The Long-run Relationship between Government Consumption and Output in Developing Countries: Evidence from Panel Data*

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Abstract

We employ heterogeneous panel cointegration techniques to examine the long-run effect of government consumption on output for 33 developing countries from 1972 to 2014. After controlling for total investment, we find that the government consumption-output coefficient is positive, but not statistically significant, on average. However, once we account for cross-country dependence due to common shocks and spillovers, this coefficient is negative and significant. This negative relationship is driven by non-sub-Saharan African countries in our sample. In contrast, the investment-output coefficient is consistently positive and significant. Policywise, the results suggest that fiscal adjustments that cut government consumption while maintaining investment spending will have smaller negative, or even a potential expansionary effect on long-run output.

JEL Classification: E62, F35, H5

Keywords: Heterogeneous panel cointegration; Fiscal consolidation; Government consumption; Output; Developing economies

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1 Introduction

Rising debt-to-GDP ratios in several low-income and developing countries could soon lead to periods of needed fiscal consolidation. This situation has led the International Monetary Fund (2018) to classify these debt levels as "risky".[1] This stems from, among other issues, a combination of slow global growth, eroding fiscal space, and weakened commodity prices (Dawood and Francois, 2018). Given the development needs of these countries, policymakers face additional challenges when designing and implementing policies that capable of reducing debt while minimizing any long-term costs to economic growth. While the literature predominantly focuses on the short-run, it is imperative to understand the long-run impact of fiscal consolidation on real GDP in these economies.[2]

We use heterogeneous panel cointegration techniques to estimate the average long-run impact of government consumption on output for a panel of 33 developing countries from 1972 to 2014.[3] Despite the robustness of this methodology to endogenous regressors and omitted variables, we also include total investment in the cointegration relation due to its importance as a determinant of output in the long-run (See Herzer and Morrissey, 2013). Additionally, including total investment can lead to richer policy-related insights regarding fiscal consolidation strategies.

Three key results emerge. First, the government consumption-output coefficient is positive, but not statistically significant. However, the coefficient is negative and statistically significant when we account for cross-country dependencies such as common shocks and spillovers. Second, this negative relationship is driven by non-sub-Saharan African countries in our sample, revealing potential regional differences. Third, we confirm that the investment-output coefficient is consistently positive and statistically significant across data treatments and samples. Together, these findings suggest that fiscal consolidation that reduces government consumption while maintaining investment levels results in a marginal contraction, or even a potential expansion, in long-run output.

2 Methodology

We employ a trivariate cointegration regression involving output, government consumption, and total investment to assess the long-run impact of government consumption on output. As mentioned earlier, we include the total investment due to its importance as a determinant of output in the long-run.[4] Thus, we begin by considering the model of the form:

$$Y_{it} = a_i + \delta_i t + \beta_1 G_{it} + \beta_2 I_{it} + \varepsilon_{it}, \tag{1}$$

[1] The Deputy Managing Director at the International Monetary Fund, Tao Zhang, has produced a reader-friendly analysis of debt vulnerabilities in low-income and developing countries in an IMFblog post on March 22nd 2018 (See https://blogs.imf.org/2018/03/22/managing-debt-vulnerabilities-in-low-income-and-developing-countries/ for further information).

[2] See Arizala, Gonzalez-Garcia, Tsangarides, and Yenice (2017); Ilzetzki, Mendoza, and Végh (2013) and Mallick (2006) for studies focusing on the short-to-medium term.

[3] See Table A1 in Appendix A for a list of the economies included in this analysis.

[4] Estimates from the bivariate cointegration regression of output and government consumption are reported in Appendix B conserve space.

where Y_{it} is defined as the log of real GDP in country $i = 1, 2, \ldots, N$ at time t. I_{it} and G_{it} are total investment and government consumption as shares of GDP in country i. The parameters β_1 and β_2 represent the coefficients of interest, while a_i and δ_i represent a constant and linear time trend associated with each country i, respectively. All time series considered in this study span the 1972-2014 period. Data on GDP comes from the World Development Indicators 2018 database. Data on investment and government consumption are from the Feenstra et al. (2015) Penn World Table (version 9.0). While these measures are imperfect, they are the best available for a reasonable sample of countries over a sufficiently long period.

Our regressors are expressed as shares of GDP because their levels are components in the calculation of output. This technique is common practice in panel cointegration studies since a positive correlation could simply result from an accounting identity, not a true economic relationship between the variables of interest (i.e. Herzer, 2008; Herzer and Morrissey, 2013). As an added benefit, given the panel of 33 distinct countries from across the globe, dividing government consumption and total investment by the size of each respective economy provides a better standard of comparison.

2.1 Pre-testing

The focus on the long run means permanent changes in the government consumption-to-GDP ratio and the investment-to-GDP ratio are associated with permanent changes in the log level of GDP. This implies that a) the individual time series in (1) must exhibit unit root behavior, and b) G_{it} and I_{it} must be cointegrated with Y_{it}. We test for both of these attributes in this section.

2.1.1 Unit Roots Tests

We employ the panel unit root test of Im, Pesaran, and Shin (2003, henceforth IPS), which is based on the Augmented Dickey-Fuller (ADF) regression for the individual cross-section unit in the panel. However, given the likelihood of common shocks or economic spillovers between countries, the error terms ε_{it} may not be independent. In this scenario, the IPS test can lead to spurious inferences. In this sense, we also consider the cross-sectionally augmented IPS (CIPS) test proposed by Pesaran (2007). The CIPS filters out any cross-section dependency by augmenting the ADF regression with the cross-section averages of lagged levels and first-differences of the individual series (i.e. Herzer and Grimm, 2012; Herzer and Morrissey, 2013).

The results show that, under both the IPS and CIPS frameworks, the unit-root null hypothesis can not be rejected for the level series (Table 1). On the other hand, the null hypothesis is rejected for the first differenced series. These suggest that the series initially considered for (1) are non-stationary I(1) processes.

Table 1: Panel Unit Root Tests

Variable	Deterministic trend	IPS statistics	CIPS statistics
Levels			
Y_{it}	c, t	2.346	-2.429
G_{it}	c, t	0.760	-2.535
I_{it}	c, t	0.375	-2.429
First Difference			
ΔY_{it}	c	-6.821^{***}	-2.610^{***}
ΔG_{it}	c	-7.505^{***}	-2.825^{***}
ΔI_{it}	c	-8.412^{***}	-2.996^{***}

Notes: *** indicates significance at the 1 percent level. For the level data, we allow for both individual country effects (c) and country-specific time trends (t). In the case of the first differenced data we allow for individual country effects (c). Four lags were selected to adjust for autocorrelation. The IPS statistic is distributed as $N(0,1)$. The relevant 5% (1%) critical value for the CIPS statistics with is -2.60 (-2.72) with an intercept and a linear trend, and -2.60 (-2.72) with an intercept.

2.1.2 Cointegration Tests

We first test for cointegration with the four standard panel and group test statistics suggested by Pedroni (1999), which all have a "no cointegration" null hypothesis. We also report the Fisher statistic proposed by Maddala and Wu (1999) which follows a χ^2 distribution with $2 \times N$ degrees of freedom.[5] It is important to note the aforementioned tests do not account for potential cross-sectional dependence – an omission that can lead to biased inference. To account for this, we also follow Holly et al. (2010) by adopting a residual-based, two-step approach in the manner of Pedroni (1999). We also extend this model with a Common Correlated Effects (CCE) estimation procedure developed by Pesaran (2006) in the first-step regression. This procedure allows for cross-sectional dependencies that potentially arise from multiple unobserved common factors by augmenting the cointegrating regression with the cross-sectional averages of the dependent variable and the observed regressors as proxies for the unobserved factors. The second step involves the computation of the CIPS statistic for the residuals from the individual CCE long-run relations (See for instance, Herzer and Grimm, 2012; Herzer and Morrissey, 2013, for details).

The results from all five cointegration procedures (panel, group, and CIPS) suggest that we should reject the "no cointegration" null hypothesis (Table 2). In addition, the Fisher χ^2-statistics also support the existence of at least one cointegrating vector. All tests are conducted at the five-percent level of significance and, in general, suggest the presence of a long-run relationship between output, government consumption, and total investment.

2.2 Estimation and Results

Following evidence of the presence of unit roots and cointegration, we now focus on the long-run relationship between government consumption on output. Recall that because investment

[5] The χ^2 value is based on MacKinnon et al. (1999) p-values for Johansen's cointegration trace test reported by Eviews.

Table 2: Panel Cointegration Tests

	Cointegration Rank		
	$r = 0$	$r = 1$	$r = 2$
Fisher statistics	188.8***	75.46	48.11
CIPS statistic		-3.284***	
Panel PP statistic		-1.869**	
Panel ADF statistic		-2.379***	
Group PP statistic		-2.724***	
Group ADF statistic		-3.647***	

Notes: ** and *** denote a rejection of the null hypothesis of no cointegration at the 5% and 1% levels, respectively. The Fisher statistic is distributed as χ^2 with $2 \times N$ degrees of freedom. The relevant 5%(1%) critical value for the CIPS statistic is -2.11(-2.23). The number of lags was determined by the Schwarz criterion with a maximum of four lags.

is a proven determinant of growth, we control for it by estimating the trivariate cointegration regression of output on government consumption and total investment. We employ the between-dimension, group-mean panel dynamic ordinary least squares (DOLS) estimator of Pedroni (2001a,b). The panel DOLS regression is given by

$$Y_{it} = \alpha_i + \delta_i t + \beta_{1i} G_{i,t} + \beta_{2i} I_{it} + \sum_{j=-p_i}^{p_i} \Psi_{1ij} \Delta G_{it-j} + \sum_{j=-p_i}^{p_i} \Psi_{2ij} \Delta I_{it-j} + \epsilon_{it}, \tag{2}$$

where Ψ_{1ij} and Ψ_{2ij} are coefficients of lead and lag differences which account for potential serial correlation and endogeneity of the regressors. A desirable and important feature of the DOLS procedure is that it generates unbiased estimates for variables that are cointegrated even in the presence of endogenous regressors. For instance, government consumption may respond to changes in output in a countercyclical or pro-cyclical fashion in developing countries. This suggests a possible endogeneity as an increase in output may induce and increase in government consumption. However, in adopting a DOLS estimation, this is not an issue. The group-mean panel DOLS estimator; computed as

$$\hat{\beta}_m = \frac{1}{N} \sum_{i=1}^{N} \hat{\beta}_{mi}, \tag{3}$$

where $m = 1, 2$ and $\hat{\beta}_{mi}$ is the conventional time-series DOLS estimator applied to the ith country of the panel; is super consistent under cointegration, and is robust to any omitted variables that do not form part of the cointegrating relationship. In order to account for cross-sectional dependence induced possibly by common shocks, trade links, and/or spillovers among countries at the same time, we apply the DOLS procedure to both the raw data and to the demeaned data. In particular, in place of Y_{it}, G_{it}, and I_{it}, we employ $\tilde{Y}_{it}$, $\tilde{G}_{it}$, and $\tilde{I}_{it}$ such that

$$\tilde{Y}_{it} = Y_{it} - \bar{Y}_t, \qquad \text{where } \bar{Y}_t = \frac{1}{N}\sum_{i=1}^{N} Y_{it},$$

$$\tilde{G}_{it} = G_{it} - \bar{G}_t, \qquad \text{where } \bar{G}_t = \frac{1}{N}\sum_{i=1}^{N} G_{it},$$

and

$$\tilde{I}_{it} = I_{it} - \bar{I}_t, \qquad \text{where } \bar{I}_t = \frac{1}{N}\sum_{i=1}^{N} I_{it}.$$

Table 3 reports the results from the cointegration regression. The coefficient of government consumption is positive but not statistically significant for the unadjusted data. However, it has a negative and significant effect on output when the demeaned data is considered. More specifically, after accounting for common shocks and spillovers, a one-percentage-point decrease in the government consumption-to-output ratio will induce an *increase* in real GDP by 0.0071 percentage points – an economically negligible, albeit positive effect. On the other hand, the investment-output ratio coefficient is consistently positive and significant for both the unadjusted and the demeaned data.

Table 3: DOLS estimates of the coefficient on government consumption and investment

	G_{it}	I_{it}
Unadjusted Data	0.0018	0.0184***
	(1.596)	(13.467)
Demeaned Data	−0.0071***	0.0122***
	(−6.848)	(7.979)

Notes: The dependent variable is Y_{it}. *** indicates significance at the 1 percent level.). t-statistics in parentheses. The number of leads and lags in the individual DOLS regressions was determined by the Schwarz criterion with a maximum of three lags. DOLS is Dynamic OLS.

The observed negative government consumption-output relationship from the demeaned data may be attributed to factors including outliers and sample-selection bias. Specifically, if a country or group of countries in a particular region have a significant effect on the results, this may drive the negative relationship. In this sense, we conduct the following exercise: First, we carry-out a sensitivity analysis by re-estimating the DOLS regression in Eq.(2)– with cross-sectionally demeaned data– and exclude one cross-sectional unit at a time from the sample. Figure 1 depicts the estimated coefficients and their corresponding t-statistics. It can be observed that the coefficients are consistently negative and significant at the 1 percent level. We can therefore draw the conclusion that the negative government-consumption relationship is not due to possible outliers.

Second, because the panel considered in this study comprises 19 sub-Saharan African (SSA) countries and 14 non-SSA countries, we group the countries in the sample into SSA and non-SSA countries. We then re-estimate Eq. (2) for these two groups. This is to check the

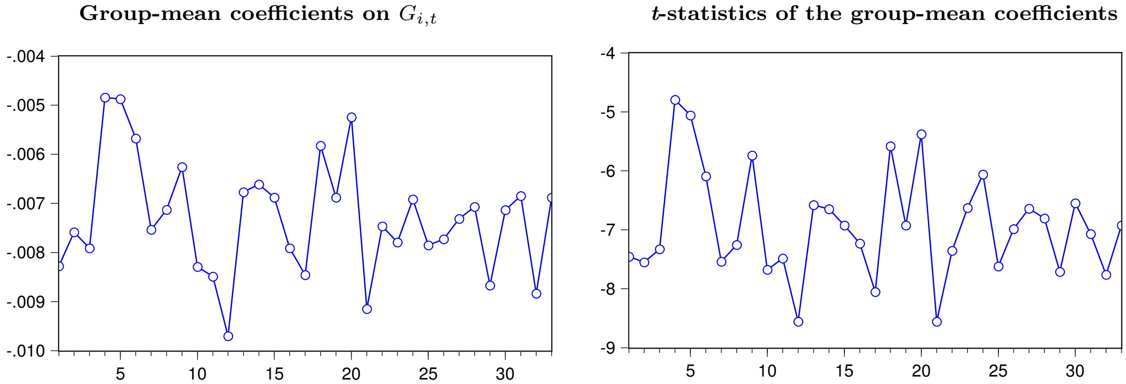

Figure 1: DOLS estimation with single country excluded from the sample

possibility that the negative relationship is not driven by sample-selection bias. Table 4 reports the result for SSA and non-SSA and it shows that the effect of government consumption on real GDP differs across the two regions considered in this study. Using the demeaned data, a one percentage point increase in the government consumption-to-output ratio increases output by 0.0013 percentage points in SSA. The same policy decreases output by 0.0067 percentage points in the non-SSA economies on average. As expected, the investment-output coefficient remains consistently positive and significant across the two regions as well as data treatment.

Table 4: DOLS estimates for sub-Saharan Africa and non-sub-Saharan Africa

	G_{it}	I_{it}
SSA		
Unadjusted Data	0.0069	0.0188***
	(4.722)	(9.712)
Demeaned Data	0.0013***	0.0083***
	(0.643)	(3.281)
Non-SSA		
Unadjusted Data	−0.0050***	0.0179***
	(−2.742)	(9.580)
Demeaned Data	−0.0067***	0.0258***
	(−3.050)	(11.053)

Notes: The dependent variable is Y_{it}. *** indicates significance at the 1 percent level. t-statistics in parentheses. The number of leads and lags in the individual DOLS regressions was determined by the Schwarz criterion with a maximum of three lags. DOLS is Dynamic OLS.

3 Discussion

The need for expanded health, education, and infrastructure in low-income and developing countries generally makes cutting government investment spending undesirable during periods of fiscal consolidation. Our results show that, holding investment constant, reducing government consumption is an effective cost-cutting policy option in the long run for these economies. Particularly, when controlling for cross-country dependence (demeaned data), we find this policy to be expansionary on average. This conclusion is important because it proves that this expansionary effect is not simply a short-run phenomenon (e.g. Hur et al., 2014; Ilzetzki et al., 2013; Jha et al., 2014; Mallick, 2006), but also applies in the long run. Interestingly, this finding differs across the SSA and non-SSA subsamples. More precisely, while a cut in government consumption will have an expansionary impact in non-SSA countries, the same policy will reduce output in SSA countries in the long run. This region-specific finding for SSA complements the short- and medium-term findings of Arizala et al. (2017). Finally, allowing common shocks and spillovers in the data (i.e. the unadjusted data) shows that, at worst, reducing government consumption will have an impact on output that is not statistically different from zero.

There are a handful of potential explanations for these results. First, the structural relationship between private and government consumption in developing countries is an obvious candidate to help understand the long-run government consumption-output relationship. Specifically, a number of studies find that private and government consumption are Edgeworth substitutes in several developing countries (See, Dawood and Francois, 2018; Francois and Keinsley, 2018; Karras, 1994). This suggests that an increase in government consumption reduces marginal utility of private consumption and causes a fall private consumption. The decrease in private consumption offsets any positive effect that government consumption has on output. The opposite is true for reductions in government consumption. Second, developing economies tend to have higher-than-average levels of corruption and weak fiscal institutions. This can lead to government spending practices that negatively impact long-run growth (See for instance, dAgostino et al., 2016). Under this scenario, a reduction in government consumption could move resources to more efficient private sectors. Finally, the observed regional differences in Table 4 can simply be attributed to regional-specific economic environments and unobserved factors.

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Appendices

A Countries of Interest

Below is a table representing the countries considered in this analysis. They are sorted by geographic location and listed alphabetically. The time series span the 1972-2014 period.

Table A1: Countries included in the analysis

Sub-Saharan Africa	**North Africa**
Benin	Morocco
Burkina Faso	Tunisia
Burundi	
Cameroon	**South Asia**
Ghana	Bangladesh
Guinea Bissau	India
Kenya	Nepal
Lesotho	Pakistan
Madagascar	Sri Lanka
Malawi	
Mali	**East Asia**
Mauritania	Indonesia
Niger	Myanmar
Nigeria	Phillipines
Rwanda	
Senegal	**South America**
Swaziland	El Salvador
Togo	Guatemala
Zambia	Honduras
	Nicaragua

B Bivariate Cointegration Results

We re-estimate a bivariate version of (2). Thus, the panel DOLS regression is given by

$$Y_{i,t} = \alpha_i + \delta_i t + \beta_i G_{i,t} + \sum_{j=-p_i}^{p_i} \Psi_{ij} \Delta G_{i,t-j} + \epsilon_{i,t}, \tag{B.1}$$

Table A2: DOLS estimates of the coefficient on government consumption

	Unadjusted Data	Demeaned Data
	-0.0042^{**}	-0.0056^{***}
	(-2.496)	(-5.091)

Notes: The dependent variable is Y_{it}. ** and *** indicates significance at the 5 percent and 1 percent levels, respectively. t-statistics in parentheses. The number of leads and lags in the individual DOLS regressions was determined by the Schwarz criterion with a maximum of three lags. DOLS is Dynamic OLS. All unit-root and cointegration tests are satisfied.