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# Why Some Countries Can Escape the Fiscal Pro-Cyclicality Trap and Others Cannot?

*Santiago Herrera*
*Wilfred A. Kouame*
*Pierre Mandon*

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## Abstract

This paper analyzes the procyclicality of fiscal policy on the tax and spending sides in a sample of 116 developing countries between 2000 and 2016. About 20 percent of the countries in the sample switched from procyclical to countercyclical policy stance. In Sub-Saharan Africa, 30 of 39 countries remained caught in the procyclicality trap and the region has the highest degree of procyclicality. The Middle East and North Africa region switched from a countercyclical policy stance to a procyclical one over time. The Europe and Central Asia and Latin America and the Caribbean regions significantly reduced the degree of procyclicality. The main economic variables that affect procyclicality are financial depth, tax base variability, and natural resource dependence. In line with the political economy literature, the perception of corruption, social fragmentation, and inequality in resource distribution are positively associated with procyclicality. The findings also show that the quality of fiscal institutions is associated with procyclicality; countries with fiscal rules have smaller procyclical bias, but the effect is not homogeneous; and higher degrees of expenditure rigidity are associated with lower procyclical bias. The study finds asymmetric policy stances along the business cycle, with procyclicality being more pronounced during recessions. Similarly, the political cycle affects procyclicality, as procyclical bias increases in electoral years. From the tax management perspective, procyclical bias is still present, but there are significant changes: most of the political economy variables lose significance; the resource-dependence variable is not significant; external credit availability reduces procyclicality; tax base variability increases procyclical bias; and expenditure rigidity is no longer significant, but fiscal space becomes determinant of procyclical bias.


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# Why Some Countries Can Escape the Fiscal Pro-Cyclicality Trap and Others Cannot?

Santiago Herrera[1], Wilfred A. Kouame, and Pierre Mandon

**Keywords:** Procyclicality, public spending, tax rate, rigidity
**JEL codes:** E62, E32, E02, F41, Q32

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## I. Introduction

This paper examines the major determinants of fiscal procyclicality identified in previous literature (Frankel et. al., 2013; Vegh and Vuletin, 2015; and Aizenman et al., 2019), expanding the database, including new variables, namely the fiscal space and degree of rigidity of spending, and measuring procyclicality of tax rates (Aizenman et al., 2019), in addition to spending. Discretionary fiscal policy can help stabilize the economy, but there is evidence that in some developing countries fiscal policy may play a destabilizing role (Suescun, 2007) and in developed economies, the stabilizing properties have been questioned (Debrun et al., 2008). The procyclical nature of fiscal policy, by which countries use contractionary policy during recessions and expand while in booms, has been associated with more volatility and has been studied for decades. Still, we observe procyclical fiscal behavior, more common in developing economies than in developed ones, more prevalent in some regions, such as Africa, than in others, and countries move from procyclical to countercyclical behavior over time.

This paper describes procyclical behavior in a large set of countries, along the lines of previous literature (Frankel et. al., 2013) with several variations: 1) Focusing exclusively on developing countries; 2) expanding the time period to 2016 to include the fiscal expansion during the Great Recession and lack of adjustment in the growth recovery phase; 3) including more specific variables to examine the quality of institutions to provide more detailed discussion; 4) Adding a set of explanatory variables to capture social fragmentation or polarization which may complement the traditional macroeconomic explanations such as borrowing constraints or volatility of revenues (Ilzetzki, 2011). 4) focusing on regional differences, between Africa, Latin America and the Middle East where the more salient features and changes in procyclicality take place; and 5) accounting for effects of expenditure rigidity and fiscal space.

The literature from the last two decades provides significant insights regarding procyclical fiscal policy, with most of the papers contrasting results between the developed economies and the developing world. The first generation of papers highlighted the lack of access to credit and international capital markets to explain such a behavior, with the seminal contribution of Gavin and Perotti (1997) focusing on Latin American countries. The second generation of papers, illustrated by Talvi and Vegh (2005) examined the role of political distortions, and particularly political polarization, to explain the "voracity effects" on the budget during booms. This explanation was found to be the most relevant empirically (Ilzetzki, 2011). Alesina et al. (2008) and showed that higher (perceived) levels of corruption (especially with a lack of fiscal transparency) led to a rational decision of the voters to "starve the Leviathan", i.e., to reduce political rents by optimally demanding more public goods (and/or lower taxes) during booms.

More recent developments in the literature have examined the resource-led boom of many developed economies and concluded that procyclical behavior was stronger in resource dependent nations (Arezki

and Bruckner, 2012), with further examination and focus on Sub-Saharan Africa (SSA) (Konuki and Villafuerte, 2016).

The paper has seven sections. The next section describes the data and stylized facts of procyclicality over the period 2000-2016. Section III presents the empirical strategy. Section IV discusses the findings of procyclicality both on the taxation and spending sides. Section V presents a discussion on policy options to mitigate procyclicality, with a focus on the effect of fiscal institutions and fiscal rules on procyclicality. Section VI explains the cross-regional differences in procyclicality. Finally, Section VII presents concluding remarks.

## II. Data sets and stylized facts

To examine the correlation between a country's fiscal policy stance and the business cycle, the standard procedure is to regress the cyclical real GDP on the cyclical real primary general government expenditures.[2] We run equation (1) below on a sample of 116 developing countries for the 2000-2016 period.[3]

$$Cycl.rggpx_{it} = \alpha + \beta Cycl.rgdp_{it} + \gamma_i + \delta_t + \varepsilon_{it}, \quad (1)$$

where α refers to the intercept, and subscripts, i and t stand for country and year. $\gamma_i$ and $\delta_t$ are country and year fixed effects (regional fixed effects are absorbed by country fixed effects). β, the coefficient of interest, captures the variation of cyclical spending (in local currency) due to changes in the cyclical GDP by $x$ units of local currency. Later sections explore cyclicality in the tax rates as in Aizenman et al. (2019), using the Vegh and Vuletin (2015) database on tax rates.

To examine how fiscal policy management evolved over time, we split the period into two subperiods: 2000-2008 (pre-global recession) and 2009-2016 (post-global recession) and compared how each country's procyclicality coefficient changed over time. In the first subperiod, 64% of the countries had a procyclical fiscal stance, while in the second one the percentage fell to 60% (Figure 1).[4] Hence, only 40% of developing countries ran countercyclical fiscal policy in the second subperiod, but in SSA the proportion was only 20% (8 of 38) (Fig. 2). In LAC, 50% of the countries ran countercyclical fiscal

[2] Alesina et al. (2008), Frankel et al. (2013). The cyclical components of GDP and expenditures are estimated using the Hodrick-Prescott (HP) filter with a smoothing parameter of 6.25, as done by Ravn and Uhlig (2002). Though correlation cannot be interpreted as causation, Ilzetsky and Vegh (2008) show that output causes government spending when properly instrumented. Konuki and Villafuerte (2016) also conclude that output shocks drive fiscal policy.

[3] See Appendix A for a detailed description of the data set and the sample selection process. To make results comparable with previous literature, Frenkel, et al. (2013), Vegh and Vuletin (2015), and Aizenman et al., (2019).

[4] Figures 1 and 2 replicate the format employed by Frankel et al. (2013).

policy. Over time, SSA countries did not change their procyclical stance, while ECA and LAC reduced their procyclical stance, and MENA switched from a countercyclical to a procyclical stance, while South Asia and East Asia maintained their countercyclical stance on average (Table 1). In the remainder of the paper, we seek to explain why procyclicality is more prevalent in some countries and regions than in others and why some countries can switch from procyclical to countercyclical fiscal policy management.

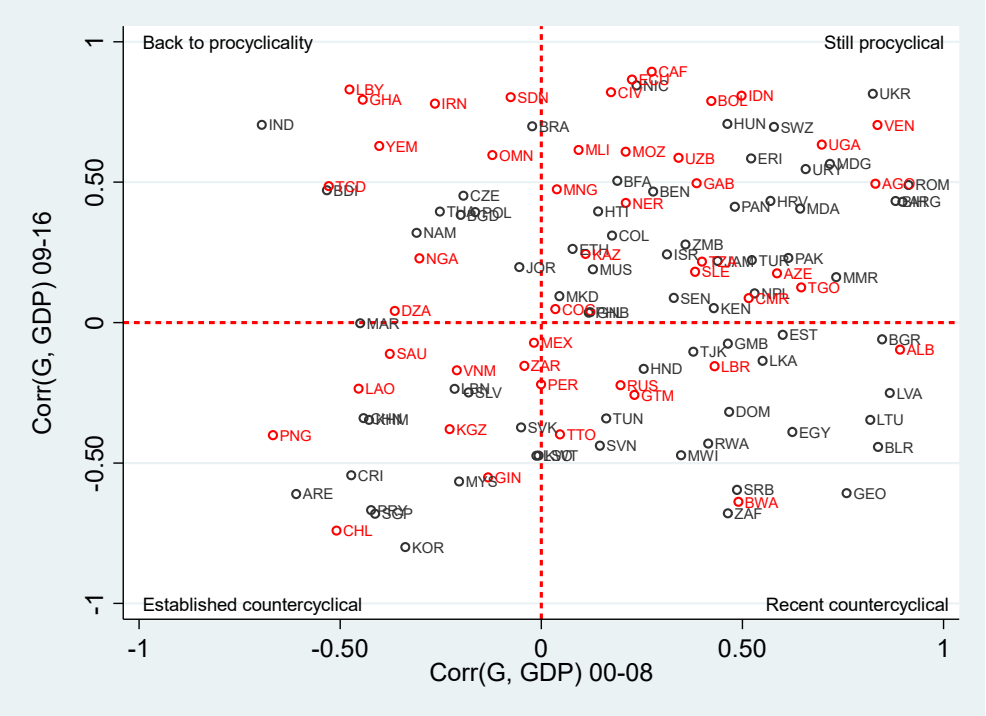
**Table 1: Evolution of (pro)cyclicality at the regional level, over time**

| # | Code | Region | Corr(G, GDP) 2000-2008 | Corr(G, GDP) 2009-2016 |
|---|---|---|---|---|
| 1 | ECA | Europe and Central Asia | 0.48 | 0.05 |
| 2 | LAC | Latin America and Caribbean | 0.20 | 0.09 |
| 3 | MENA | Middle East and North Africa | -0.23 | 0.12 |
| 4 | SEAP | South, East Asia, and Pacific | -0.07 | -0.02 |
| 5 | SSA | Sub-Saharan Africa | 0.23 | 0.22 |

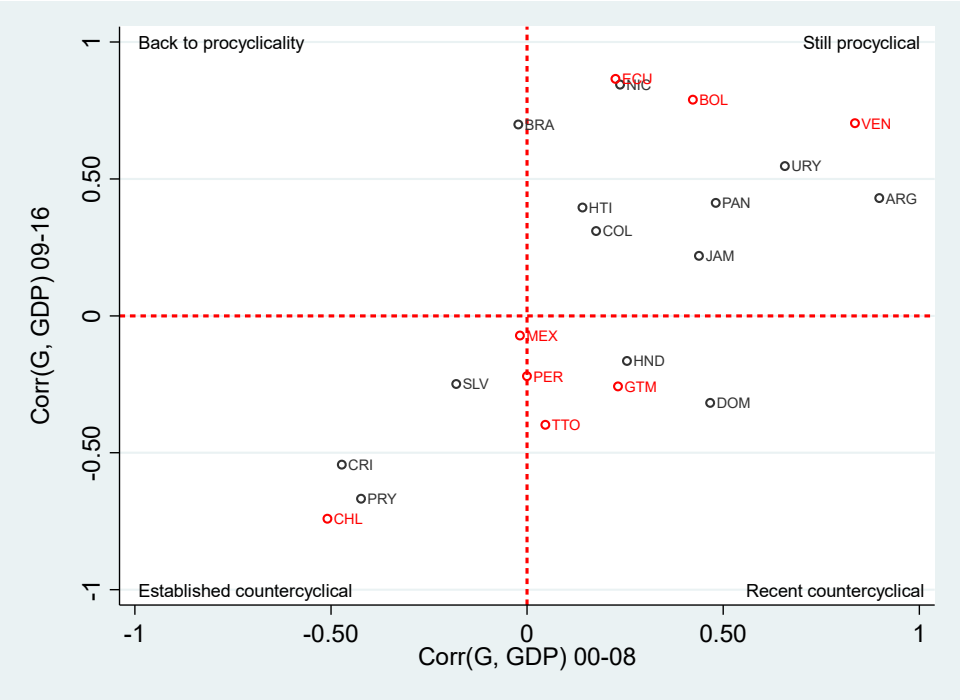
**Figure 1: Progress in Fiscal Policy Management 2009-2016**

(In red, resource-rich countries)

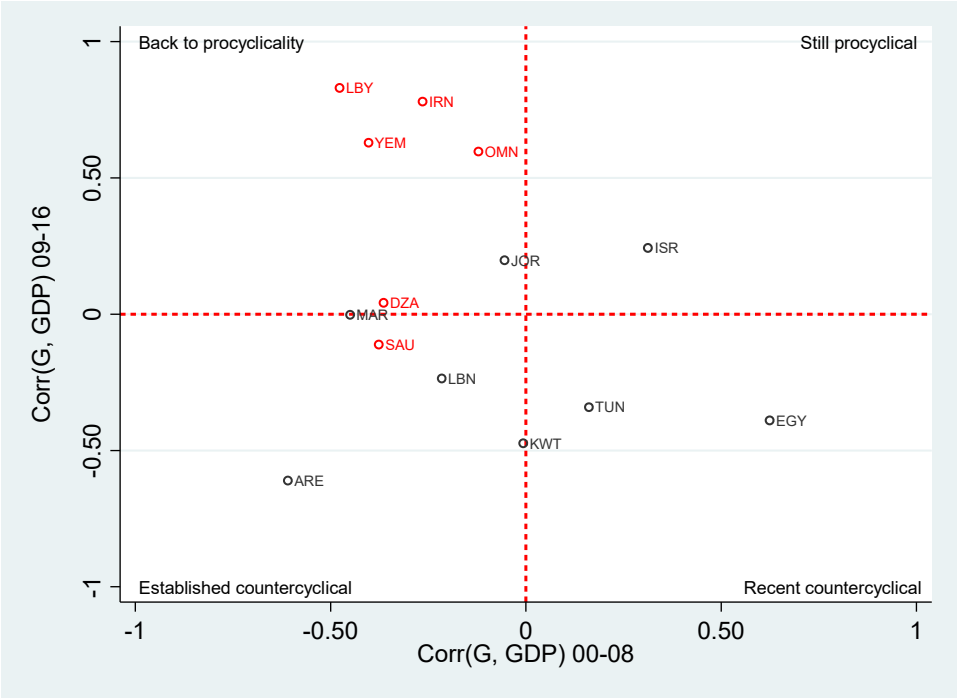
**A. Entire sample**



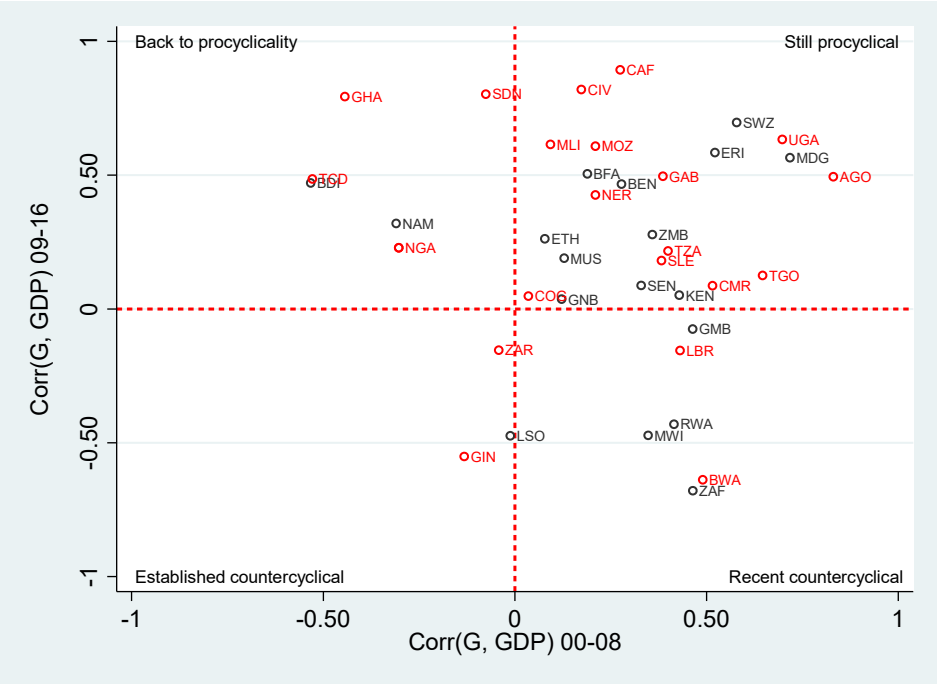
## B. Latin America and the Caribbean (LAC)



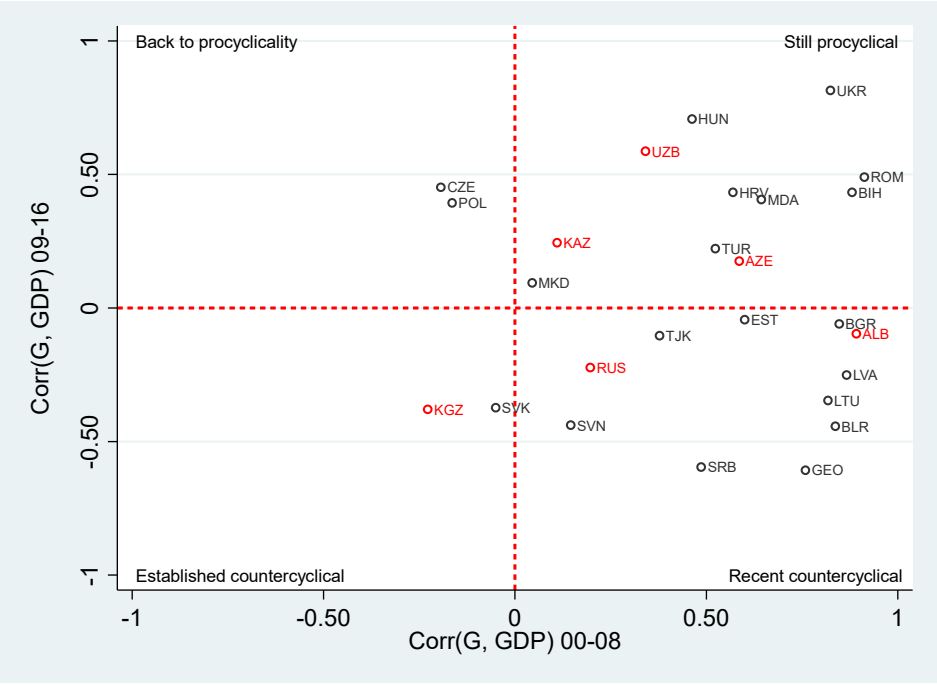

## C. Middle East and North Africa (MENA)



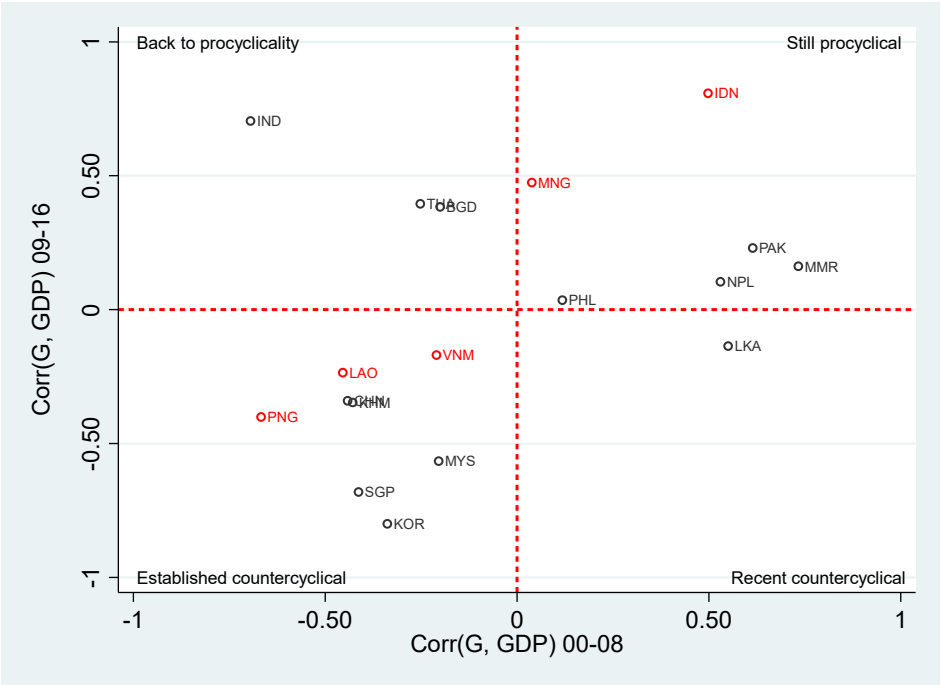
## D. Sub-Saharan Africa (SSA)




## E. Eastern and Central Europe (ECA)



### F. South, East Asia and Pacific (SEAP)




## III. Empirical strategy

To analyze the determinants of fiscal procyclicality both on the tax and spending sides, regression (1) is expanded to include, as covariates, interacting terms of the output gap with the conditioning explanatory variables, following Alesina et al. (2008) and Frankel et al. (2013). Eq. (2) captures the effects of conditional factors on procyclicality as follows[5]:

$$Cycl.rggpx_{it} = \alpha + \beta Cycl.rgdp_{it} + \varphi Cycl.rgdp_{it} \times W_{it} + \mu W_{it} + \boldsymbol{\rho_x X}_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (2)$$

The variable $W_{it}$ refers to conditional effects of procyclicality and capture the non-linearity of the cyclical GDP on spending. We check for the following possible conditioning factors considered in the literature.

**Financial depth effects.** The first generation of papers on the determinants of procyclicality focused on the role of liquidity constraints as the main explanatory factor. Gavin and Perotti (1997) and

[5] The cyclical component of expenditure is measured as in Frankel, et al. (2013), while the cyclicality of tax rates is based on the Vegh et. al. database and the method presented by Aizenman et al. (2019).

Mendoza and Oviedo (2006) are classic examples of this literature. Along these lines, several measures of financial depth or access to international credit markets are used. Financial depth is proxied by the ratio of credit to the private sector over GDP and capital openness with the Kaopen index by Chinn and Ito (2006),

**Tax base variability effects.** Some of the pioneer studies on procyclicality stressed how the volatility of the revenue base, in the presence of political constraints of generating higher surpluses during boom periods, lead to borrowing less during recessions to maintain intertemporal budget constraints, and hence, configuring the procyclical nature of policy (Talvi and Vegh, 2005).

**Rigidity of spending.** This paper defines rigidity of spending as the relative importance of factors explaining the current levels of spending. Rigid components of public expenditure are difficult to change due mainly to the associated costs. The rigidity of public spending is measured as the sum of the components of public expenditure in wages, pensions, and interest payment as a percentage of total expenditure. The expected sign is ambiguous as the less flexible spending is, the less it can be used as a countercyclical tool. But a higher degree of structural spending will stabilize spending and hence will not increase due to upturns in the cycle, which are temporary.

**Quality of institutions.** Papers in the political economy literature examining factors that determine fiscal outcomes emphasized the role of perceived corruption in a system of low transparency and limited fiscal monitoring leading rational voters to "starve the Leviathan" in order to mitigate the principal-agent problem (Alesina et al., 2008). Hence, during booms, the rational voter would demand more public goods and services, leading to the procyclical bias. Besides perceived corruption, other institutional factors may affect procyclical bias. Some authors consider averages of several indicators (Frankel et al., 2013), which has the advantage of parsimony, though at the cost of reduced granularity for policy implications. Here we include fiscal institutions and examine the role of rigidities in the budget as well as that of fiscal rules and fiscal councils on procyclicality.

**Level playing field.** A branch of the literature examines the role of political and social fragmentation or the poor rule of law and, more generally, unequal distribution of resources within societies, which may lead to "voracity effects" on the budget and accentuate the common pool problem, and hence the procyclical bias (Ilzetzki, 2011).

**Natural resources.** As highlighted by the natural resource curse literature, natural resources imply large public rents originated without taxation and are subject to potential elite capture problem. Hence, it is

expected that the procyclicality would be even higher in resource-dependent and resources-rich countries due to exacerbated political distortions.

**Other potential factors.** We examine whether the procyclical behavior is symmetric along the business cycle, i.e., if governments increase spending during recessions but do not cut it during booms. Hence, we explore whether there is an asymmetry along the business cycle. We also examine the impact of political cycles on the fiscal policy reaction function. Another factor which may be associated with procyclicality of fiscal management is the existence of buffers to accommodate shocks, such as the level of public debt or the stock of international reserves. Higher public debt reduces the fiscal space to absorb shock and hence would lead to a more procyclical policy (Frankel et al., 2013).

## IV. Estimation results

### A. Cyclicality of public spending

Equation 2 is estimated in multiple stages to examine the role of each factor separately (Tables 1 and 2). The main results to be highlighted are as follows. Without conditioning for any factor, fiscal policy is procyclical (column (3)).[6] The degree of procyclicality decreases with the level of development (column 4).[7] The effect remains large even after introducing conditioning variables. The sign of the $\beta$ coefficient changes when results are conditioned on the perception of corruption variables, but when the average values of those variables are used, then the total effect of the business cycle is about the same order of magnitude, between 0.4 and 0.6. Below we discuss the impact of the different conditioning factors in the sequential stages summarized in Tables 3, 4, and 5. The tax base variability has the expected positive sign (Column (4)), as predicted by the literature.[8] Talvi and Vegh (2005) show that, in the presence of political distortions that make it costly to generate budget surpluses, tax base fluctuations will lead to procyclical policy. We analyze the role of political economy variables later in this section.

The hypothesis of credit constraints being associated with procyclicality cannot be rejected when using the domestic financial depth: larger ratios of credit to the private sector to GDP are associated with lower procyclicality (column 5). At the mean level of the ratio, 35 percent, the total effect of the business cycle is 0.62, which is procyclical. But in countries where the credit ratio is higher, for instance close

[6] All regressions control for a set of missing observations as described in Appendix A.
[7] The level of development is a discrete categorical variable with values from 1 to 4, with 1 assigned to the least developed group and 4 to the most developed.
[8] Variability was measured as the absolute deviation from the mean for each year. Given limited degrees of freedom, it was impossible to calculate other statistics.

to the maximum level (160 percent), fiscal policy is countercyclical, and the reverse happens in countries close to the minimum. The threshold level for switching from procyclical to countercyclical is 68%, which is significantly higher than the median of 21% for developing countries.

The external credit availability, measured by the Chinn and Ito (2006) capital openness variable (column 6) was not significant, similar to previous findings for African countries (Konuki and Villafuerte, 2016), but different from studies with broader samples which include developed economies (Frankel et al., 2013).

The role of the quality of institutions is proxied by two variables which capture the impact of the (perceived) corruption in both the political sphere and in the public services (columns 7 and 8). Higher indices of perceived corruption are associated with higher degrees of procyclicality, in line with previous literature (Alesina et al., 2008). Fiscal policy is procyclical when the perceived corruption indexes exceed .53 (in the political sphere) and .66 (in the public services) threshold levels, as summarized in Table 2. Other papers that explore the role of quality of institutions aggregate different variables to measure the quality of institutions, which has the benefit of parsimony in the analysis but does not allow granularity (Frankel et al., 2013). We also examine the role of institutions by including variables related to the rule of law, and the sign is the expected one (Table 3, column 9), with countries with higher scores in law and order having lower procyclicality bias.

**Table 2: Thresholds to reach a countercyclical policy, whole sample (2000-2016)**

| Conditional effects | Threshold level | Median in sample |
|---|---|---|
| Development level | 3.47 | 2.00 |
| Revenue.ratio (%) | 22.84% | 23.64% |
| Credit.ratio (%) | 82.31% | 25.99% |
| Pol.corruption (0-1) | 0.53 | 0.37 |
| Pub.service.corruption (0-1) | 0.66 | 0.71 |
| Law and order (1-6) | 4.94 | 3.00 |
| Resource.distribution (0-1) | 0.80 | 0.59 |
| Ethnicandrel.stability (0-6) | 2.55 | 4.25 |

**Notes**: Median values are computed on the sample of the respective regression, not the whole sample of 116 countries.

Table 3: Fiscal (pro)cyclicality of expenditure, whole sample (2000-2016): Impacts of development level, tax base, credit constraints, corruption, rule of law and order

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: Cyclicality of real general government primary spending | | | | | | | | | | |
| Cyclicality of real GDP | 0.425** | 2.124*** | 0.107 | 0.279*** | 1.070*** | -0.089 | -1.320** | -0.829** | 1.730*** | -0.114 |
| | (0.199) | (0.706) | (0.378) | (0.092) | (0.313) | (0.310) | (0.653) | (0.400) | (0.118) | (0.414) |
| **Development level** | | | | | | | | | | |
| Crgdp*dvpt.level (polytomic) | | -0.612*** | | | | | | | | |
| | | (0.229) | | | | | | | | |
| **Tax base effect** | | | | | | | | | | |
| Crgdp*tax | | | 0.041 | | | | | | | |
| | | | (0.057) | | | | | | | |
| Crgdp*tax.base.variability | | | | 0.091*** | | | | | | |
| | | | | (0.002) | | | | | | |
| **Credit constraints** | | | | | | | | | | |
| Crgdp*credit.ratio | | | | | -0.013*** | | | | | |
| | | | | | (0.004) | | | | | |
| Crgdp*kaopen | | | | | | 1.178 | | | | |
| | | | | | | (0.920) | | | | |
| **Perceived corruption** | | | | | | | | | | |
| Crgdp*pol.corruption | | | | | | | 2.808** | | | |
| | | | | | | | (1.106) | | | |
| Crgdp*pub.service.corruption | | | | | | | | 2.452*** | | |
| | | | | | | | | (0.927) | | |
| **Rule of law and order** | | | | | | | | | | |
| Crgdp*law.order | | | | | | | | | -0.350*** | |
| | | | | | | | | | (0.042) | |
| Crgdp*rule.of.law | | | | | | | | | | 1.213 |
| | | | | | | | | | | (1.153) |
| Constant | -377.001 | 152.592 | -1,680.682 | -1,180.377 | -66.903 | -8.790 | -1,044.820 | -1,185.272 | 575.096 | -158.364 |
| | (340.819) | (518.802) | (1,848.808) | (956.057) | (461.523) | (582.628) | (1,388.965) | (1,020.610) | (859.336) | (467.021) |
| Adjusted R-squared | 0.067 | 0.135 | 0.083 | 0.114 | 0.148 | 0.105 | 0.150 | 0.157 | 0.122 | 0.108 |
| Rmse | 5,531 | 5,324 | 9,347 | 9,188 | 5,339 | 5,607 | 5,497 | 5,437 | 5,823 | 5,629 |
| Joint significance (p-value) | - | 0.000 | 0.074 | 0.000 | 0.003 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0)/I(1) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,954 | 1,954 | 663 | 663 | 1,802 | 1,707 | 1,639 | 1,639 | 1,569 | 1,639 |
| # countries | 116 | 116 | 42 | 42 | 115 | 115 | 112 | 112 | 99 | 112 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.1 in appendix A for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

We examine the role of variables derived from the political economy literature such as the degree of social fragmentation (Ilzetzki, 2011) or the absence of a level playing field, such as the power distribution among social groups, the distribution of resources within societies, and the level of ethnic-religious tensions (Table 4, columns 1 to 3). All these variables are considered as a proxy to the social polarization, to capture the impact of the "voracity effect" on the budget. Indeed, social polarization is mostly captured by ethnic/linguistic/religious polarization indicators. We find that more equal distribution of resources and more ethnic-religious stability are associated with less procyclicality.

One of the more critical determinants of procyclicality is whether the country is resource-dependent or resource-rich (Table 4, columns 4, 5 and 6).[9] In all cases, we find a strong procyclical bias in resources-dependent and resources-rich countries, suggesting a procyclical resource curse, in line with the recent literature (Arezki and Bruckner, 2012; Konuki and Villafuerte, 2016). One of the more interesting results is that procyclicality is arising from resource-dependence increases over time.

We also found a more significant procyclicality bias during election years (Column 7 of Table 4), though the effect appears decreasing over time. This effect is more pronounced in AFR than in LAC or MENA. We find no impact of the debt level on the procyclicality l bias, contrary to findings by Frankel et al. (2013) but like Konuki and Villafuerte (2016) for Africa.

To examine the correlation of procyclicality and fiscal institutions, we include a measure of the rigidity of the budget and variables that describe fiscal rules. The rigidity of spending variable dampens the procyclical bias. The rigid component of public expenditure reduces the procyclical bias (Table 4, column 9). But the effect is asymmetric over the business cycle: the mitigation of procyclicality through spending rigidity is larger during the upturns of the cycle (column 2 of Table 5). Finally, we found no evidence that fiscal space affects the procyclicality of public spending (Table 4, column 10). However, exploring potential heterogeneity over the period, we find that the fiscal space variable affects procyclicality, with lower fiscal space inducing higher procyclicality, but only when the sample is broken to include the most recent years 2009-2016.[10]

Finally, we find evidence of heterogeneous procyclical behavior along the cycle: at first, we find no direct evidence of the asymmetry (Table 5, Column 1), but when the rigidity and fiscal space variables

[9] Resources-dependent countries are countries for which commodity revenues (GGRC in WEO data set) account for at least 10 percent of total revenues minus grants (GGR and GGRG series in WEO data set) at least 50 percent of the time over the considered period. This definition is derived from Konuki and Villafuerte (2016) and enables us to capture countries with a resource-dependent revenue structure. For more details, see Table E.1. Resources-rich countries are defined by the IMF (2012), here is a direct access to the report (https://www.imf.org/external/np/pp/eng/2012/082412.pdf). According to this definition, we capture countries where production on natural resources reached more than 20% of exports. For more details, see Table A.2.

[10] The findings are not presented in the paper but available upon request.

are included, the asymmetric impact becomes evident (Table 5, columns, 2 and 3).[11] However, as discussed above, the level rigidity allows mitigating the procyclicality during the upturns of the business cycle.

[11] The "good times" dummy was constructed as 1 when the cyclical component of GDP was above the potential level, and zero otherwise.

Table 4: Fiscal (pro)cyclicality of expenditure, whole sample (2000-2016): Impacts of the level playing field, natural resources, and other factors

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: Cyclicality of real general government primary spending | | | | | | | | | | |
| Cyclicality of real GDP | 0.496*** | 1.557*** | -0.159** | -0.154** | -0.159** | 0.385** | 0.393* | 1.143** | 0.473* | 0.473* |
| | (0.174) | (0.453) | (0.073) | (0.075) | (0.073) | (0.191) | (0.232) | (0.459) | (0.268) | (0.268) |
| **Level playing field** | | | | | | | | | | |
| Crgdp*power.distribution | 0.364 | | | | | | | | | |
| | (0.326) | | | | | | | | | |
| Crgdp*resource.distribution | | -2.291*** | | | | | | | | |
| | | (0.624) | | | | | | | | |
| Crgdp*ethnicandrel.stability | | | -0.416*** | | | | | | | |
| | | | (0.152) | | | | | | | |
| **Natural resources** | | | | | | | | | | |
| Crgdp*resource.dependant (bd) | | | | 0.610** | | | | | | |
| | | | | (0.243) | | | | | | |
| Crgdp*resource.rich (bd) | | | | | 0.605** | | | | | |
| | | | | | (0.240) | | | | | |
| Crgdp*resource dependant and rich | | | | | | 0.610** | | | | |
| | | | | | | (0.244) | | | | |
| **Other factors** | | | | | | | | | | |
| Crgdp*elections | | | | | | | 0.161** | | | |
| | | | | | | | (0.066) | | | |
| Crgdp*debt.ratio | | | | | | | | 0.001 | | |
| | | | | | | | | (0.003) | | |
| Crgdp*rigidity | | | | | | | | | -0.037** | |
| | | | | | | | | | (0.015) | |
| Crgdp*fiscal space | | | | | | | | | | -0.000 |
| | | | | | | | | | | (0.000) |
| Constant | -269.523 | -270.481 | 482.975 | -330.074 | -292.797 | -298.574 | -413.932 | -434.781 | 537.497 | -540.189 |
| | (502.504) | (436.305) | (807.001) | (367.332) | (328.276) | (327.165) | (355.390) | (283.039) | (376.005) | (420.066) |
| Adjusted R-squared | 0.113 | 0.094 | 0.185 | 0.078 | 0.078 | 0.078 | 0.069 | 0.065 | 0.004 | 0.066 |
| Rmse | 5,615 | 5,672 | 5,610 | 5,497 | 5,498 | 5,497 | 5,525 | 5,593 | 824 | 5,632 |
| Joint significance (p-value) | 0.00 | 0.001 | 0.000 | 0.029 | 0.029 | 0.029 | 0.004 | 0.009 | 0.015 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,639 | 1,639 | 1,569 | 1,954 | 1,954 | 1,954 | 1,954 | 1,913 | 871 | 1,886 |
| # countries | 112 | 112 | 99 | 116 | 116 | 116 | 116 | 115 | 54 | 113 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.1 in appendix for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Fiscal (pro)cyclicality of expenditure, whole sample (2000-2016): Impacts of rigidity, fiscal space and business cycle

| Dependent variable: Cyclicality of real general government primary spending | (1) | (2) | (3) |
|---|---|---|---|
| Cyclicality of real GDP | 0.611*** | -0.407 | 0.402 |
| | (0.028) | (1.059) | (0.376) |
| **Business cycle** | | | |
| Crgdp*economic upturn | -0.230 | 2.763*** | 2.959* |
| | (0.299) | (0.817) | (1.549) |
| Crgdp*economic upturn*rigidity | | -0.047*** | |
| | | (0.017) | |
| Crgdp*rigidity | | 0.005 | |
| | | (0.019) | |
| Rigidity of public spending | | -9.681 | |
| | | (6.120) | |
| Crgdp*economic upturn*fiscal space | | | -0.001 |
| | | | (0.002) |
| Fiscal space | | | 0.150 |
| | | | (0.164) |
| Crgdp*fiscal space | | | 0.001 |
| | | | (0.002) |
| Economic upturn | 29.722 | 66.490* | 21.955 |
| | (226.974) | (34.059) | (220.581) |
| Constant | -468.287 | 464.121 | -453.536 |
| | (569.519) | (371.214) | (486.993) |
| Adjusted R-squared | 0.071 | 0.013 | 0.078 |
| Rmse | 5,518 | 820,2 | 5,597 |
| Joint significance (p-value) | 0.00 | 0.002 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) |
| Cluster | country | country | country |
| Covariates | Yes | Yes | Yes |
| Observations | 1,954 | 871 | 1,886 |
| # countries | 116 | 54 | 113 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.1 in appendix A for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

**Instrumental Variable Estimation**

Our identification strategy in the estimations above has two problems: the omitted variable bias and endogeneity of the cyclical real GDP. Regarding the omitted variable bias, a significant number of potential covariates might affect both cyclical spending and cyclical GDP, and here we have included a large number of covariates analyzed in the literature. Still, there is uncertainty regarding the true model underlying the determination of procyclicality. Future research could consider a Bayesian approach to estimation.

Regarding the endogeneity of cyclical real GDP, one might infer the reverse causality in the empirical specification, due to multiplier effects (IMF, 2014). To address these problems, we adopt an instrumentation strategy in the spirit of Fatas and Mihov (2013), collapsing the panel data over the period 2000-2016 and using instruments from the year 1999, the year before the start of our sample period. The main instrument is the initial cyclical real GDP, and in successive columns we consider the initial values for each conditioning factor highlighted in Tables 1 and 2: the initial values for the tax ratio; the credit ratio; the perceived corruption of politicians; the perceived corruption in public services; the rule of law; the power distribution; the resource distribution; and the ethnic/religious stability. The multivariate regressions are summarized in Table 6. Irrespective to the set of instruments, procyclicality coefficients are statistically significant and robust.[12]

[12] Note that with the collapse of the data, all binary dummy (BD) variables refer not to the presence of a condition (i.e. a missing variable), but to the percent of time with the considered condition (i.e. the percent of time with a missing variable over 2000-2016).

## Table 6: Fiscal (pro)cyclicality, Instrumental Variables Regressions (2000-2016)

| | Cyclicality of real general government primary spending | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Variables | IV 2SLS | | | | | | |
| Cyclicality of real GDP | 0.329*** | 0.327*** | 0.322*** | 0.320*** | 0.328*** | 0.324*** | 0.327*** |
| | (0.067) | (0.063) | (0.063) | (0.063) | (0.068) | (0.063) | (0.068) |
| Constant | -3.128 | -3.862 | -4.644 | -4.715 | -4.009 | -4.556 | -4.040 |
| | (24.320) | (22.203) | (22.544) | (22.532) | (25.390) | (22.560) | (25.250) |
| Centered R-squared | 0.141 | 0.145 | 0.147 | 0.148 | 0.144 | 0.146 | 0.145 |
| Rmse | 156 | 147 | 147 | 147 | 146 | 147 | 158 |
| Weak ID test (stat>10) | 103.953 | 119.327 | 118.917 | 120.440 | 100.334 | 119.050 | 100.753 |
| OID test (p-value) | 0.813 | 0.803 | 0.189 | 0.177 | 0.329 | 0.426 | 0.948 |
| Intruments | Initial Crgdp | Initial Crgdp | Initial Crgdp | Initial Crgdp | Initial Crgdp | Initial Crgdp | Initial Crgdp |
| | Initial revenue.ratio | Initial credit.ratio | Initial pol.corruption | Initial pub.service.corruption | Initial law.order | Initial resource.distribution | Initial ethnicandrel.stability |
| Covariates | Set2 | Set2 | Set2 | Set2 | Set2 | Set2 | Set2 |
| Observations (# countries) | 95 | 108 | 108 | 108 | 108 | 108 | 94 |

Notes: The year 1999 is considered as reference for the initial Crgdp and successive instruments. The full list of removed countries per columns is available upon request. With the collapse of the data, all BD variables refer not to the presence of a condition (i.e., a missing variable), but to the percent of time with the considered condition (i.e., the percent of time with a missing variable over 2000-2016).

### B. Cyclicality of policy: Tax rates

The cyclical behavior of policy can also be examined from the tax side, as proposed by Vegh and Vuletin (2015) and done recently by Aizenman et. al. (2019). Accordingly, we study the cyclicality of policy based on three different taxes, namely the individual income tax rate, the corporate tax rate and the VAT rate, and the same conditioning factors described in the previous part of this paper. Results are summarized in Tables B.1 to B.9 in appendix B. We find unconditional procyclical fiscal policies, as coefficients in column 1 of Tables B.1, B.4 and B.7 are negative and statistically significant, implying lower tax rates during good times and higher tax rates during bad times.

In addition, we find notable economic nonlinearities and heterogeneity across the different types of taxes. VAT tax rates show significantly lower procyclical bias, which would imply a benefit of using this type of tax from a purely stabilizing perspective. The development level of countries (column 2 of Tables B.1, B.4 and B.7) seems to reduce only the procyclicality of corporate tax rates. The level of resource mobilization reduces the procyclicality in the case of corporate tax and VAT rates but amplifies it in the case of individual income rates (Tables B.1, B.4 and B.7, column 3). Tax base variability is associated with more procyclical individual income and corporate tax rate but less procyclical VAT rates (column 4 of Tables B.1, B.4 and B.7). The financial openness, proxied with the capital account openness index mitigates the procyclicality of individual income and corporate taxes, but does not have any impact on VAT rates (column 6 of Tables B.1, B.4 and B.7). The levels of perceived political corruption and corruption in the public service are positively correlated with the procyclicality of VAT rates (columns 7, 8 of Table B.4).

The ethnic and religious stability contributes to reduce the procyclicality of VAT rates (column 3 of Table B.5). Elections are also associated to less procyclicality of corporate income tax rates and VAT tax rates (column 7 of Tables B.2 and B.11). Note that the expenditure rigidity is not correlated with the cyclicality of tax rates, but larger fiscal space reduces the procyclicality of VAT rates, without any statistically significant effect on the cyclicality of individual income and corporate tax rates (columns 9, 10 of Table B.3, B.5 and B.8). Resource dependence is not statistically significant as a conditioning factor of procyclicality in the tax rates.

## V. How to mitigate the procyclicality bias: Policy options budget composition, decentralization, and fiscal rules

***Top-down solution: Fiscal rules***

This section explores the correlation between the procyclical bias and the existence of fiscal rules and some of their features.[13] National fiscal rules are generally recognized to be more effective than supranational fiscal rules (Tapsoba, 2012). Indeed, supranational rules generally suffer from a problem of insufficient enforcement and compliance. Fiscal rules (FRs) are often criticized to amplify the procyclical bias,[14] but Guerguil et al. (2016) suggest that the design of the rules matters. Based on the fiscal rules data set from the Fiscal Affairs Department, we consider several characteristics of the national FRs, namely (i) if a fiscal council also exists; (ii) the presence of effective monitoring mechanisms; (iii) the presence of effective enforcement mechanisms; (iv) the coverage of general government for the rules; (v) the existence of a written legal basis for the rules (statutory or constitutional); (vi) the presence of escape clauses; and (vii) the presence of other kind of flexibility - investment-friendly rules and cyclically-adjusted rules (see Guerguil et al., 2016). The comparison of the procyclicality bias between countries with and without these features shows (Table C.1 and Figure C.3) that countries with national FRs have a lower procyclical bias, though still positive. The other characteristics that show statistically significant differences are (i) fiscal councils; (ii) monitoring mechanisms; (iii) enforcement mechanisms; (iv) a written legal basis; (v) the presence of escape clauses, and (vi) flexibility features are associated with less procyclicality than non-FR countries, highlighting the relevance of adequate design of national FRs to mitigate procyclicality.

**[insert Table C.1 and Figure C.1]**

***Top-down solution: Fiscal councils***

The other potential top-down solution we explore is another fiscal institution, namely the fiscal councils. Fiscal councils (FCs) are defined as independent, non-partisan agencies with an official mandate to assess fiscal policies, plans, rules, and performance (Debrun et al., 2013). They do not have a direct role in setting policy instruments, but they can influence fiscal behavior through three main channels. First, by fostering transparency of fiscal policy, an FC might reduce the rationale for voters to "starve the Leviathan." Second, they can increase the reputational costs for politicians on unsound policies and broken commitments. Third, they can provide direct inputs to the budget process, with forecasts or assessments of structural positions; as suggested in the previous paragraph they can close technical loopholes that allow governments to circumvent numerical fiscal rules (Debrun et al., 2017). Taking advantage of the FC data set from the Fiscal Affairs Department, we check (i) whether the FC

[13] We account for numerical fiscal rules. For a literature review on procedural rules, see Alesina and Perotti (1999).
[14] On procyclical bias, a petition signed by 1,100 economists and 11 Nobel economists in the New York Times claimed that attempts to strictly keep the budget balance (in US states) would aggravate recession (see Levinson, 1998).

encompasses a large coverage (i.e. general government); (ii) whether the FC make forecasts; (iii) whether the FC makes forecasts on the preparation of the fiscal policy; (iv) whether the FC makes forecasts assessments on the fiscal policy; (v) whether the FC makes recommendations to the government; (vi) whether the FC makes long-term sustainability analyses; (vii) whether the FC establish consistency with the objectives; (viii) whether the FC evaluates the costs of fiscal measures; (ix) whether the FC makes ex-post analysis; (x) whether the FC publish public reports; and (xi) whether the FC has a high media impact. We focus on the period 2009-2016 to evaluate the efficiency of post-crisis policies. The comparison of the procyclical bias across groups of countries with and without these features (Table C.2 and Figure C.2) shows that countries with fiscal councils have lower procyclicality bias; but the largest impact comes from attributes of the council, especially those that examine sustainability and evaluate the costs of different measures. The features are associated with countercyclical spending. Transparency through public reports and the media exposure also matters, in line with predictions by Alesina et al. (2008).

**[insert Table C.2; Figure C.2]**

***Bottom-up solution: Fiscal decentralization***

Though fiscal decentralization may be an effective mechanism to enhance the provision of public service delivery in developing countries, such as the access to primary education, the access of drinking water, the access of refuse and sewage disposal facilities. The discussion still exists around the optimal level of fiscal decentralization for both spending and expenditures. So, the decentralization might be also effective in the struggle against fiscal procyclicality of the general government because of the application of subsidiarity principle. Indicators of fiscal decentralization generally refer to the fiscal composition ratio established by the IMF's Government Finance Statistics Yearbooks (see Blume and Voigt (2008) and Blume et al. (2009) for more details). Instead of establishing arbitrary thresholds for the fiscal ratio, we focus on indicators of political decentralization (PD) established by the Database of Political Institutions provided by the World Bank Group. Namely, we focus on (i) whether there are contiguous autonomous regions; (ii) whether local governments and legislature are elected; (iii) whether state/provinces governments and legislature are elected; (iv) whether states/provinces have authority over taxing, spending, or legislating; and (v) whether the constituencies of the upper house members are the states/provinces. We focus on the period 2009-2015 (2016 not available yet in data) to evaluate the efficiency of post-crisis policies. The correlations (Table C.3 and Figure C.3) show that the closest proxy of fiscal decentralization (i.e. the authority of states/provinces over spending, taxing or legislating) is negatively correlated with fiscal procyclicality, suggesting that decentralization may be a tool to mitigate the procyclicality bias.

**[insert Table C.3; Figure C.3]**

***Bottom-up solution: Direct democracy***

Since the classic Alesina et al. (2008) paper shows that procyclicality (associated with corruption) is a feature of democracies, we explore the role of democratic institutions on procyclicality. Taking advantage of the Varieties of Democracy (V-dem) database, we identify (i) whether the initiative is permitted at the subnational level, and or at the national level; and (ii) whether the popular referendum is permitted at the subnational level, and or at the national level. We focus on the period 2009-2015 (2016 not available yet in data). The correlations (Table C.4 and Figure C.4) show that both the initiative and the referendum are negatively correlated with fiscal procyclicality, but the effect seems stronger for the initiative rights. This finding echoes results of Matsusaka (2014) regarding the effects of initiative on fiscal congruence and fiscal conservatism in U.S. states. Hence, delegating more fiscal legislation to the citizens may be a tool to reduce the procyclical bias.

**[insert Table C.4; Figure C.4]**

***Bottom-up solution: Spending and tax composition***

The literature shows that different types of spending behave differently along the cycle. Ardanaz and Izquierdo (2017) show that current spending is more procyclical during upswings of the cycle, whereas capital spending is more procyclical during downturns. Hence, for policy making purposes and institutional design, it would be beneficial to limit the growth of current spending in the good times, while in bad times protecting the capital spending would be beneficial for stabilization. In this paper, we show that when spending is more rigid, it will be less procyclical during the good times, but less countercyclical during the downturns. The composition of the tax structure also indicates that VAT rates are less procyclical than the other types of taxes., hence adding a potential benefit to using this type of taxes for economic stabilization, along with the proposal of sales tax holidays during the Great Recession (Furman, 2018).

## VI. Differences across regions and countries

Using the Mean Group (MG) estimator (Pesaran and Smith, 1995) we estimate the individual country coefficients of the cyclicality of the real GDP on the cyclicality of primary spending for the entire sample. Equation (2) is adapted for the MG estimator:

$$Cycl.rggpx_{it} = \alpha_i + \beta_i Cycl.rgdp_{it} + \boldsymbol{\rho_{ix}} \boldsymbol{X}_{it} + \varepsilon_{it} \quad (3)$$

To facilitate comparison across regions, we first compute the MG coefficient for the entire sample and then estimate the same model for each region. That is, we compute the procyclicality coefficient for the 112 countries, similar to Table 1, but relaxing the fixed effects constraint.[15] The disadvantage is the limited degrees of freedom when applying this estimator because the methodology consists of estimating OLS regressions at the country level.[16] Table 7 summarizes the results for the entire sample and the different regions. For the overall sample, the effect is positive, indicating the procyclicality effect. Across different regions, the effect is larger in SSA, followed by LAC, and then ECA. The effect is not significant for the overall MENA region.

**Table 7: MG Estimator (2000-2016)**

| | (1) Whole sample | (2) SSA | (1) LAC | (2) MENA | (1) ECA | (2) SEAP |
|---|---|---|---|---|---|---|
| Cyclicality of real GDP | 0.164*** | 0.289*** | 0.229** | -0.042 | 0.188*** | 0.167*** |
| | (0.049) | (0.099) | (0.109) | (0.120) | (0.059) | (0.150) |
| Observations | 1,954 | 653 | 357 | 221 | 440 | 283 |
| # countries | 116 | 39 | 21 | 13 | 26 | 17 |

Notes. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table D.1 allows comparing the different determinants of procyclicality across regions. SSA and LAC, the more procyclical regions, show the lowest credit to private sector ratios. SSA has the highest perception of corruption. Also, it is the region with the highest degree of ethnic and religious fragmentation. Also, SSA has the most unequal distribution of resources, after MENA. All the conditioning factors point at SSA as the one with the highest procyclicality bias.

[15] This is equivalent to relaxing the common know-how (common intercept for each country), and of common technology (common coefficient for each country) which are critical when using macro data.

[16] When balanced, we have 17 observations per country (2000-2016), and six coefficients to be estimated, excluding the intercept. The **xtmg** command by Markus Eberhardt (https://sites.google.com/site/medevecon/code) is considered to regress the MG estimator on STATA software.

MENA is a puzzling case. It has the highest inequality and second highest level of corruption, and it is, on average, not procyclical despite its resource wealth. The level of credit to the private sector is the second highest, suggesting that financial depth may be compensating the negative impact of the other two factors. Maybe the extreme cases of the United Arab Emirates, Saudi Arabia, and Kuwait, that are strongly countercyclical drive the results for the region. This result needs further analysis, probably by introducing the level of international reserves as a control variable, which provides a cushion that allows the policy to be managed countercyclically.

**Across countries**

We compute individual coefficients, and individual standard errors for the 38 SSA countries, which are available upon request. Using such a methodology, we find five to six countries which are countercyclical over the whole period: Guinea, Lesotho and Democratic Republic of Congo, Mauritius, South Africa, and Botswana.[17]

Based on the individual country-coefficients, we examine whether procyclicality is different in the sample of SSA countries for resource-dependent economies.[18] We find that procyclical bias is higher in resource-rich or resource-dependent economies. The average coefficient for SSA economies is .31; for resource-dependent economies, it is .33; and for the other SSA economies, it is .27 (Figure D.1).

The comparison between resource-dependent (and resource-rich) countries in SSA and resource-dependent countries in other regions shows that the procyclicality bias is bigger in SSA. While the SSA resource-dependent economies have a procyclicality coefficient of .33 the analogous category in other regions has .23. However, the resource-rich countries show an even larger contrast: the SSA resource-rich show a procyclicality coefficient of .33 while those of other regions register .08. This is due to the one-to-one mapping between the two groups of countries (resource-rich and resource-dependent), while in other regions the correspondence is not as clear (Figure D.2). In other regions there are resource-rich countries, such as Chile and Mexico, which are not resource-dependent; both show countercyclical behavior.[19]

**[insert Tables D.1 and D.2; Figures D.1 and D.2]**

[17] Cyclicality coefficients for the entire sample of countries in both subperiods are available upon request.
[18] Table 1 shows that the variable is significant for the entire sample, assuming homogeneous coefficients and FE.
[19] The evolution of the coefficient of procyclicality is available upon request.

## VII. Concluding remarks

Fiscal procyclicality has a substantial impact on macroeconomic stability and development outcomes in developing countries. This paper adds to the literature by (i) accounting for the effects of fiscal rigidity and fiscal space; (ii) expanding the time period to 2016 and hence including the fiscal expansion in many countries to tackle the Great Recession and the adjustment of lack of it during the growth recovery; (iii) including more granular examination of the quality of institutions, comparing policy cyclicality in countries with fiscal rules or fiscal councils with that of countries without those institutions; (iv) adding a set of explanatory variables to capture social fragmentation or polarization which may complement the traditional macroeconomic explanations such as borrowing constraints or volatility of revenues; and (v) focusing on regional differences between Africa, Latin America and the Middle East where the more salient features and changes in procyclicality take place.

We find that fiscal policy in developing countries is procyclical both on the tax and spending sides. However, the degree of procyclicality of public spending is conditional on the level of development, the extent of domestic credit constraints, the perceived level of corruption, ethnic-religious stability, and equal distribution of resources. One of the more critical aspects that determine procyclicality is whether the country is natural resource-dependent or not, with the impact of this variable becoming larger over time. On the fiscal institutions, we find that the rigidity of public spending reduces procyclicality bias while the effect is asymmetric along the business cycle: The mitigation of procyclicality is larger during the upturn phase of the cycle.

On the revenue side, we examined three types of tax rates (personal income tax rate, corporate tax rate, and value-added tax rate), and all of them show the procyclical behavior of policymakers. The VAT tax rate shows a smaller procyclical bias. As on the spending side, the development level and financial openness reduce the procyclicality of corporate tax rates. Tax base variability is associated with more procyclicality of the personal income and corporate tax rate while reducing the procyclicality of the VAT rate. The ethnic and religious stability and elections contribute to reducing the procyclicality of VAT rates. Finally, we find no evidence that the rigidity of fiscal spending affects the procyclicality of fiscal space, and the fiscal space does affect the procyclicality of VAT rates. The lower fiscal space increases the procyclicality of the impact on personal and corporate tax rates but operates in the opposite direction in the VAT rate management: lower fiscal space is associated with more countercyclical behavior.

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## Appendix A: Data construction and variable description

### Data construction

Our data set of reference is the WEO (October 2016 version) to capture the general government primary expenditures (GGX and GGEI series), gross domestic product, current prices (NGDP series), the GDP deflator (NGDP_D series), and the terms of trade (TT series).[20] We consider the period of reference by Frankel et al. (2013) from 1960-2009, extended to 2016. To select our countries, we apply the following criteria:

1. We first drop every observation with strictly fewer than one million inhabitants, following Alesina et al. (2008). The underlying idea is those tiny countries are exposed to very large shocks, making the comparison with larger countries more difficult.[21]

2. Then, we drop every country with strictly fewer than 16 years of data (over 1960-2016) for general government primary spending and gross domestic product series, still following Alesina et al. (2008). The underlying idea is that we need to observe at least two or three cycles in each country as we study fiscal procyclicality.

3. We drop all the countries which are simultaneously (i) classified as "high income" for the year 2017 by the World Bank (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups); and (ii) were members to the OECD strictly before the fall of the Soviet Union (year 1992). Under this double selection process, we safely remove all established developed countries, and we keep Turkey, high-income non-OECD countries (such as Saudi Arabia or Singapore) and recent OECD members (such as Israel, Mexico, and Slovenia). By keeping these countries in a first step, we are able to capture more variability in our results and eventually to remove them in a second step for robustness checks.

Applying these three criteria leaves us with a sample of 116 developing countries (the Syrian Arab Republic is removed due to the war) over the period 1960-2016. To maximize the number of countries displayed in our descriptive statistics, we focus mainly on the sub-period 2000-2016.[22]

[20] More details on the variables in Table A.5. We consider the general government primary expenditures, instead of central government, total expenditure and net lending (GCENL series) used by Frankel et al. (2013) as the last one is not available since WEO archives 2009. Accounting for the general government coverage enables us to have comparable spending figures between unitary states and federal states (such as the Democratic Republic of Congo and Nigeria). Accounting for primary spending enables us to account for current performance of administrations, irrespective to the debt service burden.

[21] To capture the population size, we use the "Population, total" series from the WDI data set (updated February 1, 2017), and removed all observations with a blank in the series. We keep Taiwan, China, which in no longer covered in WDI data set, as the population size is over the threshold of one million inhabitants for the whole period.

[22] For example, we do not have data on general government primary expenditures available before 2000 for Nigeria. To avoid confusion, we do not attempt to apply the criteria #2, on the sub-period 2000-2016; as recalled by Alesina et al. (2008), in general, the larger the cutoff for inclusion is –relative to the time horizon we have-, the stronger the results are.

We also highlight resource-dependent countries and resource-rich countries in our sample (note that the two lists are not mutually exclusive), as they are highlighted to be particularly procyclical in the recent literature (Arezki and Bruckner, 2012; Konuki and Villafuerte, 2016):

1. Resource-dependent countries are countries for which commodity revenues (GGRC in WEO data set) account for at least 10 percent of total revenues minus grants (GGR and GGRG series in WEO data set) at least 50 percent of the time over the considered period. This definition is derived from Konuki and Villafuerte (2016) and enables us to capture countries with a resource-dependent revenue structure. For more details, see Table E.1 in Appendix E.

2. Resource-rich countries are defined by the IMF (2012), here is direct access to the report (https://www.imf.org/external/np/pp/eng/2012/082412.pdf). According to this definition, we capture countries where production on natural resources reached (or expected to reach) significant levels. For more details, see Table E.2 in Appendix E.

Treatment of missing data

We expand equation 1 as follows:

$$Cycl.rggpx_{it} = \alpha + \beta Cycl.rgdp_{it} + \boldsymbol{\rho_x X}_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad \text{(A-1)}$$

The vector of covariates $\boldsymbol{X}_{it}$ includes the standard deviation of the terms of trade (TT series in WEO database) measured with five years rolling window, two binary dummy (BD) variables equaling one if the original real primary expenditures and the cyclical components of real GDP were missing, zero otherwise. Last but not least, we include two additional BD variables equaling one if the cyclical components of expenditures and GDP were missing the previous year. This is the Set 1 of covariates. The Set 2 of covariates differs with the inclusion of two BD variables equaling one if the cyclical components of expenditures and GDP were missing from one to five years ago, zero otherwise. With this, we aim to capture inaccurate cycles due to the linear interpolation method.

**Table A.1: Variable Definitions (2000-2016)**

| # | Name | Description | Souces | N | Mean | S.D. | Min | Max |
|---|---|---|---|---|---|---|---|---|
| 1 | Cyclicality real primary spending* | Cylcicality of real primary general government expenditures (HP filter λ=6.25). | WEO (October, 2016) and Own Construction. | 1,933 | -20.66 | 5,755.94 | -77,767.53 | 82,694.79 |
| 2 | Cyclicality real GDP** | Cylcicality of real gross domestic product (HP filter λ=6.25). | WEO (October, 2016) and Own Construction. | 1,933 | -26.67 | 4,832.80 | -82,929.94 | 106,627.20 |
| 3 | Volatility ToT | 5y rolling window standard deviation of the terms of trade (TT series). | WEO (October, 2016). | 1,886 | 10.13 | 12.58 | 0.13 | 135.91 |
| 4 | Real general government total revenues*** | Total real revenue (% of GDP). | WEO (October, 2016) and Own Construction. | 1,933 | 11.06 | 11.03 | 0.64 | 72.47 |
| 5 | Real general government total tax**** | Total real tax (% of GDP). | WEO (October, 2016) and Own Construction. | 651 | 13.07 | 5.83 | 0.00 | 31.48 |
| 6 | Revenue base variability | Annual absolute variation of real general government total internal revenue. | WEO (October, 2016) and Own Construction. | 632 | 1.06 | 1.15 | 0.00 | 12.44 |
| 7 | Credit to private sector | Domestic credit to private sector (% of GDP). | WDI (February, 2017). | 1,779 | 35.15 | 30.33 | 0.00 | 160.12 |
| 8 | Kaopen | Index measuring the degree of capital account openness | Chinn and Ito (2006). | 1,688 | 0.48 | 0.35 | 0.00 | 1.00 |
| 9 | Political corruption | Political corruption (v2x_corr series) | V-dem vers. 6.2. | 1,620 | 0.41 | 0.23 | 0.03 | 0.96 |
| 10 | Public service corruption | Corruption of the public services (v2x_pubcorr series) | V-dem vers. 6.2. | 1,620 | 0.41 | 0.25 | 0.04 | 0.97 |
| 11 | Rule of law | v2xcl_rol series. | V-dem vers. 6.2. | 1,620 | 0.66 | 0.24 | 0.04 | 0.99 |
| 12 | Political Power distribution | v2pepwrsocl series. | V-dem vers. 6.2. | 1,620 | 0.48 | 1.08 | -2.46 | 3.10 |
| 13 | Distribution of resources | v2xeg_eqdr series. | V-dem vers. 6.2. | 1,620 | 0.58 | 0.21 | 0.10 | 0.97 |
| 14 | Ethnic and religious Stability | Average between the indicator of ethnic tensions and religious tensions. | ICRG indicators, PRS group. | 1,530 | 4.11 | 1.09 | 0.00 | 6.00 |
| 15 | Resource dependent | Binary variable if the country is ressource dependent. | Adapted from Konuki and Villafuerte (2016). | 1,933 | 0.28 | 0.45 | 0.00 | 1.00 |
| 16 | Resource rich | Binary variable if the country is ressource rich. | IMF (2012). | 1,933 | 0.40 | 0.49 | 0.00 | 1.00 |
| 17 | Bad times | Binary variable if the yearly growth rate is negative. | Own Construction | 1,932 | 0.09 | 0.29 | 0.00 | 1.00 |
| 18 | Elections | Binary variable for the year of the highest level national election. | DPI (2015) and Own Construction. | 1,933 | 0.18 | 0.39 | 0.00 | 1.00 |
| 19 | Debt ratio | Gross debt ratio over GDP. | WEO (October 2016). | 1,892 | 40.83 | 51.99 | 1.01 | 789.83 |

Notes: *: To compute real general government primary spending we substract GGEI series to GGX series and deflate it with the NGDP_D series. **: To compute real GDP spending we deflate the NGDP series with the NGDP_D series. ***: To compute real revenue over GDP we divide the GGR series to NGDP series. The series are deflated with the NGDP_D series. ****: To compute real internal revenue over GDP we subtract GGRG series to GGR series and divide it with the NGDP series. The series are deflated with the NGDP_D series. Information regarding variables used in the section of ``Potential solutions'' are available upon request.

**Appendix B: Regression tables – Tax rate procyclicality**

Table B.1: Fiscal (pro)cyclicality of individual income tax rates, whole sample (2000-2016): Impacts of development level, tax base, credit constraints, corruption, rule of law and order

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: Individual income tax | | | | | | | | | | |
| Cyclicality of real GDP | -0.338*** | -0.709 | 0.166 | 0.403*** | -0.695 | -0.801** | -1.641 | -0.385 | 2.220 | 0.273 |
| | (0.041) | (0.535) | (0.313) | (0.044) | (0.598) | (0.353) | (2.008) | (0.292) | (2.557) | (0.577) |
| **Development level** | | | | | | | | | | |
| Crgdp*dvpt.level (polytomic) | | 0.122 | | | | | | | | |
| | | (0.170) | | | | | | | | |
| **Tax base effect** | | | | | | | | | | |
| Crgdp*tax | | | -0.068* | | | | | | | |
| | | | (0.037) | | | | | | | |
| Crgdp*tax.base.variability | | | | -1.268*** | | | | | | |
| | | | | (0.066) | | | | | | |
| **Credit constraints** | | | | | | | | | | |
| Crgdp*credit.ratio | | | | | 0.009 | | | | | |
| | | | | | (0.012) | | | | | |
| Crgdp*kaopen | | | | | | 1.611* | | | | |
| | | | | | | (0.898) | | | | |
| **Perceived corruption** | | | | | | | | | | |
| Crgdp*pol.corruption | | | | | | | 2.496 | | | |
| | | | | | | | (3.279) | | | |
| Crgdp*pub.service.corruption | | | | | | | | 0.329 | | |
| | | | | | | | | (0.647) | | |
| **Rule of law and order** | | | | | | | | | | |
| Crgdp*law.order | | | | | | | | | -0.598 | |
| | | | | | | | | | (0.642) | |
| Crgdp*rule.of.law | | | | | | | | | | -1.152 |
| | | | | | | | | | | (1.643) |
| Constant | 2.011** | 66.846*** | -1.163 | 2.659 | 6.789** | 7.041** | 41.887*** | 42.290*** | 2.591 | 32.860*** |
| | (0.890) | (0.970) | (3.887) | (1.955) | (2.998) | (3.399) | (3.616) | (3.446) | (4.488) | (4.651) |
| Adjusted R-squared | 0.874 | 0.874 | 0.947 | 0.948 | 0.881 | 0.881 | 0.835 | 0.837 | 0.880 | 0.832 |
| Rmse | 4.325 | 4.328 | 3.175 | 3.154 | 4.237 | 4.246 | 4.282 | 4.246 | 4.292 | 4.320 |
| Joint significance (p-value) | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.046 | 0.001 | 0.002 | 0.027 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 826 | 826 | 289 | 289 | 761 | 725 | 689 | 689 | 746 | 689 |
| # countries | 50 | 50 | 19 | 19 | 50 | 50 | 47 | 47 | 48 | 47 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.2: Fiscal (pro)cyclicality of individual income tax rates, whole sample (2000-2016): Impacts of level playing field, natural resources, and other factors

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: Individual income tax | | | | | | | | | | |
| Cyclicality of real GDP | -0.200** | 0.121 | 0.408 | -0.096 | -0.065 | -0.096 | -0.384*** | -0.060 | 8.195 | 0.377*** |
| | (0.083) | (0.434) | (0.816) | (0.163) | (0.169) | (0.163) | (0.084) | (0.442) | (12.065) | (0.034) |
| **Equality of conditions** | | | | | | | | | | |
| Crgdp*power.distribution | -0.051 | | | | | | | | | |
| | (0.138) | | | | | | | | | |
| Crgdp*resource.distribution | | -0.396 | | | | | | | | |
| | | (0.684) | | | | | | | | |
| Crgdp*ethnicandrel.stability | | | -0.201 | | | | | | | |
| | | | (0.293) | | | | | | | |
| **Natural resources** | | | | | | | | | | |
| Crgdp*resource.dependant (bd) | | | | -0.256 | | | | | | |
| | | | | (0.182) | | | | | | |
| Crgdp*resource.rich (bd) | | | | | -0.288 | | | | | |
| | | | | | (0.188) | | | | | |
| Crgdp*resource dependant and rich | | | | | | -0.255 | | | | |
| | | | | | | (0.182) | | | | |
| **Other factors** | | | | | | | | | | |
| Crgdp*elections | | | | | | | 0.176 | | | |
| | | | | | | | (0.188) | | | |
| Crgdp*debt.ratio | | | | | | | | -0.021 | | |
| | | | | | | | | (0.036) | | |
| Crgdp*rigidity | | | | | | | | | -1,598.647 | |
| | | | | | | | | | (2,139.051) | |
| Crgdp*fiscal space | | | | | | | | | | -30.251*** |
| | | | | | | | | | | (1.268) |
| Constant | 36.452*** | 22.366** | -0.766 | 2.008** | 2.007** | 2.008** | 2.006** | 3.433*** | 44.874*** | 2.934*** |
| | (1.904) | (8.656) | (4.602) | (0.891) | (0.891) | (0.891) | (0.892) | (1.067) | (4.441) | (0.877) |
| Adjusted R-squared | 0.831 | 0.835 | 0.880 | 0.874 | 0.874 | 0.874 | 0.874 | 0.879 | 0.778 | 0.879 |
| Rmse | 4.326 | 4.279 | 4.287 | 4.327 | 4.327 | 4.327 | 4.330 | 4.270 | 5.559 | 4.240 |
| Joint significance (p-value) | 0.003 | 0.097 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.433 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 689 | 689 | 746 | 826 | 826 | 826 | 826 | 814 | 399 | 823 |
| # countries | 47 | 47 | 48 | 48 | 50 | 50 | 50 | 50 | 26 | 50 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.3: Fiscal (pro)cyclicality of individual income tax rates, whole sample (2000-2016): Impacts of rigidity, fiscal space and business cycle

| Dependent variable: Individual income tax | (1) | (2) | (3) |
|---|---|---|---|
| Cyclicality of real GDP | 0.052 | 55.509 | -2.194 |
| | (0.188) | (35.893) | (3.394) |
| **Business cycle** | | | |
| Crgdp*good times | -5.960e+07** | -5.781e+09 | 2.369e+08 |
| | (22995752.015) | (5.978e+09) | (3.385e+08) |
| Crgdp*good times*rigidity | | 1.431 | |
| | | (1.227) | |
| Crgdp*rigidity | | -13,856.972 | |
| | | (8,135.989) | |
| Rigidity of public spending | | -0.089 | |
| | | (0.061) | |
| Crgdp*good times*fiscal space | | | -0.015 |
| | | | (0.017) |
| Fiscal space | | | 116.726 |
| | | | (170.358) |
| Crgdp*fiscal space | | | -0.001* |
| | | | (0.001) |
| good times | 1.740 | 3.339 | 1.306 |
| | (1.310) | (3.066) | (1.100) |
| Constant | 0.375 | 42.418*** | 1.648 |
| | (1.731) | (5.691) | (1.373) |
| Adjusted R-squared | 0.876 | 0.781 | 0.880 |
| Rmse | 4.300 | 5.520 | 4.230 |
| Joint significance (p-value) | 0.00 | 0.002 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) |
| Cluster | country | country | country |
| Covariates | Yes | Yes | Yes |
| Observations | 826 | 399 | 823 |
| # countries | 50 | 26 | 26 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.4: Fiscal (pro)cyclicality of corporate tax rates, whole sample (2000-2016): Impacts of development level, tax base, credit constraints, corruption, rule of law and order

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: Individual income tax | | | | | | | | | | |
| Cyclicality of real GDP | -0.338*** | -1.221** | -4.267*** | 0.085 | -1.349 | -1.181*** | -2.312 | -0.634 | -0.534 | 0.389 |
| | (0.043) | (0.521) | (0.936) | (0.099) | (0.896) | (0.391) | (3.248) | (0.773) | (4.002) | (0.962) |
| **Development level** | | | | | | | | | | |
| Crgdp*dvpt.level (polytomic) | | 0.290* | | | | | | | | |
| | | (0.169) | | | | | | | | |
| **Tax base effect** | | | | | | | | | | |
| Crgdp*tax | | | 0.476*** | | | | | | | |
| | | | (0.113) | | | | | | | |
| Crgdp*tax.base.variability | | | | -0.679*** | | | | | | |
| | | | | (0.153) | | | | | | |
| **Credit constraints** | | | | | | | | | | |
| Crgdp*credit.ratio | | | | | 0.018 | | | | | |
| | | | | | (0.018) | | | | | |
| Crgdp*kaopen | | | | | | 2.144** | | | | |
| | | | | | | (0.979) | | | | |
| **Perceived corruption** | | | | | | | | | | |
| Crgdp*pol.corruption | | | | | | | 3.437 | | | |
| | | | | | | | (5.331) | | | |
| Crgdp*pub.service.corruption | | | | | | | | 0.758 | | |
| | | | | | | | | (1.612) | | |
| **Rule of law and order** | | | | | | | | | | |
| Crgdp*law.order | | | | | | | | | 0.054 | |
| | | | | | | | | | (0.991) | |
| Crgdp*rule.of.law | | | | | | | | | | -1.741 |
| | | | | | | | | | | (2.745) |
| Constant | 59.535*** | 18.554*** | 59.612*** | 63.086*** | 64.350*** | 60.164*** | 40.269*** | 37.649*** | 60.042*** | 29.966*** |
| | (1.136) | (1.251) | (2.950) | (3.590) | (2.151) | (3.093) | (2.894) | (1.805) | (3.233) | (4.539) |
| Adjusted R-squared | 0.732 | 0.732 | 0.639 | 0.636 | 0.741 | 0.730 | 0.724 | 0.723 | 0.715 | 0.728 |
| Rmse | 4.369 | 4.371 | 6.055 | 6.080 | 4.323 | 4.388 | 3.695 | 3.703 | 4.468 | 3.673 |
| Joint significance (p-value) | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 831 | 831 | 291 | 291 | 766 | 730 | 700 | 700 | 751 | 700 |
| # countries | 50 | 50 | 19 | 19 | 50 | 50 | 47 | 47 | 48 | 47 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.5: Fiscal (pro)cyclicality of corporate tax rates, whole sample (2000-2016): Impacts of level playing field, natural resources, and other factors

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: Individual income tax | | | | | | | | | | |
| Cyclicality of real GDP | -0.258** | -1.359* | 0.788 | -0.416 | -0.441 | -0.416 | -0.401*** | -0.043 | -31.549 | -0.146** |
| | (0.104) | (0.770) | (1.492) | (0.425) | (0.440) | (0.424) | (0.047) | (0.281) | (23.212) | (0.058) |
| **Equality of conditions** | | | | | | | | | | |
| Crgdp*power.distribution | 0.098 | | | | | | | | | |
| | (0.172) | | | | | | | | | |
| Crgdp*resource.distribution | | 1.740 | | | | | | | | |
| | | (1.243) | | | | | | | | |
| Crgdp*ethnicandrel.stability | | | -0.372 | | | | | | | |
| | | | (0.539) | | | | | | | |
| **Natural resources** | | | | | | | | | | |
| Crgdp*resource.dependant (bd) | | | | 0.083 | | | | | | |
| | | | | (0.420) | | | | | | |
| Crgdp*resource.rich (bd) | | | | | 0.110 | | | | | |
| | | | | | (0.435) | | | | | |
| Crgdp*resource dependant and rich | | | | | | 0.083 | | | | |
| | | | | | | (0.420) | | | | |
| **Other factors** | | | | | | | | | | |
| Crgdp*elections | | | | | | | 0.208** | | | |
| | | | | | | | (0.102) | | | |
| Crgdp*debt.ratio | | | | | | | | -0.021 | | |
| | | | | | | | | (0.024) | | |
| Crgdp*rigidity | | | | | | | | | 5,727.836 | |
| | | | | | | | | | (3,927.079) | |
| Crgdp*fiscal space | | | | | | | | | | -8.396*** |
| | | | | | | | | | | (1.575) |
| Constant | 39.587*** | 40.695*** | 59.060*** | 59.537*** | 59.537*** | 59.537*** | 59.533*** | 58.880*** | 38.483*** | 59.068*** |
| | (2.361) | (9.174) | (5.738) | (1.138) | (1.138) | (1.138) | (1.133) | (1.180) | (2.696) | (1.195) |
| Adjusted R-squared | 0.723 | 0.723 | 0.716 | 0.732 | 0.732 | 0.732 | 0.732 | 0.737 | 0.819 | 0.743 |
| Rmse | 3.705 | 3.705 | 4.465 | 4.371 | 4.371 | 4.371 | 4.374 | 4.359 | 3.021 | 4.288 |
| Joint significance (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.139 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 700 | 700 | 751 | 831 | 831 | 831 | 831 | 819 | 407 | 828 |
| # countries | 47 | 47 | 48 | 48 | 50 | 50 | 50 | 50 | 26 | 50 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.6: Fiscal (pro)cyclicality of corporate tax rates, whole sample (2000-2016): Impacts of rigidity, fiscal space and business cycle

| Dependent variable: Individual income tax | (1) | (2) | (3) |
|---|---|---|---|
| Cyclicality of real GDP | 0.560** | -9.308 | -2.741 |
| | (0.227) | (12.916) | (5.671) |
| **Business cycle** | | | |
| Crgdp*good times | -1.230e+08*** | -3.576e+09 | 2.221e+08 |
| | (26210474.704) | (3.773e+09) | (5.662e+08) |
| Crgdp*good times*rigidity | | 0.535 | |
| | | (0.652) | |
| Crgdp*rigidity | | 2,743.200 | |
| | | (2,791.339) | |
| Rigidity of public spending | | 0.034 | |
| | | (0.046) | |
| Crgdp*good times*fiscal space | | | -0.017 |
| | | | (0.028) |
| Fiscal space | | | 162.312 |
| | | | (279.729) |
| Crgdp*fiscal space | | | 0.003** |
| | | | (0.001) |
| good times | 0.453 | -0.164 | 0.932 |
| | (1.037) | (0.775) | (1.115) |
| Constant | 59.088*** | 38.562*** | 58.122*** |
| | (1.508) | (2.595) | (1.662) |
| Adjusted R-squared | 0.733 | 0.818 | 0.744 |
| Rmse | 4.359 | 3.029 | 4.275 |
| Joint significance (p-value) | 0.000 | 0.168 | 0.009 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) |
| Cluster | country | country | country |
| Covariates | Yes | Yes | Yes |
| Observations | 831 | 407 | 828 |
| # countries | 50 | 26 | 50 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.7: Fiscal (pro)cyclicality of VAT rates, whole sample (2000-2016): Impacts of development level, tax base, credit constraints, corruption, rule of law and order

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: Individual income tax | | | | | | | | | | |
| Cyclicality of real GDP | -0.057*** | -0.168 | -1.107* | -0.263*** | -0.125*** | -0.473* | 0.023 | 0.118 | -0.329* | -0.121** |
| | (0.019) | (0.176) | (0.569) | (0.036) | (0.031) | (0.273) | (0.070) | (0.123) | (0.172) | (0.057) |
| **Development level** | | | | | | | | | | |
| Crgdp*dvpt.level (polytomic) | | 0.036 | | | | | | | | |
| | | (0.057) | | | | | | | | |
| **Tax base effect** | | | | | | | | | | |
| Crgdp*tax | | | 0.125* | | | | | | | |
| | | | (0.068) | | | | | | | |
| Crgdp*tax.base.variability | | | | 0.328*** | | | | | | |
| | | | | (0.017) | | | | | | |
| **Credit constraints** | | | | | | | | | | |
| Crgdp*credit.ratio | | | | | 0.001 | | | | | |
| | | | | | (0.000) | | | | | |
| Crgdp*kaopen | | | | | | 0.948 | | | | |
| | | | | | | (0.684) | | | | |
| **Perceived corruption** | | | | | | | | | | |
| Crgdp*pol.corruption | | | | | | | -0.209* | | | |
| | | | | | | | (0.123) | | | |
| Crgdp*pub.service.corruption | | | | | | | | -0.452* | | |
| | | | | | | | | (0.266) | | |
| **Rule of law and order** | | | | | | | | | | |
| Crgdp*law.order | | | | | | | | | 0.055 | |
| | | | | | | | | | (0.044) | |
| Crgdp*rule.of.law | | | | | | | | | | 0.056 |
| | | | | | | | | | | (0.132) |
| Constant | -0.262 | 33.047*** | -0.139 | -0.259 | 0.575 | -0.647 | 19.695*** | 19.651*** | -1.505* | 19.376*** |
| | (0.249) | (0.566) | (0.637) | (0.388) | (0.446) | (0.975) | (0.564) | (0.429) | (0.818) | (1.391) |
| Adjusted R-squared | 1.000 | 1.000 | 0.971 | 0.971 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Rmse | 1.008 | 1.009 | 1.148 | 1.144 | 0.978 | 0.963 | 1.002 | 0.995 | 0.992 | 1.006 |
| Joint significance (p-value) | - | 0.012 | 0.041 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 823 | 823 | 291 | 291 | 758 | 722 | 687 | 687 | 743 | 687 |
| # countries | 50 | 50 | 19 | 19 | 50 | 50 | 47 | 47 | 48 | 47 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.8: Fiscal (pro)cyclicality of VAT rates, whole sample (2000-2016): Impacts of level playing field, natural resources, and other factors

| Dependent variable: Individual income tax | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Cyclicality of real GDP | -0.082*** | -0.103 | -0.217*** | 0.001 | -0.013 | 0.001 | -0.070*** | -0.111* | -3.662 | -0.205*** |
| | (0.022) | (0.173) | (0.046) | (0.035) | (0.036) | (0.035) | (0.019) | (0.057) | (3.669) | (0.026) |
| **Equality of conditions** | | | | | | | | | | |
| Crgdp*power.distribution | 0.047 | | | | | | | | | |
| | (0.028) | | | | | | | | | |
| Crgdp*resource.distribution | | 0.013 | | | | | | | | |
| | | (0.295) | | | | | | | | |
| Crgdp*ethnicandrel.stability | | | 0.035*** | | | | | | | |
| | | | (0.012) | | | | | | | |
| **Natural resources** | | | | | | | | | | |
| Crgdp*resource.dependant (bd) | | | | -0.063 | | | | | | |
| | | | | (0.040) | | | | | | |
| Crgdp*resource.rich (bd) | | | | | -0.047 | | | | | |
| | | | | | (0.041) | | | | | |
| Crgdp*resource dependant and rich | | | | | | -0.063 | | | | |
| | | | | | | (0.040) | | | | |
| **Other factors** | | | | | | | | | | |
| Crgdp*elections | | | | | | | 0.042** | | | |
| | | | | | | | (0.019) | | | |
| Crgdp*debt.ratio | | | | | | | | 0.004 | | |
| | | | | | | | | (0.004) | | |
| Crgdp*rigidity | | | | | | | | | 670.223 | |
| | | | | | | | | | (655.163) | |
| Crgdp*fiscal space | | | | | | | | | | 6.248*** |
| | | | | | | | | | | (0.392) |
| Constant | 20.068*** | 19.372*** | -0.731 | -0.263 | -0.263 | -0.263 | -0.262 | -0.416 | 20.722*** | -0.350 |
| | (0.705) | (1.708) | (1.314) | (0.249) | (0.249) | (0.249) | (0.248) | (0.334) | (0.670) | (0.287) |
| Adjusted R-squared | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Rmse | 1.003 | 1.007 | 0.997 | 1.009 | 1.009 | 1.009 | 1.009 | 1.014 | 0.865 | 1.007 |
| Joint significance (p-value) | 0.000 | 0.002 | 0.011 | 0.011 | 0.012 | 0.011 | 0.000 | 0.007 | 0.548 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) | I(0) |
| Cluster | country | country | country | country | country | country | country | country | country | country |
| Covariates | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 687 | 687 | 743 | 823 | 823 | 823 | 823 | 811 | 410 | 820 |
| # countries | 47 | 47 | 48 | 48 | 50 | 50 | 50 | 50 | 26 | 50 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

Table B.9: Fiscal (pro)cyclicality of VAT rates, whole sample (2000-2016): Impacts of rigidity, fiscal space and business cycle

| | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variable: Individual income tax | | | |
| Cyclicality of real GDP | -0.105*** | -10.364 | -0.776 |
| | (0.036) | (10.232) | (0.848) |
| **Business cycle** | | | |
| Crgdp*good times | 6725549.158* | 8.833e+08 | 58844199.784 |
| | (3520752.871) | (1.607e+09) | (83654229.792) |
| Crgdp*good times*rigidity | | -0.190 | |
| | | (0.302) | |
| Crgdp*rigidity | | 2,166.815 | |
| | | (2,028.945) | |
| Rigidity of public spending | | 0.004 | |
| | | (0.011) | |
| Crgdp*good times*fiscal space | | | -0.003 |
| | | | (0.004) |
| Fiscal space | | | 33.016 |
| | | | (42.190) |
| Crgdp*fiscal space | | | 0.000 |
| | | | (0.000) |
| good times | 0.033 | 0.001 | 0.062 |
| | (0.123) | (0.151) | (0.125) |
| Constant | -0.293 | 20.710*** | -0.411 |
| | (0.270) | (0.695) | (0.320) |
| Adjusted R-squared | 1.000 | 1.000 | 1.000 |
| Rmse | 1.009 | 0.868 | 1.008 |
| Joint significance (p-value) | 0.012 | 0.413 | 0.000 |
| CD test (p-value) | 0.000 | 0.000 | 0.000 |
| Order of integration | I(0) | I(0) | I(0) |
| Cluster | country | country | country |
| Covariates | Yes | Yes | Yes |
| Observations | 823 | 410 | 820 |
| # countries | 50 | 26 | 50 |

Notes. Standard errors (in parentheses) clustered at the country level. All interactive variables are also introduced in level but not reported to save space. Coefficients attached to cyclicality of GDP or its interactions are multiplied by 10000. All regressions include the volatility of the terms of trade, BD for missing data in real GDP and real expenditure series, BD for five years HP cycle correction. See Table A.3 for further discussion on variables definition. *** p<0.01, ** p<0.05, * p<0.1.

## Appendix C: How to mitigate procyclicality bias?

**Table C.1: Potential top-down solutions: fiscal rules (correlation 2009-2015)**

| Fiscal rule (FR) | without | N (without) | with | N (with) | p-value ≠ 0 |
|---|---|---|---|---|---|
| National FR | 0.14<br>(0.02) | 580 | 0.06<br>(0.03) | 214 | 0.02 |
| FR with fiscal council | 0.15<br>(0.02) | 572 | 0.08<br>(0.04) | 128 | 0.12 |
| FR with monitoring | 0.14<br>(0.02) | 580 | -0.05<br>(0.06) | 81 | 0.00 |
| FR with enforcement | 0.14<br>(0.02) | 580 | -0.03<br>(0.04) | 96 | 0.00 |
| FR with large coverage | 0.14<br>(0.02) | 573 | 0.20<br>(0.04) | 105 | 0.25 |
| FR with written legal basis | 0.14<br>(0.02) | 573 | -0.01<br>(0.03) | 185 | 0.03 |
| FR with escape clause | 0.14<br>(0.02) | 580 | 0.02<br>(0.04) | 74 | 0.04 |
| FR with flexibility | 0.14<br>(0.02) | 573 | -0.04<br>(0.05) | 99 | 0.00 |

Notes: For consistency, the control group systematically exclude FRers countries, so not any country in the control group has a national FR, irrespective to the specification.

Figure C.1: Correlation conditional to FRs characteristics (2009-2015)

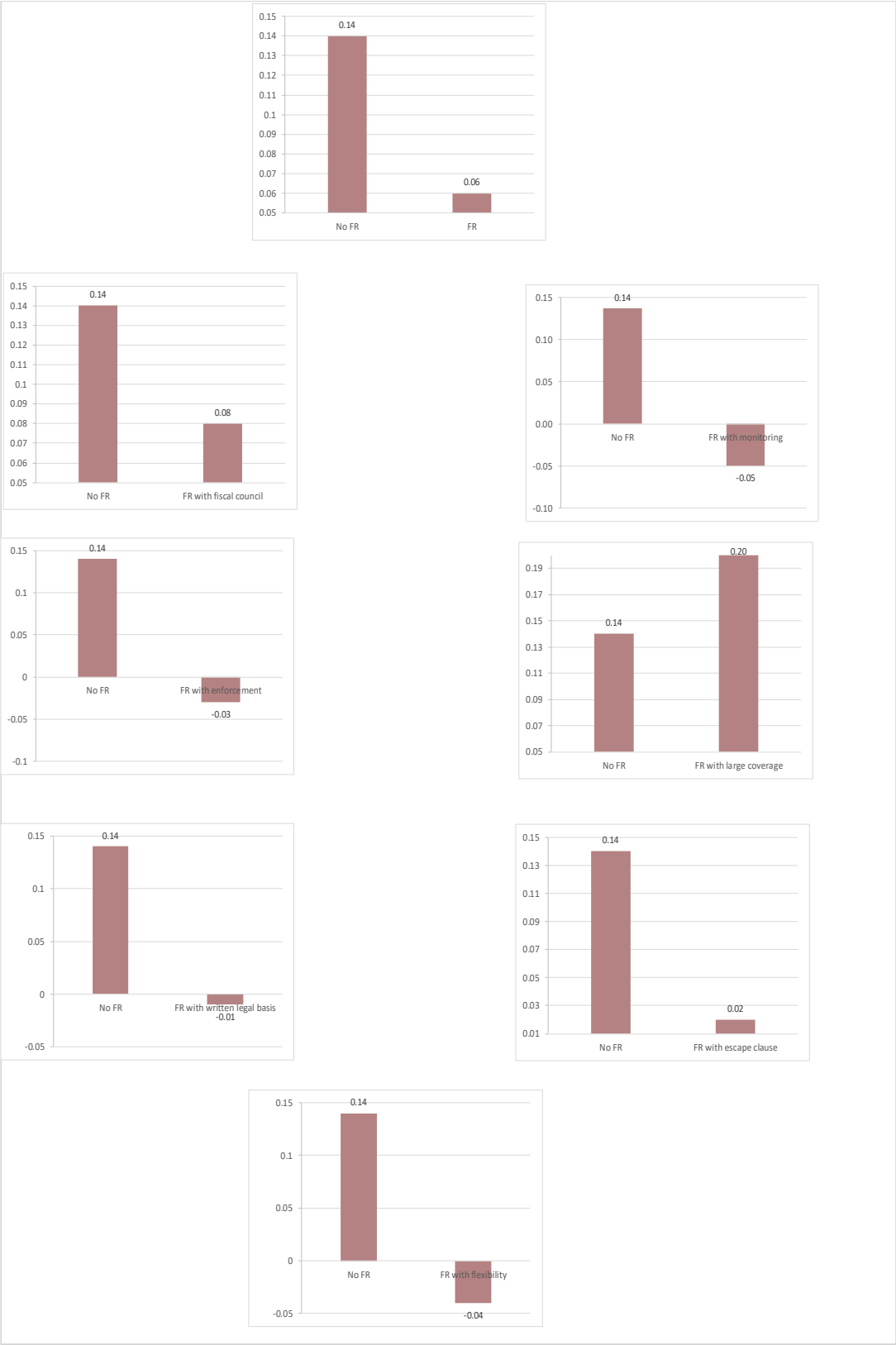


Table C.2 : Potential top-down solutions: fiscal councils (correlation 2009-2016)

| Fiscal council (FC) | without | N (without) | with | N (with) | p-value ≠ 0 |
|---|---|---|---|---|---|
| FC | 0.13<br>(0.02) | 811 | -0.02<br>(0.06) | 96 | 0.00 |
| FC with large coverage | 0.13<br>(0.02) | 811 | 0.07<br>(0.08) | 64 | 0.25 |
| FC with forecast prep. | 0.13<br>(0.02) | 811 | 0.03<br>(0.07) | 66 | 0.07 |
| FC with forecast asses. | 0.13<br>(0.02) | 811 | 0.04<br>(0.06) | 79 | 0.10 |
| FC with recommendation | 0.13<br>(0.02) | 811 | -0.06<br>(0.07) | 74 | 0.00 |
| FC with sustainability | 0.13<br>(0.02) | 811 | -0.38<br>(0.07) | 40 | 0.00 |
| FC with consistency | 0.13<br>(0.02) | 811 | -0.10<br>(0.07) | 73 | 0.00 |
| FC evaluating costs of measures | 0.13<br>(0.02) | 811 | -0.29<br>(0.06) | 54 | 0.00 |
| FC with ex-post analysis | 0.13<br>(0.02) | 811 | -0.08<br>(0.07) | 67 | 0.00 |
| FC with reports | 0.13<br>(0.02) | 811 | 0.01<br>(0.06) | 93 | 0.01 |
| FC with media impact | 0.13<br>(0.02) | 811 | 0.02<br>(0.07) | 67 | 0.06 |

Notes: For consistency, the control group systematically exclude FCers countries, so not any country in the control group has a FC, irrespective to the specification.

Figure C.2: Correlation conditional to FCs characteristics (2009-2016)

Table C.3: Potential bottom-up solutions: Political Decentralization (correlation 2009-2015)

| Political Decentralization (PD) | without | N (without) | with | N (with) | p-value ≠ 0 |
|---|---|---|---|---|---|
| PD | 0.10<br>(0.02) | 332 | 0.13<br>(0.02) | 462 | 0.54 |
| with autonomous regions | 0.14<br>(0.02) | 318 | 0.17<br>(0.04) | 126 | 0.43 |
| with local governments elected | 0.16<br>(0.03) | 192 | 0.18<br>(0.03) | 266 | 0.69 |
| with state governments elected | 0.16<br>(0.03) | 213 | 0.17<br>(0.04) | 112 | 1.00 |
| with state fiscal and legislative authority | 0.28<br>(0.05) | 94 | 0.15<br>(0.04) | 119 | 0.04 |
| with state constituencies in the upper house | -0.02<br>(0.06) | 60 | 0.12<br>(0.04) | 147 | 0.05 |

Notes: For consistency, the control group systematically exclude PDers countries, so not any country in the control group has decentralization, irrespective to the specification.

Figure C.3: Correlation conditional to PD characteristics (2009-2015)

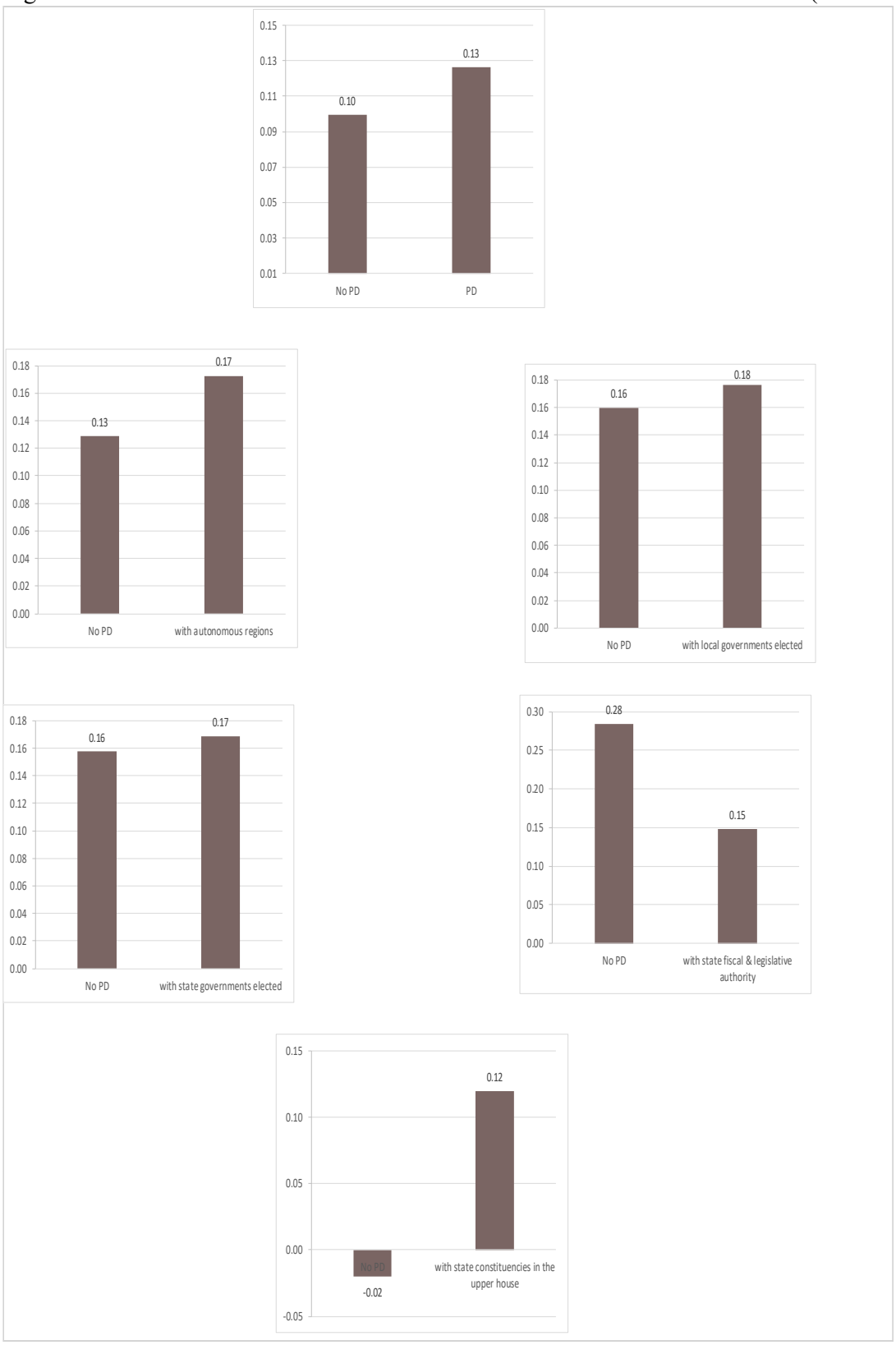
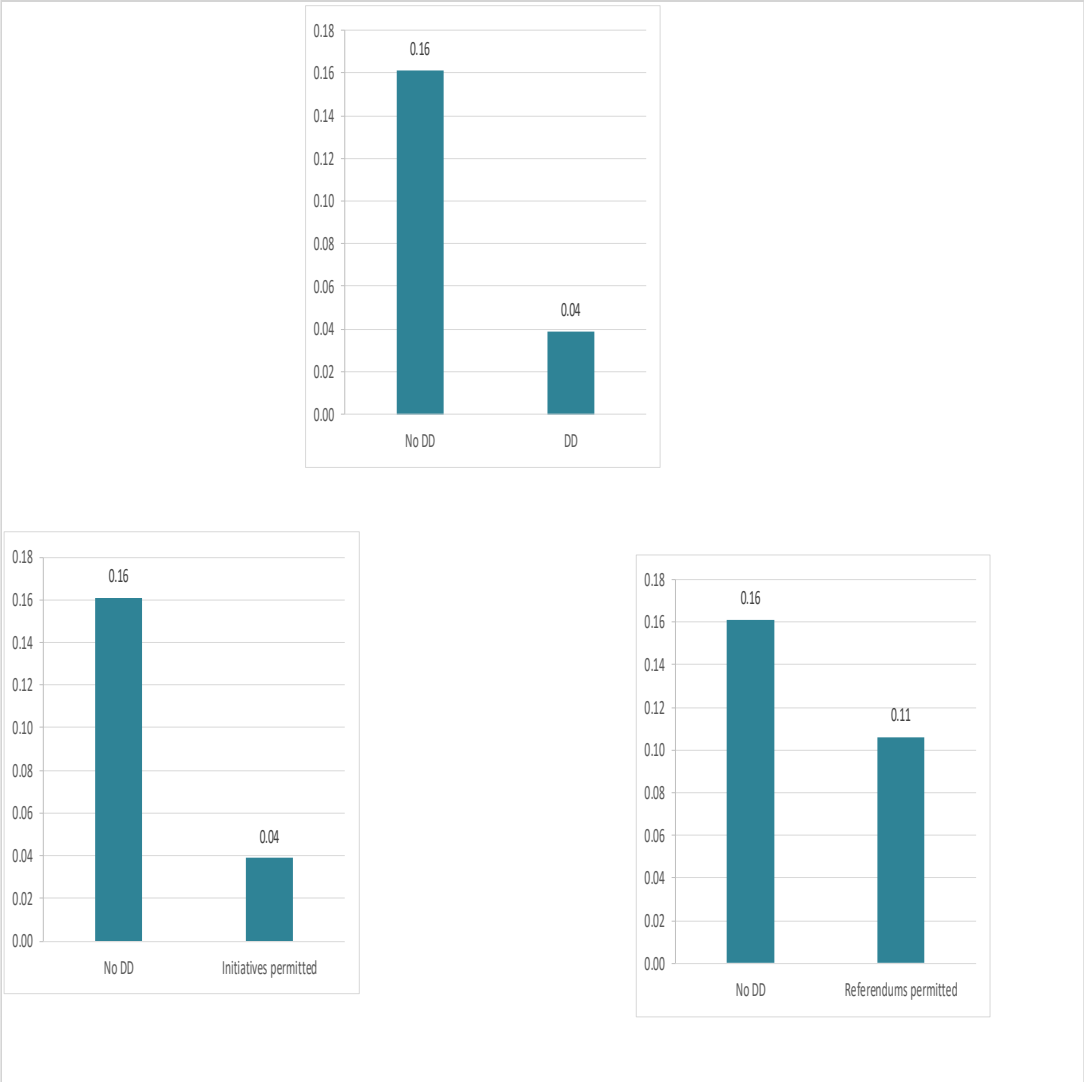


Table C.4 : Potential bottom-up solutions: direct democracy (correlation 2009-2016)

| Direct democracy (DD) | without | N (without) | with | N (with) | p-value ≠ 0 |
|---|---|---|---|---|---|
| DD | 0.16<br>(0.02) | 448 | 0.04<br>(0.04) | 184 | 0.00 |
| Initiatives permitted* | 0.16<br>(0.02) | 448 | 0.04<br>(0.04) | 184 | 0.00 |
| Referendums permitted | 0.16<br>(0.02) | 448 | 0.11<br>(0.05) | 103 | 0.10 |

Notes: For consistency, the control group systematically exclude DDers countries, so not any country in the control group has DD irrespective to the specification.
*: Same as DD.

Figure C.4: Correlation conditional to DD characteristics (2009-2015)



## Appendix D: Difference across regions

**Figure D.1: (Pro)cyclicality in SSA, Resource Rich vs. Other Countries**

**Figure D.1.a: (Pro)cyclicality in SSA countries, separating for resource-dependent countries**

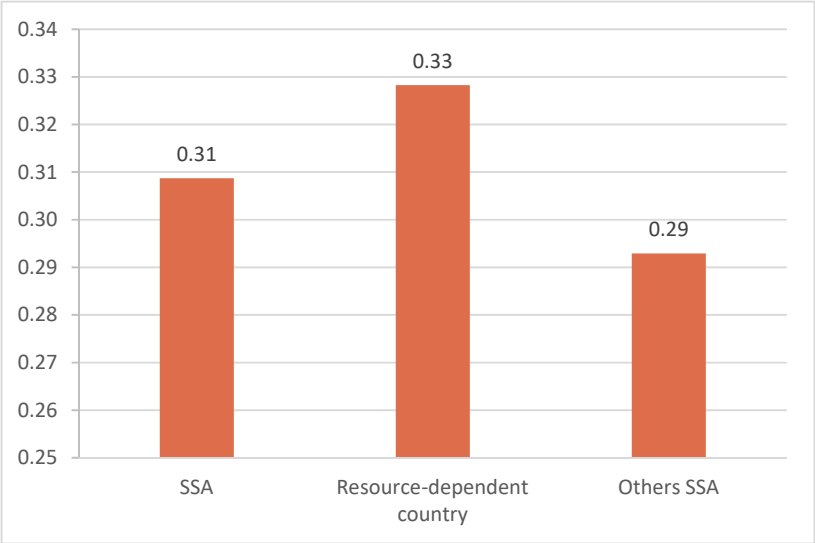



**Figure D.1.b: (Pro)cyclicality in SSA countries, separating for resource-rich countries**

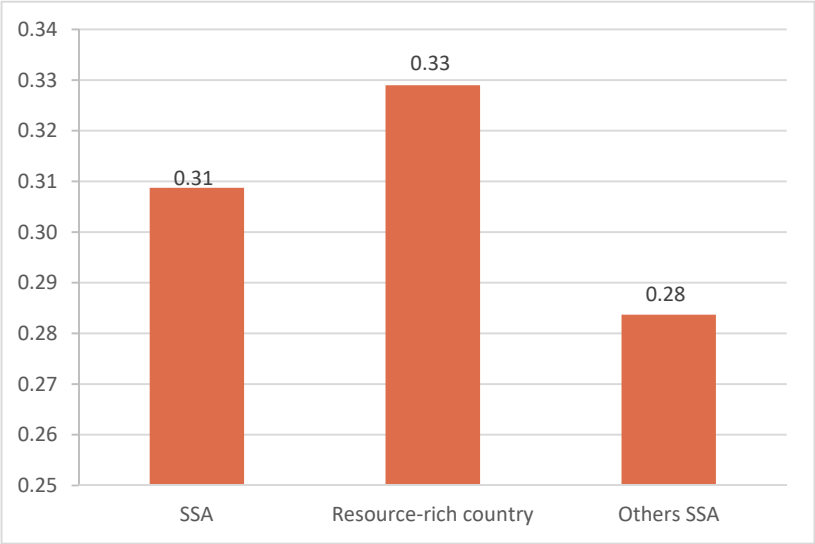


**Figure D.2: (Pro)cyclicality in Resource- Rich SSA countries vs Resource Rich in other regions**

**Figure D.2.a: (Pro)cyclicality in SSA countries, separating for resource-dependent countries**

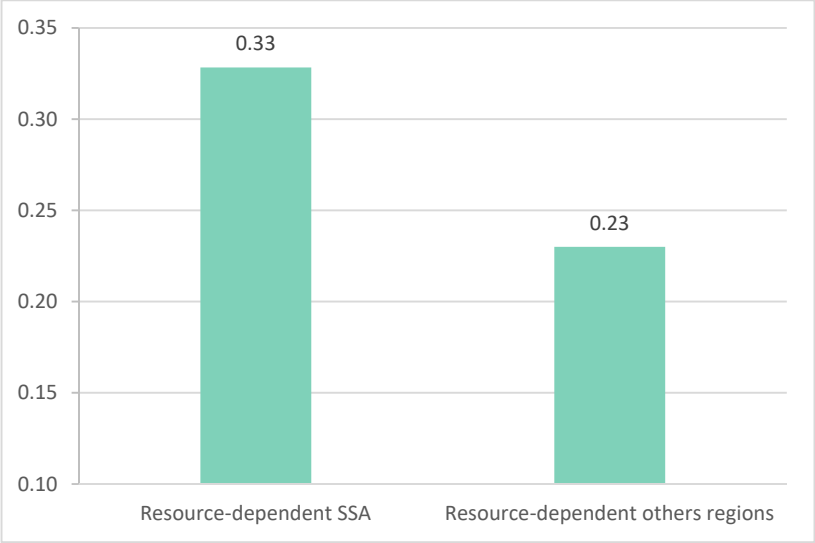



**Figure D.2.b: (Pro)cyclicality in SSA countries, separating for resource-rich countries**

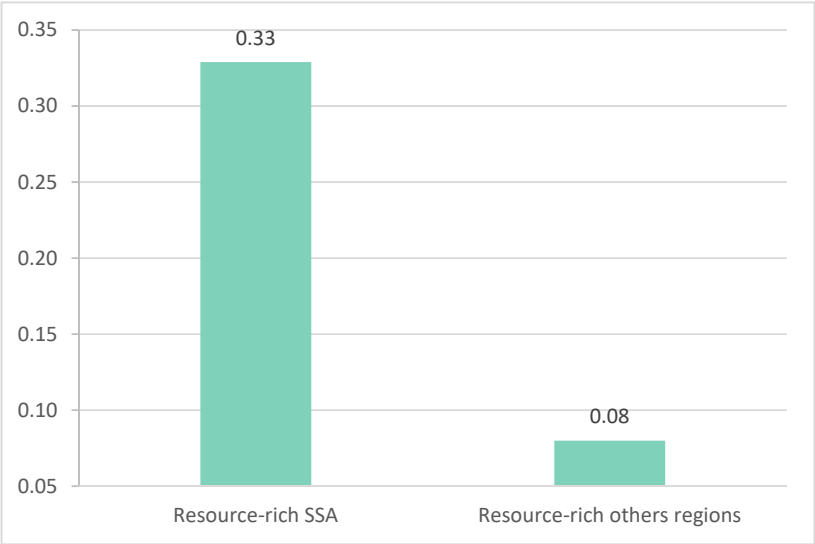


Table D.1: Key indicators by regions

| # | Code | Region | Revenue ratio (%) 2000-2008 | 2009-2016 |
|---|---|---|---|---|
| 1 | ECA | Europe and Central Asia | 34.48 | 36.52 |
| 2 | LAC | Latin America and Caribbean | 22.01 | 24.01 |
| 3 | MENA | Middle East and North Africa | 36.97 | 33.72 |
| 4 | SEAP | South, East Asia and Pacific | 17.72 | 19.76 |
| 5 | SSA | Sub-Saharan Africa | 22.27 | 22.49 |
| | | | Tax (%) 2000-2008 | 2009-2016 |
| 1 | ECA | Europe and Central Asia | 28.07 | 24.39 |
| 2 | LAC | Latin America and Caribbean | 24.39 | 20.16 |
| 3 | MENA | Middle East and North Africa | 8.11 | 8.50 |
| 4 | SEAP | South, East Asia and Pacific | 13.98 | 17.27 |
| 5 | SSA | Sub-Saharan Africa | 11.12 | 12.56 |
| | | | Credit ratio (%) 2000-2008 | 2009-2016 |
| 1 | ECA | Europe and Central Asia | 28.96 | 47.09 |
| 2 | LAC | Latin America and Caribbean | 32.50 | 38.75 |
| 3 | MENA | Middle East and North Africa | 43.98 | 56.29 |
| 4 | SEAP | South, East Asia and Pacific | 48.30 | 66.43 |
| 5 | SSA | Sub-Saharan Africa | 16.70 | 23.15 |
| | | | Political corruption (0-1) 2000-2008 | 2009-2016 |
| 1 | ECA | Europe and Central Asia | 0.46 | 0.48 |
| 2 | LAC | Latin America and Caribbean | 0.48 | 0.51 |
| 3 | MENA | Middle East and North Africa | 0.40 | 0.46 |
| 4 | SEAP | South, East Asia and Pacific | 0.35 | 0.36 |
| 5 | SSA | Sub-Saharan Africa | 0.33 | 0.35 |
| | | | Public service corruption (0-1) 2000-2008 | 2009-2016 |
| 1 | ECA | Europe and Central Asia | 0.48 | 0.49 |
| 2 | LAC | Latin America and Caribbean | 0.52 | 0.54 |
| 3 | MENA | Middle East and North Africa | 0.38 | 0.42 |
| 4 | SEAP | South, East Asia and Pacific | 0.38 | 0.38 |
| 5 | SSA | Sub-Saharan Africa | 0.30 | 0.33 |
| | | | Law and order (1-6) 2000-2008 | 2009-2016 |
| 1 | ECA | Europe and Central Asia | 4.13 | 3.92 |
| 2 | LAC | Latin America and Caribbean | 2.69 | 2.40 |
| 3 | MENA | Middle East and North Africa | 4.23 | 4.19 |
| 4 | SEAP | South, East Asia and Pacific | 3.43 | 3.43 |
| 5 | SSA | Sub-Saharan Africa | 2.96 | 2.90 |
| | | | Resource distribution (0-1) 2000-2008 | 2009-2016 |
| 1 | ECA | Europe and Central Asia | 0.77 | 0.75 |
| 2 | LAC | Latin America and Caribbean | 0.57 | 0.59 |
| 3 | MENA | Middle East and North Africa | 0.49 | 0.52 |
| 4 | SEAP | South, East Asia and Pacific | 0.55 | 0.54 |
| 5 | SSA | Sub-Saharan Africa | 0.51 | 0.53 |
| | | | Ethnic and religious stability (0-6) 2000-2008 | 2009-2016 |
| 1 | ECA | Europe and Central Asia | 1.02 | 0.99 |
| 2 | LAC | Latin America and Caribbean | 4.96 | 5.04 |
| 3 | MENA | Middle East and North Africa | 3.79 | 3.97 |
| 4 | SEAP | South, East Asia and Pacific | 3.75 | 3.46 |
| 5 | SSA | Sub-Saharan Africa | 3.61 | 3.67 |

Notes: Average levels are computed for the subperiods 2000-2008; 2009-2016.

Table D.2: Key indicators by group

| # | Code | Region | Revenue ratio (%) 2000-2008 | 2009-2016 |
|---|---|---|---|---|
| 1 | EG | Established Graduates | 24.63 | 27.16 |
| 2 | RG | Recent Graduates | 27.14 | 28.93 |
| 3 | BS | Back to School | 28.30 | 26.08 |
| 4 | SS | Still in School | 25.07 | 25.73 |
| | | | Tax (%) 2000-2008 | 2009-2016 |
| 1 | EG | Established Graduates | 11.53 | 13.04 |
| 2 | RG | Recent Graduates | 18.18 | 20.15 |
| 3 | BS | Back to School | 8.25 | 8.85 |
| 4 | SS | Still in School | 12.79 | 14.50 |
| | | | Credit ratio (%) 2000-2008 | 2009-2016 |
| 1 | EG | Established Graduates | 44.15 | 60.93 |
| 2 | RG | Recent Graduates | 33.28 | 45.02 |
| 3 | BS | Back to School | 39.59 | 56.29 |
| 4 | SS | Still in School | 22.38 | 31.58 |
| | | | Political corruption (0-1) 2000-2008 | 2009-2016 |
| 1 | EG | Established Graduates | 0.44 | 0.47 |
| 2 | RG | Recent Graduates | 0.47 | 0.54 |
| 3 | BS | Back to School | 0.38 | 0.38 |
| 4 | SS | Still in School | 0.35 | 0.37 |
| | | | Public service corruption (0-1) 2000-2008 | 2009-2016 |
| 1 | EG | Established Graduates | 0.42 | 0.45 |
| 2 | RG | Recent Graduates | 0.49 | 0.55 |
| 3 | BS | Back to School | 0.36 | 0.36 |
| 4 | SS | Still in School | 0.37 | 0.38 |
| | | | Law and order (0-6) 2000-2008 | 2009-2016 |
| 1 | EG | Established Graduates | 3.72 | 3.54 |
| 2 | RG | Recent Graduates | 3.35 | 3.20 |
| 3 | BS | Back to School | 3.48 | 3.48 |
| 4 | SS | Still in School | 3.19 | 3.06 |
| | | | Resource distribution (0-1) 2000-2008 | 2009-2016 |
| 1 | EG | Established Graduates | 0.54 | 0.55 |
| 2 | RG | Recent Graduates | 0.68 | 0.71 |
| 3 | BS | Back to School | 0.53 | 0.52 |
| 4 | SS | Still in School | 0.57 | 0.58 |
| | | | Ethnic and religious stability (0-6) 2000-2008 | 2009-2016 |
| 1 | EG | Established Graduates | 4.44 | 4.44 |
| 2 | RG | Recent Graduates | 4.31 | 4.32 |
| 3 | BS | Back to School | 3.55 | 3.66 |
| 4 | SS | Still in School | 4.05 | 4.01 |

Notes: Average levels are computed for the subperiods 2000-2008; 2009-2016.

## Appendix E: List of resource-dependent and resource-rich countries

Table E.1: List of Resource-dependent countries in our sample (2000-2016)

| # | Region | Code | Resource-dependent countries | Percent time with RD revenues | Oil exporters | Mineral exporters | Other exporters |
|---|---|---|---|---|---|---|---|
| 1 | Sub-Saharan Africa | AGO | Angola | 100% | yes | | |
| 2 | Middle East and North Africa | ARE | United Arab Emirates | 100% | yes | | |
| 3 | Sub-Saharan Africa | BFA | Burkina Faso | 86% | | yes | |
| 4 | Latin America and Caribbean | BOL | Bolivia | 100% | yes | | |
| 5 | Sub-Saharan Africa | BWA | Botswana | 100% | | yes | |
| 6 | Sub-Saharan Africa | CIV | Côte d'Ivoire | 100% | | | yes (cocoa) |
| 7 | Sub-Saharan Africa | CMR | Cameroon | 100% | yes | | |
| 8 | Sub-Saharan Africa | COG | Congo, Rep. | 100% | yes | | |
| 9 | Middle East and North Africa | DZA | Algeria | 100% | yes | | |
| 10 | Latin America and Caribbean | ECU | Ecuador | 100% | yes | | |
| 11 | Sub-Saharan Africa | GAB | Gabon | 100% | yes | | |
| 12 | Sub-Saharan Africa | GIN | Guinea | 100% | yes | | |
| 13 | Sub-Saharan Africa | GMB | Gambia, The | 100% | | | yes (artificial filament) |
| 14 | Sub-Saharan Africa | GNB | Guinea-Bissau | 65% | | | yes (coconut, Brazil nuts, cashew) |
| 15 | South, East Asia and Pacific | IDN | Indonesia | 88% | yes | | |
| 16 | Middle East and North Africa | IRN | Iran, Islamic Rep. | 100% | yes | | |
| 17 | Middle East and North Africa | KWT | Kuwait | 100% | yes | | |
| 18 | Sub-Saharan Africa | LBR | Liberia | 53% | | yes | |
| 19 | Sub-Saharan Africa | MLI | Mali | 100% | | yes | |
| 20 | Sub-Saharan Africa | NGA | Nigeria | 100% | yes | | |
| 21 | Middle East and North Africa | OMN | Oman | 100% | yes | | |
| 22 | Latin America and Caribbean | PER | Peru | 71% | | yes | |
| 23 | Europe and Central Asia | RUS | Russian Federation | 94% | yes | | |
| 24 | Middle East and North Africa | SAU | Saudi Arabia | 100% | yes | | |
| 25 | Sub-Saharan Africa | SDN | Sudan | 88% | yes | | |
| 26 | Sub-Saharan Africa | SEN | Senegal | 94% | | yes | |
| 27 | Sub-Saharan Africa | SWZ | Eswatini | 100% | | yes | |
| 28 | Sub-Saharan Africa | TCD | Chad | 100% | yes | | |
| 29 | Latin America and Caribbean | TTO | Trinidad and Tobago | 100% | yes | | |
| 30 | Latin America and Caribbean | VEN | Venezuela, RB | 88% | yes | | |
| 31 | South, East Asia and Pacific | VNM | Vietnam | 88% | | | yes (telephone sets) |
| 32 | Middle East and North Africa | YEM | Yemen, Rep. | 100% | yes | | |

Notes: The repartition is based on the principal exportation according to OEC (http://atlas.media.mit.edu/en/visualize/tree_map/hs07/export/fra/all/show/2014/ ; dataset HS07) for the last year available (2014).

Table E.2: List of Resource-rich countries in our sample (2000-2016)

| # | Region | Code | Resource-rich countries | Oil exporters | Mineral exporters | Other exporters |
|---|---|---|---|---|---|---|
| 1 | Sub-Saharan Africa | AGO | Angola | yes | | |
| 2 | Europe and Central Asia | ALB | Albania | yes | | |
| 3 | Europe and Central Asia | AZE | Azerbaijan | yes | | |
| 4 | Latin America and Caribbean | BOL | Bolivia | yes | | |
| 5 | Sub-Saharan Africa | BWA | Botswana | | yes | |
| *6* | *Sub-Saharan Africa* | *CAF* | *Central African Republic*[i] | | | *yes (wood)* |
| 7 | Latin America and Caribbean | CHL | Chile | | yes | |
| 8 | Sub-Saharan Africa | CIV | Côte d'Ivoire | | | yes (cocoa) |
| 9 | Sub-Saharan Africa | CMR | Cameroon | yes | | |
| 10 | Sub-Saharan Africa | COG | Congo, Rep. | yes | | |
| 11 | Middle East and North Africa | DZA | Algeria | yes | | |
| 12 | Latin America and Caribbean | ECU | Ecuador | yes | | |
| 13 | Sub-Saharan Africa | GAB | Gabon | yes | | |
| 14 | Sub-Saharan Africa | GIN | Guinea | yes | | |
| *15* | *Latin America and Caribbean* | *GTM* | *Guatemala*[i] | | | *yes (can and beet sugar)* |
| 16 | South, East Asia and Pacific | IDN | Indonesia | yes | | |
| 17 | Middle East and North Africa | IRN | Iran, Islamic Rep. | yes | | |
| *18* | *Europe and Central Asia* | *KGZ* | *Kyrgyz Republic*[i] | | *yes* | |
| 19 | South, East Asia and Pacific | LAO | Lao PDR | | | yes (wood) |
| 20 | Sub-Saharan Africa | LBR | Liberia | | yes | |
| 21 | Middle East and North Africa | LBY | Libya | yes | | |
| 22 | Latin America and Caribbean | MEX | Mexico | yes | | |
| 23 | Sub-Saharan Africa | MLI | Mali | | yes | |
| 24 | South, East Asia and Pacific | MNG | Mongolia | | yes | |
| *25* | *Sub-Saharan Africa* | *MOZ* | *Mozambique*[i] | | *yes* | |
| 26 | Sub-Saharan Africa | NER | Niger | | yes | |
| 27 | Sub-Saharan Africa | NGA | Nigeria | yes | | |
| 28 | Middle East and North Africa | OMN | Oman | yes | | |
| 29 | Latin America and Caribbean | PER | Peru | | yes | |
| 30 | South, East Asia and Pacific | PNG | Papua New Guinea | yes | | |
| 31 | Europe and Central Asia | RUS | Russian Federation | yes | | |
| 32 | Middle East and North Africa | SAU | Saudi Arabia | yes | | |
| 33 | Sub-Saharan Africa | SDN | Sudan | yes | | |
| *34* | *Sub-Saharan Africa* | *SLE* | *Sierra Leone*[i] | | *yes* | |
| 35 | Middle East and North Africa | SYR | Syrian Arab Republic | | yes | |
| 36 | Sub-Saharan Africa | TCD | Chad | yes | | |
| *37* | *Sub-Saharan Africa* | *TGO* | *Togo*[i] | *yes* | | |
| 38 | Latin America and Caribbean | TTO | Trinidad and Tobago | yes | | |
| *39* | *Sub-Saharan Africa* | *TZA* | *Tanzania*[i] | | *yes* | |
| *40* | *Sub-Saharan Africa* | *UGA* | *Uganda*[i] | | | *yes (coffee)* |
| 41 | Europe and Central Asia | UZB | Uzbekistan | | yes | |
| 42 | Latin America and Caribbean | VEN | Venezuela, RB | yes | | |
| 43 | South, East Asia and Pacific | VNM | Vietnam | | | yes (telephone sets) |
| 44 | Middle East and North Africa | YEM | Yemen, Rep. | yes | | |
| 45 | Sub-Saharan Africa | ZAR | Congo, Dem. Rep. | | yes | |