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Fiscal Procyclicality in Commodity Exporting Countries

How Much Does It Pour and Why?

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Abstract

A large literature has documented that fiscal policy is procyclical in emerging markets and developing economies and acyclical/countercyclical in advanced economies. This paper analyzes fiscal procyclicality in commodity-exporting countries. It first shows that the degree of fiscal procyclicality is twice as high in commodity exporters than in non-commodity exporters. Further, while fiscal procyclicality has been falling in commodity exporters over the past 15 years, it is still pervasive and has fallen slower than in non-commodity exporting countries. In addition to testing the main theories behind fiscal procyclicality in commodity exporters and the role of institutional variables, the paper makes two novel contributions. First, based on the idea of fiscal procyclicality as a "when it rains, it pours" phenomenon (that is, contractionary fiscal policy amplifies the effects of a fall in commodity prices), the paper shows that, on average, government spending amplifies the business cycle by 21 percent of the initial drop in output following a fall in commodity prices. Put differently, the "pours" component accounts for 17 percent of the total fall in output. Second, the paper estimates the welfare costs of fiscal procyclicality at 2.6 percent of the costs associated with the regular business cycle in commodity exporters.

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Fiscal procyclicality in commodity exporting countries: How much does it pour and why?[*]

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1 Introduction

As is well-known by now, fiscal policy tends to be procyclical (i.e., expansionary in good times and contractionary in bad times) in emerging markets and developing economies (EMDE) and acyclical/countercyclical in advanced economies (AE).[1] Figure 1, updated from Kaminsky *et al.* (2004), shows the correlations for the HP-cyclical components of GDP and government spending for 189 countries (152 EMDE and 37 AE) for the period 1980-2020.[2] Red bars identify EMDE and black bars AE. A positive correlation indicates procyclicality, while a negative correlation indicates countercyclicality. The visual impression is striking. We see a large red mass on the right-side of the figure illustrating the fact that, on average, most EMDE have been procyclical over the past 40 years. In contrast, most black bars lie on the left-side of the picture, indicating that industrial countries have been typically countercyclical.[3] The average correlation for EMDE is 0.42 (and significant at the 1 percent level). For AE, the average is slightly negative but not significantly different from zero. Procyclical fiscal policy in EMDE thus amplifies an already volatile business cycle (especially in emerging markets). As government spending often spirals out of control in good times, the inability to borrow in bad times makes the inevitable adjustment even more painful. Ironically, fiscal policy thus becomes a source of instability, contrary to its intended stabilizing role in a Keynesian world.

The role of fiscal policy as a possible source of macroeconomic instability is particularly relevant in commodity exporters, given the significant response of fiscal variables to commodity shocks. In an early policy analysis, Cuddington (1989) examines fiscal management in five developing countries (Colombia, Cameroon, Kenya, Nigeria, and Jamaica) in the 1970s in response to commodity price booms. While Colombia and Cameroon avoided large increases in fiscal revenues and government expenditures, fiscal authorities in the other three countries essentially lost control over public finances, with government spending increasing markedly as a proportion of GDP and actually

[1] For an early empirical look at the fiscal procyclicality phenomenon, see Kaminsky *et al.* (2004) and, more recently, Frankel *et al.* (2013), Carneiro and Garrido (2016), Richaud *et al.* (2019), and the references therein.

[2] See Table A1 for details.

[3] As shown by Vegh and Vuletin (2015), the same pattern emerges on the taxation side based on an analysis of tax rates.

surpassing the increase in revenues, leading to higher fiscal deficits and often more foreign borrowing. The lack of budgetary control frequently led to full-blown fiscal crises.

More recently, and using the same Dutch-disease conceptual framework in modern VAR clothes, Pieschacon (2012) revisits Cuddington's analysis for Mexico and Norway and concludes that, in the case of Norway, disciplined fiscal management was welfare-improving while, in the case of Mexico, an undisciplined fiscal response led to a welfare-reducing response.[4] Norway's policies were in the mold of Cameroon's, where the initial windfall from the 1976-77 coffee boom accrued to commodity stabilization funds, as prices paid to domestic producers were kept below world prices (Cuddington, 1989, p. 150). Cespedes and Velasco (2014) also document the fiscal indiscipline following commodity booms but argue that fiscal management improved in the boom period just prior to the 2008 crisis compared to the boom of the late 1970s and early 1980s.[5] Regardless, Richaud *et al.* (2019) stress the need for fiscal consolidation in commodity exporting countries since building fiscal space may be constrained by contingent liabilities resulting from exposure to state-owned enterprises and state banks.

The complex link between commodity prices and fiscal policy has come back with a vengeance in light of the sharp increase in commodity prices during 2020-2022. While many analysts foresee (hope for?) higher public savings to build fiscal space after heavy public spending during the pandemic, others take a more realistic stance, look at the historical experience, and brace for possibly another round of fiscal instability. Within this framework of fiscal instability/indiscipline in commodity producers, this paper pushes the analysis further in several important directions, including a novel approach to quantifying the effects of fiscal instability on output and the welfare costs of fiscal instability.

We start our analysis by using correlations between the cyclical components of real GDP and real government spending to establish some basic stylized facts on fiscal

[4] Other contributions that build on Cuddington's (1989) analysis of fiscal instability, often in the context of fiscal cyclicality, include Abdih *et al.* (2010), Kaminsky (2010), Villafuerte and Lopez-Murphy (2010), Rasmussen and Roitman (2011), Villafuerte *et al.* (2011), Schmidt-Hebbel (2012), Roch (2017), Richaud *et al.* (2019), and Wilson *et al.* (2021).

[5] This is consistent with the "graduation" hypothesis (i.e., the switch from procyclicality to countercyclicality) documented in Frankel *et al.* (2013) in a significant number of EMDE as a response to improvements in institutional quality.

procyclicality in commodity exporters and how fiscal procyclicality is related to key macroeconomic and institutional variables. Five stylized facts are identified. First, commodity exporters are twice as procyclical as non-commodity exporters regardless of their main commodity export. Second, while fiscal procyclicality in commodity-exporters (CE) has been falling over the past decade and a half, procyclicality in CE is still a very significant phenomenon and has fallen much less than in non-CE countries (which are, on average, acyclical by now). Third, the relationship between fiscal procyclicality and key macro-variables is not always as expected. Procyclicality is higher (i) when capital controls are present, and (ii) under fixed/predetermined exchange rates. Procyclicality, however, does not seem to be associated with the cyclical stance or the level of external debt. Fourth, the relationship between fiscal procyclicality and major institutional variables is generally as expected. Specifically, fiscal procyclicality is higher the higher is political risk, the lower is bureaucracy quality, the lower is control of corruption, and the lower is law and order. Finally, the relationship between fiscal procyclicality and fiscal rules cannot be easily teased out from simple correlations and formal econometric work involving instrumental variables is needed.

At a more fundamental level, a question still open in the literature is why some commodity producers would do a better job at "managing abundance" than others. This idea of managing abundance, stressed already by Cuddington (1989), is often a serious concern of policymakers and economic analysts in CE. Needless to say, managing abundance is the mirror image of fiscal cyclicality. A country that manages not to spend more than permanent increases in resources will be following acyclical or countercyclical fiscal policy. In contrast, a country that mismanages abundance and spends part or all of any temporary increase in resources will be following procyclical fiscal policy. However, without a proper understanding of the causes and factors involved, it is hard to see how this general concern about mismanaging abundance would translate into concrete public policies.

In terms of managing abundance, the theoretical literature offers several possible political-economy explanations as to why a country would follow procyclical fiscal policy. Among the best-known theories, Tornell and Lane (1999) argue that, in response to a positive shock to terms of trade, for example, the more fiscal claimants there are (i.e., the more ministries, provinces, etc.), the higher will fiscal appropriations be (the "voracity" effect). Talvi and Vegh (2005) argue that political pressures to spend in good times induce policymakers to try to reduce primary surpluses (by cutting tax rates) to limit wasteful spending. Finally, a related explanation is offered by Alesina *et al.* (2008) who argue that, in a corrupted political environment, voters will attempt to "starve the beast" to prevent corrupt government officials from misappropriating funds by demanding more transfers and lower taxes. We test these three theories and find empirical support for the second (Talvi and Vegh) and third (Alesina *et al.*) but not for Tornell and Lane's voracity effect. The policy implication is that the fiscal authority is most vulnerable in good times and resisting political pressures to spend should be a top priority.

Having tested the main theories behind mismanaging abundance, we take advantage of our econometric framework to test whether institutional variables can help fiscal authorities resist political pressures to spend. We find that better public institutions (such as government stability and law and order), commodity stabilization funds, and fiscal rules help reduce fiscal procyclicality. We instrument fiscal rules with bureaucracy quality to take care of reverse causality problems.

Our third, and novel, contribution is to quantify the "when it rains, it pours" phenomenon (a term coined by Kaminsky *et al.*, 2004). This expression calls attention to the fact that, by reacting procyclically, policymakers amplify the underlying business cycle. For instance, if a fall in commodity prices provokes an initial recession (the "rain"), cutting government spending in response (i.e., procyclical fiscal policy) will, through the fiscal multiplier, aggravate the initial recession (the "pours"). In other words, the total fall in output is the sum of rain plus pours since the government amplifies the initial recession by adopting a contractionary fiscal policy. Despite its obvious policy importance, there is little empirical evidence on the quantitative importance of this "pours" channel.[6] Commodity exporters should constitute an ideal testing ground because changes in commodity prices lead to large commodity cycles (World Bank, 2022).

To estimate the pours component, we proceed in four steps. In the first step, we estimate the response of real GDP to a country-specific commodity export price index

[6] Notice that procyclicality would not affect output if the fiscal multiplier were zero. Hence, estimating the fiscal multiplier (not an issue that typical papers on fiscal procyclicality are concerned with) is a critical step in our pours analysis.

(thus estimating the total change in GDP). The second step consists in running another panel regression to estimate a fiscal policy reaction function (i.e., how does government spending react to changes in commodity prices?). For instance, we expect government spending in EMDE to fall in response to lower commodity prices. In the third step, we estimate a fiscal multiplier for our sample using the Blanchard-Perotti identification. Finally, the pours (i.e., amplification) component follows from combining the fiscal response and the fiscal multiplier. We express the pours component as a percentage of the rain component for every country in the sample. This ratio is positive for the EMDE in the sample (indicating fiscal procyclicality) and negative for the AE (indicating fiscal countercyclicality). The average value of the ratio pours/rain for EMDE is 21.4 percent (ranging from 11.6 to 35.0 percent). In other words, in response to a fall in GDP of 1 percent, the procyclical fiscal response further reduces GDP by 0.214 percent. For the AE, the average value is -0.654 percent, implying that in response to a fall in GDP of one percent, the countercyclical fiscal response increases GDP by 0.654 percent, so that the net overall fall in GDP is 0.346 percent. An alternative way of thinking is that, on average, 17.4 percent of the total fall in GDP in bad times in EMDE is due to fiscal procyclicality. To grasp the significance of the pours component, we calculate that, during the commodity boom of 2003-2008, 84 percent of the difference in growth between commodity-exporters in EMDE and AE (6.5 percent versus 1.6 percent, respectively) was due to EMDE responding procyclically and AE responding countercyclically.

Our fourth and final novel contribution is to compute the welfare costs (à la Lucas, 1987) of fiscal procyclicality. Specifically, we compute by how much households would be willing to be penalized (i.e., taxed) to avoid the pours effect. We express this welfare cost as a percentage of the welfare costs arising from the regular business cycle. We conclude that the welfare costs for EMDE are 2.6 percent of the regular business cycle, while for AE the figure is -5.3 percent. Since the pours is negative for AE due to countercyclical policy, welfare costs are negative (i.e., there is a positive gain in welfare due to countercyclical fiscal policy).

In sum, the paper shows that commodity-exporters are a breed apart in terms of how procyclical they are. In particular, the econometric evidence is clear in identifying political pressures to spend more in good times as a key distortion that feeds procyclicality. As a result, on average, fiscal policy amplifies the business cycle by 21.4 percent. The good news is that implementing/deepening certain institutions, including fiscal rules overseen by independent fiscal councils and sovereign wealth funds, should help in reducing procyclicality.

The paper proceeds as follows. The next section will present a set of stylized facts that will serve as a general framework to interpret the subsequent empirical and numerical analysis. Section 3 carries out the econometric testing of different theories to explain fiscal procyclicality. Section 4 tests the significance of institutional variables. Section 5 provides the numerical analysis of the pours component. Section 6 computes the welfare costs of fiscal procyclicality. Finally, Section 7 closes the paper with policy implications and directions for further research.

2 Stylized facts for commodity exporters

This section develops a set of stylized facts for understanding procyclicality in commodity-exporters that will provide the foundations for the more formal econometric/quantitative analysis in the rest of the paper. We first look at some basic facts on fiscal procyclicality in CE, and then turn to macroeconomic and institutional variables expected to have an impact on the degree of procyclicality.[7]

2.1 Fiscal procyclicality

As shown in Figure 1, over the past forty years EMDE have been strongly procyclical while AE have been acyclical. But what has happened in commodity-exporting countries compared to non-commodity-exporting countries? Figure 2 shows that, while both groups of countries have been procyclical, the correlation between the cyclical components of real government spending and real GDP for CE is twice as large as that for non-CE (0.43 compared to 0.22, both highly significant).[8] [9] In fact, this result continues to hold when we look at the three major commodities categories (i.e.,

[7]Throughout this analysis, we rely on the Hodrick-Prescott filter. The results are robust to the use of alternative filters, such as Baxter-King (see Appendix 9 for details), or non-parametric filters, as shown by Kaminsky *et al.* (2004) and Carneiro and Garrido (2016).

[8]Henceforth, "highly significant" will be taken to mean significant at the one percent level.

[9]For commodity exporters, we use the World Bank definition.

agriculture, metals, and energy), as illustrated in Figure 3. We thus conclude that:

Stylized fact # 1. *Commodity exporters are twice as procyclical as non-commodity exporters regardless of their major commodity export.*

An interesting question to ask is whether the procyclicality observed in CE, relative to non-CE, has changed over time. A simple way of looking at this issue is to break the sample in 2006 and repeat the calculation in Figure 2 for the two sub-samples (i.e., before and after 2006). The year 2006 seems a natural choice because casual observation and empirical work suggest that countries' willingness and ability to pursue countercyclical fiscal policy increased in the aftermath of the global financial crisis.[10] Comparing Figures 4 and 5, we indeed find that procyclicality in CE has fallen from 0.35 (and highly significant) before 2006 to 0.26 (also highly significant) after 2006. This reduction in procyclicality, however, has not been as dramatic as in non-CE, where it has fallen from 0.21 (and highly significant) to -0.03 (and not significantly different from zero). We thus conclude:

Stylized fact # 2 *On average, fiscal procyclicality in CE has been falling over the last decade and a half. Procyclicality, however, is still a very significant phenomenon and has fallen much less than in non-CE countries (which are, on average, acyclical by now).*

2.2 Macroeconomic factors

The first macroeconomic question we will address is whether CE with more stringent capital controls are more procyclical than those with less stringent capital controls. Intuitively, we would expect that countries with more capital controls would be more procyclical because, in bad times, they would have only sporadic access to international credit markets. Figure 6 confirms this intuition. We can see that CE with high capital controls have a correlation of 0.51 (and highly significant) compared to 0.33 (and also highly significant) for CE with lower capital controls. Further, the difference between 0.51 and 0.33 is significant at the 5 percent level.[11] [12] Notice that this finding

[10] See, for example, Alvarez and De Gregorio (2014) and Vegh and Vuletin (2014).

[11] Notice that we can test whether the two coefficients in Figure 6 are statistically different because the sample is the same. This is not the case in Figure 1, for example, where the samples behind each average are different.

[12] This is consistent with the RBC model of Fernandez et *al.* (2021) in which a steeper upward sloping supply of funds (which makes borrowing from the rest of the world more costly) implies more procyclical fiscal

strengthens the case for removing capital controls because it shows that, in addition to the standard microeconomic distortions and rent-seeking arguments, capital controls make the business cycle more volatile through their impact on fiscal procyclicality.

A second macroeconomic factor is the possible impact of the exchange rate regime. If, as shown by Ilzetzki *et al.* (2013), fiscal multipliers are larger under fixed/predetermined exchange rates than under flexible exchange rates, then it may be the case that the correlation is higher under fixed/predetermined because the pours component would, in principle, be higher for the same reduction in government spending.[13] Figure 7 supports this idea by showing that the correlation between the cyclical components of government spending and GDP is larger under fixed/predetermined exchange rate regimes than under flexible exchange rates (0.46 versus 0.36). The difference between the two, however, is not significant at the 10 percent level (i.e., the p-value is 0.17). Still, there seems to be some merit to this idea and further analysis may be warranted.

A third macroeconomic factor is the level of external debt. According to Ilzetzki *et al.* (2013), fiscal multipliers are lower the higher is external debt, most likely due to the unsustainability of any fiscal expansion. Hence, one would think that the correlation between real GDP and real government spending will be lower the higher is external debt. This notion, however, is not borne out by our data, as illustrated in Figure 8. The correlation is the same under high and low external debt.

The fourth, and last, macroeconomic issue that we will look at in this section is whether the degree of fiscal procyclicality depends on the stance of the business cycle (i.e., whether the economy is in good or bad times). This is inspired by the findings of Auerbach and Gorodnichenko (2010 and 2013) for OECD countries to the effect that the size of fiscal multipliers seems to depend on the stance of the business cycle.[14] Multipliers in bad times appear to be larger than in good times. This makes perfect sense, of course, since there is much less spare capacity, if any, in good than in bad times. In an extreme case, the fiscal multiplier would be zero in good times which, all else

policy. Notice that other international credit market imperfections, such as limited commitment (Bauducco and Caprioli, 2014) and sovereign risk (Cuadra *et al.*, 2010, Bianchi *et al.*, 2019, Dzhambova, 2021), may play a similar role as capital controls and thus increase fiscal procyclicality.

[13] As argued by Tornell and Velasco (2000), an alternative mechanism may come into play. In their model, fiscal spending is higher under fixed/predetermined exchange rates because flexible rates impose more discipline in the short-run.

[14] See also Ghassibe and Zanetti (2022), who show that the optimal fiscal response may depend on the source of fluctuations.

equal, would produce no pours, reducing the correlation. Figure 9, however, indicates that the difference in the correlations (0.29 in good times and 0.23 in bad times) is not significantly different from zero. Summarizing our findings for macroeconomic factors:

Stylized fact # 3 *The relationship between fiscal procyclicality and key macro-variables is not always as expected. Procyclicality is higher when (i) capital controls are present and (ii) under fixed/predetermined exchange rates. Procyclicality, however, does not seem to be associated with the cyclical stance or the level of external debt.*

Clearly, further analytical work on the relationship between fiscal procyclicality and key macro-variables is needed. In contrast, as discussed in Section 4, analytical models based on institutional variables (particularly political-economy variables) are much more established.

2.3 Institutional variables

We now turn to institutional variables.[15] Our first institutional variable is political risk.[16] As expected, and shown in Figure 10, high-political-risk CE are more procyclical (i.e., have a higher correlation between the cyclical components of real GDP and real government spending) than low-political-risk CE. The correlation is 0.49 for high-risk and 0.28 for low-risk, with the difference significant at the 10 percent level. When it comes to bureaucracy quality, Figure 11 shows that CE with low bureaucracy quality have an average correlation of 0.47 compared to just 0.33 for countries with high bureaucracy quality. While large, the difference is not significantly different from zero (p-value = 0.16). As to corruption, Figure 12 shows that countries with low corruption control have an average correlation of 0.50 compared to 0.31 for countries with high corruption control, with the difference being statistically significant at the five percent level. Another institutional variable is government stability. Again, as expected, countries with high government stability have a correlation of 0.39 compared to countries with low government stability (0.45), as illustrated in Figure 13. The dif-

[15] Section 4 will look at institutional variables in a formal econometric set-up.

[16] The source for the first five institutional variables (political risk, bureaucracy quality, control of corruption, government stability, and law and order) is the International Country Risk Guide (ICRG). The political risk index is based on 12 components with varying weights: government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and bureaucracy quality.

ference, however, is not significantly different from zero. Finally, as shown in Figure 14, law and order appears to matter a great deal: countries with low law and order have a correlation of 0.50 compared to just 0.28 for countries with high law and order (and the difference is significant at the one percent level). We thus conclude:

Stylized fact # 4 *The relationship between fiscal procyclicality and major institutional variables is generally as expected. Specifically, fiscal procyclicality is more pronounced the higher is political risk, the lower is bureaucracy quality, the lower is control of corruption, and the lower is law and order.*

Finally, we look at the relationship between fiscal procyclicality and fiscal rules.[17] As shown in Figure 15 for our sample of CE, the average correlation for countries with fiscal rules is 0.44 compared to 0.48 for countries without fiscal rules (and both highly significant). The difference between these two figures, however, is not significantly different from zero. This is an unexpected finding since one would have expected fiscal rules to lower fiscal procyclicality. Hence, either fiscal rules are ineffective in lowering fiscal procyclicality and/or there may be reverse causality (i.e., endogeneity problems). Clearly, causality may go from fiscal rules to fiscal procyclicality (for example, a structural balanced budget rule lowers fiscal procyclicality) or from fiscal procyclicality to fiscal rules (a country that has been long suffering from fiscal procyclicality may decide to implement a fiscal rule).

As a further check, Figure 16 shows the relationship between fiscal procyclicality and fiscal rules for the full sample. In this case, the result is as expected in that countries without fiscal rules are more procyclical (correlation of 0.42) than countries with fiscal rules (correlation of 0.19), though the difference is not significant. We thus conclude:

Stylized fact # 5 *Based on simple correlations, the relationship between fiscal procyclicality and fiscal rules is unclear due, most likely, to reverse causality problems.*

To get at the core of this issue, more formal econometric work involving instrumental variables will be carried out in Section 4.

[17] See Data Appendix in Section 8 for details on how the fiscal rules variable was computed.

3 Testing theories of fiscal procyclicality

As illustrated in Figures 1 and 2, most EMDE – and, in particular, commodity exporters – are overwhelmingly procyclical. This is, of course, a puzzle since procyclical fiscal policy amplifies the underlying business cycle, which is already quite volatile, especially for CE. Why would a country's fiscal authority pursue procyclical fiscal policy? Leaving aside sheer ineptitude (an unattractive and most likely wrong explanation), there must be some frictions in these economies that induce policymakers to pursue such misguided policies from a social point of view. In fact, there is a relatively large theoretical literature attempting to explain fiscal procyclicality. This section reviews the theories that, in our view, are potentially the most relevant ones and assess their empirical validity. To do so, we look for a single explanatory variable that captures the main friction in each of the main theories and run panel regressions.[18]

3.1 Imperfections in international capital markets

This explanation is, by far, the most popular *macroeconomic* explanation (as opposed to the *political economy* explanations analyzed below). We purposely use the term "imperfections" to capture different frictions that may prevent EMDE from borrowing in bad times. Lack of access to international credit markets in bad times will impart a procyclical bias to fiscal policy as the need to finance a primary deficit will induce the fiscal authority to cut spending and/or raise taxes in bad times.[19]

A policy-induced imperfection is the macroeconomic use of capital controls over the business cycle. As is well-known by now, the IMF has endorsed using capital controls as a last resort.[20] While the primary impetus for this unexpected IMF policy

[18] Earlier and related econometric studies of factors causing fiscal procyclicality include Lane (2003), who covers only OECD countries; Calderon and Schmidt-Hebbel (2008) who also distinguish between financial and institutional variables, and Calderon *et al.* (2010) who focus on the role of institutions. See also Ilzetzki (2011), who provides a novel political economy explanation based on successive governments disagreeing on the desired distribution of public spending, and examines different theories of procyclicality by running numerical simulations in calibrated models.

[19] In a first-best neo-classical world, the fiscal authority would save (or repay debt) in good times and dis-save (or borrow) in bad times, leading to an acyclical fiscal policy (i.e., constant government spending and constant tax rates); see, for example, Vegh (2013), Chapter 10.

[20] For the original IMF view, see Ostry *et al.* (2010). For an opposite view, see Calvo (2010). For the current (essentially unchanged) view, see IMF (2022). The current view holds that while free capital flows bring substantial and well-known benefits, capital controls (referred to as capital flow management measures) can be useful in certain cases but are not a substitute for macroeconomic adjustment.

position is the so-called Tobin tax (i.e., preventing socially excessive borrowing in good times), the use of capital controls in good times will inevitably make it more likely to see capital controls in bad times as well. Binding capital controls in bad times will naturally prevent the fiscal authority from keeping tax rates or government spending constant over the business cycle and lead to procyclical fiscal policy.

A more subtle, but equally disruptive, friction in a model with uncertainty is the presence of incomplete markets, which allows for only risk-free (i.e., non-state-contingent) borrowing. In other words, the absence of complete markets (in the Arrow-Debreu sense) that would allow the fiscal authority to borrow conditional on every state of the world – and thus replicate the first-best fiscal policy in a neo-classical model – renders fiscal policy procyclical. In fact, Fernandez *et al.* (2021) show, in the context of a DSGE model how, under certain conditions, incomplete markets is all that is needed for the optimal (in a second-best sense) fiscal policy to become procyclical. Further, procyclicality continues to be the best policy if sovereign risk is added to the picture (see Cuadra *et al.*, 2010, Bianchi *et al.*, 2019, and Dzhambova, 2021).[21]

To capture the effects of capital controls and other financial frictions which, effectively, curtail borrowing in bad times, we will resort to the well-known Chinn-Ito (2006) financial openness index. This index, constructed based on information from the IMF, is normalized between 0 and 1, with higher values indicating more financially-opened economies. As of mid-2022, the Chinn-Ito index covers the period 1970-2019 for 182 countries.

3.2 Political economy explanations

The second major group of potential explanations for the procyclicality of EMDE relies on political economy considerations. As discussed in the Introduction, all these political economy factors would make it more difficult to manage the abundance triggered by positive shocks to commodity prices. In one way or another, all these leading theories predict that political distortions would make it more difficult to prevent wasteful spending and/or spend only permanent increases in resources.

[21] Yet another financial friction in the form of limited commitment is analyzed in Bauducco and Caprioli (2014). This friction generates procyclical tax policy for an exogenously-given path of government spending.

3.2.1 The voracity effect

Tornell and Lane (1999) develop a model in which a number of fiscal claimants (ministries, provinces, unions, and so forth) attempt to appropriate resources in good times without taking into account the effects of their actions on other claimants (like fishing from a common pool), which they refer to as the "voracity effect." As the intensity of fiscal competition increases in good times, the rise in government spending could be higher than the windfall. Government spending will thus be procyclical. Further, the more claimants there are (which they interpret as power being more dispersed), the higher the level of government spending in good times (i.e., the more procyclical government spending is).

While the voracity effect is certainly an attractive idea to think about procyclical government spending and captures a key political friction, how to quantify power dispersion for econometric purposes is far from trivial. Specifically, the empirical measure used by Lane (2003) is the Political Constraint Index (POLCON), taken from Henisz (2000) and Henisz and Zelner (undated).[22] This (0,1) index counts the number of veto points in the political system and the distribution of preferences across and within the different branches of government.[23] As Lane (2003) himself discusses, the empirical complications stem from the fact that this index can be interpreted as capturing the voracity effect or actually measuring the opposite effect. On the one hand, we could argue that a larger number of veto power points implies that power is more dispersed and hence should lead to a larger voracity effect (i.e., power dispersion is bad). In such a case, we would expect that the higher is POLCON, the larger is the correlation between the cyclical components of government spending and GDP. On the other hand, Henisz (2000) concludes that POLCON is positively correlated with higher growth because a larger number of veto points enhances property rights, ensures efficient and predictable bureaucratic procedures, and limits the executive branch's ability to introduce legal or constitutional changes (i.e., power dispersion, as measured by the number of veto points, is good).

This tension on how to interpret POLCON is clearly reflected in Lane's (2003)

[22] The POLCON index starts in 1960 for more than half of the countries and 1980-1990 for the rest. It is currently updated up to 2016 for all 86 current countries.

[23] In actuality, the construction of this index is quite complex and the reader is referred to Henisz and Zelner (undated) for details.

regressions as this index is often not significant and/or has the "wrong" sign from the point of view of the voracity effect hypothesis. Since Lane's work is confined to OECD countries, our much larger sample will allow us to re-test the voracity effect hypothesis with much more power.

3.2.2 Costly budget surpluses

A second, and related, political economy explanation (in the context of an otherwise neo-classical model) is proposed by Talvi and Vegh (2005). The starting point is the standard neo-classical model where the optimal fiscal policy would be acyclical and primary surpluses would arise in good times and primary deficits in bad times. Importantly, these primary imbalances would be larger, the larger the underlying shocks (commodity prices in our case). In this context, the idea is that, in good times, the primary surpluses would lead to intense spending pressures from lobbyists and many other economic agents. When the coffers are filled, it is simply hard for the fiscal authority to say no to additional spending. To avoid this, tax rates are often reduced to lower the primary surplus and hence the risk of wasteful spending. In other words, finance ministers argue that they would rather give back resources to the private sector in the form of lower taxes than let the public sector do the spending. We thus have procyclical fiscal policy both on the spending side (inevitably, spending goes up although less than in the absence of tax reductions) and the taxation side. These results can be shown formally in the context of a simple neo-classical model by assuming that government spending has a convex endogenous component that depends on the size of the primary surplus.

A convenient feature of the Talvi-Vegh model is its easily testable empirical implication. Notice that the higher the variability of the tax base over the business cycle, the larger will be the primary surpluses in good times, and hence the more procyclical should fiscal policy be. Tax base variability can be captured by income variability (personal income tax) and/or consumption variability (VAT rate). The model's prediction would thus be that the higher income variability (denoted by SD(y)), the more procyclical is fiscal policy.

3.2.3 Starving the beast

In a paper closely-related to Talvi and Vegh (2005), Alesina *et al.* (2008) endogenize the political distortion that is taken as given by Talvi-Vegh by providing a compelling political-economy story. Specifically, in good times voters seek to "starve the beast" to reduce political rents appropriated by corrupt politicians. Voters observe the state of the economy but not the rents appropriated by corrupt politicians. Therefore, when voters observe a boom, they optimally demand more public goods and/or lower taxes, which leads to procyclical fiscal policy. The more corrupt the government and close political allies, the higher the rents that they will appropriate, and the higher the public demand for public goods and/or lower taxes. From an empirical point of view, the key variable to capture Alesina *et al.*'s story is some measure of corruption. We will use the variable "corruption" from the International Country Risk Guide (ICRG).[24]

3.3 Regressions

Table 1 reports the results of cross-country regressions for commodity exporters. The dependent variable is the country correlation between the cyclical components of real government spending and real GDP measured over the entire time interval. The explanatory variables are the four independent variables discussed above that capture each of the four explanations for the existence of procyclical fiscal policy: the financial openness index; the political constraint index; the standard deviation of income (SD(y)); and control of corruption.

Columns (1)-(4) report the regressions results with each variable individually. We can see that each variable is significant at least at the five percent level. In light of the discussion above, three of the four coefficients have the expected signs: higher financial openness reduces procyclicality (Column (1)); more control of corruption decreases procyclicality (Column (2)); and larger volatility of output increases procyclicality (Column (4)). In contrast, Column (3) shows a *negative* coefficient, indicating that the higher the political constraint index, the less procyclical fiscal policy is. Based on

[24]ICRG views corruption as a threat to foreign investment by introducing distortions in the economic environment, reducing government efficiency, and rendering the political system more unstable. Since a higher number implies less corruption, we refer to this index as "control of corruption." For further details, see ICRG's website.

the above discussion, this finding indicates that either the voracity effect does not hold in practice or, most likely, that POLCON is not the appropriate variable to capture the detrimental effects of more fiscal claimants on available resources.

Finally, Column (5) includes the four explanatory variables in the same regression. Due to multicollinearity, no explanatory variable is significantly different from zero at the 10 percent level.[25] However, the F-test for the joint significance of financial openness, corruption control, and GDP volatility (i.e., the variables that validate the respective theoretical explanations) is significant at the 5 percent level.[26] We thus conclude that all of our theoretical expectations hold to econometric scrutiny, except for the voracity effect hypothesis that would require further research to find an index that captures with more precision what the theory has in mind.[27]

4 Testing institutional variables

In this section, we test whether institutional variables may play a role in reducing procyclicality. Based on the stylized facts in Section 2, we expect government stability and law and order to be important factors in reducing fiscal procyclicality. As already mentioned, the source of these two variables is the International Country Risk Guide (ICRG). The ICRG views government stability as the government's ability to carry out its intended public policies and its ability to stay in office. It has three subcomponents: government unity, legislative strength, and popular support. Law and order are assessed separably. For "law," strength and impartiality of the judicial system are the critical features, while for "order" the critical factor is the public's observance of the law.

A new variable that we will introduce in these institutional regressions is whether countries have a sovereign wealth fund or not.[28] More specifically, we are thinking

[25] We should note, though, that the p-values for financial openness, corruption control, and SD(Y) are 0.13, 0.12, and 0.12, respectively; very close to the 10 percent significance level.

[26] In line with Lane (2003), and to check the robustness of our results, we added GDP per capita, size of the public sector relative to GDP, and openness (export + imports as a proportion of GDP) as controls in regression (5) one at a time. GDP per capita is significant at the 5 percent level but the two other control variables are not significant. In all three cases, the F-test for the joint significance of the three relevant explanatory variables is significantly different from zero at least at the 10 percent level.

[27] See the discussion above, Lane (2003), and Tornell and Lane (1998).

[28] This is a dummy variable that takes a value of 1 if a country has a sovereign wealth fund and 0 otherwise.

about commodity stabilization funds that are used to save during commodity booms and dis-save in bad times. In theory, fully saving (dis-saving) temporary increases (declines) in commodity prices should reduce fiscal procyclicality to zero.[29]

Given the importance of fiscal rules, we will also assess their effect on fiscal procyclicality. As discussed in Section 2, however, we need to be concerned about the possible endogeneity of fiscal rules. While fiscal rules may reduce procyclicality, the existence of fiscal procyclicality may prompt policymakers to adopt fiscal rules. We thus need an instrument to deal with this problem. We will use bureaucracy quality, also from the ICRG, as our instrument. Bureaucracy quality is viewed by the ICRG as a shock absorber that limits policy changes when governments alternate in power. The bureaucracy tends to function autonomously without major interference from the political process. Since implementing enforceable fiscal rules requires technocrats well versed in economic policy and political stability to enable their success, we would expect bureaucracy quality and fiscal rules to be positively correlated.[30] At the same time, bureaucracy quality should not directly impact fiscal procyclicality since a qualified and stable bureaucracy is not related in an obvious way to government spending and/or tax policy.[31]

We will thus run cross-country regressions of the correlation between the cyclical components of real GDP and real government spending on government stability, law and order, fiscal rules, and sovereign wealth funds, using bureaucracy quality as an instrument for fiscal rules in our instrumental variables estimations (two-stage least squares). Results are shown in Table 2.

Columns (1)-(4) in Table 2 report the regressions results with each variable individually.[32] We can see that all four variables have the expected negative sign and

We take the average per country of this variable across the sample time interval. The data source is the Sovereign Wealth Fund Institute.

[29] While Fasano (2000) finds mixed evidence, the empirical analysis of Asik (2017) supports our conjecture (at least for oil-rich countries).

[30] Indeed, the simple correlation between bureaucracy quality and fiscal rules is 47 percent.

[31] Further, as of 2020, public employee compensation varies widely across countries, ranging from 5%-15% in Europe to 30%-50% in Africa, suggesting that factors other than bureaucratic quality come into play. In fact, in the public service literature (see, for example, Dolan, 2002, and the references therein), the main determinant of bureaucrats' budgets is the extent to which their priorities reflect the public's preferences.

[32] We estimate this regression for the full sample (as opposed to the CE sample). The reason is that, for this particular set of variables, we have only 38 observations in the CE sample (as opposed to 83 in the full sample). Further, if we estimate regressions 1-4 in Table 4 keeping constant the sample at 83 observations, the same results follow.

are significantly different from zero, at least at the five percent level. Thus, higher government stability, more law and order, and the presence of fiscal rules and sovereign wealth funds all tend to lower fiscal procyclicality. Column (5) shows the IV estimation of fiscal rules. We can see that the OLS results in Column (3) continue to hold. When all four variables are included together (column (6)), we lose the significance of government stability due to multicollinearity. However, an F-test confirms the joint significance of the four variables at the 1 percent level. Finally, column (7) shows the corresponding IV estimation. Similar results go through since an F-test also confirms the joint significance of the four explanatory variables at the 1 percent level.[33]

In sum, our econometric analysis strongly suggests that better institutions clearly lead to reduced fiscal procyclicality. This is not surprising given that better institutions should tend to compensate for the frictions mentioned above that cause more fiscal procyclicality. For instance, by ensuring that public policies are carried out and the political cycle is smooth, government stability should reduce output volatility and hence lower the fluctuations in the tax base that lead to more fiscal procyclicality in Talvi and Vegh's model. In the same vein, more law and order should diminish opportunities for corruption and hence result in less fiscal procyclicality in terms of Alesina *et al.*'s model. Finally, and particularly from a public policy point of view, it is certainly reassuring to see that there is causality from fiscal rules to fiscal procyclicality. This strengthens the case for the adoption of fiscal rules and independent fiscal councils, which objectively monitor whether fiscal rules are complied with. Like structural balanced rules, fiscal rules that induce the fiscal authority to save more in good times and dis-save more in bad times will naturally reduce fiscal procyclicality. The Chilean experience clearly supports this notion.[34] In a similar vein, commodity stabilization funds reduce fiscal procyclicality by enabling the government to save in good times.

[33]To check robustness of our results, we added GDP per capita, size of the public sector relative to GDP, and openness (export + imports as a proportion of GDP) as controls in regression (7) one at a time. No control variable is significant at the 10 percent level. The F-test for the joint significance of the four institutional variables holds at the 1 percent level for size of the public sector and openness, and at the 10 percent level for GDP per capita.

[34]See, for example, Frankel (2011) and Larrain *et al.* (2019).

5 Measuring the "pours" component

Kaminsky *et al.* (2004) coined the expression "when it rains, it pours" to capture the amplification effect of procyclical fiscal policy on output. Consider, for example, a fall in commodity prices. Such a shock will have a direct negative effect on output through standard channels, which is the "rain" component.[35] The fall in output and consumption will reduce the tax base, thus increasing the primary fiscal deficit and forcing the fiscal authority to reduce government spending and/or increase taxes to restore fiscal balance. This, in turn, will have an additional negative output effect (the "pours" component). The total effect of the fall in commodity prices can be thus decomposed into a rain and a pours component:

$$change\ in\ GDP = rain + pours. \tag{1}$$

The purpose of this section is to quantify the "pours" component. This will be done in four steps:

- Panel regression (with country fixed-effects) to quantify the effects of changes in commodity prices on output. (This will be the total output effect)
- Panel regression (with country fixed-effects) to quantify the effects of changes in commodity prices on government spending. This is the fiscal response.
- Computation of the average fiscal multiplier.
- Computation of the pours component.

5.1 Data

Our sample consists of 15 commodity-exporting countries: 11 EMDE and 4 AE. The EMDE countries are Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Honduras, Indonesia, Russian Federation, South Africa, and Ukraine, and the 4 advanced economies are Australia, Canada, New Zealand, and Norway.[36] [37] The data is an-

[35] On the output effects of terms of trade shocks, see, for example, Mendoza (1995).

[36] The number of countries in our sample was limited by the need to have quarterly data for the purposes of computing an average fiscal multiplier using the Blanchard-Perotti identification.

[37] We should note that results are robust to the exclusion of Russian Federation and Argentina.

nual for the period 1980-2019.[38] The sources are IFS (IMF) for GDP and government expenditure; World Bank for terms of trade; and Gruss and Kebhaj's (2019) database for commodity export price indices.[39]

5.2 Effects of commodity prices on GDP

The first stage is to run a fixed-effects panel regression of output on commodity export prices. The results are summarized in Table 3. We use two control variables: terms of trade (as a way of controlling for trade effects) and the lagged dependent variable (to capture underlying growth unrelated to commodity prices).[40] We can see that the coefficient for EMDE (0.085) in Column (1) is about 3.5 times as much as the coefficient for AE (0.024) in Column (4).[41] In other words, an increase of 10 percent in commodity export prices increases GDP by 0.63-0.85 percent in EMDE and 0.18-0.26 percent in AE.[42] The estimates are quite robust across specifications.[43]

5.3 Effects of commodity prices on fiscal response

The second stage is to run a fixed-effect panel regression of government spending on commodity export prices. As in the case of Table 3, we control for terms of trade and the lagged dependent variable. The results are summarized in Table 4.[44] From

[38] For the computation of fiscal multipliers below, we use quarterly data from IFS (IMF).

[39] It is worth mentioning that the commodity price indices from Gruss and Kebhaj's (2019) are country-specific. Specifically, for each country, the change in the international price of up to 45 individual commodities is weighted using commodity-level data for the period 1962-2018.

[40] If we use the Arellano-Bond estimator for dynamic linear panel methods to deal with lagged-dependent variables, the same results hold for regressions (3) and (6). Also, using as controls world trade (as percentage of GDP) instead of terms of trade and public debt as percentage of GDP does not change the results.

[41] Notice that regressions (4)-(6) control for the EMDE response by introducing an interactive term.

[42] Since all variables are log-differences, the estimated coefficients are elasticities.

[43] Comparing our quantitative estimates to those of other studies is not easy since empirical specifications vary considerably. With that caveat in mind, our estimates are very much comparable to those of, for example, Richaud *et al.* (2019). Based on a sample of 87 EMDE commodity exporters, Richaud *et al.* report a range of 0.34 to 1.25 percent for the cumulative impulse response of GDP to a one standard deviation shock in commodity prices. In our case, the sample is 11 EMDE with a coefficient range in the panel regressions in Table 3 of 0.063-0.085. Since the standard deviation of changes in commodity prices for EMDE is 14.4 percent, the range for the impact on GDP is 0.92 to 1.22 percent. Notice that the comparison is valid because changes in commodity prices tend to be very persistent (see Cashin *et al.*, 2000).

[44] Again, if we use the Arellano-Bond estimator for dynamic linear panel methods to deal with lagged-dependent variables, the same results hold for regressions (3) and (6). Further, if we use as control variables (i) volume of world trade as percentage of GDP (in lieu of terms of trade) and (ii) government debt as a percentage of GDP, the same results obtain.

Columns (1)-(3), we can see that EMDE increase government spending in response to a rise in commodity export prices, indicating a procyclical fiscal policy. In fact, a 10 percent increase in commodity export prices leads to an increase in government spending of about 0.6–0.8 percent.[45]

In contrast, advanced economies respond countercyclically. We can see, from Columns (4)-(6), that an increase of 10 percent in commodity export prices elicits a *reduction* in government spending of about 0.7-1.2 percent.

5.4 Fiscal multiplier

The third stage consists in computing an average fiscal multiplier for commodity-exporting countries. To this effect, we use quarterly data for GDP and government expenditure from IFS (IMF) for the period 1990-2019. We estimate a panel SVAR and use Blanchard-Perotti as our identification method.[46] Figure 17 shows the resulting cumulative multiplier. In computing the pours component, we will use the value of the multiplier after 4 quarters (given by 0.88).[47]

5.5 Computation of pours component

With the above calculations in hand, we can now proceed to compute the pours component for each country in the sample. The pours component is given by

$$\underbrace{pours}_{\triangle y/y} = \underbrace{change\ in\ CEP * coefficient\ FR}_{\triangle g/g} * \underbrace{fiscal\ multiplier}_{\triangle y/\triangle g} * \underbrace{g/y}_{g/y}, \qquad (2)$$

where CEP is the commodity export price, $coefficient\ FR$ is the estimated coefficient in the fiscal regression, and g/y is the ratio of government spending to GDP.[48] Below the different terms, we have noted the units to show how the right-hand side of the

[45] For a sample of 48 countries (including 4 AE), Cespedes and Velasco (2014) compute elasticities of 0.08 and 0.11 pre- and post-2000, respectively, which is comparable to our results.

[46] The availability of quarterly data is critical for relying on Blanchard and Perotti's (2002) identification method since Blanchard-Perotti assumes that output can respond to government spending within the period but government does not respond to GDP. In other words, all contemporaneous correlation is attributed to fiscal policy affecting GDP. See Ilzetzki *et al.* (2013) for a detailed discussion.

[47] The sample is too small to further break it down into CE and non-CE. If we computed multipliers for AE and EMDE, the values would be broadly similar (0.67 for AE and 0.57 for EMDE). Ilzetzki *et al.* (2013) also report multipliers below 1 after 4 quarters for both industrial and developing economies.

[48] We compute g/y as the average over the sample period for each country.

equation yields a percentage change in output. To understand the above equation, notice that the product of $change\ in\ CEP$ and $coefficient\ FR$ gives us the estimated change in government spending (in percentage terms) for a given change in the commodity price index. Multiplying this government spending by the fiscal multiplier yields the change in output relative to government spending. Multiplying this by g/y gives us the pours component (i.e., change in output in percentage terms). Finally, notice that while $coefficient\ FR$ varies between EMDE and AE and $fiscal\ multiplier$ is common to all countries, $change\ in\ CEP$ and g/y are country-specific.

To put the magnitude of the pours component in perspective, it proves helpful to express it as a percentage of the rain component. To this effect, we first compute the change in GDP as

$$change\ in\ GDP\ = change\ in\ CEP * coefficient\ OR, \tag{3}$$

where $coefficient\ OR$ is the estimated coefficient in the output regression. Using equation (1), we then compute the rain component as

$$rain = change\ in\ GDP - pours. \tag{4}$$

We then divide pours (equation (2)) by rain (equation (4)) to obtain the pours/rain ratio.

Table 5 shows the computations of the pours/rain ratio for the 15 countries in our sample.[49] The average for the EMDE sample is 21.4 percent. This means that, when faced with, for instance, a rise in commodity prices, the procyclical response in government spending will amount to 21.4 percent of the direct increase in GDP due to higher commodity prices. This figure ranges from 11.6 percent for Indonesia to 35.0 percent for Ukraine. Notice that, by construction, since we use a common fiscal response estimate for EMDE and AE, all EMDE will have a positive pours component and all AE will have a negative one.

As also shown in Table 5, the pours component for the four advanced countries in our sample is negative. The average pours component is -65.4 percent. A negative pours means that government spending reacts countercyclically. For example, in

[49] The estimates we use are 0.085 and 0.024 from Table 3 and 0.061 and -0.123 from Table 4.

response to a fall in commodity prices, the countercyclical fiscal response would be 65.4 percent of the original fall in GDP.

An alternative way of showing *pours* for EMDE is to compute it as a fraction of the total change in GDP. While we could compute this ratio $pours/change\ in\ GDP$ simply from the ratio $pours/rain$ and equation (4), it proves insightful to compute it as follows. Notice first that

$$change\ in\ GDP\ = change\ in\ CEP * coefficient\ OR, \tag{5}$$

where $coefficient\ OR$ is the estimated coefficient in the fiscal regression. Now divide equation (2) by equation (5) and simplify to obtain:

$$\frac{pours}{change\ in\ GDP} = \frac{coefficient\ FR * fiscal\ multiplier * g/y}{coefficient\ OR}. \tag{6}$$

Based on this last equation, we can compute a figure for pours/change in GDP. Notice that this ratio will be country-specific since g/y is country-specific (the other three variables on the RHS of equation (6) are either group-specific or common across countries).[50] Table 6 shows the computations of the pours components for all 11 EMDE in our sample. The average for the EMDE sample is 17.4 percent. This means that, when faced with, for instance, a fall in commodity prices, 17.4 percent of the total fall in output is due to government spending being cut in response (i.e., procyclical fiscal response). This figure ranges from 10.4 percent for Indonesia to 26.0 percent for Ukraine.

5.6 Application to commodity boom episode

It should prove interesting to apply the analytical apparatus described above to an episode involving a large increase in commodity prices. The largest boom in commodity prices in recent decades took place between 2003-2008 (see Table 7). During this period, commodity export prices for EMDE and AE rose by 76.3 percent and 65.7 percent, respectively. Hence, using the parameter estimates from Tables 3 and 4, we conclude that GDP in EMDE would have increased by 6.5 percent ($= 0.763 * 0.085$)

[50] Although less obvious, the same is true, of course, of the $pours/rain$ ratio since it is easy to check that $pours/rain = 1/(GDP/pours - 1)$

and 1.6 percent ($= 0.657 * 0.024$) in AE. In the same vein, the fiscal response in EMDE would have been 4.6 percent ($= 0.763 * 0.06$) and -8.1 percent ($0.657 * (-0.123)$) in AE.

The pours component would have been 1.1 percent ($= 0.763 * 0.06 * 0.88 * 0.28$) in EMDE and -3.0 percent ($= 0.657 * (-0.123) * 0.88 * 0.416$) in AE. We obtain the rain component by subtracting the pours component from the total change in output. For EMDE, the rain component is 5.4 percent ($= 6.5 - 1.1$) and for AE the rain component is 4.6 percent ($1.6 - (-3)$).

An interesting way of thinking about the role of fiscal policy in this episode is as follows. The difference in total growth between EMDE and AE was 4.9 percentage points of GDP ($= 6.5\% - 1.6\%$). But 4.1 percentage points ($= 1.1\% + 3.0\%$) of this difference is explained by their opposite fiscal responses. In other words, 84 percent ($= 4.1/4.9$) of the difference in total growth is explained by the procyclicality/countercyclicality of their fiscal policy responses. In fact, in the absence of fiscal responses, the difference in growth would have been only 0.8 percent ($= 5.4\% - 4.6\%$). Viewed in this light, the critical role of the fiscal response becomes abundantly clear.

6 Welfare costs

As already discussed, procyclical government spending amplifies the underlying business cycle. Except in the presence of perfect capital markets, a more pronounced business cycle will reduce welfare by making the consumption path more volatile. In the extreme case of no capital mobility, consumption will exhibit about the same volatility as output.[51] In other words, by rendering the consumption path more volatile, households' welfare will be lower. This section quantifies the corresponding welfare costs in the Lucas (1987) sense.

[51] In a closed endowment economy (with perishable goods), the path of consumption will be the same as the endowment path. With durable goods and/or investment, the volatility of the consumption path will not be as pronounced as that of output.

6.1 Reporting the welfare costs

By definition, the welfare cost (ω) is the share of (steady-state) consumption that households living in an economy without procyclicality would have to forego to equate lifetime utility in an economy with output fluctuations induced by a procyclical fiscal response. Formally, ω is implicitly defined by the following equation:

$$\sum_{t=0}^{\infty} \beta^t u[\overline{c}(1-\omega)] = \sum_{t=0}^{\infty} \beta^t u(c_t), \tag{7}$$

where the present discounted values of $\overline{c}$ and c_t are the same.[52]

How will we report the welfare costs of fiscal procyclicality? Notice that if there were no fiscal response to changes in GDP resulting from changes in commodity prices, the pours component would be zero and hence GDP volatility would simply be that of the regular business cycle (the one Lucas focused on). We know, by the way, that the costs of such volatility are rather low (though higher for developing countries than for advanced economies).[53]

But what would happen to welfare costs if, as shown in Section 2, policymakers increased (reduced) government spending in response to the higher (lower) GDP brought about by a rise (fall) in commodity prices? Such procyclical fiscal policy (the pours component) would increase the volatility of GDP by making booms bigger and busts more pronounced. The interesting issue is thus the *additional* welfare costs (over and above the welfare costs of the regular business cycle). Hence, we will report the welfare costs of the pours component in relation to the welfare costs of the regular business cycle. Put differently, if this figure is, for example, 3 percent, it means that procyclical fiscal policy adds a welfare loss of 3 percent relative to the one that would occur if fiscal policy were acyclical.

[52] The path of c_t is the one that would arise under financial autarky. Hence, consumption equals endowment.

[53] Pallage and Robe (2003) find that the median welfare cost of aggregate fluctuations in poor countries is at least 10 times what it is in the United States. A conservative estimate of the welfare costs of economic fluctuations in poor countries is 0.34 percent of steady-state consumption.

6.2 Computations

To compute the welfare costs, we need to specialize the preferences in equation (7). We will choose the iso-elastic family.

If $u(c_t) = \log c_t$, it then follows from equation (7) that welfare costs are given by

$$\omega = 1 - \frac{e^{PDV(u(c_t))\left(\frac{r}{1+r}\right)}}{\bar{c}}, \tag{8}$$

where $PDV(u(c_t))$ denotes the present discounted value of $u(c_t)$.

If utility takes the CES form

$$u(c_t) = \frac{[c_t(1-\omega)]^{1-1/\sigma} - 1}{1 - 1/\sigma}, \qquad \sigma \neq 1,$$

where $\sigma > 0$ is the intertemporal elasticity of substitution, then equation (7) implies that the welfare cost is given by

$$\omega = 1 - \frac{1}{\bar{c}} \left[PDV(u(c_t)) \left(\frac{r}{1+r} \right) (1 - 1/\sigma) + 1 \right]^{\frac{1}{1-1/\sigma}}. \tag{9}$$

Using equations (8) and (9), we now compute the welfare costs for the pours component of EMDE and AE. Based on our estimations in Section 5, the volatility of pours + rain is 1.2 percent for EMDE and 0.33 percent for overall AE. We then compute the welfare cost of the regular business cycle.[54] We then divide the welfare cost of the pours component by the welfare cost of the regular business cycle for both EMDE and AE to obtain the relative welfare cost reported in Table 8. We report this figure for three different values of σ, the intertemporal elasticity of substitution.[55]

As shown in Table 8, in the log case, the welfare cost of the pours component (in terms of steady-state consumption) relative to those of the regular business cycle is 2.62-2.63 percent for EMDE and -5.30 for AE. These figures change very little with values of σ since both numerator and denominator are affected. In sum, our estimates

[54] The regular business cycle (defined as the standard deviation of the log change in real GDP) is estimated to be 4.1 percent for our current sample of 15 CE. The corresponding Lucas-type welfare cost is 0.17%, essentially the same as in Cole and Obstfeld (1991), which is 0.2%.

[55] By $\sigma = 1$, we mean the logarithmic case. We choose these three values f σ as capturing the more common estimates in the literature. Though not shown, the welfare costs of the pours component is decreasing in σ because the lower is σ (i.e., the less willing to substitute is the consumer), the more he/she will be hurt by a given volatility of output.

suggest that welfare costs for EMDE increase 2.6 percent as a result of procyclical fiscal policy.[56] For developed countries, the figure -5.3% indicates the *reduction* in volatility – relative to the actual business cycle – resulting from countercyclical fiscal policy.

7 Conclusions

This paper has focused on fiscal cyclicality in commodity-exporting countries. Our starting point is that procyclical fiscal policy in CE is twice as high as in non-CE. This reflects CE's inability to manage the abundance in good times. In other words, when commodity prices increase, governments' income rises substantially, not only through the standard channel of higher tax revenues (due to higher tax base), but also through various revenue taxes on commodity-producing firms and higher profits in the case of state-owned commodity-producing enterprises. The temptation for governments and other national agencies to spend out of these windfalls is often irresistible. As a result, many CE fall into the fiscal procyclicality trap, thus increasing output volatility. Ironically, fiscal policy becomes a source of instability precisely during a fiscal bonanza.

The when-it-rains-it-pours phenomenon refers to the fact that fiscal procyclicality amplifies the already volatile business cycle of CE by leading to expansionary fiscal policy in good times and contractionary fiscal policy in bad times. The main contribution of this paper is to quantify the "pours" channel. In other words, we provide a quantitative measure of how much more volatile the business cycle becomes due to procyclical fiscal policy. Based on a four-stage procedure, we conclude that, on average, the pours component is 21.4 percent of the initial fall in output (the rain). That is, if GDP fell by 10 percent in response to a reduction in commodity prices, the resulting contractionary fiscal policy would add a further fall in GDP of 2.14 percent. Hence, in total, output would fall by 12.14 percent. An alternative way of thinking is that 17.4 percent of the total fall in GDP following a negative commodity-price shock is due to

[56] Of course, in an absolute sense, Lucas-type welfare costs capture only the costs of the regular business cycle and tend to be small. However, we now know that the distribution for GDP crises has fat tails, so the welfare costs of a GDP crisis are considerably more (see, for example, Barro and Jin, 2011). In fact, Medina *et al.* (2023) show that even for values of the coefficient of risk aversion less than 3.5, welfare gains of opening up to total financial integration increase by a factor of 2 to 8 relative to Cole and Obstfeld's (1991) well-known estimate of 0.2 percent of steady-state output. Hence, in a world of fat tails, the welfare costs of the pour component should increase accordingly.

the procyclical response. By any measure, this "pours" calculation is substantial and implies a sharp increase in output volatility. In contrast, if fiscal policy were countercyclical (as in some AE that are also CE), the pours calculation is -65.4 percent. If an increase in commodity prices raised output by 10 percent, the countercyclical reduction in government spending would limit the rise to 3.46 percent.

A natural follow-up to this computation is to calculate the welfare cost of the extra volatility in GDP. Following Lucas (1987), we compute the welfare cost as the tax that would need to be imposed on households not subject to fiscal procyclicality to have the same present discounted value of utility as households subject to fiscal procyclicality. It proves insightful to express the welfare costs of fiscal procyclicality as a percentage of the welfare costs imposed by the regular business cycle. In terms of this metric, the welfare costs of fiscal procyclicality turn out to be 2.6 percent (in terms of steady-state consumption). In contrast, the welfare costs accruing to AE are -5.3 percent (i.e., a welfare gain due to countercyclical fiscal policy).

We have provided econometric evidence to the effect that two main factors play a critical role in generating fiscal procyclicality: political-economy pressures to spend in good times and (ii) the inability to borrow in bad times. Public policies should thus be focused on addressing these fundamental causes. Fiscal institutions should be strengthened and fiscal rules implemented, together with independent fiscal councils. Fiscal councils housed within the Treasury are likely to have no *de facto* independence to openly point out deviations from fiscal rules. Rules focused on the structural balance budget are clearly the most appropriate, at least from a conceptual point of view.

The inability to borrow in bad times is typically history-dependent. Credit markets are, understandably, reticent to lend to countries with a reputation of serial defaulters. Here multilateral lending institutions such as the IMF have a role to play. In the final analysis, however, the only long-term solution is to build a reputation for repaying loans in good times, rather than squandering windfalls.

In terms of future research, much remains to be done empirically and theoretically. From an empirical point of view, an even closer look at different de-trending methods – including dealing satisfactorily with the problem of "the cycle is the trend" – is certainly warranted. Also, checking the direction of causality of various channels should provide further evidence on mechanisms behind fiscal procyclicality. From a theoretical point of view, incorporating different transmission channels in calibrated models and assessing them quantitatively seems a natural step forward.

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8 Appendix: Data

Table A1 lists all the countries in our main sample of Figure 1. The total is 189 countries, comprising 152 EMDE and 37 AE or 94 commodity-exporters and 95 non-commodity exporters.

Figures 1 through 16 plot the country correlations between the HP filtered cyclical components of real government spending and real GDP (WEO, IMF, April 2022). The sample period is 1980-2020, but the panel is unbalanced since some countries do not have data for the whole sample period. The institutional variables (political risk, bureaucracy quality, control of corruption, government stability, and law and order) are taken from the International Country Risk Guide (ICRG). The threshold to distinguish countries with better institutions from those with worse institutions was computed by taking an average score for each country between 1984-2020 and comparing it to the cross-country median score. For capital controls, the Chinn-Ito index was used to calculate the financial openness of an economy for the period 1980-2019. The Ilzetzki *et al.* (2021) database was used to calculate the average exchange rate regime of an economy between 1980 and 2019.

In the regressions of Section 3, the size of the public sector is defined as government spending as a proportion of GDP, from WEO (IMF). WEO is also the source for GDP per capita. For openness (defined as exports plus imports as a proportion of GDP), the source is the World Integrated Trade Solution (World Bank). In the regressions of Section 4, fiscal rules are taken from the fiscal database in Davoodi *et al.* (2022). This database distinguishes between budget balance rules, debt rules, expenditure rules, and revenue rules. The variable fiscal rules is a dummy-variable that takes the value 1 if any rule is being enforced and 0 if none is. We then take the average over the country sample. Sovereign wealth funds (SWF) is a dummy-variable that takes the value 1 if a fund is in existence and 0 if it is not. We then take the average over the country sample.

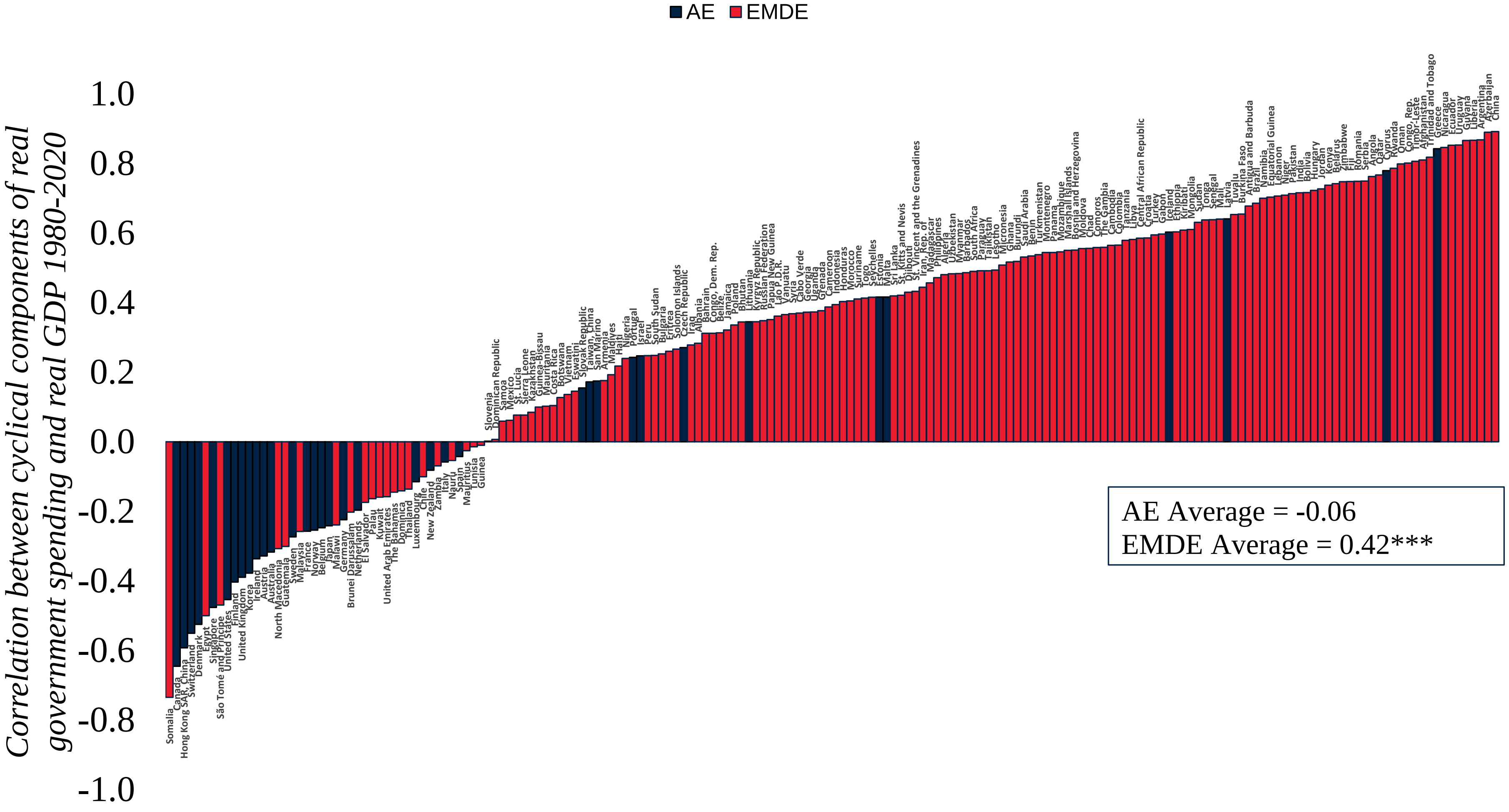
9 Appendix: Baxter-King filter

The best way of detrending macroeconomic time series data has proved to be a long-lasting and still unsettled matter (see, for example, Guay and St.-Amant, 2005). In the text, we have used the most popular filter, Hodrick-Prescott, which is based on decomposing a time series into permanent and transitory components. The most common alternative filter is surely Baxter and King (1999), which is based on isolating certain business fluctuations in the data. This appendix suggests that the main message behind our key stylized facts is robust to using the Hodrick-Prescott filter.[57]

Table A2 reports the correlations that follow from replicating Figures 1, 2, 4, and 5 for the case of the Baxter and King filter. The table indicates that our three main stylized facts continue to hold. First, EMDE are more procyclical than AE (0.26 versus -0.19, respectively). Second, commodity exporters are more procyclical than non-commodity exporters (0.27 versus 0.07. with the latter not significantly different from zero.) Third, while procyclicality in both AE and EMDE has fallen since 2006, it has fallen more in non-CE. Indeed, a comparison of Columns 4 and 5 in Table A2 shows that procyclicality in CE has fallen from 0.28 to 0.20 but, in non-CE, acyclicality has turned into significant countercyclicality.

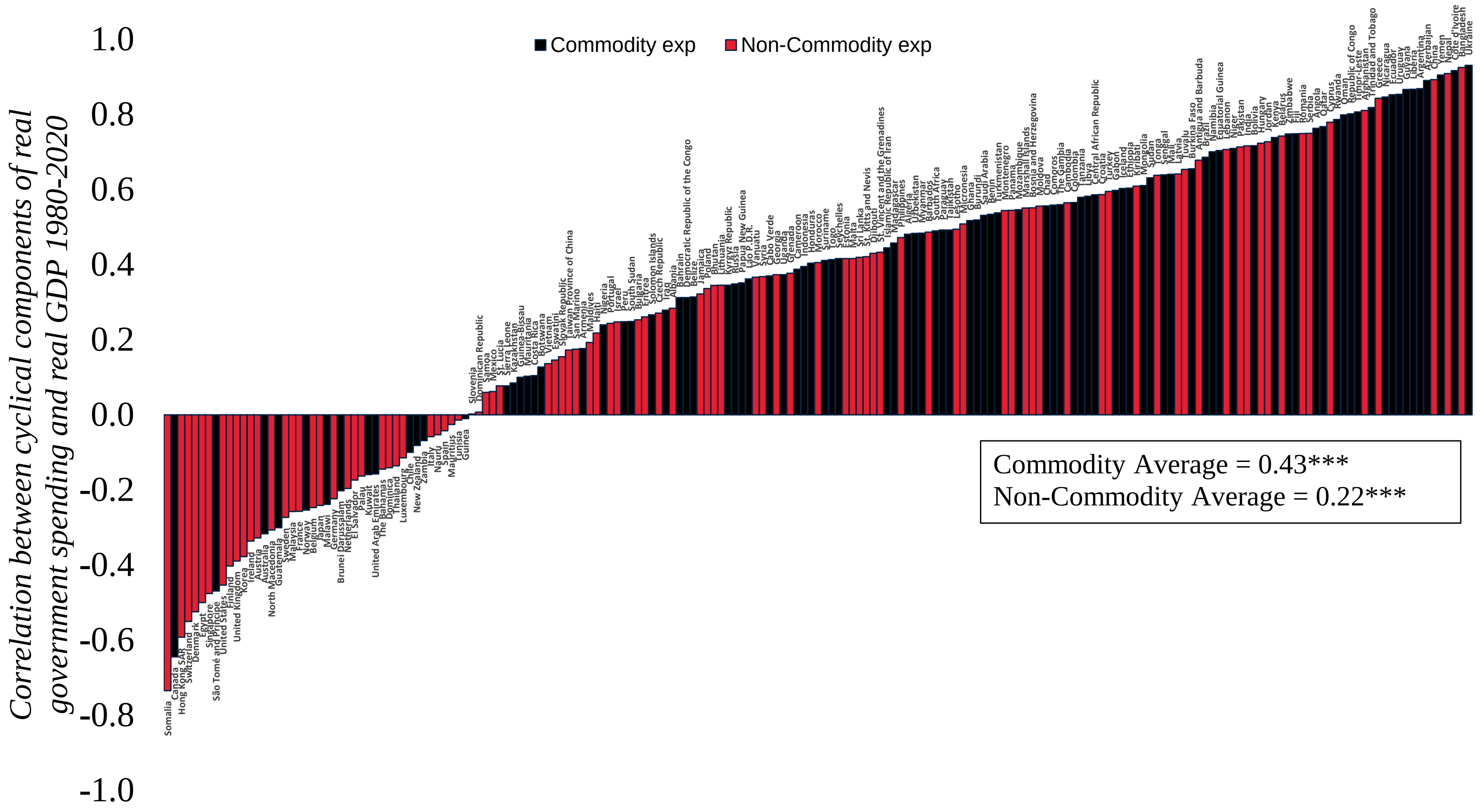
[57] Kaminsky *et al.* (2004) and Carneiro and Garrido (2016) also test robustness using the Baxter-King filter. In addition, the latter compute fiscal cyclicality indicators using the Christiano-Fitzgerald and Butterworth filters and the Harvey unobserved component model. All key results are unaffected.

Figure 1. Country correlations between cyclical components of real government spending and real GDP, 1980-2020



Notes: Black (dark) bars denote AE. Red (light) bars denotes EMDE. Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
Sources: Authors' calculations based on WEO (IMF) data.

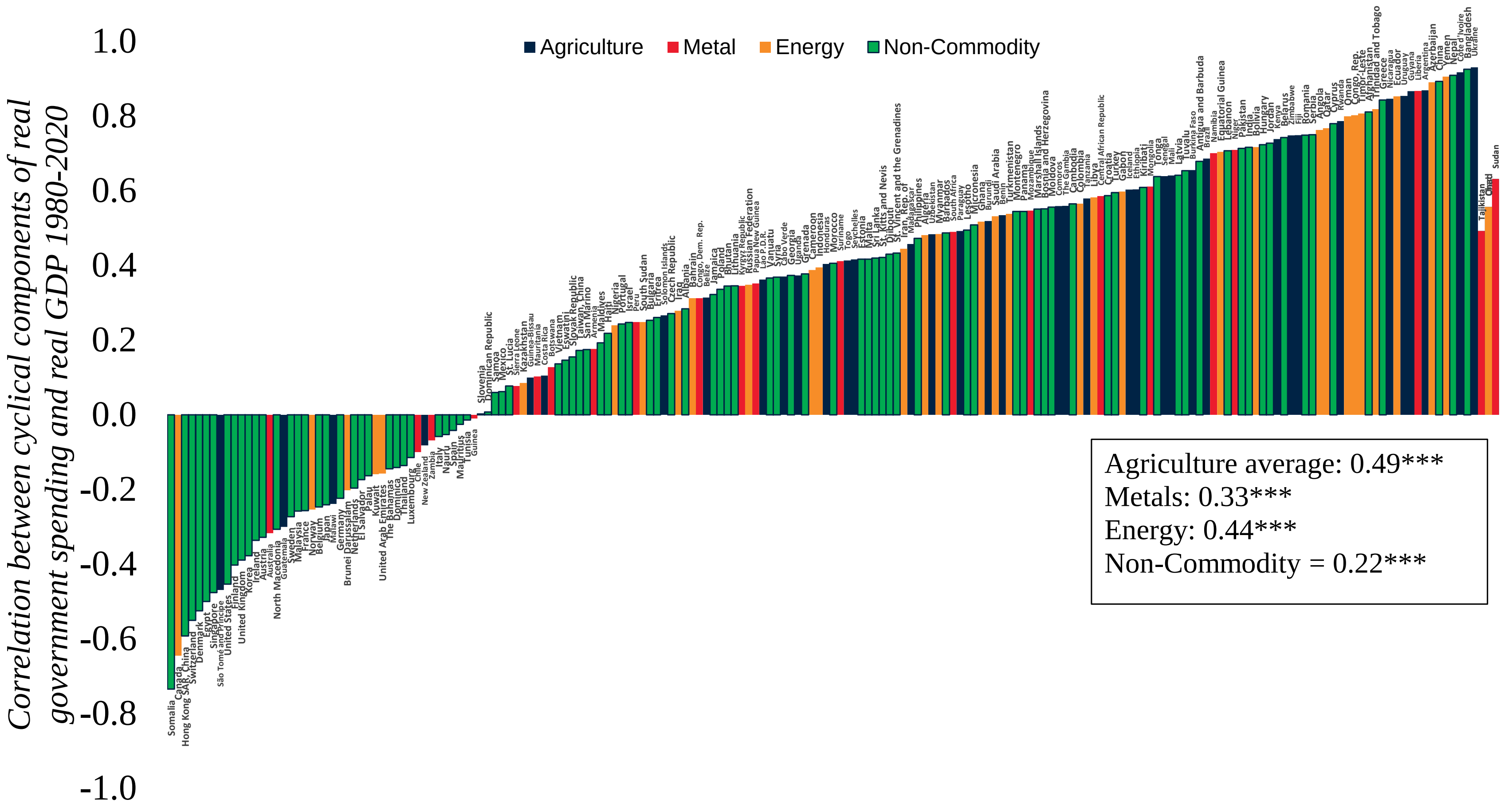
Figure 2. Country correlations for commodity exporters versus non-commodity exporters, 1980-2020



Note: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for commodity exporters versus non-commodity exporters. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Sources: Authors' calculations based on WEO (IMF) data. Commodity classification from World Bank.

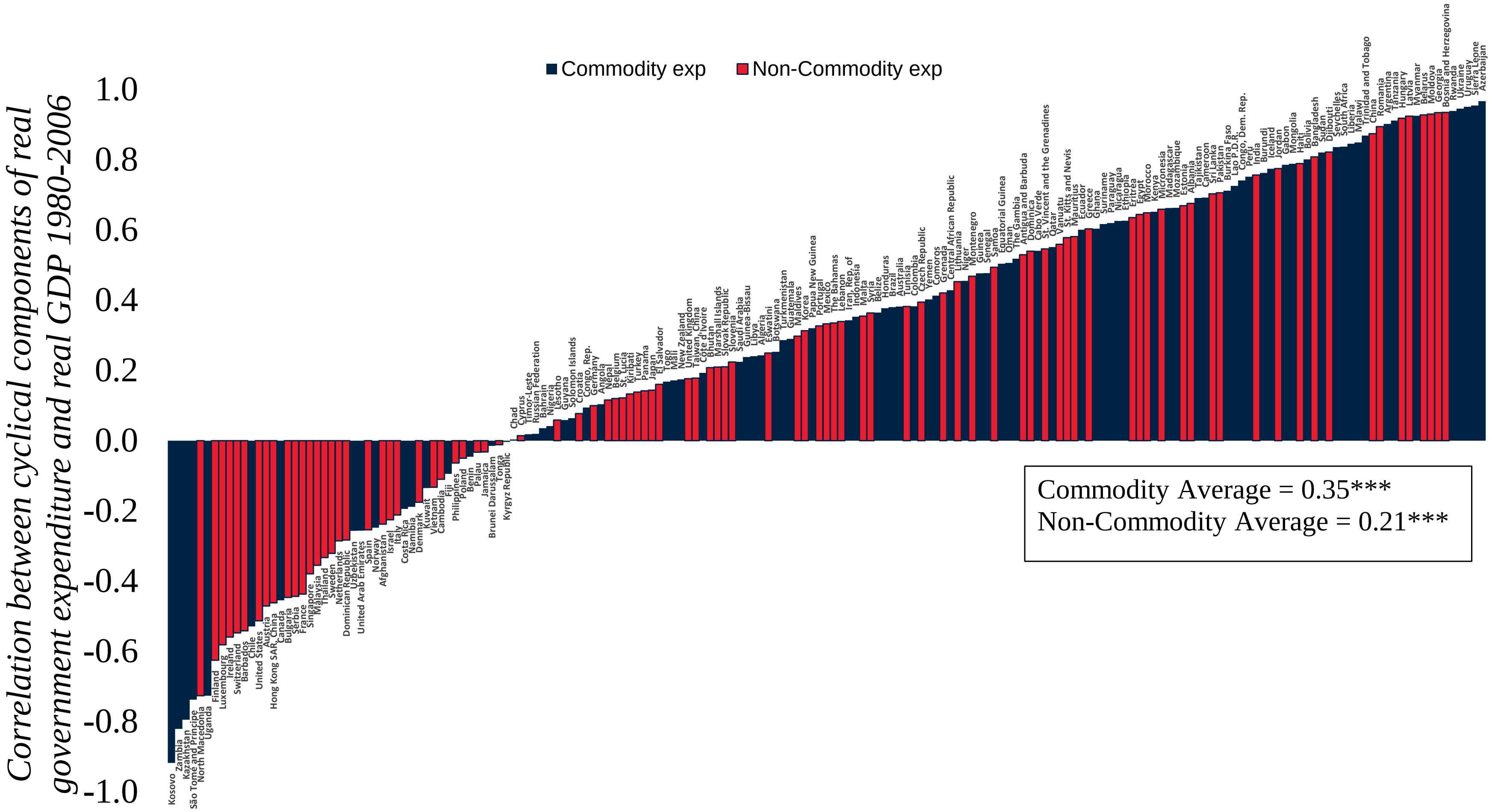
Figure 3. Country correlations for categories of CE versus non-CE, 1980-2020



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for different commodity categories and non-commodity exporters. Chad, Sudan, and Tajikistan are also classified as major agricultural exporters (black portion of the bar not shown). *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

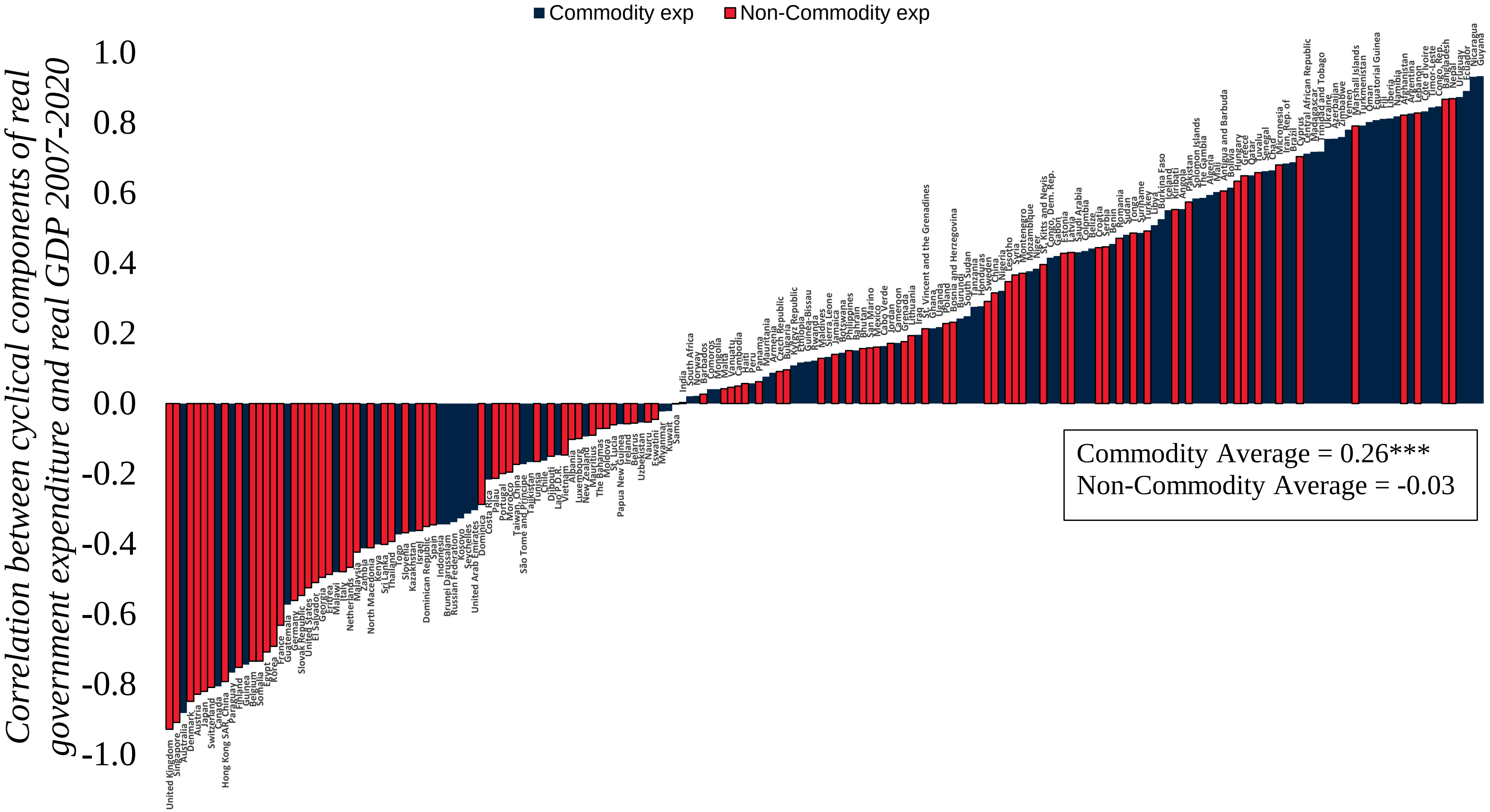
Sources: Authors' calculations based on WEO (IMF) data. Commodity categories from World Bank.

Figure 4. Country correlations for commodity exporters versus non-commodity exporters, 1980-2006



Note: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for commodity exporters versus non-commodity exporters. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
Sources: Authors' calculations based on WEO (IMF) data. Commodity classification from World Bank.

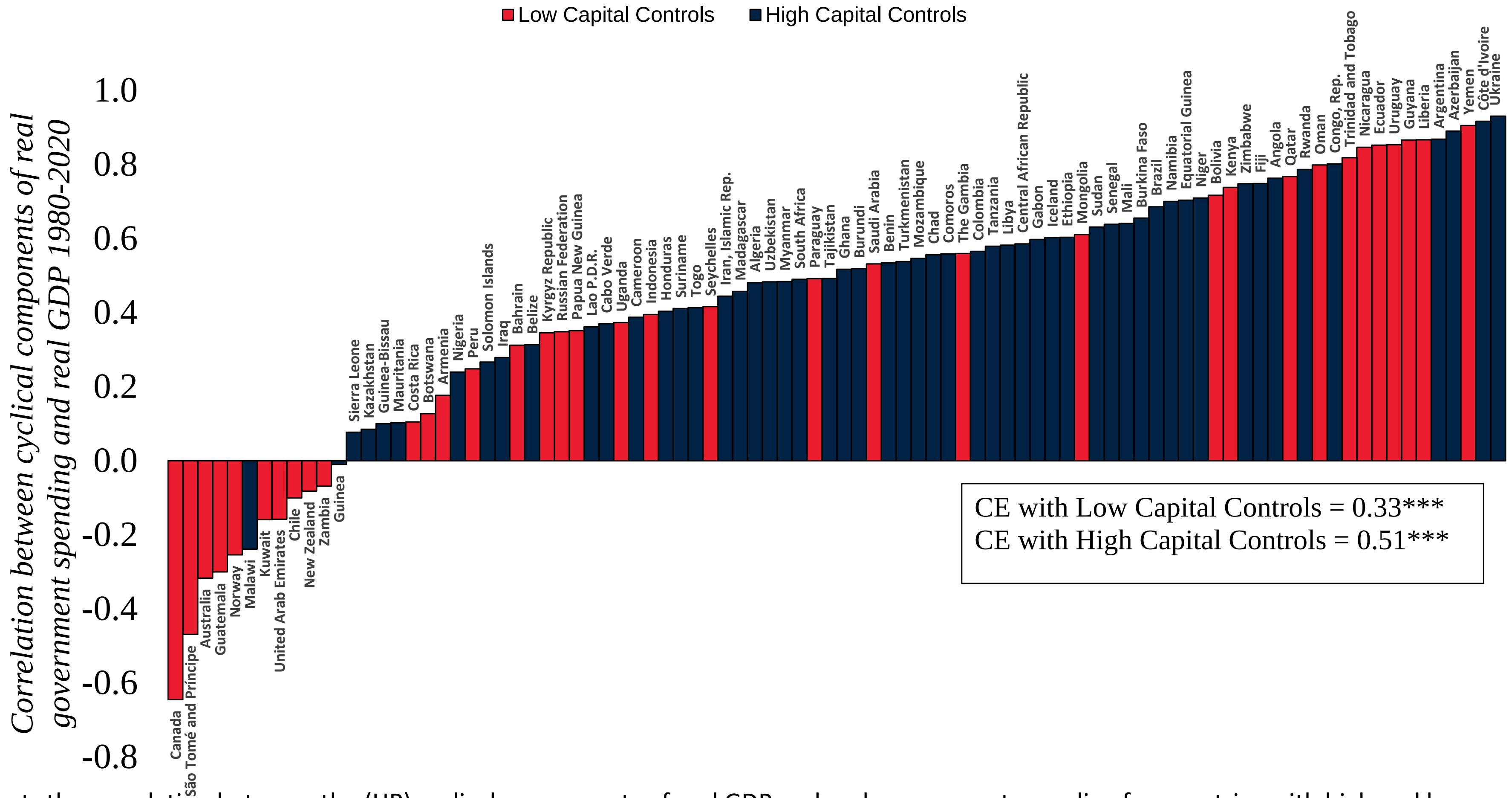
Figure 5. Country correlations for commodity exporters versus non-commodity exporters, 2007-2020



Note: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for commodity exporters versus non-commodity exporters. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Sources: Authors' calculations based on WEO (IMF) data. Commodity classification from World Bank.

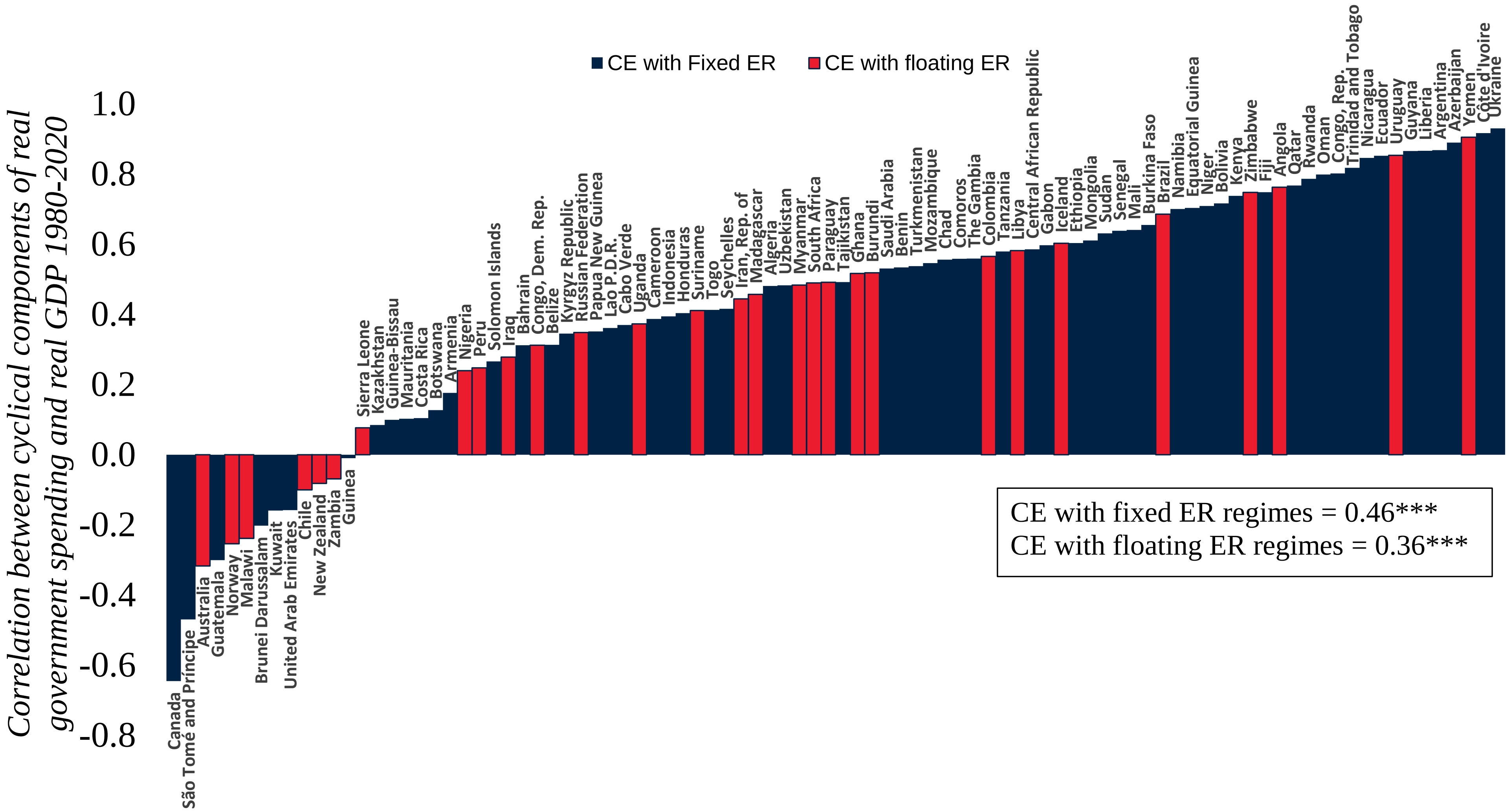
Figure 6. Country correlations for CE with high capital account restrictions, versus CE with low capital account restrictions, 1980-2020



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with high and low capital account restrictions. Based on the Chinn-Ito index of financial openness (where a higher number represents more financial openness), a country is classified as having high (low) capital account restrictions if its Chinn-Ito index is below (above) the median. The difference between the two averages is significant at the 5 percent level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Sources: Authors' calculations based on Chinn-Ito index and WEO (IMF) data. Commodity classification from World Bank.

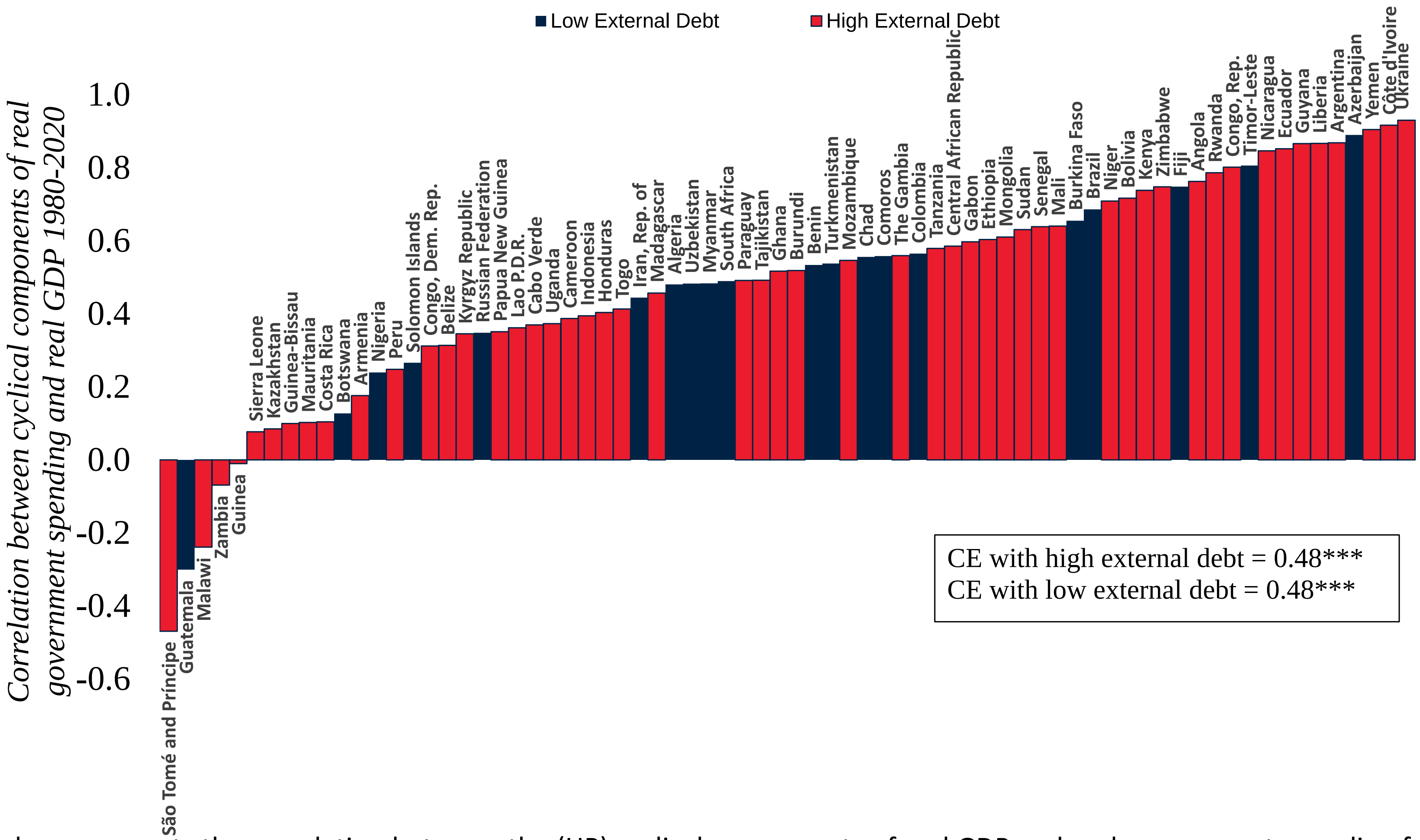
Figure 7. Country correlations and exchange rate regime



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries operating under fixed exchange rates or floating exchange rate regimes during the sample period, according to the classification in Ilzetski *et al* (2021). The difference between the two averages is not significant (p-value is 0.17). *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

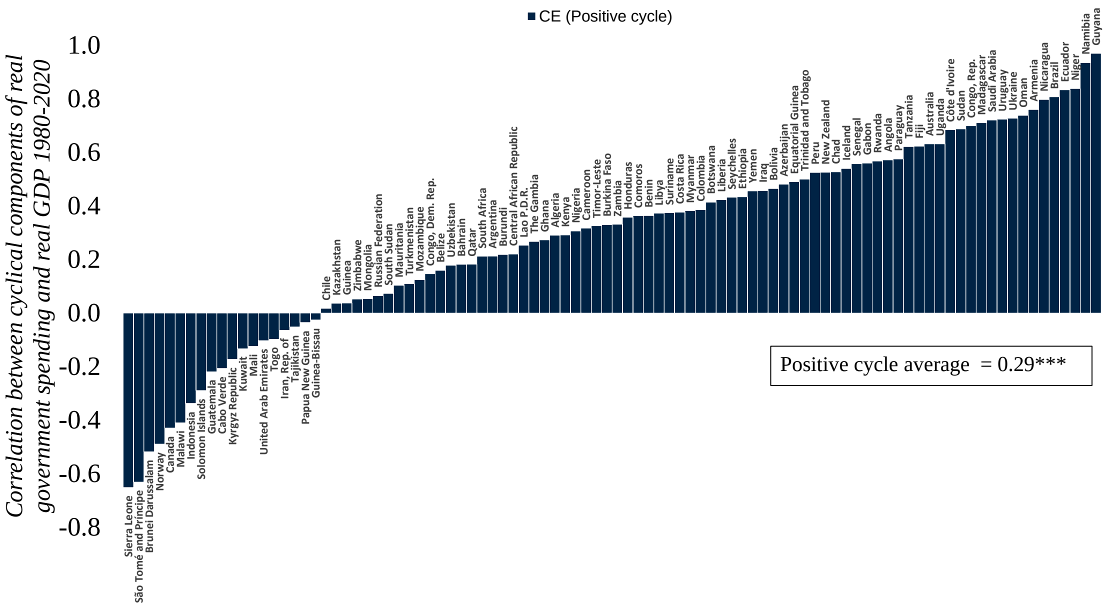
Sources: Authors' calculations based on Ilzetzki *et al.* (2021) and WEO (IMF) data.

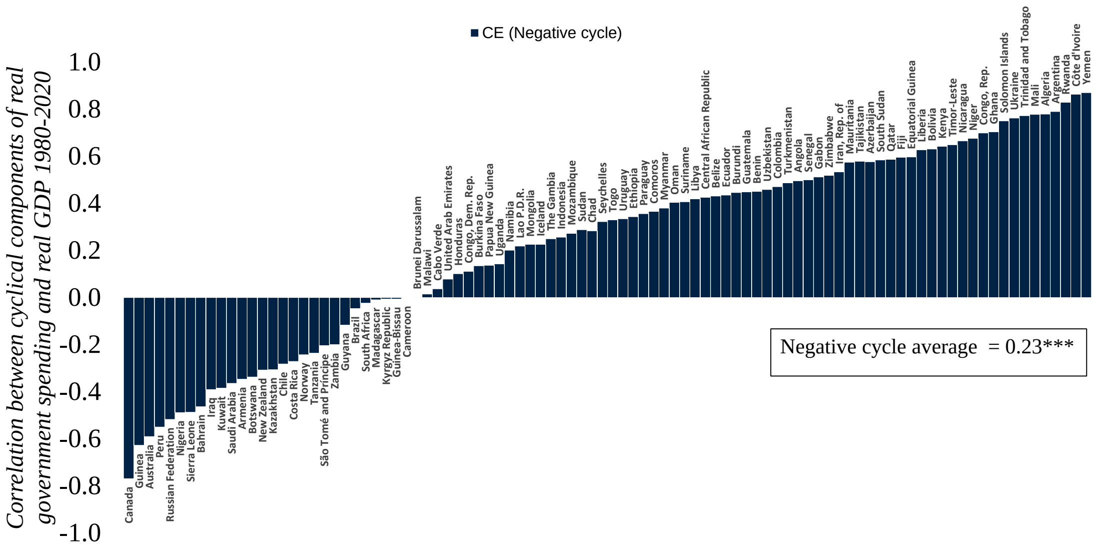
Figure 8. Commodity exporters with high and low external debt



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with high and low external debt, defined as external debt, as percentage of GNI, above (below) the sample median. The difference between the two averages is not significant. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
Sources: Authors’ calculations based on International Debt Statistics (World Bank) and WEO (IMF) data.

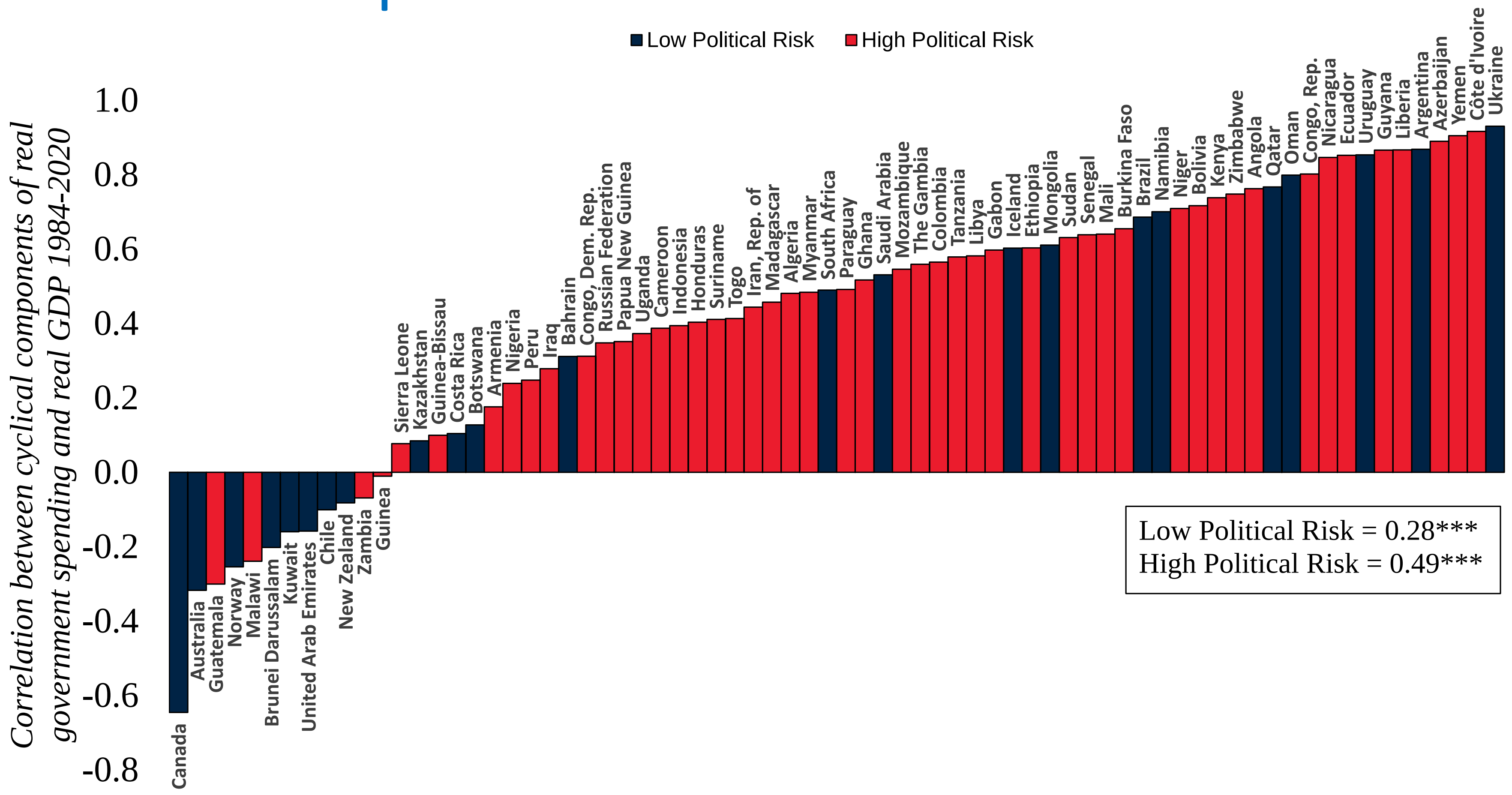
Figure 9. Country correlations for commodity exporters in good and bad times





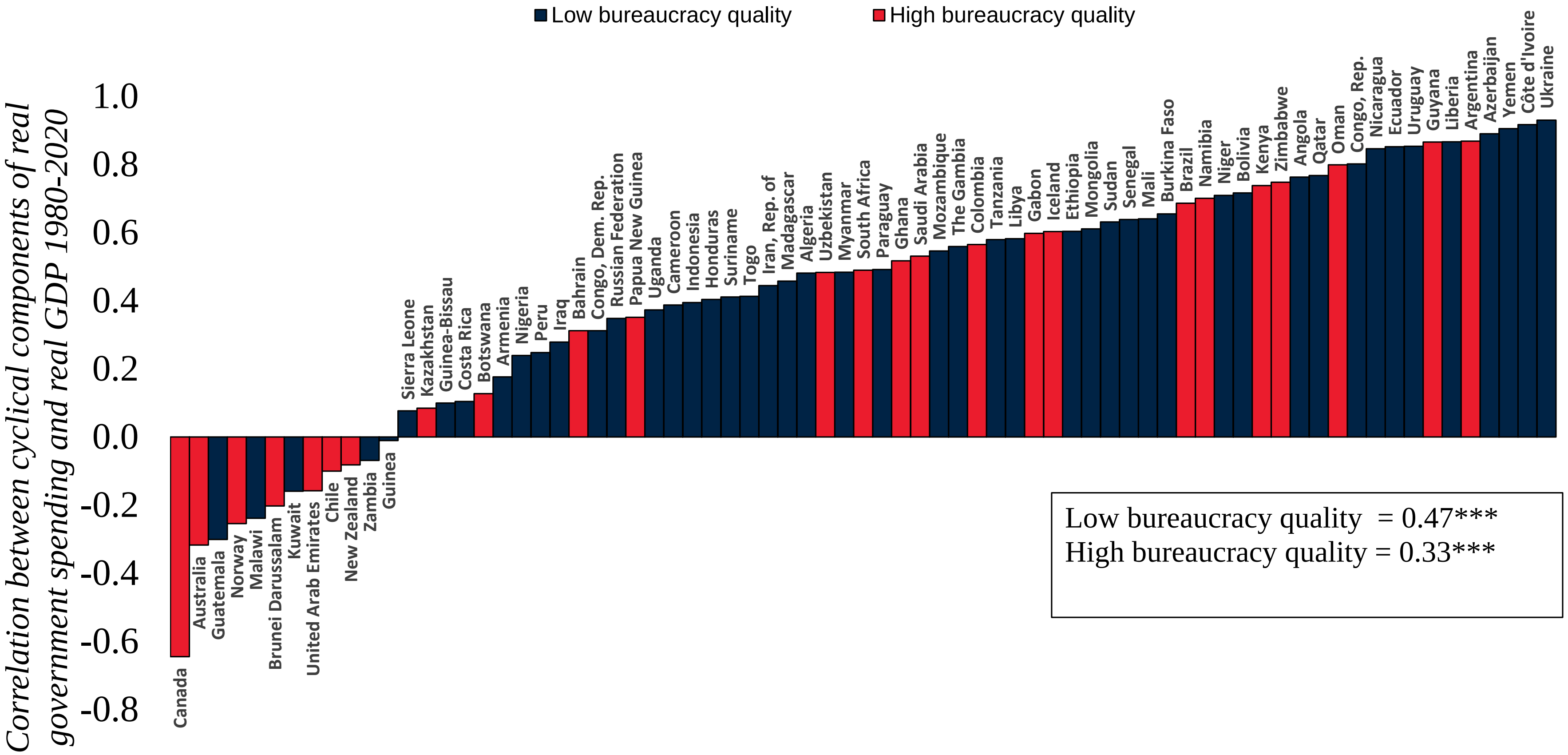
Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for each country in good and bad times. Good (bad) times are defined as a positive (negative) HP-cycle. The difference between the two averages is not significant. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
Sources: Authors’ calculations based on WEO (IMF) data.

Figure 10. Country correlations for commodity exporters and political risk



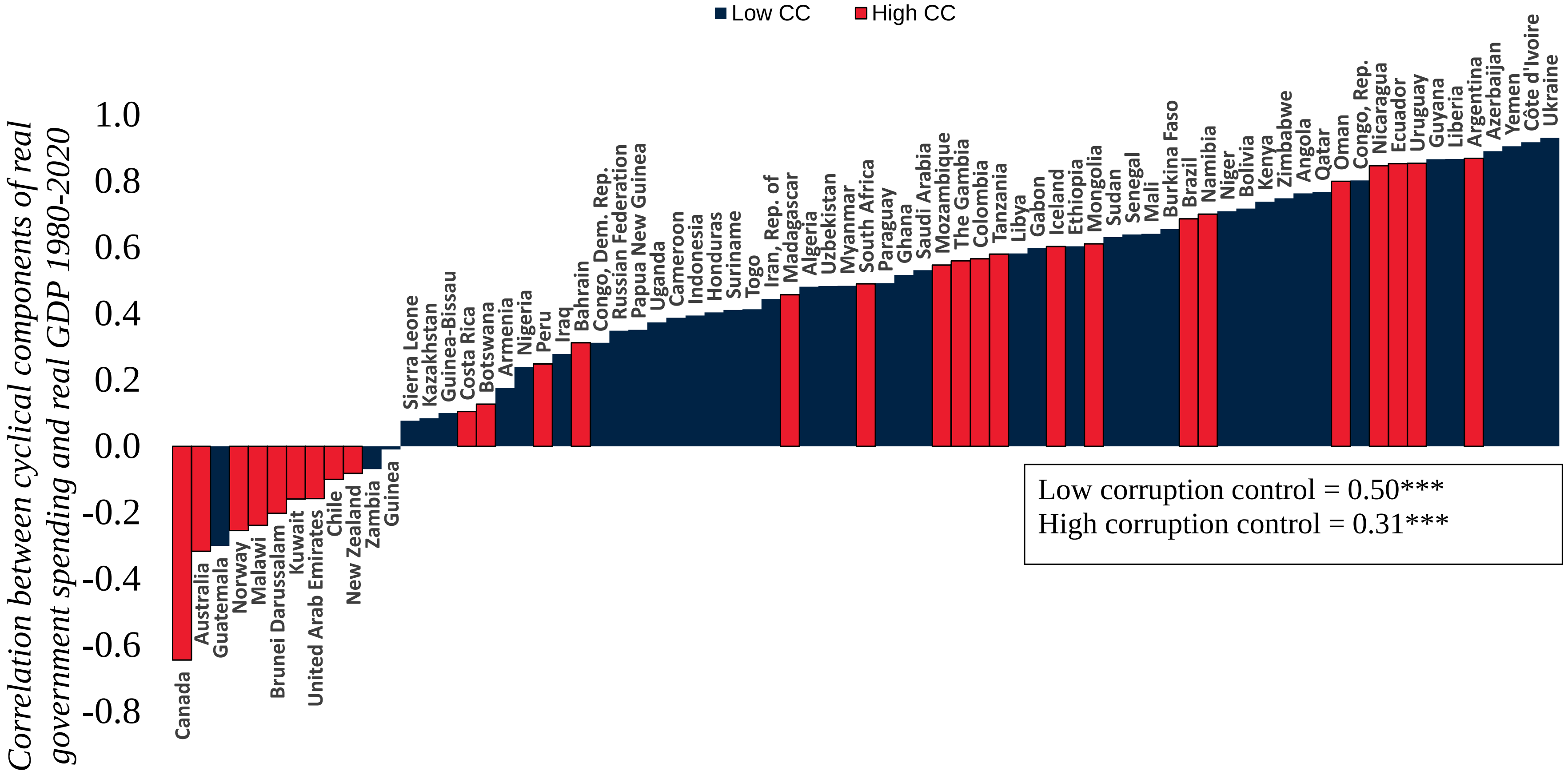
Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with high (low) political risk, defined as political risk above (below) the sample median. The difference between the two averages is significant at the ten percent level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
Sources: Authors' calculations based on International Country Risk Guide and WEO (IMF) data.

Figure 11. Country correlations for CE and level of bureaucracy quality



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with high (low) bureaucracy quality, defined as bureaucracy quality above (below) the sample median. The difference between the two averages is not significant at the 10 percent level (p-value = 0.16). *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
Sources: Authors' calculations based on International Country Risk Guide and WEO (IMF) data.

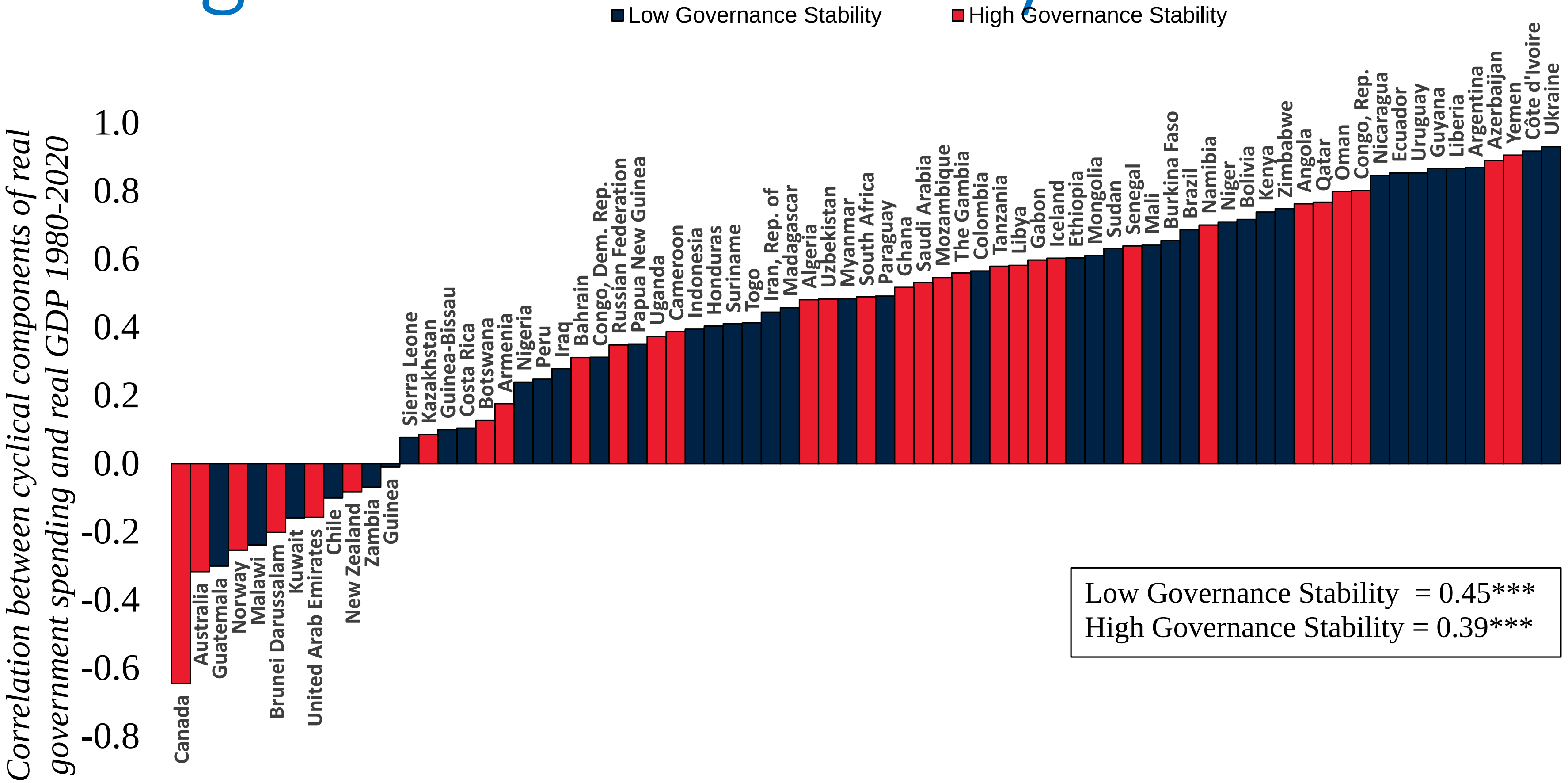
Figure 12. Country correlations for CE and control of corruption



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with high (low) control of corruption, defined as control of corruption above (below) the sample median. The difference between the two averages is significant at the 10 percent level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Sources: Authors' calculations based on International Country Risk Guide and WEO (IMF) data.

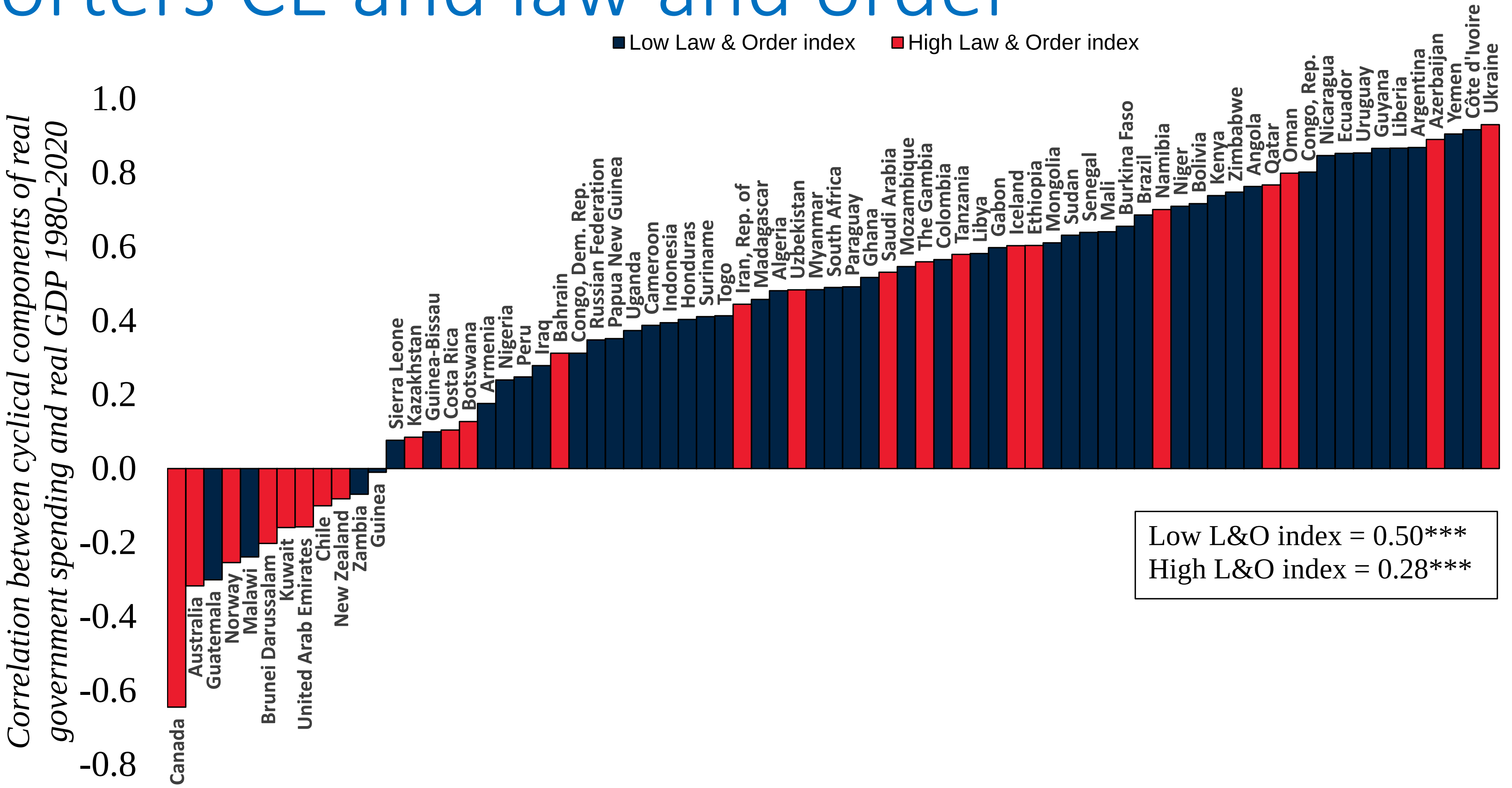
Figure 13. Country correlations for CE and level of government stability



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with high (low) government stability, defined as government stability above (below) the sample median. The difference between the two averages is not significant. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

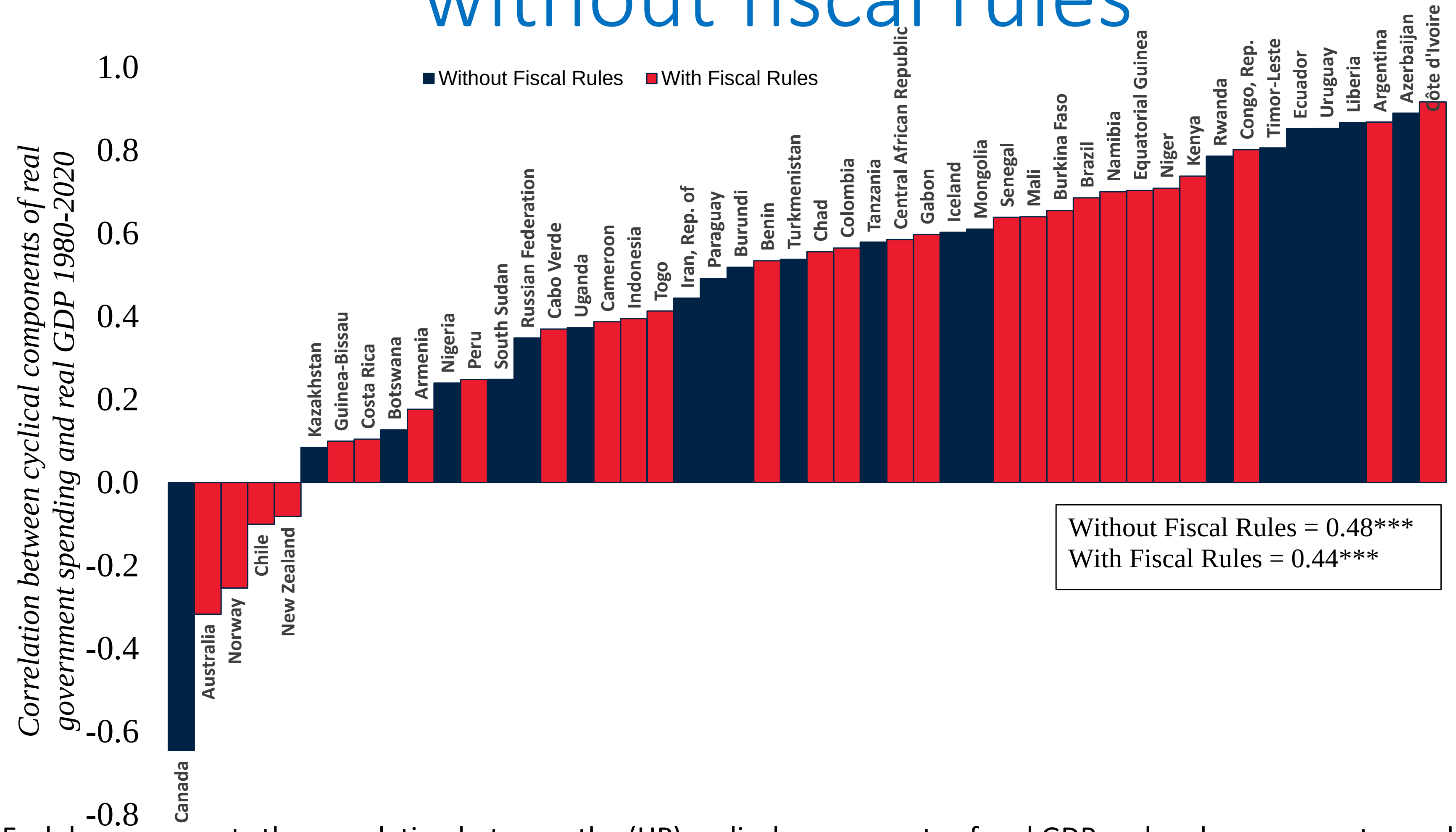
Sources: Authors' calculations based on International Country Risk Guide and WEO (IMF) data.

Figure 14. Country correlations for commodity exporters CE and law and order



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with high (low) law and order, defined as law and order above (below) the sample median. The difference between the two averages is significant at the 5 percent level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
Sources: Authors' calculations based on International Country Risk Guide and WEO (IMF) data.

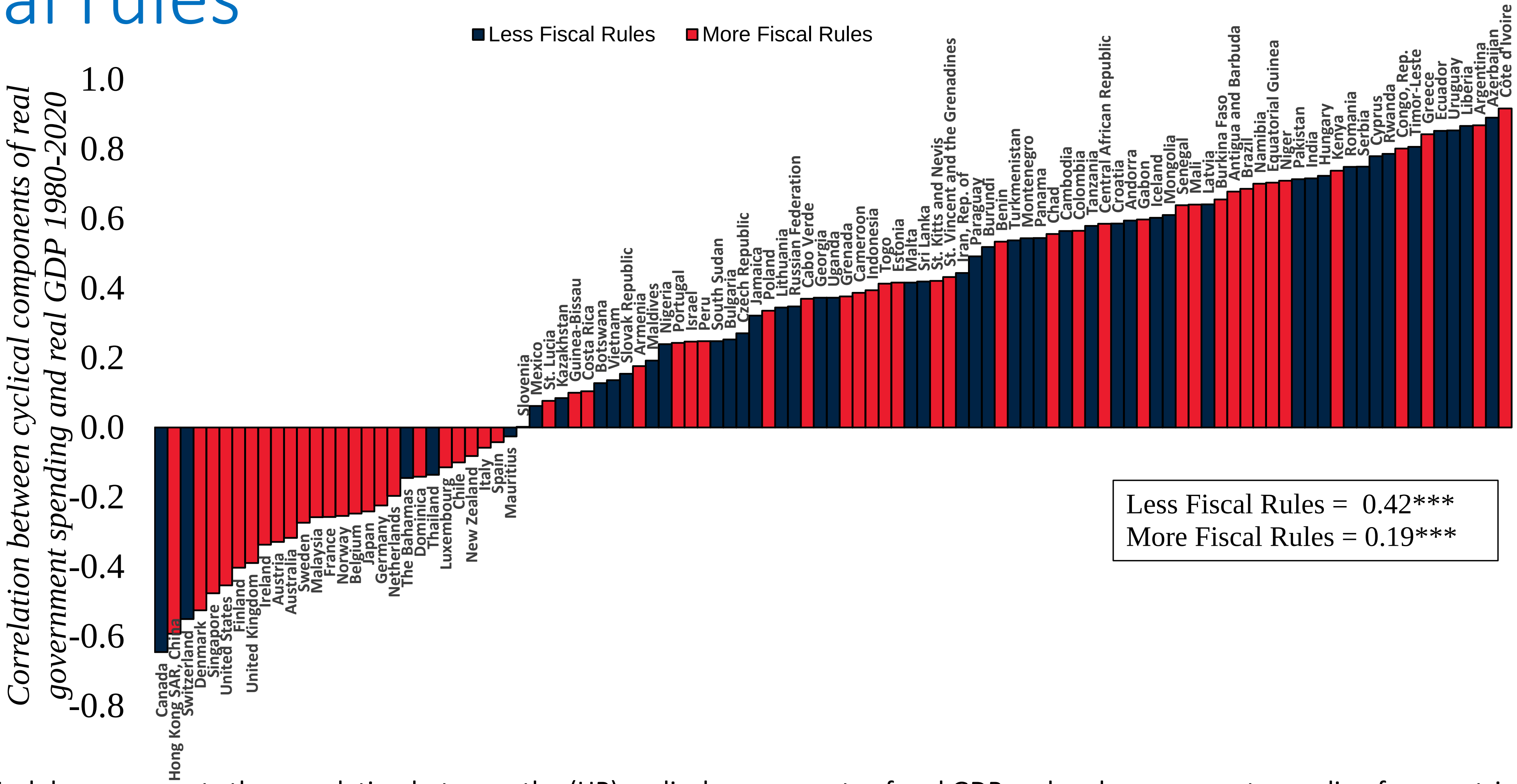
Figure 15. Commodity exporters with and without fiscal rules



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with and without fiscal rules. "With" fiscal rules indicates that at least one fiscal rule is being enforced; "without" means no fiscal rule is being enforced. The difference between the two averages is not significant. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Sources: Authors' calculations based on Davoodi et *al.* (2022) fiscal database and WEO (IMF) data.

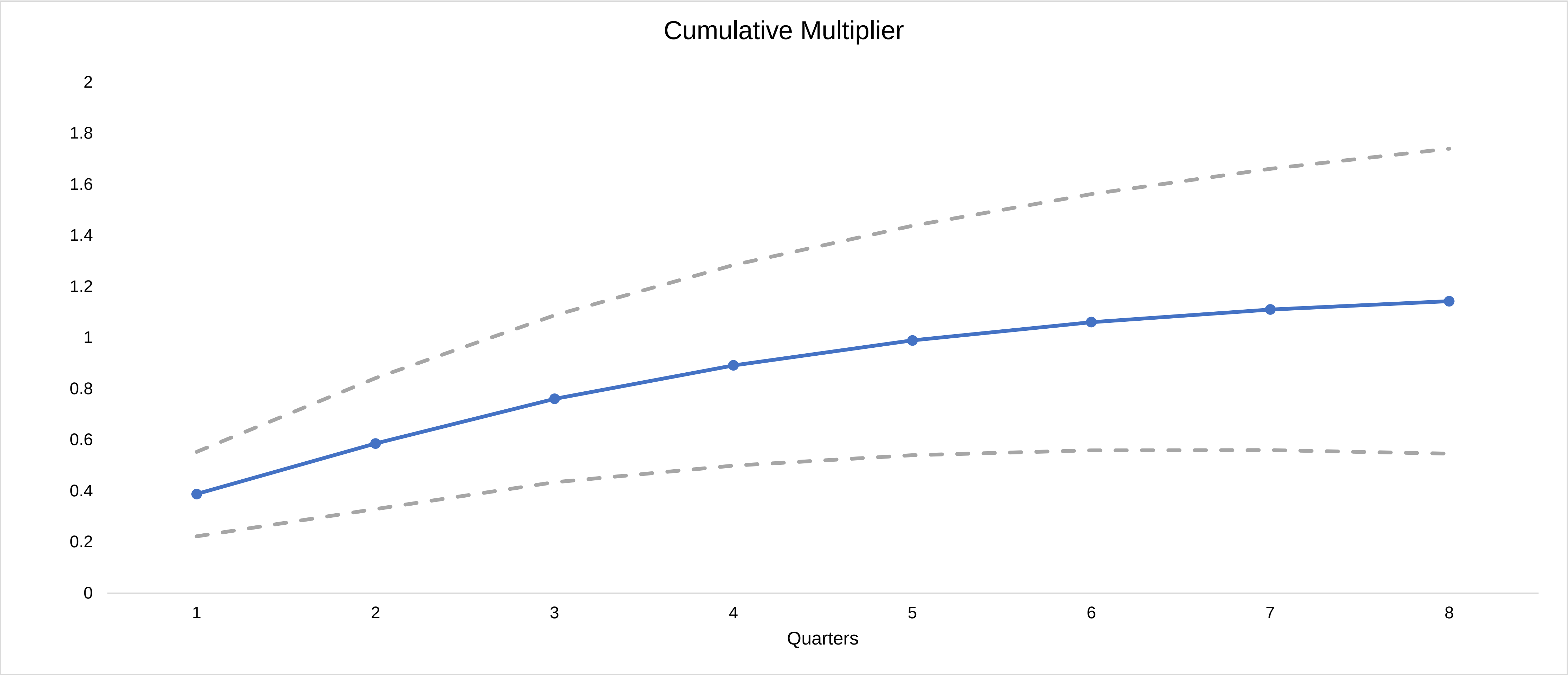
Figure 16. Full sample: Countries with and without fiscal rules



Notes: Each bar represents the correlation between the (HP) cyclical components of real GDP and real government spending for countries with and without fiscal rules. "With" fiscal rules indicates that at least one fiscal rule is being enforced; "without" means no fiscal rule is being enforced. The difference between the two averages is not significant. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Sources: Authors' calculations based on Davoodi et *al*. (2022) fiscal database and WEO (IMF) data.

Figure 17. Fiscal multiplier



Source: Computed by the authors from quarterly data for commodity exporters using a panel SVAR with the Blanchard-Perotti identification.

Table 1. Testing theories of fiscal procyclicality

	Dependent variable: CORR(g, y)				
	(1)	(2)	(3)	(4)	(5)
Financial openness	-0.25 **				-0.19
Corruption Control		-0.12 ***			-0.07
Political Constraint Index			-0.470 **		-0.08
GDP Volatility				1.58 **	1.26
F-test					**
R-squared	0.05	0.13	0.05	0.06	0.18
Observations	92	74	92	97	72

Notes: Cross-section OLS for commodity exporters. For regression (5), the F-test evaluates the joint significance of financial openness, corruption control, and GDP volatility. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 2. Testing institutional variables

	Dependent variable: CORR(g, y)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Government Stability	**-0.09 ****					**-0.01**	**-0.07**
Law and Order		**-0.13 *****				**-0.12 *****	**-0.06**
Fiscal Rules			**-0.61 *****		**-2.11 *****	**-0.31 ****	**-1.26 ****
Sovereign Wealth Funds				**-0.53 *****		**-0.37 *****	**-0.21**
F-test						***	***
R-squared	**0.05**	**0.24**	**0.17**	**0.13**	**n/r**	**0.47**	**0.15**
Observations	**137**	**137**	**106**	**194**	**83**	**83**	**83**

Notes: Cross-section regression for full sample. Regressions (1)-(4) and (6): OLS. Regressions (5) and (7): IV (two-stage least squares). n/r means not reported by STATA. For regressions (6) and (7), the F-test reported evaluates the joint significance of the three institutional variables. Regression (7), centered R-squared. Overidentification tests do not apply to regressions (5) and (7) since equations are perfectly identified. In regressions (5) and (7), the first-stage F-test of excluded instruments implies rejection of the null hypothesis of weak identification (p-value = 0.00) in both cases. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 3. Panel fixed-effects regression of output growth on commodity prices

	Dependent variable: GDP					
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	**EMDE**	**EMDE**	**EMDE**	**Full**	**Full**	**Full**
Commodity Export Price Index (EPI)	0.085 ***	0.063 ***	0.080 ***	0.024	0.018	0.026
Terms of Trade		0.029			0.026	
GDP (-1)			0.367 ***			0.366 ***
Commodity Export Price Index x EMDE				0.062 **	0.046 *	0.054 **
Observations	381	364	370	533	436	518
Countries	11	11	11	15	15	15
F-Test joint Commodity EPI and EMDE interaction				***	***	***

Notes: Panel least squares with country fixed effects. All variables are in log-differences. Full refers to the sample with AE and EMDE. *,**, and *** indicate statistical significance at 10, 5, and 1 percent, respectively.

Table 4. Panel fixed-effects regression of government spending on commodity prices

	Dependent variable: Real Government Spending					
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	**EMDE**	**EMDE**	**EMDE**	**Full**	**Full**	**Full**
Commodity Export Price Index (EPI)	**0.061** *	**0.080** *	**0.061** *	**-0.123** ***	**-0.072**	**-0.121** ***
Terms of Trade		**-0.060**			**-0.072**	
GDP (-1)			**0.688** ***			**0.625** ***
Commodity Export Price Index x EMDE				**0.184** ***	**0.158** ***	**0.183** ***
Observations	**276**	**269**	**276**	**415**	**341**	**413**
Countries	**11**	**11**	**11**	**15**	**15**	**15**
F-Test joint Commodity EPI and EMDE interaction				***	**	***

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

Table 5. Pours as a fraction of rain in CE

Emerging Markets	Pours/rain
Argentina	23.4%
Brazil	31.2%
Chile	16.3%
Colombia	18.3%
Costa Rica	12.1%
Ecuador	22.8%
Honduras	17.8%
Indonesia	11.6%
Russian Federation	26.6%
South Africa	20.5%
Ukraine	35.0%
Average	21.4%

Advanced Economies	Pours/rain
Australia	-61.9%
Canada	-66.6%
New Zealand	-65.3%
Norway	-67.8%
Average	-65.4%

Note: Authors' calculations (see text for details).

Table 6. EMDE: Pours as a fraction of change in GDP

Emerging Markets	Pours	Rains
Argentina	19.0%	81.0%
Brazil	23.8%	76.2%
Chile	14.0%	86.0%
Colombia	15.5%	84.5%
Costa Rica	10.8%	89.2%
Ecuador	18.6%	81.4%
Honduras	15.1%	84.9%
Indonesia	10.4%	89.6%
Russian Federation	21.0%	79.0%
South Africa	17.0%	83.0%
Ukraine	26.0%	74.0%
Average	17.4%	82.6%

Note: Columns add up to 100.

Source: Authors' calculations (see text for details).

Table 7. Application to commodity boom episode

2003-2008 Cycle	
Increase in commodity export prices EMDE	76.3%
Increase in commodity export prices AE	65.7%
Government reaction EMDE	4.6%
Government reaction AE	-8.1%
GDP reaction EMDE	6.5%
GDP reaction AE	1.6%
Pours EMDE (GDP pp)	1.1%
Pours AE (GDP pp)	-3.0%
Rain EMDE (GDP pp)	5.4%
Rain AE (GDP pp)	4.6%

Source: Authors' calculations (see text for details).

Table 8. Welfare costs

σ	EM: Pours/GDP	A: Pours/GDP
0.5	2.62%	-5.30%
0.75	2.62%	-5.30%
1	2.63%	-5.30%

Source: Authors' calculations (see text for details).

Table A1. Sample of countries

Commodity exporters	
Algeria	Liberia
Angola	Libya
Argentina	Madagascar
Armenia	Malawi
Australia	Mali
Azerbaijan	Mauritania
Bahrain	Mongolia
Belize	Mozambique
Benin	Myanmar
Bolivia	Namibia
Botswana	New Zealand
Brazil	Nicaragua
Brunei Darussalam	Niger
Burkina Faso	Nigeria
Burundi	Norway
Cabo Verde	Oman
Cameroon	Papua New Guinea
Canada	Paraguay
Central African Republic	Peru
Chad	Qatar
Chile	Russian Federation
Colombia	Rwanda
Comoros	São Tomé and Príncipe
Congo, Dem. Rep.	Saudi Arabia
Congo, Rep.	Senegal
Costa Rica	Seychelles
Côte d'Ivoire	Sierra Leone
Ecuador	Solomon Islands
Equatorial Guinea	South Africa
Ethiopia	South Sudan
Fiji	Sudan
Gabon	Suriname
Ghana	Tajikistan
Guatemala	Tanzania
Guinea	The Gambia
Guinea-Bissau	Timor-Leste
Guyana	Togo
Honduras	Trinidad and Tobago
Iceland	Turkmenistan
Indonesia	Uganda
Iran, Islamic Rep.	Ukraine
Iraq	United Arab Emirates
Kazakhstan	Uruguay
Kenya	Uzbekistan
Kuwait	Yemen
Kyrgyz Republic	Zambia
Lao PDR	Zimbabwe

Non-commodity exporters	
Afghanistan	Malaysia
Albania	Maldives
Antigua and Barbuda	Malta
Austria	Marshall Islands
Bangladesh	Mauritius
Barbados	Mexico
Belarus	Micronesia
Belgium	Moldova
Bhutan	Montenegro
Bosnia and Herzegovina	Morocco
Bulgaria	Nauru
Cambodia	Nepal
China	Netherlands
Croatia	North Macedonia
Cyprus	Pakistan
Czech Republic	Palau
Denmark	Panama
Djibouti	Philippines
Dominica	Poland
Dominican Republic	Portugal
Egypt	Romania
El Salvador	Samoa
Eritrea	San Marino
Estonia	Serbia
Eswatini	Singapore
Finland	Slovak Republic
France	Slovenia
Georgia	Somalia
Germany	Spain
Greece	Sri Lanka
Grenada	St. Kitts and Nevis
Haiti	St. Lucia
Hong Kong SAR, China	St. Vincent and the Grenadines
Hungary	Sweden
India	Switzerland
Ireland	Syria
Israel	Taiwan, China
Italy	Thailand
Jamaica	The Bahamas
Japan	Tonga
Jordan	Tunisia
Kiribati	Turkey
Korea	Tuvalu
Latvia	United Kingdom
Lebanon	United States
Lesotho	Vanuatu
Lithuania	Vietnam
Luxembourg	

Table A2: Baxter-King filter

	Figure 1	Figure 2	Figure 4	Figure 5
AE	-0.19***			
EMDE	0.26***			
CE		0.27***	0.28***	0.20***
Non-CE		0.07	0.04	-0.14**