U.S. dollars.
Gross National Expenditure (Current US$)	Gross national expenditure (formerly domestic absorption) is the sum of household final consumption expenditure (formerly private consumption), general government final consumption expenditure (formerly general government consumption), and gross capital formation (formerly gross domestic investment). Data are in current U.S. dollars.

Source: World Development Indicator [databank.worldbank.org].

The sample frame included information on three variables for 59 IDA countries from the period 1960 to 2020. A sample selection process was used to ensure the inclusion of maximum number of panels (countries) while forming a balanced panel dataset. In this process, any irregular and missing observations were dropped.

The first balanced panel dataset consisted of 29 countries for 29 years from 1991 to 2019. Upon shortening the time frame to include more countries, a second and third balanced panel dataset were acquired. The second sample dataset consisted of 35 countries for 25 years from 1994 to 2018, and the third dataset consisted of 39 countries for 11 years from 2008 to 2018. The analysis of the study is based on these three different datasets or samples.

Among the countries in the sample frame, 20 countries did not fit the selection criteria for data and were therefore excluded. The information on the countries and timeframe for each of the three samples, as well as the excluded countries, is presented in Table 2.

Table 2. List of the IDA countries and samples

29 Countries: 1991-2019 [A]	35 Countries: 1994-2018 [B]	39 Countries: 2008-2018 [C]
Bangladesh; Benin; Bhutan; Burkina Faso;	[A] plus	[B] plus
Burundi; Central African Republic; Chad; Cote d'Ivoire;	Cambodia	Kosovo
Gambia, The; Ghana; Guinea; Guinea-Bissau;	Comoros	Lesotho
Haiti; Honduras; Madagascar; Mali;	Congo, Dem. Rep.	Liberia
Mauritania; Mozambique; Nepal; Niger;	Kyrgyz Republic	Myanmar
Rwanda; Senegal; Sierra Leone; Solomon Islands;	Nicaragua	
Sudan; Tanzania; Togo; Uganda; Vanuatu	Tajikistan	

Excluded Countries: *Afghanistan; Djibouti; Eritrea; Ethiopia; Guyana; Kiribati; Lao PDR; Malawi; Maldives; Marshall Islands; Micronesia, Fed. Sts.; Samoa; Sao Tome and Principe; Somalia; South Sudan; Syrian Arab Republic; Tonga; Tuvalu; Yemen, Rep.; Zambia*.

4. Results

4.1 Preliminary Tests

To prepare for the panel VAR model, we conducted some preliminary tests on each dataset with three different timeframes. These tests allowed us to address any potential issues with the variables, such as transforming them to their growth rates to satisfy the stationary data condition.

The following preliminary tests were conducted: (i) Variance Inflation Factor (VIF) to detect multicollinearity, (ii) Pesearan CD test to identify cross-section dependence, (iii) Second generation unit root test to detect unit roots in the presence of a cross-sectional dependence, and (iv) Lag-order selection statistics for panel VAR, which reports the overall coefficient of determination for the model. We then used the results of these tests to take any necessary measures, which are explained further below.

First, we conducted the Variance Inflation Factor (VIF) test to detect multicollinearity in the variables. The results of these tests can be found in Table 3.

Table 3. Multicollinearity test [VIF test]

	29 Countries: 1991-2019 [A]		35 Countries: 1994-2018 [B]		39 Countries:2008-2018 [C]	
Variable	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
gdp	n.a	n.a	n.a	n.a	n.a	n.a
exdebt	4.25	0.235517	3.93	0.254353	6.69	0.149505
govexp	4.25	0.235517	3.93	0.254353	6.69	0.149505
Mean VIF	*4.25*		*3.93*		*6.69*	
ggdp	n.a	n.a	n.a	n.a	n.a	n.a
gexdebt	1.04	0.963508	1.03	0.970990	1.06	0.943393
ggovexp	1.04	0.963508	1.03	0.970990	1.06	0.943393
Mean VIF	*1.04*		*1.03*		*1.06*	

The mean VIF score for the three datasets at the level ranged between 3.93 and 6.69, whereas the corresponding scores for the variables' growth rate ranged from 1.03 to 1.06. Based on the mean VIF score being close to 1 for the growth rate variables, we can safely conclude that multicollinearity is not a problem.

Secondly, to detect the presence of cross-sectional dependence, we conducted the Pesaran CD test. The results of this test are presented in Table 4. Both the variables at the level and the growth rates suggest cross sectional dependence. However, the correlation (absolute) at the growth rates is less than 25% (40%) compared to less than 95% (95%) at levels.

Table 4. Pesaran [2004] CD test

	29 Countries: 1991-2019 [A]				35 Countries: 1994-2018 [B]				39 Countries:2008-2018 [C]			
Variable	CD-test	p-value	Corr	abs(corr)	CD-test	p-value	corr	abs(corr)	CD-test	p-value	corr	Abs(corr)
gdp	100.86	0.00	0.93	0.93	113.8	0.00	0.93	0.93	58.27	0.00	0.65	0.71
exdebt	38.03	0.00	0.35	0.59	30.46	0.00	0.25	0.62	33.76	0.00	0.37	0.64
govexp	101.32	0.00	0.93	0.93	114.0	0.00	0.93	0.93	55.90	0.00	0.62	0.66
ggdp	24.62	0.00	0.23	0.26	27.16	0.00	0.23	0.28	19.85	0.00	0.23	0.38
gexdebt	18.83	0.00	0.18	0.25	15.92	0.00	0.13	0.23	4.16	0.00	0.05	0.30
ggovexp	*24.30*	*0.00*	*0.23*	*0.26*	*25.77*	*0.00*	*0.22*	*0.26*	*17.59*	*0.00*	*0.20*	*0.35*

Note. Under the null hypothesis of cross-section independence CD ~ N(0,1).

Thirdly, in the presence of cross-sectional dependence, we need to perform a second generation unit root test (CIPS test) to check if the variables have a unit root. The results of this test are presented in Table 5.

Across all three datasets, we fail to reject the null hypothesis that the series is I(1) for the levels of the variables, while for the growth rate variables, we reject the null hypothesis. The result is the same for both the with-trend and without-trend specifications of the test. This suggests that the variables have a unit root at the level, but the transformation to growth rates resulted in a stationary dataset.

Table 5. Second generation Unit root test – CIPS (Zt-bar) or Pesaran (2007) Panel Unit Root test (CIPS)

Variable	29 Countries: 1991-2019 [A]				35 Countries: 1994-2018 [B]				39 Countries:2008-2018 [C]			
	Without trend		With trend		Without trend		With trend		Without trend		With trend	
	Zt bar	Pval	Zt bar	pval	Zt bar	pval	Zt bar	pval	Zt bar	pval	Zt bar	Pval
gdp	-1.30	0.10	0.33	0.63	-0.80	0.21	0.84	0.80	0.33	0.63	2.67	1.00
exdebt	2.76	1.00	3.21	1.00	3.27	1.00	3.43	1.00	1.92	0.97	2.52	0.99
govexp	-1.46	0.07	0.81	0.79	-0.36	0.36	1.55	0.94	-1.10	0.14	2.00	0.98
ggdp	-16.81	0.00	-15.13	0.00	-17.25	0.00	-15.32	0.00	-5.38	0.00	-3.20	0.00
gexdebt	-16.86	0.00	-14.55	0.00	-16.23	0.00	-13.41	0.00	-3.90	0.00	-3.17	0.00
ggovexp	-16.79	0.00	-14.78	0.00	-16.80	0.00	-14.58	0.00	-5.97	0.00	-3.94	0.00

Note. Null for MW and CIPS tests: series is I(1). CIPS test assumes cross-section dependence is in form of a single unobserved common factor.

Finally, we used PVAR lag order selection criteria to report the overall coefficient of determination (CD) of the model. Others statistics, such as Hansen's J statistic (J), p-value (Jp-value), moment model selection criteria (MMSC), Bayesian Information criterion (MBIC), MMSC – Akaike information criterion (MAIC), and MMSC – Hannan and Quinn information criterion (MQIC) are also reported. The details are presented in table 6 below.

Table 6. Lag Order Selection

	29 Countries: 1991-2019						35 Countries: 1994-2018						39 Countries:2008-2018					
Lags	CD	J	J pval	MBIC	MAIC	MQIC	CD	J	J pval	MBIC	MAIC	MQIC	CD	J	J pval	MBIC	MAIC	MQIC
1	0.40	238.32	0.26	-1225	-212	-604	0.20	211.09	0.13	-1017	-167	-496.44	0.81	60.14	0.58	-272.06	-65.86	-149.35
2	0.40	230.28	0.24	-1174	-202	-579	0.14	202.60	0.12	-967	-157	-471.24	0.80	50.26	0.62	-234.48	-57.74	-129.30
3	0.42	222.40	0.22	-1124	-192	-553	0.21	191.35	0.14	-920	-151	-448.80	0.79	48.73	0.33	-188.55	-41.27	-100.90
4	0.43	205.07	0.35	-1083	-191	-536	0.38	182.81	0.13	-870	-141	-423.65	0.71	40.92	0.26	-148.90	-31.08	-78.78

Based on the lag order selection criteria, the optimal number of lags for estimating the panel VAR model is one. This is because Hansen's J statistic (J) is higher, and other statistics such as MBIC, MAIC, and MQIC values are lower, with one lag of the variables for each of the three datasets. Therefore, we estimated the panel VAR model using one lag, which is reported in Table 7.

4.2 Empirical Results

This section analyzes the results of the panel VAR estimates, Eigen Value Stability Condition, Granger Causality Wald Test, Forecast-Error Variance Decomposition (FEVD), and Impulse-Response function.

The Panel VAR estimates for all three datasets were computed after removing the common time fixed effects, and panel-specific fixed effects. Table 7 shows that the growth rate of GDP (ggdp) has a negative association with its past realization (ggdp.L1) in all three datasets. However, the estimates are only significant for dataset A (29 countries; 1991-2019) at a 10% significance level and dataset C (39 countries; 2008-2018) at a 1% significance level. On average, ceteris paribus, the past realization of the growth rate of GDP (ggdp.L1) accounts for a 10% to 34% decline in the growth rate of GDP (ggdp).

Similarly, the past realization of growth rate of external debt (gexdebt.L1) is positively associated with the growth rate of GDP (ggdp) in all three datasets. The significant estimates indicate that, on average, ceteris paribus, the past realization of the growth rate of external debt (gexdebt.L1) accounts for a 4% to 7% increase in the growth rate of GDP (ggdp).

Moreover, the relationship between the past realization of the growth rate of government expenditure (ggovexp.L1) and the growth rate of GDP (ggdp) shows an inconsistent relationship. It exhibits a positive association in dataset A and C and a negative relationship in dataset B. The only significant relationship in dataset C (39 countries; 2008-2018) infers a 36% increase in the growth rate of GDP (ggdp) resulting from the past realization of growth rate of government expenditure (ggovexp.L1) ceteris paribus.

When comparing the growth rates of external debt (gexdebt) as the dependent variable with the past realization of the growth rate of external debt (gexdebt.L1) itself and the past realization of the growth rates of other two variables, we find that only the past realization of the growth rate of external debt (gexdebt.L1) exhibits a consistent positive relationship across all three datasets. The significant estimates indicate, on average, ceteris

paribus, that the past realization of the growth rate of GDP (ggdp.L1) accounts for a 13% to 15% increase, the past realization of the growth rate of external debt (gexdebt.L1) accounts for an 18% increase, and the past realization of the growth rate of government expenditure (ggovexp.L1) accounts for a 13% decline in the growth rate of external debt (gexdebt).

Table 7. PVAR model results

Variable	29 Countries: 1991-2019 [A]	35 Countries: 1994-2018 [B]	39 Countries:2008-2018 [C]
ggdp			
ggdp	-0.10*	-0.05	-0.34***
L1.	(0.05)	(0.37)	(0.00)
gexdebt	0.07***	0.04**	0.01
L1.	(0.00)	(0.02)	(0.49)
ggovexp	0.08	-0.06	0.36***
L1.	(0.10)	(0.33)	(0.00)
gexdebt			
ggdp	0.13**	0.15**	-0.05
L1.	(0.04)	(0.03)	(0.70)
gexdebt	0.04	0.05	0.18**
L1.	(0.12)	(0.10)	(0.01)
ggovexp	-0.13**	-0.13**	0.20
L1.	(0.04)	(0.04)	(0.16)
ggovexp			
ggdp	0.02	0.00	-0.11
L1.	(0.69)	(0.99)	(0.22)
gexdebt	0.04***	0.01	0.02
L1.	(0.00)	(0.74)	(0.37)
ggovexp	-0.03	-0.11*	0.12
L1.	(0.52)	(0.07)	(0.12)
N	754	770	312
J	243.06	216.03	65.04
J pval	0.19	0.09	0.41

Note. * p<0.1;** p<0.05;*** p<0.01.

Lastly, when the growth rate of government expenditure (ggovexp) acts as the dependent variable, it is again the growth rate of external debt (gexdebt) exhibiting consistent and positive relationship, while the growth rate of the other two variables exhibited an inconsistent relationship across all three datasets. The significant estimates indicate, on average, ceteris paribus, that the past realization of the growth rate of external debt (gexdebt.L1) accounts for a 4% increase, and the past realization of the growth rate of government expenditure (ggovexp.L1) accounts for an 11% decline in the growth rate of government expenditure (ggovexp).

To summarize, the past realization of the growth rate of external debt (gexdebt.L1) showed a positive relationship with the growth rate of GDP (ggdp). In turn, the past realization of the growth rate of GDP (ggdp.L1) showed a positive relationship with growth rate of external debt (gexdebt). On the other hand, the past realization of the growth rate of government expenditure (ggovexp.L1) showed an inconsistent association with the growth rate of GDP (ggdp), and the past realization of the growth rate of GDP (ggdp.L1) showed an inconsistent and insignificant relation with the growth rate of government expenditure (ggovexp). Finally, the past realization of the growth rate of government expenditure (ggovexp.L1) showed a negative relationship with the growth rate of external debt (gexdebt), while the past realization of the growth rate of external debt (gexdebt.L1) showed a positive relationship with the growth rate of government expenditure (ggovexp).

We computed the Eigen ValueStability testto check the stability condition of the estimates of the panel VAR model, as graphically depicted in Figure 1. As the roots of the companion matrix across the three datasets lie inside the unit circle, we conclude that the estimates are stable.

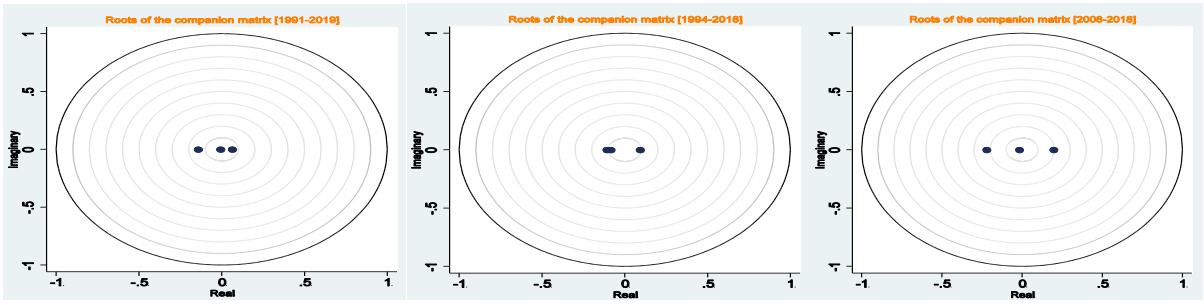


Figure 1. Eigen Value Stability Condition (Graph)

Since the Panel VAR is stable, we can proceed to estimate the Forecast-error Variance Decomposition (FEVD) and Impulse-Response function. Nonetheless, before doing so, we need to conduct a Granger Causality Walt test to determine the causal relationship and direction of the endogenous variables. The results of the Granger Causality Walt test are presented in Table 8.

Table 8. Panel VAR-Granger Causality Wald Test

	29 Countries: 1991-2019 [A]			35 Countries: 1994-2018 [B]			39 Countries:2008-2018 [C]		
Equation\Excluded	chi2	Df	p>chi2	chi2	df	p>chi2	chi2	df	p>chi2
ggdp									
ggdp	24.405	1	0.000	5.854	1	0.016	0.486	1	0.486
gexdebt	2.725	1	0.099	0.935	1	0.333	18.70	1	0.000
ggovexp	31.006	2	0.000	6.460	2	0.040	20.77	2	0.000
gexdebt									
ggdp	4.260	1	0.039	4.655	1	0.031	0.151	1	0.698
gexdebt	4.215	1	0.040	4.121	1	0.042	1.948	1	0.163
ggovexp	4.349	2	0.114	4.705	2	0.095	4.241	2	0.120
ggovexp									
ggdp	0.162	1	0.687	0.000	1	0.989	1.524	1	0.217
gexdebt	8.352	1	0.004	0.109	1	0.741	0.807	1	0.369
ggovexp	8.752	2	0.013	0.111	2	0.946	3.047	2	0.218

*Note.*Ho: Excluded variable does not Granger-cause Equation variable.

In the equation using the growth rate of GDP (ggdp) as the dependent variable, we observe that it granger-causes itself in datasets A and B. Additionally, the growth of external debt (gexdebt) granger-causes the growth rate of GDP (ggdp) in datasets A and C. Furthermore, the growth rate of government expenditure granger-causes the growth rate of GDP (ggdp) in all three datasets.

Similarly, in the equation using the growth rate of external debt (gexdebt) as the dependent variable, we find that the growth rate of GDP (ggdp) ganger-causes the dependent variables in datasets A and B, the growth rate of external debt (gexdebt) granger-causes itself in datasets A and B, and the growth rate of government expenditure (ggovexp) granger-causes the dependent variable in dataset B.

Finally, when the dependent variable is the growth rate of government expenditure, we find it granger-causes itself in dataset A, the growth rate of GDP (ggdp) did not granger-cause the dependent variable in any of the three datasets, and the growth rate of external debt (gexdebt) granger-causes the dependent variable in dataset A.

In summary, there is a two-way granger causality between growth rate of GDP (ggdp) and the growth rate of external debt (gexdebt), supported by two datasets. There is a unidirectional causality where the growth rate of government expenditure (ggovexp) granger-causes the growth rate of GDP (ggdp), supported by all three datasets. Finally, there is weak two-directional granger causality between growth rate of external debt (gexdebt) and the growth rate of government expenditure (ggovexp), supported by one dataset.

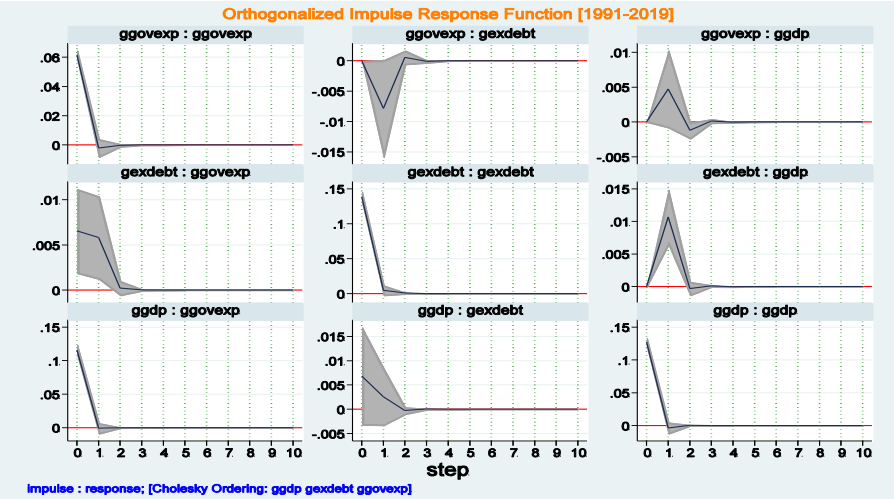
We present the estimates of Forecast-Error Variance Decomposition in Table 9 and analyze the results.

Table 9. Forecast-Error Variance Decomposition

		29 Countries: 1991-2019 [A]			35 Countries: 1994-2018 [B]			39 Countries:2008-2018 [C]		
Response Variable		Impulse Variable			Impulse Variable			Impulse Variable		
Forecast Horizon		ggdp	gexdebt	ggovexp	ggdp	gexdebt	ggovexp	ggdp	gexdebt	ggovexp
ggdp										
	1	1	0	0	1	0	0	1	0	0
	3	.992	.007	.001	.998	.001	.001	.946	.002	.051
	5	.992	.007	.001	.998	.001	.001	.944	.002	.054
	8	.992	.007	.001	.998	.001	.001	.944	.002	.054
	10	.992	.007	.001	.998	.001	.001	.944	.002	.054
gexdebt										
	1	.002	.998	0	.002	.998	0	.007	.993	0
	3	.003	.994	.003	.002	.995	.003	.013	.982	.005
	5	.003	.994	.003	.002	.995	.003	.013	.982	.005
	8	.003	.994	.003	.002	.995	.003	.013	.982	.005
	10	.003	.994	.003	.002	.995	.003	.013	.982	.005
ggovexp										
	1	.778	.002	.219	.865	.001	.134	.632	.005	.363
	3	.777	.004	.219	.865	.001	.134	.628	.006	.366
	5	.777	.004	.219	.865	.001	.134	.628	.006	.366
	8	.777	.004	.219	.865	.001	.134	.628	.006	.366
	10	.777	.004	.219	.865	.001	.134	.628	.006	.366

The results from the Forecast-Error Variance Decomposition (FEVD) indicate that the growth rate of GDP (ggdp) and the growth rate of external debt (gexdebt) explain more than 95 % to 100% of their forecast-error variance. Meanwhile, 63% to 78% of the forecast-error variance in the growth rate of government expenditure (ggovexp) is explained by the growth rate of GDP (ggdp), and the remaining variance is explained by the variable itself. The findings suggest that the growth rate of GDP (ggdp) and the growth rate of external debt (gexdebt) have a strong endogenous impact, while the growth rate of government expenditure (ggovexp) has a strong exogenous impact.

In the following analysis, we will examine how a shock to one endogenous variable in a panel VAR system affects other endogenous variables, by utilizing the impulse response function illustrated in Figure 2.



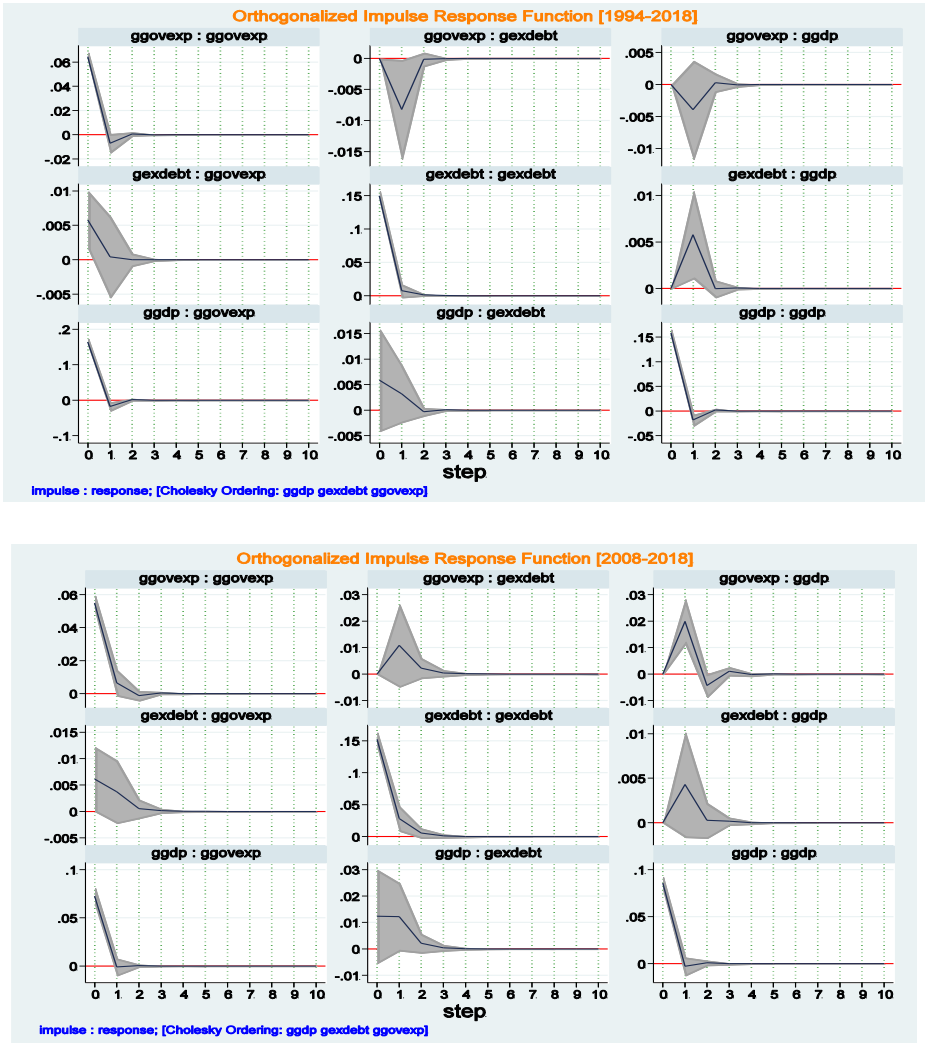


Figure 2.Orthogonalized Impulse response function (Graph) - [1991-2019] [1994-2018] [2008-2018]

To establish the Cholesky ordering of endogenous variables, we assumed that shocks to the growth rate of GDP (ggdp) have a contemporaneous effect on both the growth rate of external debt (gexdebt) and the growth rate of government expenditure (ggovexp). Similarly, shocks to the growth rate of external debt (gexdebt) have a contemporaneous effect on the growth rate of government expenditure (ggovexp). Therefore, the Cholesky ordering or the channel of influence is represented as ggdp → gexdebt → ggovexp; and the orthogonalized impulse-response results are reported following this order. The choice of Cholesky ordering is a crucial factor in VAR models (Gillanders, 2016).

Our findings indicate that a one standard deviation shock to the variables typically has a shot-term increasing effect on themselves, settling to an equilibrium state after a year. Additionally, all these datasets confirm a one-year positive effect from the shock to the growth rate of GDP (ggdp) on the growth rate of government expenditure (ggovexp). Furthermore, a one standard deviation shock to the growth rate of external debt (gexdebt) has a positive effect on the growth rate of GDP (ggdp) in datasets A and B, and a positive effect on the growth rate of government expenditure (ggovexp) in dataset A, reaching equilibrium after two years. Finally, a one standard deviation shock to the growth rate of government expenditure (ggovexp) exhibits a two-year positive effect on the growth rate of GDP (ggdp) in dataset A. We excluded results in which the equilibrium level fell within the confidence interval of the impulse-response function.

5. Discussion

The study employed a panel VAR model to investigate the dynamics among three macroeconomic variables, namely GDP, External Debt Stocks, and Government expenditure, in selected underprivileged economies in

International Development Association (IDA) countries. Our findings revealed that external debt had a favorable impact on economic growth and government expenditure. While the variables under study did have an impact on each other, the results were not as consistent and conclusive as those observed for the external debt variable. Our analysis indicated that a 100% increase in Total External Debt growth would lead to a 4-7% increase in Gross Domestic Product growth. The positive association was confirmed by the transmission of shocks from Total External Debt growth to Gross Domestic Product growth, but this lasted for only two periods and rapidly returned to an equilibrium state.

The findings of Kasidi and Said (2013); Uzun, Karakoy, Kabadayi, and Emsen (2012); and Mohamed (2018) also indicated a positive association between the external debt and economic growth. However, governments should consider various economic, political, and sustainability aspects, including their debt servicing capability, before pursuing external debt financing. The provision of external debt financing in the midst of rampant corruption and inefficient management could have detrimental effects on the economy.

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Appendix A

Table A1. Descriptive Statistics of gdp, exdebt, and govexp across countries

Country	*29 Countries: 1991-2019 [A]*				*Billion($)*		*35 Countries: 1994-2018 [B]*				*Billion($)*	
	N	mean	max	min	sd	P50	N	mean	max	min	sd	P50
Bangladesh												
gdp	29.0	103.8	302.6	30.96	78.15	69.44	25.0	104.4	274.0	33.77	69.52	71.82
exdebt	29.0	24.28	57.09	13.00	11.96	19.71	25.0	24.26	52.14	14.26	10.37	20.16
govexp	29.0	109.8	323.2	31.68	83.75	72.76	25.0	110.5	297.1	35.56	74.50	75.20
Benin												
gdp	29.0	7.12	14.39	1.60	4.41	6.57	25.0	7.44	14.25	1.60	4.13	7.03
exdebt	29.0	1.69	3.88	0.66	0.71	1.48	25.0	1.66	3.59	0.66	0.60	1.50
govexp	29.0	7.48	15.28	1.72	4.61	6.71	25.0	7.81	15.28	1.72	4.33	7.29
Bhutan												
gdp	29.0	1.07	2.53	0.23	0.79	0.80	25.0	1.11	2.45	0.26	0.74	0.87
exdebt	29.0	0.89	2.70	0.09	0.86	0.66	25.0	0.91	2.61	0.10	0.80	0.69
govexp	29.0	1.31	3.06	0.26	0.98	0.94	25.0	1.37	3.06	0.30	0.94	1.04
Burkina Faso												
gdp	29.0	7.49	16.06	1.90	4.79	6.15	25.0	7.67	16.06	1.90	4.64	6.55
exdebt	29.0	1.92	3.69	0.97	0.75	1.61	25.0	1.95	3.32	1.14	0.65	1.76
govexp	29.0	8.19	16.95	2.10	5.01	7.04	25.0	8.39	16.71	2.10	4.83	7.41
Burundi												
gdp	29.0	1.62	3.17	0.78	0.86	1.17	25.0	1.64	3.17	0.78	0.86	1.27
exdebt	29.0	0.98	1.41	0.58	0.30	1.07	25.0	0.99	1.41	0.58	0.31	1.12
govexp	29.0	1.91	3.54	0.88	1.01	1.38	25.0	1.93	3.50	0.88	1.02	1.63
Cambodia												
gdp							25.0	9.58	24.57	2.79	6.68	7.27
exdebt							25.0	4.55	13.53	1.74	3.48	2.89
govexp							25.0	10.07	24.34	3.18	6.69	7.78
Central African Republic												
gdp	29.0	1.53	2.51	0.85	0.52	1.41	25.0	1.53	2.51	0.85	0.53	1.46
exdebt	29.0	0.85	1.12	0.55	0.17	0.88	25.0	0.85	1.12	0.55	0.18	0.88
govexp	29.0	1.70	2.84	0.86	0.65	1.55	25.0	1.69	2.84	0.86	0.66	1.57
Chad												
gdp	29.0	6.37	13.94	1.18	4.65	6.65	25.0	6.72	13.94	1.18	4.62	7.43
exdebt	29.0	1.79	3.72	0.62	0.92	1.65	25.0	1.87	3.72	0.78	0.85	1.76
govexp	29.0	6.71	15.10	1.40	4.71	5.98	25.0	7.10	15.10	1.40	4.68	7.48
Comoros												
gdp							25.0	0.72	1.18	0.32	0.30	0.70
exdebt							25.0	0.24	0.30	0.13	0.05	0.24
govexp							25.0	0.85	1.38	0.38	0.36	0.82
Congo, Dem. Rep												
gdp							25.0	19.02	46.83	4.71	12.92	16.74
exdebt							25.0	9.66	13.23	4.96	3.30	11.43
govexp							25.0	19.88	48.52	4.42	13.67	17.07
Cote d'Ivoire												
gdp	29.0	23.34	58.54	8.31	15.27	17.09	25.0	23.42	58.01	8.31	14.18	17.82
exdebt	29.0	14.12	19.82	9.54	3.13	13.22	25.0	13.35	19.52	9.54	2.63	12.97
govexp	29.0	22.28	58.47	7.38	15.36	16.48	25.0	22.26	58.47	7.38	14.33	16.57

continued…

Country	*29 Countries: 1991-2019 [A]*				*Billion($)*		*35 Countries: 1994-2018 [B]*				*Billion($)*	
	N	mean	max	min	sd	P50	N	mean	max	min	sd	P50
Gambia, The												
gdp	29.0	1.09	1.83	0.49	0.38	1.03	25.0	1.11	1.67	0.49	0.36	1.05
exdebt	29.0	0.54	0.72	0.38	0.11	0.53	25.0	0.55	0.72	0.40	0.10	0.53
govexp	29.0	1.21	2.13	0.52	0.45	1.16	25.0	1.22	1.94	0.52	0.43	1.18
Ghana												
gdp	29.0	24.98	67.23	4.98	22.02	10.74	25.0	25.53	65.32	4.98	21.15	20.44
exdebt	29.0	10.13	26.61	3.70	6.71	7.10	25.0	10.13	23.26	3.70	6.11	7.24
govexp	29.0	27.86	69.90	5.90	23.76	13.46	25.0	28.67	69.21	5.90	23.03	23.62
Guinea												
gdp	29.0	5.72	13.51	2.83	3.00	3.87	25.0	5.71	11.86	2.83	2.67	4.22
exdebt	29.0	2.85	3.54	1.34	0.56	3.08	25.0	2.87	3.54	1.34	0.60	3.16
govexp	29.0	6.60	15.18	2.87	3.85	4.07	25.0	6.68	13.16	2.87	3.56	5.14
Guinea-Bissau												
gdp	29.0	0.67	1.50	0.21	0.41	0.59	25.0	0.69	1.50	0.21	0.39	0.59
exdebt	29.0	0.78	1.13	0.28	0.30	0.91	25.0	0.79	1.13	0.28	0.33	0.94
govexp	29.0	0.75	1.65	0.25	0.44	0.68	25.0	0.77	1.59	0.25	0.40	0.68
Haiti												
gdp	29.0	8.39	15.97	1.88	4.82	7.05	25.0	8.85	15.97	2.17	4.59	7.41
exdebt	29.0	1.37	2.22	0.76	0.49	1.28	25.0	1.41	2.22	0.76	0.45	1.29
govexp	29.0	10.09	19.83	2.39	5.94	8.28	25.0	10.62	19.83	2.56	5.66	9.09
Honduras												
gdp	29.0	12.24	25.09	4.64	6.83	9.76	25.0	12.61	24.07	4.64	6.37	10.92
exdebt	29.0	5.53	9.74	3.01	1.74	5.10	25.0	5.55	9.17	3.01	1.58	5.16
govexp	29.0	14.36	29.65	4.97	8.29	11.56	25.0	14.85	29.04	5.11	7.73	13.21
Kyrgyz Republic												
gdp							25.0	3.97	8.27	1.25	2.48	2.83
exdebt							25.0	3.78	8.16	0.45	2.61	2.60
govexp							25.0	5.26	11.22	1.43	3.71	3.89
Madagascar												
gdp	29.0	7.81	14.19	3.25	3.72	6.37	25.0	8.05	13.61	3.52	3.50	6.40
exdebt	29.0	3.59	4.98	1.53	0.83	3.80	25.0	3.54	4.98	1.53	0.88	3.53
govexp	29.0	8.42	15.05	3.38	4.10	6.80	25.0	8.71	14.56	3.65	3.88	6.85
Mali												
gdp	29.0	7.84	17.28	2.08	5.15	6.25	25.0	8.07	17.07	2.08	4.90	6.91
exdebt	29.0	3.08	5.10	1.59	0.75	3.01	25.0	3.03	4.63	1.59	0.69	3.05
govexp	29.0	8.73	19.20	2.44	5.81	6.76	25.0	8.97	18.97	2.44	5.58	7.19
Mauritania												
gdp	29.0	4.01	7.60	1.75	2.19	2.94	25.0	4.10	7.22	1.75	2.14	3.92
exdebt	29.0	3.15	5.37	1.56	1.20	2.49	25.0	3.18	5.24	1.56	1.16	2.50
govexp	29.0	4.43	8.59	1.78	2.54	3.84	25.0	4.55	8.32	1.78	2.47	3.96
Mzambique												
gdp	29.0	9.16	17.72	2.64	4.98	8.54	25.0	9.65	17.72	2.80	4.73	9.18
exdebt	29.0	8.45	20.11	4.53	4.40	6.68	25.0	8.39	18.68	4.53	3.93	7.14
govexp	29.0	11.69	26.38	3.65	7.07	9.77	25.0	12.25	26.38	3.79	6.89	10.07
Nepal												
gdp	29.0	12.83	34.19	3.40	9.76	8.13	25.0	13.08	33.11	4.07	9.03	9.04
exdebt	29.0	3.40	6.51	1.77	1.08	3.37	25.0	3.46	5.51	2.32	0.80	3.40
govexp	29.0	15.47	43.10	3.73	12.38	9.34	25.0	15.74	41.31	4.57	11.43	10.66
Nicaragua												
gdp							25.0	7.80	13.79	3.86	3.31	6.76
exdebt							25.0	7.69	12.41	4.11	2.55	6.82
govexp							25.0	9.26	15.67	4.30	3.81	8.44
Niger												
gdp	29.0	5.94	12.91	1.94	3.67	4.38	25.0	5.98	12.85	1.94	3.58	4.76
exdebt	29.0	1.86	3.61	0.76	0.63	1.72	25.0	1.82	3.20	0.76	0.56	1.72
govexp	29.0	6.69	14.95	2.08	4.33	4.80	25.0	6.75	14.77	2.08	4.20	5.17

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Country	*29 Countries: 1991-2019 [A]*				*Billion($)*		*35 Countries: 1994-2018 [B]*				*Billion($)*	
	N	mean	max	min	sd	P50	N	mean	max	min	sd	P50
Rwanda												
gdp	29.0	4.49	10.36	0.75	3.09	2.93	25.0	4.56	9.64	0.75	2.98	3.32
exdebt	29.0	1.93	6.51	0.43	1.57	1.30	25.0	1.87	5.68	0.43	1.37	1.31
govexp	29.0	5.18	11.84	1.19	3.56	3.31	25.0	5.27	10.95	1.19	3.44	3.70
Senegal												
gdp	29.0	12.50	23.31	5.03	6.02	11.07	25.0	12.67	23.12	5.03	5.85	11.74
exdebt	29.0	5.28	15.14	2.15	2.87	4.00	25.0	5.07	12.68	2.15	2.28	4.10
govexp	29.0	14.27	26.79	5.66	7.02	12.75	25.0	14.49	26.79	5.66	6.83	13.57
Sierra Leone												
gdp	29.0	2.16	5.02	0.64	1.45	1.65	25.0	2.25	5.02	0.64	1.42	1.89
exdebt	29.0	1.36	1.85	0.55	0.32	1.39	25.0	1.33	1.80	0.55	0.33	1.34
govexp	29.0	2.61	6.41	0.69	1.90	1.82	25.0	2.74	6.41	0.71	1.88	2.02
Solomon Islands												
gdp	29.0	0.75	1.57	0.23	0.44	0.53	25.0	0.77	1.57	0.35	0.41	0.54
exdebt	29.0	0.19	0.38	0.09	0.06	0.17	25.0	0.20	0.38	0.14	0.06	0.18
govexp	29.0	0.84	1.73	0.34	0.45	0.63	25.0	0.85	1.64	0.34	0.43	0.64
Sudan												
gdp	29.0	31.12	65.63	7.03	20.26	26.52	25.0	33.71	65.63	9.02	20.27	34.52
exdebt	29.0	18.82	22.50	15.01	2.58	18.38	25.0	19.07	22.50	15.01	2.43	18.49
govexp	29.0	32.78	68.07	7.50	20.72	30.30	25.0	35.46	68.07	9.76	20.64	36.79
Tajikistan												
gdp							25.0	4.03	9.11	0.86	2.97	2.83
exdebt							25.0	2.57	6.09	0.58	1.89	1.35
govexp							25.0	5.37	13.10	0.80	4.43	3.20
Tanzania												
gdp	29.0	24.90	61.14	4.26	18.26	18.40	25.0	25.89	57.00	4.51	16.78	18.65
exdebt	29.0	10.33	24.16	4.12	5.63	7.51	25.0	10.22	22.35	4.12	5.23	7.77
govexp	29.0	26.65	64.79	5.46	19.37	18.95	25.0	27.61	60.63	5.67	17.96	19.76
Togo												
gdp	29.0	3.00	7.22	0.98	1.83	2.28	25.0	3.01	7.11	0.98	1.70	2.35
exdebt	29.0	1.45	2.01	0.62	0.33	1.47	25.0	1.44	1.97	0.62	0.34	1.47
govexp	29.0	3.38	7.82	1.02	2.07	2.52	25.0	3.41	7.74	1.02	1.94	2.71
Uganda												
gdp	29.0	15.53	35.17	2.86	11.76	9.24	25.0	16.23	32.91	3.99	11.20	9.98
exdebt	29.0	5.13	13.97	1.30	3.41	3.77	25.0	5.05	12.32	1.30	3.11	3.78
govexp	29.0	16.89	37.38	3.32	12.57	10.21	25.0	17.67	35.22	4.27	12.00	11.26
Vanuatu												
gdp	29.0	0.49	0.93	0.20	0.25	0.39	25.0	0.50	0.91	0.23	0.24	0.44
exdebt	29.0	0.15	0.42	0.03	0.11	0.15	25.0	0.16	0.40	0.05	0.10	0.15
govexp	29.0	0.53	1.01	0.21	0.28	0.41	25.0	0.55	0.94	0.24	0.26	0.46
Total												
gdp	841.0	11.99	302.6	0.20	25.21	4.96	875.0	11.49	274.0	0.21	22.55	5.44
exdebt	841.0	4.69	57.09	0.03	6.51	2.26	875.0	4.67	52.14	0.05	5.99	2.40
govexp	841.0	13.06	323.2	0.21	26.81	5.58	875.0	12.56	297.1	0.24	23.95	6.15