Economics Bulletin

Volume 43, Issue 3

On estimates of overall budget sensitivity parameters across income groups: Some evidence

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Abstract

This note provides estimates of the overall budget sensitivity parameter for different income groups over the 2010-2021 period. The results reveal a positive and statistically significant response of the cyclical component of the fiscal balance in response to changes in the output gap. There is however varying degrees of the strength of the estimated association across different income groups. Specifically, our estimates uncover that the budgetary sensitivity parameter is 0.40 in high income, 0.39 in upper middle income, 0.2 in lower-middle, and 0.31 in low income countries. The main findings reveal that the parameter of interest depends on the level of income. Typically, the higher the income level, the higher the budgetary sensitivity parameter. However, the budget sensitivity parameter is higher in low-income countries than in lower-middle income countries. Given the scarcity of estimates of the budget sensitivity parameter for developing countries, the note provides new and informative estimates for low- and lower-middle income countries useful for computing measurement of fiscal position.

We would like to thank the editor John P. Conley, the associate editor Benjamin Keen, and our anonymous referee for useful comments, suggestions, and guidance that have significantly improved this paper. This note has also benefited from valuable comments and suggestions from Chiara Bronchi, Santiago Herrera, Fernando Blanco, Annette De Klein, and Jaffar Al Rikabi. The paper has also benefited from presentations with the Fiscal Policy and Sustainable Growth Unit in the World Bank. All errors are hereby ours. Disclaimer: The findings, interpretations and conclusions expressed in this paper are entirely those of the authors and should not be attributed to the World Bank, its Executive Directors, or the countries they represent.

Citation: John Nana Francois and Eric Antony Lacey and Robert Johann Utz, (2023) "On estimates of overall budget sensitivity parameters across income groups: Some evidence", *Economics Bulletin*, Volume 43, Issue 3, pages 1458-1469

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Submitted: March 02, 2023. **Published:** September 30, 2023.

1. Introduction

Pursuing effective fiscal policy strategies requires useful and informative fiscal indicators. In the context of the fiscal balance (fiscal deficit or surplus), the cyclically adjusted fiscal balance provides a measure of the fiscal position that is net of the impact of macroeconomic dynamics on the budget. Notice that government revenue comprises in part taxes and social contributions that are levied on different types of economic activities (e.g., expenditure and income) via statutory tax rates. Consequently, government revenue will increase and decrease with economic activity upturns and downturns, respectively. Government spending on the other hand largely comprises more discretionary components such as wages and salaries as well as capital expenditure, which typically do not automatically adjust with the business cycle (Burnside and Meshcheryakova, 2005). Hence, except for unemployment benefits, government spending is less affected by the economic cycle, implying that the fiscal balance would tend to improve during economic expansions and deteriorate during contractions. This cyclical component of the deficit, when unaccounted for, can (over-)under-state the size of the fiscal deficit. It is therefore critical to correct for the impact of economic cycles on the fiscal balance by appropriately expunging the cyclical component of the fiscal balance to arrive at a more precise and informative measure.

Traditionally, international organizations including the European Commission, International Monetary Fund, and the Organization of Economic Cooperation and Development utilize a standard "two-step approach" in uncovering the cyclically adjusted component of the fiscal balance. This generally involves first computing the cyclical component of the fiscal accounts of a country and then subtracting the resulting cyclical component from the actual fiscal balance (Burnside and Meshcheryakova, 2005). Mathematically, the cyclical adjusted balance (CAB) is defined as $(FB/Y)^A$–$(FB/Y)^C$, where $(FB/Y)^A$ represents the actual fiscal balance to GDP ratio and $(FB/Y)^C$ is the cyclical component of the fiscal balance. The cyclical component is linked to the output gap, Y^{gap}, via the linear relation $(FB/Y)^C = \alpha Y^{gap}$, where α is defined as the cyclical-adjustment parameter, which also measures the overall budget sensitivity to the business cycle (Mourre et al., 2013). Given the previous relations, the CAB can be denoted as $(FB/Y)^A - \alpha Y^{gap}$. Evidently, obtaining the CAB requires two key subcomponents: (1) "good" measure of Y^{gap} (i.e., the business cycle in output), and (2) a reliable estimate of α that links the output gap and cyclical component of the fiscal balance. The challenge in computing the CAB therefore lies in employing the appropriate methodologies to measure the output gap and accurately estimating the cyclical-adjustment parameter, α.[1] Additionally, while several estimates of α and other fiscal semi-elasticity

[1] There are several methodologies and techniques in computing the cyclical component of the fiscal balance. It is therefore well-known that no single methodology or strategy for adjusting fiscal balances exists. This argument is further reinforced because the appropriate adjustment needs to take into account several country-specific factors, including data availability, the economic structure of the country, the fiscal regime amongst

parameters exist for advanced and emerging economies (e.g., Alberola et al., 2018; Larch and Turrini, 2010), there is scarcity of these parameter estimates for low and lower-middle income countries.

It is worth mentioning that providing estimates of the budget sensitivity parameter across different groups can help inform important fiscal reform for fiscal policy effectiveness during recessions. In particular, recent studies suggest that severe recessions can lead to output hysterisis (see for example, Cerra, Fatás, and Saxena, 2023). Fiscal policy can be effective in addressing these types of recessions (see, Tervala and Watson, 2022). Nonetheless, if the fiscal semi-elasticity is small, automatic stabilizers may not function effectively, which would require a greater need for discretionary fiscal stimulus in recessions. This further underscores the relevance of the need to understand the fiscal semi-elasticity in different income groups and highlights the potential implications for fiscal policy in the event of a recession.

This note uses data from 2010-2021 and panel system Generalized Method of Moments (GMM) to estimate of the overall budget sensitivity parameter for different income groups according to World Bank's income group classification—i.e., high , upper-middle, lower-middle income, and low income countries. Given the scarcity of estimates of the overall budget sensitivity parameter for developing countries, the note provides preliminary, but new and informative estimates for low- and lower-middle income countries. We find evidence of a positive and statistically significant response of the cyclical component of the fiscal balance in response to changes in the output gap with different degrees of response across income groups. More precisely, in high income countries (HICs) and upper-middle income countries (UMCs), a 1% output gap will be associated to the cyclical component of the budget balance being around 0.4% of GDP. In low-income countries (LICs) and lower-middle income countries (LMCs), a 1% output gap will be associated to cyclical component of the budget balance being around 0.3% and 0.2% of GDP, respectively. Our estimates for HICs is consistent with estimates of the overall budget sensitivity parameter in the literature. More specifically, focusing on the EU area (of which several countries fall into HICs in our sample), Larch and Turrini (2010, Table 1) estimate the overall budget sensitivity parameter, α, to be 0.48, which is close to our estimate of 0.4 for HICs. Balassone and Kumar (2007) on the other hand find an estimate of 0.3 for industrial economies in their sample but find a statistically insignificant coefficient of the overall budget balance for developing and emerging economies over the 1970-2002 period. The latter results is in contrast to our findings.

The results of this study suggest that automatic stabilizers have been effective: during an economic upswing (downturn), the fiscal balance improves (worsens). Additionally,

other things (International Monetary Fund, 2017). See https://www.imf.org/external/np/fad/strfiscbal/ for a detailed discussion.

the results indicate that the budget sensitivity is dependent on a country's income level. Generally, the lower the income level, the lower the fiscal semi-elasticity, which means that changes in the output gap have a smaller impact on the fiscal balance. In low-income countries, public sector revenues do not vary significantly with economic cycles, likely because the progressivity of the tax system is lower than in high-income countries.[2] Furthermore, income transfers such as unemployment benefits are smaller in low-income and lower-middle income countries, resulting in less variation in public sector expenditures with economic cycles. Consequently, automatic stabilizers are less effective in low-income countries compared to high-income countries. Moreover, the finding that the point estimate of the budget sensitivity parameter is higher in LICs than in LMCs remains puzzling as we do not have an immediate economic interpretation. As further investigation, and to aid better inference, we follow the advice of Romer (2020) and report the confidence intervals for the point estimates. We find a tight confidence interval for the point estimate of the budget sensitivity parameter for LICs but find a relatively wider confidence interval for LMCs suggesting lower precision of the estimate of the budget sensitivity parameter for LMCs. This might be an indication of the well-known weak instrument problem of the system GMM estimator we employ in our study. The point estimates uncovered in the paper should therefore be interpreted with caution and future research should aim at improving the precision and the reliability of these estimates with more robust estimators. Despite this limitation, our empirical estimates for LICs and LMCs provide some valuable guide for practitioners when computing the cyclical adjusted fiscal balance for these economies where estimates for the budget sensitivity parameter remains scarce.

The rest of the note is organized as follows: Section 2 presents the methodology and brief description of the data source. Section 3 presents the results and Section 4 concludes.

2. Methodology

The standard fixed effect approach addresses the issue of heterogenous omitted unobserved country factors that are invariant over time. These omitted factors can lead to endogeneity issues when estimating α if the former is correlated to the error term in the regression analysis. While the fixed effect estimator can address omitted unobserved country-specific factors, it does not address the issue of endogeneity of the output gap. Specifically, the output gap may be correlated to the error term in the regression, or there may be issues of reverse causality and simultaneity bias. The system GMM (SGMM) estimator can circumvent the more complex forms of endogeneity via instrumenting the independent variables with corresponding lags and differences (i.e., internal instruments). Importantly, the estimator includes potential time-invariant omitted variables in the estimation to account for

[2] We would like to thank one of our anonymous referees for helping us clarify and expound on this point.

some unobserved heterogeneity as in the fixed effect estimator. Moreover, the system GMM is a more efficient estimator that attempts mitigates the weak instrument problem by using additional moment conditions (Asiedu and Lien, 2011).

Despite the aforementioned benefits, a well-known disadvantage of the system GMM procedure is that it exhibits the "too many" instrument problem. This instrument proliferation issue can overfit endogenous variables and fail to efface their endogenous components (Asiedu and Lien, 2011). Additionally, this issue weakens the Hansen J test to detect invalidity of the system GMM instruments (Roodman, 2009a,b). In particular, Roodman shows and argues that the Hansen J test loses its power when the number of cross-sectional units, N, is less than the number of instruments, i—i.e., when the instrument ratio $r = N/i$ is less than 1. In order to mitigate the spillover issues induced by the instrument proliferation problem, Roodman suggests that, as a minimally arbitrary rule of thumb, the instrument ratio (r) should be greater than or equal to 1. This can be done by limiting the lags used in the GMM-style instruments and collapsing the number of instruments. Thus, in all our baseline regressions, we limit the number of lags used in the GMM-style instruments.

We report the standard test for second-order autocorrelation, the Hansen J test for overidentifying restrictions, and the instrument ratio as advocated by Roodman (2009b) and applied in Asiedu and Lien (2011), Asongu and Acha-Anyi (2019), Gaspart and Pecher (2019), Francois et al. (2021), and Francois (2022), amongst others. We also follow Bazzi and Clemens (2013) and report underidentification tests of Kleibergen and Paap (2006). A rejection of the null (i.e., a large test statistic) indicates that the model is identified (i.e., the excluded instruments are "relevant"). Failure to reject indicates that the model is underidentified. In summary, we estimate Eq.(1) by employing the two-step GMM estimator, which is asymptotically efficient and robust to all kinds of heteroscedasticity and Windmeijer-corrected standard errors as in Windmeijer (2005).

Our specification is parsimonious and follows similar specification for estimating the overall budget sensitivity parameter (see, Balassone and Kumar, 2007, for details). Hence, the baseline equation of interest is given in the panel data form as:

$$(FB/Y)^C_{it} \; = \; u_i \quad + \delta t + \; \alpha Y^{gap}_{it} + \varepsilon_{it}, \tag{1}$$

where i and t are country i in our panel and time (in years), respectively. $(FB/Y)^C$ is the cyclical component of the fiscal balance to GDP ratio and Y^{gap}_{it} is the output gap is defined as the level of output relative to some benchmark measure. Data on fiscal balance and real GDP, which is employed to compute the output gap are retrieved from the World Economic Outlook (2022). We use the Hodrick and Prescott (HP) filter to obtain the cyclical component of the fiscal balance and output gap (see, Burnside and Meshcheryakova, 2005, for further discussions). Our estimation controls for both country-specific fixed effects (u_i) and time effects (δt). The parameter of interest is α, which captures the overall budget sensitivity. Intuitively, an α estimate of 0.5 means a 2% output gap will be associated to the cyclical component of the budget balance being around 1% of GDP. Given that the parameter may vary across income groups, we conduct the estimation for individual income groups with income classification according to the World Bank. We focus on recency and limit our estimation to the last decade (i.e., 2010-2021). This provides us with a timelier estimate of the relationship in question.

3. Results

Table 1 presents the estimates from the fixed effect model and Table 2 reports estimates from the SGMM estimator, which is the preferred estimator for the reasons explained in section 2. The results from the fixed effect model are simply presented for comparative analysis. Country classification follows the World Bank's income classification. HIC is high income countries, LIC is low-income countries, LMC is lower middle-income countries, and UMC is upper middle-income countries.

We begin by discussing the results from the fixed effect model in Table 1. Estimates of the overall budget sensitivity parameter, α, is estimated to be positive for all income groups except for LMC, where the parameter estimate is negative and statistically insignificant. Recall that the fixed effect model does not address key endogeneity issues that can impact the precision of the estimation of the parameter of interest. To this end, we utilize the SGMM in an attempt to mitigate some of the endogeneity issues described in section 2.

Table 1: Fixed Effects estimates of overall budget sensitivity parameter

	(1) HIC	(2) LIC	(3) LMC	(4) UMC
Output Gap, $\hat{\alpha}$	0.173**	0.151***	-0.0555	0.255*
	(0.0792)	(0.0408)	(0.0867)	(0.145)
Constant	-1.544***	-0.414	-1.028**	-0.487
	(0.369)	(0.305)	(0.408)	(0.413)
No. of Observations	814	344	637	675
R-squared	0.286	0.157	0.047	0.175
Number of countries	63	27	49	52

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The estimation accounts for both country-specific and time effects.

Table 2 reports the parameter estimates from the SGMM. The estimates across all income groups are positive and statistically significant. We however observe differences in the estimated size of the overall budget sensitivity parameter across income groups. Specifically, on one hand, a 1% output gap will be associated to cyclical component of the budget balance being around 0.4% of GDP in HICs and UMCs. Our estimates of α for HICs are similar to those uncovered in the existing studies. For example, in the EU area (of which several countries fall into HICs), Larch and Turrini (2010, Table 1) estimate the overall budget sensitivity parameter, α, to be 0.48, which is close to our estimate of 0.4 for HICs. On the other hand, low and lower-middle income countries, a 1% output gap will be associated to the cyclical component of the budget balance being around 0.3% and 0.2% of GDP, respectively.

To further aid better inference and reliability of our point estimates, we follow the advice of Romer (2020) and report the confidence intervals for each of the point estimates of the budget sensitivity parameters. We find a tight confidence interval for the point estimate of the budget sensitivity parameter for HICs and LICs. For LMCs and UMCs, on the other hand, we find a relatively wide confidence interval suggesting lower precision of the point estimates of the budget sensitivity parameter for LMCs and UMCs. This results may be attributed to the well-known weak instrument problem of the system GMM estimator we employ for our estimation. The point estimates uncovered in the paper should therefore be interpreted with caution.

Table 2: System GMM estimates of overall budget sensitivity parameter

	(1) HIC	(2) LIC	(3) LMC	(4) UMC
Output Gap, $\hat{\alpha}$	0.400***	0.307***	0.185**	0.398**
	(0.0834)	(0.0266)	(0.0870)	(0.170)
95% Confidence interval	[0.24, 0.56]	[0.25, 0.36]	[0.01, 0.36]	[0.06, 0.73]
Constant	-3.716***	-0.394	-0.366	0.211
	(0.677)	(0.365)	(0.499)	(0.433)
Kleibergen-Paap underidentification test p-value	0.00972	0.0583	7.02e-05	0.0217
Arellano and Bond AR(1) test p-value	0.000794	0.0733	0.0857	0.0406
Arellano and Bond AR(1) test p-value	0.214	0.304	0.262	0.807
Hansen-J test p-value	0.748	0.900	0.203	0.170
Number of Observations	751	317	588	623
Number of countries (N)	63	27	49	52
Instrument ratio ($N/i > 1$)	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. For the Hansen J test, the null hypothesis is that the instruments are not correlated with the residuals. For the Serial correlation test, the null hypothesis is that the errors in the first difference regression exhibit no secondorder serial correlation. The null hypothesis of the Kleibergen–Paap LM test is that the structural equation is underidentified (i.e., the rank condition fails). The test uses a procedure from Kleibergen and Paap (2006). For the instrumentation strategy, we use a combination of curtailed and collapsed instruments. Hence, the number of lags of dependent and endogeneous variables are limited to one. We use xtabond2 command in Stata for the estimation.

Finally, we turn to the postestimation tests reported at the bottom of Table 2, which are designed to help validate the parameter estimates in Table 2. It is clear throughout the table that the p-value of the Hansen J test is greater than the 5 percent significance level in all the regressions. This implies that one cannot reject the null hypothesis that the instruments are valid. Moreover, the serial correlation test shows that the p-values of the Arellano and

Bond AR(2) statistics are all above the 5 percent significance level, confirming the absence of second-order serial correlation. Notice that the presence of serial correlation would render our results inconsistent. In the case of the Kleibergen-Paap LM test, the p-values show a rejection of the null at all relevant significance level, which indicates that the matrix is full column rank—i.e., the model is identified.

Generally, the postestimation test in Table 2 all validate the estimation results as well as the relevancy and validity of the internal instrument employed for the estimation (see Bazzi and Clemens, 2013; Francois, 2022; Roodman, 2009a,b, for a detailed interpretation of the postestimation results).

4. Conclusion

This note provides estimates of the overall budget sensitivity parameter for different income groups according to World Bank over the 2010-2021 period. We utilize system GMM method to uncover the overall budget sensitivity parameter. We uncover a positive and statistically significant overall budget sensitivity parameter across all income groups. Nonetheless, there are differences in the size of the estimated parameter across the income groups. In particular, a 1% output gap will be associated to cyclical component of the budget balance being around 0.4% of GDP in high income and upper-middle income countries. In contrast, in low and lower-middle income countries, a 1% output gap will be associated to cyclical component of the budget balance being around 0.3% and 0.2% of GDP, respectively. Our estimated values for the overall budget sensitivity parameter for HICs is consistent with estimates in the literature. For example, Larch and Turrini (2010) estimate the overall budget sensitivity parameter, α, to be 0.48 for the EU area, which is close to our estimate of 0.4 for HICs. On the other hand, Balassone and Kumar (2007) uncover an estimate of 0.3 for industrial economies in their sample but find a statistically insignificant coefficient of the overall budget balance for developing and emerging economies over the 1970-2002 period. The latter results is in contrast to our findings for the developing countries in our sample.

The results of the analysis suggest that the fiscal semi-elasticity is generally dependent on a country's income level. The fiscal semi-elasticity tends to be lower in low and lower-middle income countries compared to high-income and upper-middle income countries. Therefore, changes in the output gap have a smaller impact on the budget balance in these countries. It is however worth mentioning that fiscal semi-elasticity is higher in low-income countries than in lower-middle income countries. Generally, this implies that automatic stabilizers tend to operate weakly in lower-middle income countries. A direct implication of this is that in the event of a recession, a small budget sensitivity parameter could limit the effectiveness of automatic stabilizers, requiring greater need for discretionary fiscal stimulus these countries.

While the results do provide evidence of the implementation of countercyclical fiscal policy behavior, it is important to note that the effectiveness of automatic stabilizers varies across countries and income levels. This therefore highlights the importance of understanding the fiscal budget sensitivity in different income groups and its potential implications for fiscal policy in the event of an economic downturn. Going forward, future studies should aim at revisiting the exercise in this study with available quarterly data and newer methodologies for more informative estimates of the overall budget sensitivity parameter.

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