Fiscal policy procyclicality in commodity exporting countries: How much does it pour and why?

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ONLINE APPENDIX

8 Online appendix

8.1 Categories of government spending

As noted in the Introduction, there is an incipient literature suggesting that social transfers play a crucial role in explaining the differences in procyclicality between EMDE and AE (Ilzetzki and Vegh, 2008, Michaud and Rothert, 2018, and Froemel and Paczos, 2024). More precisely, the idea is that EMDE and AE do not significantly differ in procyclicality when it comes to government *consumption* (i.e., excluding social transfers) but they do when using government *spending* (which includes social transfers).

Table O1 illustrates this point by showing the correlation between the cyclical components of GDP and various measures of government expenditure. We see that, for government consumption, both EMDE and AE are procyclical (although EMDE are much more procyclical, with a correlation of 0.54 compared to only 0.08 for AE). In contrast, for government spending, AE become countercyclical (correlation of -0.16) while EMDE remain highly procyclical (correlation of 0.66).[53] The inference is clear: the reason behind the counter-cyclicality of government spending in AE must be the large presence of social transfers. In fact, Michaud and Rothert (2018) provide direct evidence by showing that social transfers are procyclical in EMDE and countercyclical in AE.[54]

8.2 Baxter-King filter

The best way of detrending macroeconomic time series data has proved to be a long-lasting and still unsettled matter (see, for example, Guay and St.-Amant, 2005). In the text, we have used the most popular filter – Hodrick-Prescott– which is based on decomposing a time series into permanent and transitory components. The most common alternative filter is surely Baxter and King (1999), which is based on isolating certain business fluctuations in the data. This appendix suggests that the main

[53] As expected, public investment (goverment capital formation) is procyclical in both EMDE and AE. Debt service is acyclical in both.

[54] As expected, social transfers are larger as a proportion of government spending in AE than in EMDE (39 versus 28 percent).

message behind our key stylized facts is robust to using the Hodrick-Prescott filter.[55]

Table O2 reports the correlations that follow from replicating Figures 1, 2, 3, and 4 for the case of the Baxter and King filter. The table indicates that our three main stylized facts continue to hold. First, EMDE are more procyclical than AE (0.26 versus -0.19, respectively). Second, commodity exporters are more procyclical than non-commodity exporters (0.27 versus 0.07, with the latter not significantly different from zero.) Third, while procyclicality in both AE and EMDE has fallen since 2006, it has fallen more in non-CE. Indeed, a comparison of Columns 3 and 4 in Table O2 shows that procyclicality in CE has fallen from 0.27 to 0.20 but, in non-CE, acyclicality has turned into significant countercyclicality.

8.3 Beta regressions

This appendix reports another method based on Lane (2003), and referred to as "beta regressions," of estimating fiscal procyclicality by using linear regressions. The variables are the log differences of real GDP and government spending. The beta regressions (one per country for a total of 195 countries) can be written as

$$d(\log(y_{it})) = \alpha_i + \beta_i d(\log(x_{it})) + \varepsilon_{it},$$

where y_{it} is real GDP for country i in year t and x_{it} is real government spending. First-order autocorrelation is corrected for. Table O3 reports the sign (positive or negative) of β_i in the beta regressions as well as the sign obtained by computing the correlation between the HP-filtered cyclical components of real GDP and government spending. A positive (negative) sign indicates government spending procyclicality (countercyclicality). Out of 195 countries, therefore, 132 countries have a positive β_1 and 147 have a positive correlation.

The correlation between the betas and the HP filter correlations is 0.66. There is thus a strong positive correlation between the two different approaches (HP filter and beta regressions).

[55] Kaminsky *et al.* (2004) and Carneiro and Garrido (2016) also test robustness using the Baxter-King filter. In addition, the latter compute fiscal cyclicality indicators using the Christiano-Fitzgerald and Butterworth filters and the Harvey unobserved components model. All key results are unaffected.

8.4 Robustness of fiscal and output estimates

Tables 2 and 3 in Section 4 report the empirical estimates of the response of output and government spending to changes in commodity prices. Given that the sample used (15 countries) is rather small, this online appendix discusses alternative specifications that show robustness and offer complementary evidence.

8.4.1 Larger sample

One simple way of showing robustness is to resort to a bigger sample. In our case, dropping the requirement that countries have quarterly fiscal data allows us to put together a dataset of 42 commodity exporters (37 EMDE and 5 AE). The criteria for EMDE to be part of this sample is that they be commodity exporters with an average population in the sample of more than 10 million and average GDP per capita of less than $25,000.[56]

We run the same set of regressions reported in Tables 2 and 3. Results are shown in Tables O4 and O5. Results are roughly the same as in Tables 2 and 3 in Section 4. In particular, our key result regarding fiscal cyclicality holds: (i) for EMDE, an increase in 10 percent in commodity prices *raises* government spending by 0.4-0.9 percent, (ii) while, for AE, it leads to a *reduction* in government spending by 0.4-1.0 percent. The corresponding figures in Table 3 are 0.6-0.8 and 0.7-1.2, respectively.

8.4.2 Non-commodity exporters

We now look at the behavior of non-commodity exporters in response to commodity price shocks. The idea is to check whether non-commodity exporters's behavior is consistent with our story. The sample comprises 86 non-exporters from Table A1 (56 EMDE and 30 AE). Results are reported in Table O6.

The main message to be taken from Table O6 is that shocks to prices of commodities have no effect on government spending, whether in EMDE non-commodity exporters or AE. This is reflected in the fact that, as Table O6 shows, the coefficient

[56] This 42-country sample comprises Afghanistan, Algeria, Angola, Argentina, Australia, Brazil, Burkina Faso, Cameroon, Canada, Chile, Colombia, Congo, Democratic Republic, Côte d'Ivoire, Ecuador, Ethiopia, Ghana, Guatemala, Iceland, Indonesia, Iran, Islamic Republic, Iraq, Kazakhstan, Kenya, Madagascar, Malawi, Mali, Mozambique, Myanmar, New Zealand, Niger, Nigeria, Norway, Peru, Russia, Senegal, South Africa, Sudan, Tanzania, Uganda, Ukraine, Uzbekistan, Yemen, Republic of.

on the commodity export price index is never significant. In contrast, in the case of commodity exporters, shocks to commodity prices always affect government spending. In other words, telling a story about "pours" requires commodity exporters; the story would not go through with non-commodity exporters.

Table O1. Cyclicality of Different Categories of Government Spending

Dependent Variable: Change in various governments spending categories

Independent Variable: Change in Log Real GDP

(Annual data)

	Emerging markets and developing economies	Advanced economies
Government spending	0.66***	-0.16***
	(0.04)	(0.05)
Government consumption	0.54***	0.08***
	(0.04)	(0.02)
Government capital formation	0.54***	0.09***
	(0.04)	(0.02)
Interest payments	-1.51	2.40
	(1.09)	(1.90)
n(Expend.)	4171	1251
n(Consump.)	3353	1181
n(GCF)	3353	1181
n(interest)	125	144

Notes: Robust standard errors in parenthesis. *, **, and *** denote significance at 10, 5, and 1 percent level, respectively. n(.) denotes number of observations for each of the four cases.

Sources: Government spending corresponds to WEO's general government total expenditure. This includes total expenses and hence social transfers. Government consumption corresponds to the World Bank's general government final consumption expenditure (from World Development Indicators). This includes all government purchases of goods and services but excludes social transfers. Gross capital formation is approximated by government spending minus government consumption. Interest payments are defined as overall fiscal balance (% of GDP) minus primary balance (% of GDP).

Table O2: Baxter-King filter

	Figure 1	Figure 2	Figure 3	Figure 4
AE	-0.19***			
EMDE	0.26***			
CE		0.27***	0.27***	0.20***
Non-CE		0.07	0.05	-0.14**

Table O3. Sign of betas and correlations

	Positive #	Negative #	Total
Beta	132	63	195
Correlations	147	48	195

Source: Authors' calculations, as reported in text.

Table O4. GDP regressions (sample B)

	Dependent variable: GDP					
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	**EMDE**	**EMDE**	**EMDE**	**Full**	**Full**	**Full**
Commodity Export Price Index (EPI)	0.045 ***	0.031 ***	0.034 ***	0.032	0.030	0.034
	(0.01)	(0.01)	(0.01)	(0.025)	(0.03)	(0.02)
Terms of Trade		0.018			0.017	
		(0.02)			(0.013)	
GDP (-1)			0.341 ***			0.343 ***
			(0.03)			(0.02)
Commodity Export Price Index x EMDE				0.013	0.002	0.0004
				(0.03)	(0.03)	(0.02)
Observations	1267	1122	1230	1457	1212	1415
R-squared	0.02	0.02	0.19	0.02	0.02	0.19
Countries	37	37	37	42	42	42
F-Test joint Commodity EPI and EMDE interaction				***	***	***

Notes: Panel least squares with country fixed effects. All variables are in log-differences. Standard deviations in parentheses. Full refers to the sample with AE and EMDE. *,**, and *** indicate statistical significance at 10, 5, and 1 percent, respectively. Sample B comprises 42 CE countries (37 EMDE and 5AE).

Table O5. Fiscal regressions (for sample B)

	Dependent variable: Real Government Spending					
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	**EMDE**	**EMDE**	**EMDE**	**Full**	**Full**	**Full**
Commodity Export Price Index (EPI)	0.050 *	0.094 ***	0.040	-0.099	-0.042	-0.098
	(0.03)	(0.04)	(0.026)	(0.07)	(0.09)	(0.07)
Terms of Trade		-0.082			-0.091 *	
		(0.05)			(0.05)	
GDP (-1)			0.451 ***			0.463 ***
			(0.1)			(0.09)
Commodity Export Price Index x EMDE				0.149 **	0.140	0.137 *
				(0.075)	(0.09)	(0.07)
Observations	926	847	917	1103	937	1091
R-squared	0.003	0.01	0.03	0.005	0.01	0.03
Countries	37	37	37	42	42	42
F-Test joint Commodity EPI and EMDE interaction				**	***	

Notes: Panel least squares with country fixed effects. All variables are in log-differences. Standard deviations in parentheses. Full refers to the sample with AE and EMDE. *,**, and *** indicate statistical significance at 0.10, 0.05, and 0.01 percent, respectively. Sample B comprises 42 CE countries (37 EMDE and 5AE).

Table O6. Fiscal regressions (for non-commodity exporters)

	Dependent variable: Real Government Spending					
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	**EMDE**	**EMDE**	**AE**	**AE**	**Full**	**Full**
Commodity Export Price Index (EPI)	-0.015	-0.013	-0.0161	-0.009	-0.016	-0.010
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
GDP (-1)		0.366 ***		0.418 ***		0.381 ***
		(0.08)		(0.06)		(0.05)
Commodity Export Price Index x EMDE					0.001	-0.03
					(0.03)	(0.03)
Observations	1397	1393	856	844	2253	2237
R-squared	0.0003	0.03	0.0012	0.08	0.0004	0.04
Countries	56	56	30	30	86	86
F-Test joint Commodity EPI and EMDE interaction						

Notes: Panel least squares with country fixed effects. Standard deviations in parentheses. All variables are in log-differences. Full refers to the sample with AE and EMDE. *,**, and *** indicate statistical significance at 0.10, 0.05, and 0.01 percent, respectively.