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Fiscal policy in oil and gas-exporting economies: Good times, bad times and

ugly times

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A B S T R A C T

We study the cyclicality of fiscal policy to oil and gas revenue in emerging and developing energy-exporting countries. We build a unique oil and gas fiscal revenue database for 30 countries and develop a novel frame-work to identify various kinds of asymmetry in the response of public expenditure to oil and gas revenue. To explore asymmetries that may occur during revenue cycles, we distinguish between high and low oil and gas revenue regimes, as well as between positive and negative revenue shocks. Using an unbalanced panel over the period 2000–2020, we find that fiscal policy is procyclical in general but neutral when confronted with high but declining revenue, possibly influenced by policymakers’ optimistic view that revenue will quickly recover. Moreover, we find the greatest level of procyclicality when revenue is low but increasing. This situation may follow periods of fiscal tightening where governments face greater social pressure to catch up with higher spending. Our results also suggest that financial openness increases procyclicality in low revenue regimes only, and that during these periods, IMF programs are associated with expenditure reductions regardless of im-

provements or deteriorations of oil and gas revenue.

1. Introduction

Emerging and Developing (ED) commodity-exporting countries need to stabilize their economies amid episodes of commodity market booms and busts. Pronounced ups and downs in the prices of exported com-modities impact the revenue streams and pose obstacles to sustainable economic growth and development. While during busts, governments face revenue shortfalls, creating challenges in meeting budgetary obli-gations; during booms, a sudden influx of revenues can pose challenges in efficiently managing and allocating resources. Both neoclassical (Chari et al., 1991) and new-Keynesian models (Christiano et al., 2011) prescribe that fiscal policy should be countercyclical or neutral to sta-bilize the economy and avoid welfare losses. As is well known, con-ducting countercyclical fiscal policy means making budget contractions (reducing expenditure or increasing tax rates) during booms and car-rying out budget expansions (increasing expenditure or reducing tax rates) during busts. Fiscal policies are neutral when budgets do not adjust to revenue booms and busts. Despite countercyclicality or neutrality being prescribed, the empirical literature (e.g., Kaminsky, 2010; Cologni and Manera, 2013; Arezki and Ismail, 2013; Richaud

et al., 2019; Coutinho et al., 2021) shows that, overall, ED commodity-

exporting countries run procyclical fiscal policies: They spend windfall commodity revenues during booms and cut expenditures during busts.

The cyclical behavior of fiscal policies in ED countries matters for many reasons. First, countercyclical fiscal policies play a key role in stabilizing the economy during economic cycles. During economic downturns, increasing government spending or cutting taxes can boost demand, create jobs, and stimulate economic growth. Conversely, in a booming economy, reducing government spending or raising taxes can prevent overheating and inflation and allow governments to build buffers against future revenue shocks. Continuous procyclical policies, on the other hand, could lead to higher debt levels, making it harder to service debt in the long run. Also, during periods of high commodity prices, procyclical fiscal policies that increase spending may lead to higher imports, exacerbating trade deficits. When commodity prices fall, revenues decline and the government may have to abruptly cut spending, leading to further economic contraction. Last but not least, consistent and predictable fiscal policies build confidence among busi-nesses and investors. When fiscal policies stabilize the economy, this reduces uncertainty and encourages long-term investments, promoting sustainable growth.

This paper contributes in four ways to the existing literature on fiscal

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Table 1

Cyclicality of government expenditure: results of fixed effects panel data model.

ΔEXP ΔRENT

ΔRENT´ FO

ΔRENT´ IQ

ΔRENT´ FRL

ΔRENT´ ERF

ΔRENT´ IMF

Constant

Observations

Number of countries

R2

(1)

Tot 0.892\*\*\* (0.278)

0.755\*\*\* (0.096) 584

30 0.333

(2)

Inv 0.157\*\*\* (0.0329)

0.037\*\*\* (0.005) 546

30 0.247

(3)

Cur 0.821\*\*\* (0.281)

0.391\*\*\* (0.050) 546

30 0.326

(4)

Tot

0.025 (0.160) 0.423\*\*\* (0.150)

0.605\*\* (0.253)

0.497\*\*\* (0.175) 0.332\*\*\* (0.041) 0.676\* (0.332)

4.246 (4.430) 485

27 0.536

(5)

Inv 0.201\* (0.104) 0.012 (0.030)

0.102 (0.101)

0.123 (0.084)

0.004 (0.026) 0.038 (0.119)

1.164 (1.877) 477

27 0.304

(6)

Cur

0.047 (0.135) 0.366\*\*\* (0.126)

0.465\* (0.230)

0.413\*\*\* (0.107) 0.299\*\*\* (0.023) 0.413 (0.250)

4.281 (3.078) 477

27 0.492

Notes: Robust clustered standard errors are in parentheses. Coefficients of control variables are not reported, for brevity. \*, \*\* and \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively. Fewer countries (27 instead of 30) are included in regressions (4) to (6) because of missing Chinn and Ito financial openness index

values.

policy in emerging and developing economies. First, it investigates the fiscal behavior of the specific group of oil and gas exporting countries. Second, cyclicality is assessed using proper oil and gas fiscal revenue data, whereas other studies use proxies based on international oil prices that very partially reflect revenue windfalls or shortfalls for the gov-ernment. Third, we introduce a novel framework that deals with asymmetry of fiscal response. It serves to investigate how high or low oil and gas revenue environments influence the way governments respond to oil and gas revenue improvement or degradation. To the best of our knowledge, examining the issue of fiscal cyclicality from such a multi-dimensional asymmetric standpoint has not been done before. Fourth, our results provide new insights. They show that the influence of structural, economic and financial factors on cyclicality is not uniform but depends on the configuration of the oil and gas revenue cycle. The factors considered include financial openness, institutional quality, ex-change rate flexibility, the presence of fiscal rules, and the occurrence of an IMF arrangement. Overall, our analysis in this paper aims at offering a deeper and more nuanced understanding of the complexities sur-rounding the cyclical nature of fiscal policy in economies reliant on oil and gas exports.

Drawing on International Monetary Fund (IMF) country reports and national sources, we have compiled a unique dataset of 30 countries’ fiscal oil and gas revenues from 1995 to 2020. We break down each country’s oil and gas revenue series, into a trend and a cyclical component, which allows us to identify three distinct types of periods: good times, bad times, and ugly times. Good times refer to the most favorable configuration, where oil and gas revenues are high and continuously rising. Conversely, bad times represent the worst-case configuration, where revenues are already low and declining further. The two intermediate situations – high but decreasing and low but

increasing revenues – are referred to as ugly times.

1 Similar terminologies are utilized in the relevant literature with different

meanings. Terms throughout this paper in italics refer to the cases specified in

our analysis.

2 In the following sections, we will present the precise definitions of good

times, bad times, and ugly times. While there is no doubt that good times exemplify the most favorable case among these three, the assessment of whether ugly times are preferable to bad times can vary depending on the specific context and subject matter. In the terminology employed within our study, the term “ugly” denotes a situation that encompasses a blend of positive and negative situa-tions, rendering it comparatively more advantageous than the term “bad,”

which carries a stronger negative connotation.

Using unbalanced panel data for the period 2000–2020, the paper presents several key findings. We confirm that, overall, government expenditure is procyclical. In addition, we find that financial openness increases procyclicality, thus validating the so-called “financial constraint hypothesis”. Our results also show that fiscal rules and flex-ible exchange rates respectively reduce and increase procyclicality. In all our estimations, the degree of procyclicality is the same during an in-crease or a decrease in oil and gas revenue. Some of our results suggest that procyclicality is greater in a lower than in a higher revenue regime but they are not robust. However we find robust results on asymmetry once we use the good times, bad times and ugly times categorization that takes into account both the level and the variation of oil and gas reve-nues. Hence we show that the fiscal response depends on whether a positive or a negative shock happens in a high or a low revenue regime. The degree of procyclicality is quite similar in good times and bad times. But pronounced fiscal response asymmetries are found between the two ugly time configurations. More precisely, low but increasing oil and gas revenues are associated with greater procyclicality. We argue that low revenue environments may be associated with low expenditure (because spending has had to be reduced). In this context, social pressure to catch up with higher expenditure levels may prompt a spending hike as soon as government revenue begins to rise. On the opposite, in case of high but declining revenue, we find that procyclicality disappears. We argue that in this configuration, policymakers believe in a quick revenue re-covery and use their favorable initial fiscal space (e.g., lower public debt and lower budget deficit) obtained thanks to windfalls in previous pe-riods to absorb adverse revenue shocks. Our results also show that financial openness, institutional quality, exchange rate flexibility, and the occurrence of IMF programs tend to have different effects on cycli-cality depending on the oil and gas revenue configuration. In particular, we find that financial openness increases procyclicality in low revenue regimes only, and that during these periods, IMF programs are associ-ated with reductions in expenditure regardless of improvements or de-teriorations of the oil and gas revenues.

The outline of the paper is as follows. The next section reviews previous studies on the cyclicality of fiscal policies in ED countries. Section 3 presents the data and explains the measurement of oil and gas fiscal revenue shocks, which informs the econometric model specifica-tion. A model with no asymmetries is estimated in Section 4. Section 5 introduces the shock asymmetries and studies the fiscal responses to different configurations of oil and gas revenue shocks. Section 6 presents robustness checks and extensions. The last section concludes with a

summary of our findings and their policy implications.

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2. Literature review

The literature on the procyclicality of fiscal policies in ED countries overall (including both commodity exporters and importers) has pro-duced some consistent findings. First, unlike advanced countries, ED countries tend to be procyclical (Gavin and Perotti, 1997; Talvi and Vegh, 2005; Ilzetzki and Vegh, 2008). Second, their procyclicality is largely characterized by fiscal contractions in periods of recession (Gavin and Perotti, 1997). Third, their current spending increases in booms, while capital spending is cut in busts (Ardanaz and Izquierdo, 2021). Last, ED economies are becoming less procyclical (Frankel et al., 2013).

Studies on the specific group of ED commodity-exporting countries conclude that they are procyclical (Kaminsky, 2010; Cologni and Man-era, 2013; Coutinho et al., 2021). In periods of commodity price downturn, they cut investments more than current expenditures (Arezki and Ismail, 2013). Moreover, they have started becoming less procycl-ical before the 2007–2008 financial crisis (Cespedes and Velasco, 2014; Villafuerte and Lopez-Murphy, 2010). However, there are signs that procyclicality has resumed in the aftermath of the oil price downturn of 2013 (Richaud et al., 2019).

There are various explanations why commodity-exporting ED econ-omies are procyclical. The financial constraints explanation suggests that commodity booms stimulate foreign capital inflows, improve financial conditions, and give governments leeway to spend more (Kaminsky et al., 2004; Riascos and Vegh, 2003). In times of busts, capital outflows deteriorate the financial conditions and may eventually prompt abrupt fiscal contractions (Kaminsky, 2010).

Other explanations of procyclicality relate to the resource curse literature. Resource endowment is associated with lower institutional quality and, therefore, less ability to conduct the countercyclical or neutral fiscal policies that would stabilize the economy. Talvi and Vegh (2005) model various groups of interest that compete for fiscal resources and, thus, increase the pressure on the government to spend in times of budget surplus. In the same vein, Arezki and Ismail (2013) develop a model where adjustment costs on current expenditure lead governments to buffer negative commodity revenue shocks by disproportionately reducing investment spending. Alesina et al. (2008) model the budget process as an imperfect contract between households that do not observe the stock of debt and a government that trades off between revenue predation and the need to stimulate the economy for reelection. Ilzetzki (2011) shows how greater polarization of opinion on where to spend public money, combined with larger chances of political alternation, tends to make policies more procyclical. Cespedes and Velasco (2014) represent a budget decision framework where multiple stakeholders maximize their particular objectives under a common budget constraint, leading to procyclical fiscal policies.

Various empirical studies have attempted to identify institutional factors that influence procyclicality. Frankel et al. (2013) find that improved institutional quality has reduced procyclicality in ED econo-mies in general, and Cespedes and Velasco (2014) find a similar result for the ED commodity exporters. Arezki and Ismail (2013) show that fiscal rules tend to increase public investment procyclicality. But other studies conclude that fiscal rules reduce fiscal procyclicality (Cespedes and Velasco, 2014; Richaud et al., 2019), and others are inconclusive on this point (Bova et al., 2014; Coutinho et al., 2021). However, recent

contributions stress that well-designed fiscal rules reduce the fiscal

3 Similarly, using a structural vector autoregression model for the Omani

economy, Al Al Jabri et al. (2022) show that oil price shocks do not have much impact on the current government expenditure, which represents two-thirds of the government total spending in Oman. In the same vein, Farzanegan (2011) studies Iranian government’s spending and find that fluctuations in oil export revenues have a significant and persistent effect on military expenditures

whereas they have no effect on education, cultural, and health spending.

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procyclicality of public investment (Guerguil et al., 2017; Ardanaz et al.,

2021).

3. Data and description of the variables

This section explains the oil and gas fiscal revenue database compiled for this study and describes additional variables incorporated in our analysis. The definitions and descriptive statistics for all variables

can be found in Tables A.1 and A.2, respectively.

3.1. The oil and gas fiscal revenue database

The studies that focus on the procyclicality of fiscal policies to commodity revenues, such as Cespedes and Velasco (2014), Richaud et al. (2019) or Arezki and Ismail (2013) have used commodity price indexes to proxy commodity-related fiscal revenues. Nevertheless, this approach has serious drawbacks. First, countries have more or less commodity-related fiscal revenue as a proportion of their gross domestic product (GDP) than others. Thus, commodity prices poorly reflect the size of the fiscal revenue shocks. Second, commodity taxation and roy-alty schemes vary across countries and reflect their specific production costs, which implies non-linearities between oil and gas prices and their related fiscal revenues. Third, oil and gas production may vary signifi-cantly over time, which indeed influences fiscal revenues. In Chad, for example, oil production was close to zero before the year 2003. Other countries, such as Timor-Leste, have seen a decline in their production due to resource exhaustion. At the same time, OPEC countries regularly adjust their production to manage oil price fluctuations. Moreover, in some cases, economic sanctions or geopolitical events may also affect production or exports and decouple energy commodity revenues and energy commodity prices.

For the reasons outlined above, we choose to assess procyclicality using oil and gas fiscal revenues and not oil and gas price indexes. But this choice brings up a data issue, as oil and gas fiscal revenues are not systematically published by any organization. OPEC (2023) provides comprehensive series of oil export revenues, but for its 13 member countries only. In addition, oil export revenues may poorly match oil and gas fiscal revenues because they do not reflect differences in pro-duction costs; and the role of domestic sales, especially considering the ongoing energy price reforms in some oil-exporting countries. Last but not least, OPEC data do not take into account gas revenues. World Bank (2021a) publishes oil and gas rents for most oil and gas exporting countries. The rents are calculated by subtracting production costs from the market value of production, which is calculated using border prices. Such rents do not accurately reflect the fiscal revenues governments receive because, in many oil-exporting countries, domestic energy prices are administered and can be significantly lower than export prices.

Finally, we had to build a proper country-level oil and gas fiscal revenue database for the 30 countries that we classify as oil and gas exporters. The database compiles information drawn mostly from IMF country reports and country-level official statistical sources. Where data

were unavailable from those sources, we have proxied the oil and gas

4 Villafuerte and Lopez-Murphy (2010) have used oil and gas fiscal revenue

data, but they have covered a very short time period (2004–2009) and their

conclusions are based on descriptive statistics only with no inferential analysis.

5 In line with World Bank (2018), a country is classified as an oil and gas

exporter if, between 2012 and 2014, exports of crude oil and natural gas accounted for at least 20% of its total exports. The 30 countries that satisfy this condition and are included in the analysis are Algeria, Angola, Azerbaijan, Bahrain, Bolivia, Brunei Darussalam, Cameroon, Chad, Colombia, Ecuador, Equatorial Guinea, Gabon, Ghana, Iran, Iraq, Kazakhstan, Kuwait, Malaysia, Myanmar, Nigeria, Oman, Qatar, the Republic of Congo, Russia, Saudi Arabia, Sudan, Timor-Leste, Trinidad and Tobago, Turkmenistan, and the United Arab

Emirates.

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fiscal revenue based on IEA’s (2022a,b) oil and gas export data, oil and gas prices from the IMF’s (2022a) commodity data portal, and produc-tion costs obtained from various sources. The sources used for building fiscal revenue time series for each country are presented in Online Ap-

pendix A.

3.2. Measuring oil and gas fiscal revenue gap, discretionary spending and

fiscal cyclicality

We consider that when governments plan their budget, they adjust spending to align it with a specific fiscal balance target (that can be a surplus or a deficit) given a baseline that represents expectations for long-term oil and gas revenue. The baseline revenue is extrapolated from past years’ revenues. External shocks create a gap between realized oil and gas revenue and the baseline. A positive gap corresponds to a windfall that the government can decide to either spend to stimulate the economy or save as a precaution for later use. A negative gap is a shortfall that will lead the government to cut spending to preserve the budget’s balance or increase spending to support the economy. We define cyclicality as the sensitivity of the discretionary part of govern-ment spending to revenue windfalls or shortfalls, as measured by the gap between actual and baseline oil and gas fiscal revenues. To isolate the gap component in the oil and gas revenue series from the baseline level, we use the Hamilton (2018) filter. With this method, the gap between actual and baseline oil and gas fiscal revenue is the residual of the linear regression of the series at time t + h on a constant and their four most recent values as of time t.

We use data from the IMF’s World Economic Outlook (IMF, 2022a), which provides governments’ total, capital and current consumption expenditures. For each of the three categories, we define the discre-tionary part of spending as the gap between actual spending and a trend based on previous years’ spending. We use the same Hamilton filter approach that was described above for the oil and gas revenue series. This definition of discretionary spending is close to the one used by Attinasi and Klemm (2016), except that, instead of reflecting spending and inflation during the previous year only, our trend is based on the

historical spending trajectory.

3.3. Other explanatory variables

Given that the cyclical nature of fiscal policy can be influenced by various structural and economic factors specific to each country, we expand our analysis by including multiple additional variables that we interact with oil and gas revenues. First, we consider financial openness (FO), represented by the index of Chinn and Ito (2006), which is a continuous variable that measures countries’ degrees of capital account openness. The more open the country is to cross-border capital flows, the higher its index value. A positive coefficient associated with this index would mean that countries more open to international capital flows are

more procyclical. As explained in Section 1, the financial constraint

6 For the purposes of this study, we do not consider governments’ non-oil and

gas revenues.

7 Given the yearly frequency and length of our data, we use h = 2 (Hamilton,

2018). Statistical reasons why we prefer a Hamilton filter over a more tradi-tional Hodrick-Prescott (HP) filter is that, first, for a nonstationary series, the HP filter may not accurately remove the trend (Hamilton, 2018). Second, as pointed out by Jonsson (2020), the HP filter presents relatively higher recursive instability, i.e., the previously estimated trend and cyclical components change significantly as more data are added. The economic reason why we choose to employ the Hamilton filter is that it reflects our assumption that governments form their oil and gas revenue baseline based on past observations. The HP filter, on the other hand, uses both the past and future values of the series to decompose it into trend and cyclical components. Therefore, the HP filter takes into account information (e.g., unanticipated shocks) unavailable at the time

the budget decisions were made.

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hypothesis states that capital inflows in times of boom and outflows in times of bust cause fiscal procyclicality. Therefore, if the financial constraint hypothesis holds, countries that have greater openness to capital flows are expected to exhibit a higher degree of procyclicality, and we should have a positive coefficient for the interaction term with the Chinn-Ito index.

To assess the role of political economy factors, we include the institutional quality index (IQ) as another explanatory variable. For this purpose, following some earlier studies (e.g., Easterly and Levine (2003)), we use the average of the six worldwide governance indicators originating from Kaufmann et al. (2010) and published by World Bank (2021b), namely (i) control of corruption, (ii) government effectiveness, (iii) political stability and absence of violence/terrorism, (iv) regulatory quality, (v) rule of law, and (vi) voice and accountability. A negative value for the interaction term with this variable would mean that better institutions reduce procyclicality.

We also test the influence of fiscal rules (FRL) by including in our regressions a dummy equal to one if the country has at least one type of fiscal rule according to the database of Davoodi et al. (2022). Their dataset covers four types of rules, namely budget balance rules, debt rules, expenditure rules, and revenue rules, which apply to the central or general government. These rules mainly aim to restrain overspending. Therefore, we expect that the fiscal rule makes fiscal policy more neutral and, therefore, that the interaction term is negative.

Moreover, we include a measurement of exchange rate flexibility (ERF) (Ilzetzki et al., 2021). We do not expect any particular sign for the interaction term, because a priori exchange rate flexibility may have both procyclical and contercyclical effects. It can make fiscal space less sensitive to revenue shocks. On this point, Grigoli et al. (2019) explain that a decline in oil prices generates exchange rate depreciation, which increases governments’ fiscal commodity revenue in local currency terms. Therefore, one could expect that flexible exchange rates reduce procyclicality. But on the other hand, in the case of flexible exchange rates, fiscal policy has less influence on economic activity than monetary policy. Therefore, from a normative perspective, with a flexible ex-change rate, a government that aims to stabilize its economy is expected to make less use of countercyclical fiscal policies. Another effect of flexible exchange rates is that they transmit the oil and gas revenue shocks to domestic prices through changes in imported goods prices. With negative shocks the exchange rate depreciates, domestic prices increase, and governments may respond to inflation with tighter mon-etary or fiscal policy. On the opposite, positive oil and gas revenue shocks curb inflation, thus creating favorable conditions for expan-sionary macroeconomic policies. Therefore, through this inflation channel, flexible exchange rates may increase procyclicality.

Last, some countries have received financial support during periods of oil and gas revenue downturns, and this may be reflected in their level of procyclicality. In order to capture this effect, we include a dummy variable (IMF) that equals one if a country has been under an IMF arrangement for at least five months in a given year (Dreher, 2006). The money disbursed in turbulent times may buffer the revenue drop and help avoid fiscal contraction, making fiscal policies less procyclical. Advices the IMF gives may also influence the government, which will save more windfall commodity revenue. On the other hand, IMF dis-bursements may come with conditions such as deficit reductions that

could prompt fiscal consolidation during oil and gas revenue shortfalls.

4. Models of fiscal cyclicality without asymmetries

To analyze the cyclicality of the ED oil and gas exporters’ fiscal

policy, we run panel data regressions over the period 2000–2020 for 30

8 The IMF programs include stand-by arrangements, an extended funds fa-

cility, and a structural adjustment facility or poverty reduction and growth

facility.

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ED oil and gas exporting countries. The regressions take into account observed and unobserved country-specific characteristics that can in-

fluence budget decisions. We estimate the following model:

Δ*EXPi,t* = *α*1*,i* + *β*Δ*RENTi,t* + *γXi,t* + *λΔRENTi,t* ´ *Xi,t* + *εi,t* (1)

where ΔEXP is the variation in discretionary government expenditure, investment expenditure, or current consumption expenditure and ΔRENT is the variation in the oil and gas revenue gap, all obtained using

the Hamilton filter (see Section 3.2). *α* denotes country fixed effects.

The coefficient *β* estimates to what extent changes in oil and gas reve-nues (either windfalls or shortfalls) lead to changes in discretionary expenditure. A positive (negative) *β* denotes procyclicality (counter-cyclicality). Eq. (1) also includes the additional explanatory variables of

Section 3.3 in a vector X that we interact with ΔRENT*.* A positive

(negative) coefficient *λ* means that the variable amplifies (reduces) procyclicality.

Table 1 presents the fixed effects estimation results of Eq. (1). Our estimates of the impacts of variations in oil and gas revenues on public expenditure without control variables (columns 1 to 3) show that gov-ernments’ total, investment and current consumption expenditures are procyclical. The value of the coefficient we obtain for ΔRENT in the total expenditure regression is only very slightly below one, which means that there is almost a 100% pass-through of additional oil and gas revenue on total expenditure. In other words, government expenditure reflects almost entirely the variations in oil and gas revenue. The value close to one is somehow higher than in Villafuerte and Lopez-Murphy (2010), who find a value closer to 0.5 during the 2004–2008 period, and up to 0.75 for low-income oil exporters. Note that the revenue and expenditure variables used in the regressions are expressed in monetary values. The lower coefficients of investment are due to a size effect: On average, over the sample, investment expenditure is smaller compared to total or current expenditure (see Table A.2).

When adding the interaction terms to the regressions (columns 4–6 in Table 1), we capture some of the factors that influence cyclicality. First, greater financial openness leads to more procyclicality of total and consumption expenditures. This finding tends to validate the financial constraint hypothesis. However, financial openness does not influence the cyclicality of government investment, suggesting that the foreign exchange inflows serve to finance current rather than investment expenditure. We also find in these regressions that greater institutional quality makes total and current expenditure less procyclical, which tends to validate the resource curse hypothesis in line with Frankel et al. (2013) and Cespedes and Velasco (2014). Moreover, our results show that fiscal rules make total and consumption expenditures less procycl-ical. However, the fiscal rules have no influence on investment expen-diture, in line with the findings of Bova et al. (2014) and Coutinho et al. (2021). In addition, there is a sign that exchange rate flexibility in-creases the procyclicality of total and current expenditure. This finding is in line with Richaud et al. (2019), who obtained results where a

flexible exchange rate increases the procyclicality of total expenditure.

5. Models with asymmetries in fiscal responses

In this section, we introduce various configurations of oil and gas

revenue shocks. We investigate asymmetric responses of fiscal policies

9 To improve the precision of the Hamilton filter, we incorporate data from

1990 onwards, despite some missing data before 2000. Likewise, there are gaps in the data for the year 2020. However, excluding this year from the regressions does not affect the results. The initial measurement for the variables in differ-

ence (Δ) represents the change between 1999 and 2000.

10 To check the stationarity of the variables, we apply the Im et al. (2003)

panel unit root test. As our panel is unbalanced, critical values cannot be calculated for some variables. For others, the (unreported) results indicate that

they are stationary.

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and explore how they are influenced by the covariates introduced in the

previous section.

5.1. Variation and position of oil and gas revenues: The good, the bad and

the ugly times

In the face of commodity revenue fluctuations, we consider that the way governments decide to adjust their fiscal response depends on two dimensions that define their assessment of the situation. First, the fiscal response may depend on the variation in fiscal oil and gas revenues, i.e., on whether the revenues improve or deteriorate. To test whether com-modity revenue improvements or deteriorations have asymmetrical

impacts on government expenditure, we use specification (2a) where

Δ+RENT and Δ RENT stand for improvements and deteriorations in the oil and gas revenue gap. Differences between coefficients *μ* (i.e., *μ* =∕ *μ* )

would indicate asymmetry.

Δ*EXPi,t* = *α*2*,i* + *μ*1Δ+*RENTi,t* + *μ*2Δ *RENTi,t* + *εi,t* (2a)

Δ*EXPi,t* = *α*3*,i* + *δ*1Δ*RENTHi,t* + *δ*2Δ*RENTLi,t* + *ε*i*,t* (2b)

Δ*EXPi,t* = *α*4*,i* + *θ*1Δ+*RENTHi,t* + *θ*2Δ *RENTHi,t* + *θ*3Δ+*RENTLi,t*

+ *θ*4Δ *RENTLi,t* + *εi,t* (2c)

Second, the fiscal response may depend on the position in the com-modity revenue cycle, i.e., on whether the oil and gas revenue gap measured is positive (windfall) or negative (shortfall). The position gives an idea of the fiscal space perceived by the government when deciding on expenditures. In windfall periods, governments may have been able to refill their fiscal buffers while ensuring a relatively high level of spending for their population. However, a government that is navigating periods of low oil and gas revenues may have exhausted some of its buffers and may have already implemented spending cuts that harm its population’s welfare. Hence, it may face more social pressure to return to a higher level of expenditure. Our second testable hypothesis here is that governments’ fiscal policy reactions in the face of a revenue shock may differ depending on whether the shock comes during a period where the revenue gap is positive or negative. The hypothesis is tested using specification (2b) where ΔRENT is the variation in commodity revenues while the gap is positive (high revenue regime). Similarly, ΔRENT stands for the variation in revenues while the gap is negative (low revenue regime). If fiscal responses are asymmetrical with respect to the position, then we should have *δ* =∕ *δ* . Although it is very relevant to fiscal decision-making in oil- and gas-exporting economies, to our knowledge, there is no study that considers this type of position asym-metry. All the studies that have examined asymmetric fiscal responses in commodity-exporting countries investigate variations only and do not consider position (Arezki and Brückner, 2012; Arezki and Ismail, 2013; Cespedes and Velasco, 2014).

We consider a third type of asymmetry: one that combines the varia-tion and the position of fiscal oil and gas revenues. As mentioned above, variation indicates that the fiscal oil and gas revenues either improve or deteriorate, whereas position represents whether the revenue gap is positive or negative. Fig. 1 illustrates the four possible combinations of position and variation. The two extreme situations are dubbed good times, when the revenues are high and improve, and bad times when they are low and deteriorate. We call ugly times the two situations in between (high but deteriorating or low but improving revenues). Ugly times

correspond to a conflicting picture of the government’s oil and gas

11 However, in periods of revenue shortfall, governments may also be less

prone to using fiscal policies since, in emerging economies, the fiscal multipliers

tend to be low or even negative than during busts (Gomes and Sakurai, 2022).

12 Ardanaz and Izquierdo (2021) and Guerguil et al. (2017) specify asymmetry

in terms of position (positive or negative output gap). However, they study the

cyclicality of fiscal responses to GDP, not to fiscal oil and gas revenues.

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revenues. We would not classify a sudden increase in revenues as a boom if it happens within a low-revenue regime. Similarly, a sudden decrease in revenues would not indicate a bust period if it occurs within a high-revenue regime. To further illustrate the point above, we plot the trend and the cyclical component of Saudi Arabia’s oil and gas fiscal revenues in Appendix B, Fig. B.1, in which we identify the periods of good, bad, and ugly times.

To test the hypothesis that governments respond differently to an increase or decrease in revenues, depending on whether they are navi-gating good, bad, or ugly times, we use the specification (2c), which al-lows for testing several asymmetry hypotheses. For example, the asymmetric fiscal responses during good times and ugly times can be tested by *θ* ∕= *θ* . Similarly, if *θ* ∕= *θ* , the fiscal responses are asym-

metrical between bad times and ugly times.

5.2. Results of the models with asymmetries

Table 2 presents the results from the fixed effect estimates of Eqs. (2a-c). All the significant coefficients are positive, denoting procyclical expenditures, in line with the conclusions of Table 1. However, as the Wald test results show, symmetric relationships are rejected in five out of the nine models estimated. Except for investment expenditure, gov-ernments’ fiscal policy responses differ depending on their oil and gas revenues’ position and variation, as described above.

The results from our estimations regarding the role of variation (columns 1 to 3) show that asymmetry exists for current expenditure, which adjusts slightly more when oil and gas revenues improve than when they deteriorate (the Wald test is significant in column 3). How-ever, there is no evidence of asymmetry for total and investment expenditure (the Wald test is not significant in columns 1 and 2). In other words, only current expenditure is found to respond differently to de-teriorations or improvements in oil and gas fiscal revenues. Finally, our results do not confirm Arezki and Ismail (2013), who find that current expenditure is sticky to the downside and that reduced oil and gas revenues mostly impact investment.

The results in Table 2 suggest that position asymmetry explains procyclicality better than variation asymmetry. In low oil and gas reve-nue regimes, the pass-through of oil and gas fiscal revenue to total and current expenditure is greater than during high revenue regimes (see columns 4 and 6). However, investment expenditure does not present any position asymmetry (column 5).

We find greater asymmetries once we consider the good times, bad times and ugly times categorization that takes into account both the level and the variation of oil and gas revenues (columns 7–9). The two ugly times situations correspond to two very contrasted types of fiscal re-sponses. During a high oil and gas revenue regime, if revenue setbacks happen, governments tend to keep the same level of spending (the co-efficients of Δ RENT are not significant). This neutral stance contrasts with the procyclicality that we find in all the other configurations. Various possible reasons may explain this specific behavior. First, the periods of high revenue may have helped build a fiscal buffer (reserves) sufficient to absorb a price downturn. Second, governments that are in periods of higher revenue may consider that negative revenue shocks are transitory, and therefore they do not require a shift in public expendi-ture. On the opposite, the greatest expenditure adjustments are found to

happen in case of low but improving revenue (the coefficients of

Δ+RENT are those with the highest values in columns 7 and 9). In other words, in a low revenue regime, governments will be particularly prone to translate an increase in revenue into an increase in spending. A possible explanation is that a low revenue environment often corre-sponds to a low level of expenditure. In this configuration, the pressure to increase expenditure is high. Therefore, once the commodity revenue outlook improves, governments may be tempted to catch up for the past

reductions in expenditure and to spend more.

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5.3. Models with asymmetries and covariates

We now extend the model with asymmetries of Eq. (2c) to assess how, in each particular configuration of the variation and position of oil and gas revenues (as presented in Fig. 1), the covariates studied in the fourth section influence fiscal cyclicality. We estimate the following

model where Xi*,*t is the vector of covariates of Eq. (1).

Δ*EXPi,t* =*α*5*,i* +*θ*1Δ+*RENTHi,t* +*θ*2Δ *RENTHi,t* +*θ*3Δ+*RENTLi,t*

+*θ*4Δ *RENTLi,t* +*γXi,t* + λ1Δ+*RENTHi,t* +*λ*2Δ *RENTHi,t* (3) +*λ*3Δ+*RENTLi,t* +*λ*4Δ *RENTLi,t* ´*Xi,t* +*εi,t,*

The results presented in Table 3 show that during low revenue re-gimes, higher financial openness leads to more procyclicality of current and total expenditure (the coefficients of *Δ*+RENT ´ FO and *Δ* RENT ´ FO in columns 1 and 3 are positive). In other words, the financial constraint hypothesis validated in the fourth section (see Table 1) holds only when countries are in a low revenue regime. This suggests that financial openness does not create a surge in spending in periods of high revenue. Likewise, in high revenue regimes, financial openness does not lead to more contraction of spending in the case of falling revenues.

The effect of financial openness is different for investment than for current and total expenditure. First, more financial integration leads to more investment during good times (the coefficient of *Δ*+RENT ´ FO in column 2 is positive), supporting the idea that capital inflows exaggerate investment spikes. However, in bad times, financial openness seems to limit the drop in investments, as the negative coefficient of *Δ* RENT ´ FO in column 2 suggests.

Institutional quality makes expenditure either procyclical or coun-tercyclical depending on the configuration of oil and gas revenue in terms of position and variation. Institutional quality makes total and current expenditure more procyclical in ugly times during high revenue regimes (the coefficients *Δ* RENT ´ IQ are positive in columns 1 and 3). It means that higher institutional quality makes governments more prone to reduce expenditure when a commodity cycle downturn is happening. On the other hand, during low revenue regimes, institutional

quality limits the expansionary response of total and current expendi-

ture to improvements in fiscal revenue (the coefficients of *Δ*+RENT ´ IQ are negative in columns 1 and 3). All in all, when the revenue outlook is mixed (ugly times), institutional quality moderates governments’ tendency to increase spending.

Fiscal rules appear to reduce the procyclicality of total and current expenditure during good times (the coefficients *Δ*+RENT ´ FRL in col-umns 1 and 3 are negative). This indicates that fiscal rules eventually serve their main purpose of moderating expenditure during booms. However, the results also show that in ugly times during low but

improving oil and gas revenues, fiscal rules increase total and current

expenditure procyclicality (the coefficient of *Δ*+RENT ´ FRL in col-umns 1 and 3 are positive). This may reflect the influence of rules that limit budget deficits. With such rules, an increase in oil and gas fiscal revenue makes room for higher spending, and governments use this opportunity to stimulate the economy when they are passing through low revenue regimes. Table 3 also shows that fiscal rules reduce pro-cyclicality during bad times (the coefficients of *Δ* RENT ´ FRL are all negative and significant). This finding suggests that fiscal rules help governments spend to avoid contractions during the most difficult economic situations.

Table 3 also shows that the positive relationship between exchange rate flexibility and procyclicality shown in Table 1 is validated during

three of the four configurations (the coefficients of *Δ* RENTH ´ ERF,

*Δ*+RENT ´ ERF and *Δ* RENT ´ ERF in columns 1 and 3 are positive). The only configuration in which this relationship is not validated is good

times, where more exchange rate flexibility is associated with less pro-

cyclicality (the coefficients of *Δ*+RENT ´ ERF are significant and negative in columns 1 and 3). Therefore, during good times, exchange

rate flexibility seems to play a stabilizing role (like fiscal rules do).

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Fig. 1. The four possible configurations of oil and gas fiscal revenues.

Notes: Δ+ and Δ stand for positive and negative variations in oil and gas revenues (RENT) during high (H) or low (L) oil and gas revenues regimes, respectively.

Table 2

Asymmetrical impacts of oil and gas revenues.

ΔEXP Δ+RENT

Δ RENT

ΔRENTH

ΔRENTL

Δ+RENTH

Δ RENTH

Δ+RENTL

Δ RENTL

Constant

Observations

Number of countries

R2

Wald test (all)

Wald test (good vs. bad times) Wald test (ugly times)

Wald test (ugly vs. bad times)

(1)

Tot 0.913\*\*\* (0.319) 0.873\*\*\* (0.258)

0.618 (0.504) 584

30 0.333 0.07

(2)

Inv 0.153\*\*\* (0.045) 0.160\*\*\* (0.027)

0.062 (0.149) 546

30 0.247 0.03

(3)

Cur 0.732\*\* (0.284) 0.906\*\*\* (0.289)

0.977\*\*\* (0.203) 546

30 0.323 8.43\*\*\*

(4) Tot

0.396\*\*\* (0.132) 1.264\*\*\* (0.407)

2.256\*\*\* (0.614) 584

30 0.396 8.31\*\*\*

(5) Inv

0.128\*\*\* (0.042) 0.181\*\*\* (0.031)

0.21\* (0.07) 546 30 0.253 1.49

(6) Cur

0.323\*\*\* (0.101) 1.245\*\*\* (0.441)

1.861\*\*\* (0.517) 546

30 0.413 6.76\*\*

(7) Tot

0.731\*\*\* (0.244)

0.341 (0.275) 2.119\*\*\* (0.571) 0.917\*\*\* (0.277)

0.843 (0.629) 584

30 0.432 6.34\*\*\* 1.82 9.72\*\*\*

13.62\*\*\*

(8) Inv

0.168\*\*\* (0.056)

0.008 (0.114) 0.160\*\*\* (0.036) 0.176\*\*\* (0.030)

0.095 (0.203) 546

30 0.268 1.24 0.02 2.24 0.18

(9) Cur

0.557\*\*\* (0.202)

0.164 (0.242) 1.871\*\*\* (0.591) 0.968\*\*\* (0.325)

0.373 (0.469) 546

30 0.436 7.17\*\*\* 9.54\*\*\* 6.40\*\* 10.7\*\*\*

Notes: The symmetry hypothesis is examined using the Wald test in different specifications. The results for the symmetry hypothesis with respect to *μ* = *μ* are presented in columns 1–3, for *δ*1 = *δ*2 in columns 4–6, and for *θ*1 = *θ*2 = *θ*3 = *θ*4 in columns 7–9. Additionally, the Wald test results are provided to test the hypothesis *θ*1 = *θ*4 for good vs. bad times, *θ*2 = *θ*3 for ugly times, and *θ*3 = *θ*4 for ugly vs. bad times (see Eqs. 2a-c). Robust clustered standard errors are in parentheses. \*, \*\* and \*\*\*

indicate significance at the 10%, 5%, and 1% levels, respectively.

The IMF programs are found to be countercyclical in ugly times with low revenue regimes (the coefficients of *Δ*+RENT ´ IMF in columns 1 and 2 are negative and significant) and procyclical during bad times (the coefficients of *Δ* RENT ´ IMF are positive and significant). This result suggests that, during low revenue regimes, the IMF programs mostly

target tightening governments’ budget constraints, which leads to a

contraction in spending regardless of the improvement or degradation in

oil and gas fiscal revenues.

6. Extensions and robustness

We present here extensions and robustness checks in order to: (i)

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Table 3

Controlling for structural and economic conditions.

(1) (2) (3)

ΔEXP Tot Inv Cur

Δ+RENTH 1.582\*\*\* 0.008 1.764\*\*\*

(0.35) (0.07) (0.41)

Δ+RENTL 1.730\*\*\* 0.381\* 2.434\*\*\*

(0.36) (0.19) (0.5)

Δ RENTL 0.025 0.339\*\*\* 0.034

(0.30) (0.10) (0.27)

Δ+RENTH ´ FO 0.254 0.111\*\*\* 0.082

(0.16) (0.03) (0.17)

Δ+RENTL ´ FO 0.622\*\* 0.069 0.689\*\*\*

(0.24) (0.07) (0.19)

Δ RENTL ´ FO 0.699\* 0.069\* 0.717\*

(0.39) (0.04) (0.38)

Δ RENTH ´ IQ 1.951\*\* 0.583 1.611\*\*

(0.90) (0.53) (0.78)

Δ+RENTL ´ IQ 2.037\*\*\* 0.108 1.81\*\*\*

(0.65) (0.15) (0.56)

Δ+RENTH ´ FRL 1.080\*\*\* 0.023 1.007\*\*\*

(0.13) (0.05) (0.16)

Δ+RENTL ´ FRL 1.692\*\*\* 0.131 2.005\*\*\*

(0.32) (0.15) (0.59)

Δ RENTL ´ FRL 0.773\*\* 0.186\* 0.872\*\*

(0.33) (0.10) (0.33)

Δ+RENTH ´ ERF 0.414\*\* 0.000 0.516\*\*

(0.18) (0.02) (0.21)

Δ RENTH ´ ERF 0.890\*\* 0.340 0.675\*\*

(0.35) (0.25) (0.30)

Δ+RENTL ´ ERF 0.222\*\* 0.026 0.279\*\*\*

(0.10) (0.03) (0.07)

Δ RENTL ´ ERF 0.295\*\*\* 0.006 0.305\*\*\*

(0.10) (0.03) (0.08)

Δ+RENTH ´ IMF 0.615\* 0.099 0.187

(0.34) (0.11) (0.37)

Δ RENTH ´ IMF 0.743 1.667\*\* 1.123

(1.28) (0.77) (0.95)

Δ+RENTL ´ IMF 4.228\* 1.631\* 2.178

(2.20) (0.89) (1.5)

Δ RENTL ´ IMF 4.135\*\*\* 0.487\*\* 3.774\*\*\*

(1.28) (0.19) (1.09) Observations 485 477 477

Number of countries 27 27 27

R2 0.69 0.39 0.68

Notes: Robust clustered standard errors are in parentheses. \*, \*\* and \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively. The table shows results only for the coefficients that are significant. The full table, with all the coeffi-

cient estimates, is available on request.

examine the impacts of macroeconomic and financial indicators on cyclicality, (ii) investigate cyclicality in military expenditure, (iii) con-trol for the demographic structure of countries, and (iv) verify that the results are robust to potential endogeneity issues, as well as the possible existence of omitted variables and outliers.

We begin with studying the impacts of real interest rates (RIR), nominal interest rates (NIR), and external debt (EXD) on the cyclicality of government expenditure. These indicators provide insights into the macroeconomic conditions at a broader level. They are commonly used to assess the monetary policy stance and evaluate the sustainability of external borrowing (see Majumder et al. (2021, 2022)). The results with no asymmetry are presented in Table 4. We see that when asymmetric relationships are disregarded, nominal interest rates slightly increase procyclicality for total and investment expenditure (though this is only significant at a 10% level), while the external debt and real interest rates have no impact.

When accounting for asymmetries (as shown in Table 5) we find that nominal interest rate and external debt intensify procyclicality of total and current expenditure during bad times. These results corroborate the validation of the financial constraint hypothesis found in Tables 1 and 3. The results on the influence of real interest rates are mixed. In ugly times,

we find that real interest rates increase procyclicality (the coefficients of

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Δ RENT ´ RIR and Δ+RENT ´ RIR are positive in columns 7 and 9).

However, we find that higher real interest rates reduce procyclicality

during bad times and good times (the coefficients of Δ+RENT ´ RIR and Δ RENT ´ RIR are negative in columns 7 and 9). On the one hand, during bad times higher real interest rate may be a sign of monetary policy discipline (for instance that limits inflation) which instills confi-dence in lenders, mitigates financial constraints faced by the govern-ment, and enables limiting expenditure contraction despite oil and gas revenue decrease. On the other hand, in good times, revenues are suffi-cient to fund the most pressing expenditures, and governments have leeway to use additional revenue to reduce debt in response to an in-crease in the real cost of borrowing.

When examining the influence of oil and gas revenues on govern-ment expenditure, it is noteworthy to explore military spending as a significant aspect, mainly due to the tendency of oil and gas-exporting countries to allocate substantial portions of their budget to military and security domains (Farzanegan, 2011, 2014). Similar to the analysis of total, investment, and current expenditure, our initial step involves calculating the cyclical component of military spending using the Hamilton filter. We then employ the year-on-year change (ΔMLT) of this component as our dependent variable in fixed effects regressions. The results of fixed effect estimates are presented in Table 6.

Overall, we observe a positive relationship between military spending and oil and gas fiscal revenue. Moreover, the results in Table 6 are quite similar to what we found in Table 1 (columns 1–3). Specif-ically, as found earlier, position asymmetry is more significant than variation asymmetry (see the Wald test results in column 2 of Table 6, which confirm the symmetry hypothesis when only negative and posi-tive variations are taken into account). Lastly, as previously illustrated, during ugly times with high revenue regime, governments tend to maintain military spending even in the face of setbacks in oil and gas revenues. The explanations we provided earlier to justify this optimistic behavior of governments can be applied to military spending as well.

Another extension of our model would be to investigate the potential impact of demographic factors and urbanization on the cyclicality of government expenditure. Previous research on this subject has been somewhat limited (see Fehr et al., 2008; Kudrna et al., 2015). In our analysis presented in Online Appendix C, we examine the association between fertility rates (FER), the proportion of the working-age popu-lation in the total population (WOP), and the share of urban population in total population (URB) with cyclicality. Our findings indicate that higher fertility rates and a younger population contribute to reducing procyclicality in low revenue regimes. Due to increased demands for essential public services, during bad times governments may face chal-lenges in cutting spending in vital areas like education and healthcare to meet the needs of a growing number of young individuals. Moreover, as spending cuts were limited during bad times, there is less catch-up of expenditure when revenue increases. We also find that higher urbani-zation reduces the procyclicality of investment expenditure. In countries with high urbanization levels, governments prioritize infrastructure development to support economic activities that generate non oil and gas fiscal revenues, thereby reducing procyclicality during bad times.

Let us now consider some econometric issues that may arise in esti-mating fiscal policy cyclicality. The first one is the omitted variable bias that can result from the potential correlation between unobserved and government expenditure variables. We employ a sensitivity test devel-oped by Cinelli and Hazlett (2020) and Cinelli et al. (2020), which helps determine the minimum level of association required for an unobserved confounding variable to alter the results regarding the impact of oil and gas revenues on government expenditure. For the sake of brevity, the

sensitivity results of the models without asymmetry are displayed in

13 Table B.1 in Online Appendix B displays the impact of structural and eco-

nomic conditions on the cyclicality of military spending. Exploring those re-

lationships in more detail would take us beyond the scope of this paper.

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Table 4

Influence of interest rates and external debt on cyclicality: fixed effects results with no asymmetry.

ΔEXP ΔRENT

ΔRENT´ NIR

ΔRENT´ EXD

ΔRENT´ RIR

Constant

Observations

N of countries

R2

(1)

Tot 1.186\*\*\* (0.263) 0.127\* (0.065)

3.460\*\* (1.330) 326

18 0.468

(2)

Inv 0.160\*\*\* (0.033) 0.013\* (0.007)

0.179 (0.129) 310

18 0.265

(3)

Cur 1.107\*\*\* (0.249) 0.112 (0.064)

2.752\*\* (1.050) 310

18 0.443

(4)

Tot

0.243 (0.483)

0.021 (0.013)

1.016\*\*\* (0.352) 363

20 0.423

(5)

Inv 0.014 (0.086)

0.0005 (0.001)

0.005 (0.067) 342

20 0.302

(6)

Cur

0.196 (0.499)

0.020 (0.014)

0.727\*\* (0.326) 342

20 0.424

(7)

Tot 0.612\*\* (0.283)

0.0001 (0.010)

0.464 (0.526) 326

18 0.389

(8)

Inv 0.168\*\*\* (0.052)

0.0006 (0.002) 0.017 (0.173) 310

18 0.238

(9)

Cur 0.550\* (0.292)

0.005 (0.012)

0.854 (0.563) 310

18 0.387

Notes: Robust clustered standard errors are in parentheses. Coefficients of control variables are not reported for brevity. \*, \*\* and \*\*\* indicate significance at the 10%,

5%, and 1% levels, respectively.

Table 5

Influence of interest rates and external debt on cyclicality: fixed effects results with asymmetry.

ΔEXP Δ+RENTH

Δ RENTH

Δ+RENTL

Δ RENTL

Δ RENTL ´ NIR

Δ RENTL ´ EXD

Δ+RENTH ´ RIR

Δ RENTH ´ RIR

Δ+RENTL ´ RIR

Δ RENTL ´ RIR

Observations

Number of countries

R2

(1)

Tot

0.184 (0.509)

0.463\*\*\* (0.154) 1.593\*\*\* (0.360) 1.727\*\*\* (0.370) 0.207\*\*\* (0.0668)

326 18 0.609

(2)

Inv 0.0278 (0.0673)

0.170 (0.102) 0.156 (0.132) 0.261\*\*\* (0.0536) 0.0162\* (0.008)

310 18 0.335

(3)

Cur

0.272 (0.538)

0.275\* (0.156) 1.301\*\*\* (0.232) 1.836\*\*\* (0.459) 0.199\*\* (0.0760)

310 18 0.585

(4)

Tot 1.190\*\* (0.535)

0.481 (0.744) 1.885 (1.931)

1.277 (0.825)

0.0275\* (0.0151)

326 18 0.609

(5)

Inv 0.162 (0.142)

0.0667 (0.144)

0.102 (0.166)

0.0003 (0.118)

0.0026 (0.0016)

310 18 0.335

(6)

Cur 0.855\*\* (0.326)

0.267 (0.639) 1.829 (1.752)

1.343 (0.956)

0.034\*\* (0.015)

310 18 0.585

(7)

Tot 0.801 (0.503)

0.220 (0.413) 2.872\*\*\* (0.812) 0.461 (0.378)

0.117\*\* (0.0516) 0.0565\*\* (0.0266) 0.195\*\* (0.0852)

0.0244\* (0.0131) 326

18 0.566

(8)

Inv 0.0858 (0.121)

0.0155 (0.0894) 0.111 (0.0834) 0.30\*\*\* (0.0445)

0.016\*\*\* (0.003) 0.009 (0.007)

0.009 (0.021)

0.0019 (0.004) 310

18 0.347

(9)

Cur 0.795\* (0.382)

0.144 (0.320) 2.778\*\*\* (0.817) 0.391 (0.333)

0.106\*\* (0.0496) 0.0451\*\* (0.0193) 0.224\*\* (0.0795)

0.0252\*\* (0.0117) 310

18 0.591

Notes: Robust clustered standard errors are in parentheses. \*, \*\* and \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively. For brevity, the table shows

results only for the coefficients that are significant in at least one specification.

Table 7, while the results for the models incorporating asymmetry are shown in Table C.1 in Appendix C.

Table 7 indicates that the treatment variables display robustness values (RV) of 43.15%, 49.48% and 49.97% for investment, current, and total expenditures, respectively. These values imply that, for example, in the case of the total expenditure equation, if an unobserved confounding factor accounts for at least 49.97% of the residual variance in both the treatment and dependent variables, the estimated treatment effect of ΔRENT would be zero. However, an unobserved confounding factor may not be strong enough to bring down the estimated effect to zero. Still, it can shift it within a range where the effectis no longer considered sta-tistically significant. As shown in column RV , confounding factors would need to account for at least 45.84% of the residual variance to

render the estimated effect of ΔRENT statistically insignificant at the 5%

level of significance in the total expenditure equation. Finally, RY∼D|X

values in Table 7 serve as a sensitivity analysis for an extreme scenario. If confounders were responsible for 100% of the residual variance of the outcome in the total expenditure equation, they would need to be quite

strong and account for at least 33.3% of the residual variance of the

treatment to nullify the estimated effect completely.

We also provide an illustration of the sensitivity analysis under extreme scenarios (see Fig. 2). The solid curves represent the cases where unobserved confounder(s) explains 100% of the residual vari-ance, while the dashed curves correspond to 75% and the dash-dotted curves to 50% of the residual variance attributed to unobserved confounder(s). Considering the total expenditure equation once again, according to the most extreme scenario (solid curve) in Panel (a) of Fig. 2, which can be deemed excessively conservative, unaccounted confounding variables would need to explain 33.3% of the residual

variance of the treatment, ΔRENT, to eliminate its impact completely. As the partial R2 of the confounder increases, we observe a decline in the treatment effect (for R2 = 0, the effect takes the estimated value of

0.892, as depicted in Table 7). This decline continues until the partial R2 value reaches 33.3%, at which point the treatment effect becomes zero. Similar interpretations can be made for scenarios where unobserved confounders explain 75% or 50% of the residual variance, as well as for the results pertaining to the investment and current expenditures

equations.

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Table 6

Cyclicality of military spending.

(1) (2) (3) (4)

ΔRENT 0.120\*\*\* (0.320)

Δ+RENT 0.114\*\*\* (0.023)

Δ RENT 0.124\*\*\* (0.043)

ΔRENTH 0.090\*\*\*

(0.029)

ΔRENTL 0.143\*\*\*

(0.035)

Δ+RENTH 0.113\*\*\*

(0.018)

Δ RENTH 0.021

(0.036)

Δ+RENTL 0.162\*\*\*

(0.032)

Δ RENTL 0.131\*\*\*

(0.016) Constant 0.078\*\*\* 0.136 0.198\*\*\* 0.017

(0.010) (0.115) (0.033) (0.175) Observations 472 476 476 476

Number of countries 29 29 29 29

R2 0.302 0.294 0.305 0.312 Wald test 0.12 13.04\*\*\* 3.99\*\*\*

Notes: Robust clustered standard errors are in parentheses. \*\*\* indicates sig-

nificance at the 1% level. The symmetry hypothesis is tested by the Wald test.

The second econometric concern pertains to the existence of outliers, which can influence the estimation of regression parameters in a linear model. To address this concern, we compare S and MM estimators as in Dehon et al. (2012) using the tools developed by Jann and Verardi (2021). More specifically, we follow a two-stage approach to choose between the S and MM estimators, considering the trade-off between robustness and efficiency in the presence of outliers. This two-stage approach builds upon Hausman’s (1978) specification test and extends it to outlier detection. Dehon et al. (2012) adopted this methodology to compare two estimators: an S estimator, which is robust against outlier contamination but somewhat inefficient, and an MM estimator, which is more efficient but potentially more sensitive to the influence of outliers. In the first step, they propose testing whether regression coefficients estimated by the least squares (LS) method (which is a special case of the MM estimator) have been significantly affected by the presence of out-liers. If the impact of outliers is not substantial, then the least squares method remains the preferred estimation technique. However, if the presence of outliers has significantly influenced the least squares esti-mator, the authors suggest moving on to the second step. In this stage, they propose testing the null hypothesis that the MM estimator is not statistically different from the S estimator for a given efficiency level. If this null hypothesis holds, it indicates that the MM estimator should be preferred due to its higher efficiency despite the potential influence of

outliers. This testing process is then repeated while gradually raising the

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efficiency level of the MM estimator. The estimator chosen in the end is the one that exhibits the highest efficiency while not rejecting the null hypothesis. We present the results for S and MM estimators in Tables 8 and 9.

In the total and investment expenditures equations, the MM esti-mator proves to be the preferred choice, given its high efficiency (as shown in Table 9). However, its efficiency diminishes when applied to the current expenditure equation. Additionally, the estimated co-efficients linked to procyclicality, while confirming procyclical fiscal policy in most cases, appear smaller compared to the findings in Table 1. Moreover, unlike in Table 2 (columns 4 and 6), the results in Tables 8 and 9 do not show that there is more procyclicality in low than in high revenue regimes.

Nevertheless, when considering asymmetries within the low and high revenue regimes, as shown in Table 10, the S and MM estimators confirm conclusions of Table 2 columns 7–9 on the specificity of fiscal adjustment in ugly times. Both estimators show that countries are more procyclical when revenues are low and increasing. Moreover, with the MM estimator, which is the most efficient, we find that in low revenue regimes, total expenditures do not respond to negative revenue shocks, in line with the results of Table 2.

We also employ Tukey’s (1958) jackknife procedure in our fixed effects estimations as an alternative approach to handle potential out-liers. The cluster jackknifing technique generates multiple sets of parameter estimates, where each set omits one country at a time. The results in Online Appendix D indicate that most of our previous findings of Tables 2 and 10 about ugly times hold. Particularly, we see that gov-ernment expenditures are more procyclical when revenues are low but improving, but that in low revenue regimes, total expenditures do not respond to negative revenue shocks.

Finally, we conclude this section by discussing potential endogeneity issues. We believe that there should be no reverse causality from gov-ernment expenditures to oil and gas revenues. The reason for this is that revenues from oil and gas exports are mostly determined by factors other than public spending, such as international prices, world oil demand, or existing production capacity. However, we still cannot rule out the possibility of endogeneity as there might be a correlation between government expenditure and oil and gas revenues arising from an endogenous determination of oil and gas revenues. If there are omitted variables that impact government expenditure and oil and gas revenues simultaneously, the latter and the country-specific error terms will be correlated, which would lead to biased coefficient estimates.

To address any potential endogeneity problem, we apply the two-step system generalized method of moments (GMM) estimator (Blun-dell and Bond, 1998). The results given in Table 11 are largely consistent with our fixed effects estimates. We find that when no control variables are included, government expenditure remains procyclical with a pass-through of additional oil revenue to total expenditure close to 100%. When interaction terms are considered, financial openness and exchange rate flexibility are associated with more procyclicality of total

and consumption expenditures, whereas fiscal rules make those

Table 7

Sensitivity to unobserved confounders.

Outcome

ΔEXP (Tot) ΔEXP (Inv) ΔEXP (Cur)

Treatment

ΔRENT

Estimate

0.892 0.157 0.821

Standard error

0.054 0.012 0.052

t-value

16.61 12.99 15.8

RY∼D|X (%) RV (%)

33.3 49.97 24.67 43.15 32.64 49.48

RV*α*=0*.*05 (%) df

45.84 553 38.18 515 45.14 515

Notes: The results are for models (1)–(3) for the fixed effects regressions in Table 1. Country-fixed effects are used in the sensitivity analysis. df = degree of freedom.

14 See Farzanegan and Gholipour (2023) for a recent application of robust-to-

outliers methods in an ordinary least squares regression.

15 Note that outcomes from the models with investments should be considered

with caution, as the estimates of the investment equation in column (2) fail to

reject the second order serial correlation (AR[2]) hypothesis.

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Fig. 2. Sensitivity analysis to extreme scenarios.

Notes: The results are for models (1)–(3) for the fixed effects regressions in Table 1. Country-fixed effects are used in the sensitivity analysis. Panels (a), (b) and (c) are for total, investment and current expenditures equations, respec-tively. The extreme scenarios assume that the residual variance of the depen-dent variable ΔEXP is solely attributed to unobserved omitted variable(s). The curves shown - solid, dashed, and dash-dotted - depict the changes in the point estimate as the strength of the relationship between the confounding variable(s) and the treatment (ΔRENT) varies, each explaining a varying proportion of the

residual variance.

expenditures less procyclical. However, interacting institutional quality and IMF programs with oil and gas revenues yield non-significant co-efficient estimates, implying that the impacts of these two variables on

procyclicality estimated with fixed effects are not robust.

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7. Conclusion and policy implications

This paper examines the cyclical nature of fiscal policy in emerging and developing energy-exporting countries. Assessing and managing fiscal policy cyclicality is key to mitigating the adverse effects of oil and gas revenue volatility, maintaining economic stability, fostering sus-tainable growth, and strenghtening fiscal resilience against external shocks. This conclusion section outlines our findings and policy impli-cations derived from our analysis.

First, our results confirm that fiscal policy is procyclical in oil- and gas-exporting countries. We also find evidence that financial openness increases procyclicality, therefore we validate the financial constraint hypothesis. Moreover, we find that exchange rate flexibility increases procyclicality. At the same time, our results show that fiscal rules foster countercyclicality. Our fixed effects estimates suggest that institutional quality improvements and IMF programs respectively reduce and in-crease procyclicality. But these two results are not confirmed in our GMM estimates, which warns us about possible endogeneity issues.

We then hypothesize that governments’ responses to revenue shocks may be asymmetric. More specifically, we argue that governments may have differentiated fiscal policy responses depending on both revenue variation (i.e. whether the revenue shock is negative or positive) and revenue position (i.e. whether the revenues are higher or lower than what is perceived as the baseline level when the shock occurs). When considering position only, we detect asymmetries in our fixed effect model, but the result is not corroborated in all the specifications that deal with outliers. When considering variations only, all our estimates corroborate the absence of asymmetry in the fiscal response to positive or negative revenue shocks.

However, we further hypothesize that the fiscal response depends on whether positive or negative shocks happen in high or low revenue re-gimes. We identify different configurations of oil and gas fiscal revenue defined in terms of both variation and position. There are 3 different configurations. Good times are when the revenues are high and improving, and bad times are when they are low and deteriorating. We call ugly times the two situations in between (high but deteriorating and low but improving revenue). When comparing fiscal responses in these configurations, we find robust evidence of asymmetries. Moreover, it is between the two configurations of ugly times that the asymmetry is the greatest. On the one hand, in high revenue regimes, governments do not reduce their expenditure, even if they identify an oil and gas revenue setback. On the other hand, in low revenue regimes, they tend to in-crease spending very substantially in response to an improvement in revenue. These two results suggest that governments are optimistic in times of reversal of the revenue cycle. They are prone to consider that downturns are temporary and that upturns are permanent. This behavior may also reflect the high social pressure for spending increase in low revenue regimes to catch up with more expenditures after periods of budget austerity. Another possible interpretation is that inertia in spending during the high revenue regimes impedes expenditure reduc-tion in times of revenue downturn.

Results further suggest that, during good times, financial openness tends to further increase investment, but not current expenditure. However, it also contributes to limiting the investment drop during bad times. We also find that when the revenue outlook is mixed (i.e., in ugly times), institutional quality is associated with less optimistic fiscal pol-icy, with governments moderating their spending. The exchange rate flexibility was generally found to generate more fiscal procyclicality, except during good times. Last, the results showed that it is during good times that fiscal rules reduce procyclicality.

Several policy implications can be drawn from these findings. First, the priority for governments should be to avoid procyclicality in the

worst scenario (i.e., bad times). In such turbulent times, financial

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Table 8

Results of S estimator.

ΔEXP Δ+RENT

Δ RENT

ΔRENTH

ΔRENTL

Observations Number of countries

Hausman test of S against LS

(1)

Tot 0.313\*\*\* (0.035) 0.243\*\*\* (0.059)

584 30 6.79

[0.034]

(2)

Inv

0.005 (0.012) 0.054\*\*\* (0.014)

546 30 24.11

[0.000]

(3)

Cur 0.115\*\*\* (0.025) 0.274\*\*\* (0.021)

546 30 4.93

[0.085]

(4) Tot

0.303\*\*\* (0.028) 0.261\*\*\* (0.091) 584

30 12.26 [0.002]

(5) Inv

0.010 (0.011) 0.054\*\*\* (0.014) 546

30 22.29 [0.000]

(6) Cur

0.164\*\* (0.069) 0.263\*\*\* (0.030) 546

30 4.86

[0.088]

Notes: The Hausman test results are given by the *χ*2 statistics, along with their corresponding p-values in brackets. The efficiency level for the S regressions is 28.7%.

Robust clustered standard errors are in parentheses. \*\* and \*\*\* indicate significance at the 5%, and 1% levels, respectively.

Table 9

Results of MM estimator.

ΔEXP Δ+RENT

Δ RENT

ΔRENTH

ΔRENTL

Observations Number of countries Efficiency

Hausman test of MM against S

(1)

Tot 0.404\*\*\* (0.126) 0.328\*\*\* (0.109)

584 30 99% 1.18

[0.555]

(2)

Inv

0.006 (0.023) 0.075 (0.057)

546 30 99% 0.16

[0.942]

(3)

Cur 0.137\* (0.073) 0.258\*\*\* (0.044)

546 30 60% 0.24 [0.89]

(4) Tot

0.303\*\*\* (0.072) 0.470\* (0.264) 584

30 99% 1.12 [0.571]

(5) Inv

0.008 (0.018) 0.088 (0.198) 546

30 99% 0.03 [0.985]

(6) Cur

0.168\*\* (0.073) 0.127 (0.101) 546

30 40% 3.52 [0.172]

Notes: The Hausman test results are given by the *χ*2 statistics, along with their corresponding p-values in brackets. Efficiency levels are reported for the MM regression.

Robust clustered standard errors are in parentheses. \*, \*\* and \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 10

Results of S and MM estimators of the effect of combined asymmetries.

ΔEXP Δ+RENTH

Δ RENTH

Δ+RENTL

Δ RENTL

Observations Number of countries Efficiency

Hausman test of S against LS

Wald test (all)

Wald test (good vs. bad times) Wald test (ugly times)

Wald test (ugly vs. bad times)

(1)

S Tot

0.328\*\*\* (0.026) 0.258\*\*\* (0.028) 0.962\*\*\* (0.052) 0.208\*\*\* (0.027) 584

30 28.7% 8.69 [0.070] 63.9\*\*\* 62.03\*\*\* 187\*\*\* 152\*\*\*

(2)

S Inv

0.003 (0.009) 0.044\*\*\* (0.013) 0.041\*\*\* (0.013) 0.055\*\*\* (0.015) 546

30 28.7% 23.99 [0.000] 6.07\*\*\* 11.22\*\*\* 13.16\*\*\* 17.55\*\*\*

(3)

S Cur

0.121\*\*\* (0.017) 0.280\*\*\* (0.028) 0.285\*\*\* (0.048) 0.097\*\* (0.041) 546

30 28.7% 11.12 [0.025] 49.21\*\*\* 0.52 0.01 11.21\*\*\*

(4)

MM Tot

0.328\*\*\* (0.029) 0.247 (0.160) 0.975\*\*\* (0.096) 0.323\*\* (0.135) 584

30 70% 2.11 [0.715]

28.03\*\*\* 0.00 30.25\*\*\* 10.19\*\*\*

(5)

MM Inv

0.009 (0.024) 0.044 (0.030) 0.045 (0.098) 0.096 (0.094) 546

30 99% 0.72 [0.949] 1.09 1.16 0.00 0.77

(6)

MM Cur

0.126\*\*\* (0.025) 0.287\*\*\* (0.025) 0.325\*\*\* (0.074) 0.231\*\*\* (0.043) 546

30 40% 1.43 [0.838]

35.98\*\*\* 5.49\*\* 0.17 0.96

Notes: The Hausman test results are given by the *χ*2 statistics, along with their corresponding p-values in brackets. Robust clustered standard errors are in parentheses.

\*\* and \*\*\* indicate significance at the 5%, and 1% levels, respectively. For details of the Wald tests see captions in Table 2.

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Table 11

Cyclicality of government expenditure: GMM results.

ΔEXPt 1

ΔRENT

ΔRENT´ FO

ΔRENT´ IQ

ΔRENT´ FRL

ΔRENT´ ERF

ΔRENT´ IMF

Constant

Observations Number of countries Hansen

AR (2)

(1)

Tot

0.322\*\*\* (0.101) 0.999\*\* (0.400)

0.66 (0.46) 554 30 0.239 0.227

(2)

Inv

0.257\*\*\* (0.036) 0.175\*\*\* (0.041)

0.035 (0.02) 516 30 0.125 0.026

(3)

Cur

0.392\*\*\* (0.068) 0.981\*\*\* (0.330)

0.407 (0.24) 516 30 0.351 0.199

(4)

Tot

0.413\*\*\* (0.043)

0.058 (1.748) 1.310\* (0.733)

0.619 (1.734)

2.938\*\*\* (0.607) 0.836\*\*\* (0.179) 9.278 (7.8) 9.419 (16.17) 460

27 0.162 0.131

(5)

Inv

0.023 (0.121) 0.235 (0.276)

0.045 (0.133) 0.096 (0.479)

0.146 (0.225) 0.046 (0.074) 1.161 (1.444) 1.846 (4.14) 452

27 0.360 0.129

(6)

Cur

0.575\*\*\* (0.049)

0.431 (1.721) 0.979\*\* (0.475)

0.447 (1.912)

1.984\*\*\* (0.612) 0.742\*\*\* (0.187) 5.748 (4.319) 10.53 (9.37)

452 27 0.279 0.109

Notes: Heteroscedasticity-consistent clustered standard errors are in parentheses. Windmeijer’s (2005) finite sample correction for standard errors is used. Year dummies are included as instruments in the regressions. Coefficients on control variables are not reported for brevity. p-values are reported for the Hansen over-identification test and the Arellano-Bond test for second-order serial correlation in the errors. \*, \*\* and \*\*\* indicate significance at the 10%, 5%, and 1% levels,

respectively.

openness fosters expenditure contractions and IMF programs are not found to support spending. Therefore, countries need to build their own fiscal space to support their economy in bad times. Limiting procycli-cality in good times would be the optimal solution. Our results show that fiscal rules can support such policies.

Expenditure may be adjusted quickly in ugly times when revenue is high but a downturn is on the horizon. Although this type of response would increase procyclicality, it would help build up the government’s reserves. Given that the contraction would happen during a period of relatively high expenditure, the effect on households would be limited. A way to introduce such a mechanism would be to make the baseline oil and gas revenue projections more downward flexible during high rev-enue regimes.

In addition, in ugly times when revenue is low but improving, pro-cyclicality needs to be reduced. In order to avoid premature hikes in expenditure at the first sign of an improvement in the oil and gas rev-enue outlook, the upward adjustment of baseline scenarios should be limited.

Last but not least, higher oil and gas revenues followed by an

increase in energy prices can bring about an expansion in domestic credit creation and trigger large capital inflows. As the IMF (2022b) notes, rapid growth in capital inflows can be particularly challenging if not invested in the right direction, as demonstrated by the Latin American debt crises during the 1980s. Given the findings of this study, during good times, policymakers need to prioritize investments that drive

economic diversification and long-term economic growth.

Credit author statement

The two authors have contributed to all the aspects of the elaboration

of this paper.

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as reflecting the views of KAPSARC.

Appendix A

Table A.1

Descriptions of the variables.

Variable EXPTot

EXPInv

EXPCur

MLT

Rent

Type Regressand

Regressand

Regressand

Regressand

Regressor

Description

Total expenditure:

General government total expenditure consists of total expense and the net acquisition of nonfinancial assets.

Variation in its cyclical component is used (ΔEXPTot)

Investment expenditure:

General government investment (gross fixed capital formation).

Variation in its cyclical component is used (ΔEXPInv)

Current expenditure:

General government final consumption expenditure (including compensation of employees).

Variation in its cyclical component is used (ΔEXPCur)

All current and capital expenditures on the armed forces, including peacekeeping forces; defense ministries and other government agencies engaged in defense projects. Variation in its cyclical component is used (ΔMLT)

Oil and gas rents:

Oil and gas fiscal revenues received by the central government. Variation in its cyclical component is used (ΔRENT)

Source IMF-WEO

IMF-WEO

IMF-WEO

WB

IMF, IEA and national sources

(continued on next page)

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Table A.1 (continued)

Variable FO

IQ

FRL

ERF

IMF

RIR

NIR

EXD

FER

WOP

URB

Type Regressor

Regressor

Regressor

Regressor

Regressor

Regressor

Regressor

Regressor

Regressor

Regressor

Regressor

Description

Financial openness:

The Chinn-Ito index measuring a country’s degree of capital account openness Institutional quality:

Average value of six governance indicators, namely (i) control of corruption, (ii) government effectiveness, (iii) political stability and absence of violence/terrorism, (iv) regulatory quality, (v) rule of law, and (vi) voice and accountability Fiscal rules:

A dummy that equals 1 if at least one of the following four types of rules are in place: budget balance rules, debt rules, expenditure rules, and revenue rules (RR), applying to the central or general government or the public sector Exchange rate flexibility:

Exchange regimes of countries are categorized on a scale of 1 to 6, representing the spectrum from the most rigid (hard peg) to the most flexible regimes, respectively.

IMF programs:

A dummy that equals 1 if a country has been under any IMF arrangement (stand-by arrangements, an extended funds facility, a structural adjustment facility or poverty reduction and growth facility) for a minimum of five months within a specific year Real interest rate:

Lending interest rate adjusted for inflation as measured by the GDP deflator Nominal interest rate:

Lending interest rate with no adjustment for inflation External debt:

Total external debt stocks to gross national income owed to non-residents repayable in currency, goods, or services Fertility rate:

Total births per woman

Share of working age population:

Total population between the ages 15 to 64 as a percentage of the total population Share of urban population:

Share of people living in urban areas as a percentage of total population

Source

Chinn and Ito (2006)

WB

Davoodi et al. (2022)

Ilzetzki et al. (2021)

Dreher (2006)

WB

WB

WB

WB

WB

WB

Table A.2

Descriptive statistics.

Variable Mean Std. dev. Min Max

EXPTot 44.80 95.71 0.226 793 EXPInv 10.06 17.43 0.010 119.3 EXPCur 34.12 79.79 0.057 699.1 Rent 19.15 32.60 0.00 207.7 FO 0.32 1.59 1.92 2.32 IQ 0.57 0.66 1.89 0.74 FRL 0.88 0.32 0.00 1.00 ERF 1.79 1.23 1.00 6.00 IMF 0.18 0.38 0.00 1.00 MLT 6.33 14.3 0.00 88.4 RIR 4.84 12.4 0.21 108.2 NIR 12.7 11.7 60.8 60.9 EXD 40.9 36.8 1.15 244.8 FER 3.35 1.51 1.95 7.25 WOP 63.95 8.89 48.19 86.08 URB 63.52 19.77 21.64

Notes: EXPTot: total expenditure; EXPInv: investment expenditure; EXPCur: current expenditure; Std. dev.:

standard deviation.

Appendix B

Fig. B.1 shows that throughout the period from 2006 to 2014, the Saudi government’s revenues were above their long-term trend with increasing (good times) or decreasing (ugly times) revenues. Government revenues then declined sharply due to oil prices dropping by 72% from $112 per barrel in June 2014 to $32 per barrel in January 2016 (nominal Brent crude oil prices obtained from the IMF (2022a) Primary Commodity Prices Database). The

following years are mostly characterized by bad times.

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Fig. B.1. Asymmetries of variation and position: illustration using Saudi Arabia.

Notes: Oil and gas revenues are in millions of US$. In Panel (A), the trend (predicted values of oil and gas revenues) is depicted in red. The blue line depicts the sum of the trend and cyclical component (i.e., the residuals from the Hamilton filter) of the oil and gas revenues. If the blue line is above (below) the red line, the cyclical component is positive (negative), indicating a good (bad) time. This relation is further illustrated in Panel (B) where the difference between the predicted values of revenues and the trend is shown in a straight line (position), whereas variation in the cyclical component

of revenues is given by a dashed line (variation).

Appendix C

Table C.1

Sensitivity to unobserved confounders: models with asymmetry.

Outcome Treatment Estimate Standard error t-value RY∼D|X (%) RV (%) RV*α*=0*.*05 (%) df

ΔEXP (Tot) Δ+RENT 0.913 0.107 8.56 11.7 30.39 24.40 552 ΔEXP (Inv) 0.153 0.023 6.60 7.81 25.18 18.45 514 ΔEXP (Cur) 0.732 0.100 7.34 9.50 27.57 21.07 514 ΔEXP (Tot) Δ RENT 0.873 0.097 8.99 12.78 31.65 25.77 552 ΔEXP (Inv) 0.160 0.023 7.13 8.99 26.88 20.31 514 ΔEXP (Cur) 0.906 0.097 9.36 14.56 33.64 27.73 514

ΔEXP (Tot) ΔRENTH 0.396 0.083 4.79 3.99 18.42 11.32 552

ΔEXP (Inv) 0.128 0.019 6.89 8.46 26.13 19.50 514 ΔEXP (Cur) 0.323 0.075 4.30 3.47 17.26 9.78 514

ΔEXP (Tot) ΔRENTL 1.264 0.071 17.9 36.64 52.44 48.55 552

ΔEXP (Inv) 0.181 0.017 10.6 17.96 37.10 31.54 514 ΔEXP (Cur) 1.245 0.069 18.1 38.87 54.05 50.17 514

ΔEXP (Tot) Δ+RENTH 0.731 0.106 6.91 7.99 25.45 18.99 550

ΔEXP (Inv) 0.168 0.025 6.85 8.40 26.04 19.38 512 ΔEXP (Cur) 0.557 0.098 5.69 5.95 22.19 15.16 512

ΔEXP (Tot) Δ+RENTL 2.119 0.174 12.2 21.21 40.14 35.06 550

ΔEXP (Inv) 0.160 0.040 4.00 3.03 16.17 8.58 512 ΔEXP (Cur) 1.871 0.161 11.7 20.99 39.94 34.64 512

ΔEXP (Tot) Δ RENTL 0.917 0.091 10.1 15.68 34.82 29.23 550

ΔEXP (Inv) 0.176 0.022 7.79 10.60 29.01 22.63 512

ΔEXP (Cur) 0.968 0.091 10.7 18.28 37.42 31.87 512 Notes: The results are for models (1)–(9) for the fixed effects regressions in Table 3. Country-fixed effects are used in the sensitivity analysis. df = degree of freedom.

Appendix D. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.eneco.2023.106987>.

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