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Fiscal Adjustments and the Asymmetric Effect of Oil Shocks

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Abstract*

This research employs a quadratic exponential model to examine the dynamics of fiscal adjustments in the context of oil shocks. The findings suggest significant state dependence, with past fiscal adjustments increasing the likelihood of future adjustments and an asymmetry in oil shock effects. Supply shocks reduce the probability of fiscal adjustments, while demand shocks increase it. Furthermore, the impact of these shocks depends on several factors. Oil demand shocks positively impact fiscal adjustment even during downturns, providing a stabilizing effect. Net oil exporters are more affected by oil shocks than importers, experiencing more significant negative effects from supply shocks and more benefits from demand shocks. Fiscal institutions play a critical role in mitigating the volatility induced by oil shocks, with fiscal rules targeting primary or structural balances proving particularly effective.

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1 Introduction

Oil shocks affect fiscal variables and can significantly impact countries' fiscal stability. These shocks affect various macroeconomic indicators and can cause fluctuations in GDP, government spending, and government revenues (Kilian, 2009; Känzig, 2021; Spatafora and Samake, 2012). However, the overall impact on a country's fiscal balance and fiscal adjustment are unclear.

The nature of oil shocks, whether driven by supply or demand factors, can affect government finances differently. If the increase in oil prices is due to aggregate demand factors, one would expect oil-exporting countries to benefit, as quantities are unchanged. Conversely, if the price increase is due to changes in supply, the overall effect on a country's finances is uncertain, given the overall change in oil quantities. This paper addresses how oil price fluctuations resulting from supply and demand shocks affect the fiscal adjustment process.

Fiscal adjustments are the result of changes in expenditure or revenue strategies. Austerity measures, which result from either reducing government spending or increasing government revenues, have been identified as having both contractionary (Guajardo et al., 2014; Jordà and Taylor, 2016) and expansionary (Giavazzi and Pagano, 1990; Alesina et al., 2002) effects. Reductions in government spending have been found to be less harmful than tax increases (Alesina, Favero, and Giavazzi, 2019). Moreover, adjustments resulting from cuts in public consumption rather than public investment have been associated with less damage to GDP (Ardanaz et al., 2021).

The literature has focused on the effect of oil shocks on aggregate fiscal variables. This paper takes a different stance. We examine the role of oil supply and demand shocks in their overall impact on fiscal adjustment. To the best of our knowledge, we are the first empirical paper to estimate the effect of oil supply and demand shocks on the probability of undergoing a fiscal adjustment. A country facing an oil shock may have less incentive to undertake a fiscal adjustment, as it may need to increase overall spending to overcome the negative shock. However, the nature of the shock, whether supply- or demand-driven, can lead to different outcomes in government revenue and spending behavior.

Using a novel exponential quadratic regression model, we identify the overall effect of oil supply and demand shocks on the associated probability of undergoing a fiscal adjustment. Our results indicate that in a country experiencing an oil supply the associated probability of undergoing a fiscal adjustment is reduced. A country experiencing an oil demand shock has an increased of such an adjustment. The results remain robust to different specifications and to correcting confidence intervals with bootstrapping approximations. Kharroubi and Smets (2023) develop a flexible price model with heterogeneous households and non-homothetic demand for energy to investigate the economic impact of energy supply shocks. They find that negative energy supply shocks act as a negative demand shock. This shock leads to a decrease in aggregate output which constrains government finances. Our empirical results find support of this theoretical channel as an oil supply shock reduces the probability of fiscal adjustments since this policy requires extra fiscal space which is reduced after an oil supply shock.

Conditioned on the state of the economy, the overall effect of supply and demand shocks is exacerbated. Demand shocks help mitigate the negative effects of business cycles, while supply shocks deepen them. Commodity exporters are more exposed to the effects of oil supply and demand shocks. Finally, the existence of a fiscal rule mitigates the effects of these shocks, especially fiscal rules that set targets for primary or structural balances.

Our results highlight the importance of oil shock asymmetry on government finances. The literature has identified oil supply shocks as having more adverse effects on output and inflation and the extent of the sensitivity depends on features of the economy such as real wage flexibility, effectiveness of monetary policy, and share of oil in consumption and production (Blanchard and Gali, 2010; Blanchard and Riggi, 2013). Our findings suggest that the effects of oil supply shocks are larger in economies that lack fiscal discipline as well as in economies whose exports rely on commodities. These findings should support policy makers when analyzing when to undergo a fiscal consolidation. Key structural aspects of a country's economy can exacerbate or mitigate the effects of oil shocks on government finances. Moreover, the nature of the oil shock plays a key role on government finances and the probability of undergoing a fiscal consolidation.

This paper is related to the literature that studies the impact of oil shocks or, more broadly, commodity shocks on fiscal variables. Since fiscal adjustments depend on the evolution of both revenues and expenditures, this paper builds on the findings of this literature. Spatafora and Samake (2012) examine the effects of commodity price shocks on fiscal outcomes. Using data from developing countries, they find that commodity prices increase both revenues and expenditures and that the response of the primary balance is ambiguous. They also find that public debt responds ambiguously to commodity price increases. Using a Proxy-SVAR estimation, Banerjee (2024) studies the impact of inflationary oil supply and demand shocks on the dynamics of the fiscal balance and public debt in oil-importing countries. The results indicate that fiscal balances increase in the medium-term following an inflationary oil shock and the effect is larger for an oil supply shock compared with an oil demand shock. Public debt-to-GDP ratios fall by similar magnitudes following an oil supply or demand shock. Similarly, our results also highlight the importance of the asymmetry of the nature of oil shocks in analyzing their impact on fiscal adjustments.

Medina (2016) analyzes the effects of commodity price shocks on fiscal revenues and expenditures in Latin America. He validates the findings from Spatafora and Samake (2012) in which both fiscal aggregates increase following a commodity price shock. The author points out that there are heterogeneous effects across countries and that the differences can be explained by the adoption of fiscal rules. Hernaiz, Miller, and Pedroni (2018) implement a heterogenous panel SVAR and find that countries with more flexible exchange rate regimes tend to accumulate fiscal space in response to commodity price shocks. Majumder, Raghavan, and Vespignani (2021) explore the impact of commodity price volatility on a country's fiscal balance. Using a dynamic panel data model, they find that a government's fiscal balance deteriorates with commodity price volatility, especially for commodity-exporting economies. Our research also underscores the relevance of fiscal rules, particularly those related to primary balance and structural balance, in mitigating the volatility generated by oil price shocks.

Roch (2019) estimates a heterogeneous panel SVAR to analyze macroeconomic adjustments to commodity price shocks. He finds evidence that exchange rate flexibility, inflation targeting regimes, and fiscal rules help insulate the economy from commodity price movements. Abubakar, Mahummad, and Mensah (2023) find that while oil price increases ultimately improve government fiscal positions through revenue growth, the short-term impact is negative. Durand-Lasserve and Karanfil (2023) show evidence about procyclical fiscal policy in oil-exporting countries, particularly during periods of low but rising revenues following fiscal tightening. Importantly, they find that low but increasing oil and gas revenues are associated with greater fiscal procyclicality while high but declining revenue the fiscal procyclicality disappears. These asymmetries have important consequences for policy makers. In the former social pressure to catch up with higher expenditure levels may prompt a spending hike as soon as government revenue begins to rise while in the latter policymakers may use the favorable initial fiscal space obtained in previous periods to absorb adverse revenue shocks. Our results suggest that depending on the state of the economy, whether is a boom or a bust, and the type of oil shock the effects on fiscal adjustments are exacerbated.

Other studies have explored the country-specific effects of oil price fluctuations (Farzanegan, 2011; Reyes-Loya and Blanco, 2008; Al Jabri, Raghavan, and Vespignani, 2022). Our research aligns with these findings by highlighting the critical role of prior adjustments in achieving successful contemporary fiscal adjustments. We contribute to the literature by demonstrating that policymakers are less effective in responding to supply shocks than demand shocks.

Another study that analyzes fiscal procyclicality in commodity rich nations is Cespedes and Velasco (2013). The results suggest that fiscal policy was procyclical but in recent episodes the procyclicality has declined. They attribute the reduced procyclicality to increases in institutional quality such as the increased use of fiscal rules. Apeti, Basdevant, and Salins (2023) investigate the performance of fiscal rules in resource rich countries. They find that fiscal rules reduce the procyclicality of real public expenditures with terms-of-trade in oil exporting countries and improve non-resource primary balances, especially during terms of trade upturns. Moreover, they show that fiscal rules support fiscal discipline which in turn explains the effectiveness of fiscal rules in future fiscal outcomes. Similarly, our results show that fiscal rules function as a stabilization mechanism against oils demand and supply shocks.

2 Defining Fiscal Adjustments

Despite the considerable attention devoted to the concept of fiscal adjustment in economic literature, a clear and universally accepted definition remains elusive. Various scholars have proposed definitions aimed at capturing different aspects of fiscal policy changes, reflecting the complexities and nuances inherent in assessing fiscal adjustments. Among these, Alesina and Ardagna (1998) seek to study sharp and large fiscal adjustments that clearly indicate a change in the fiscal stance. To this end, they define a fiscal adjustment as a year in which the cyclically adjusted primary balance (CAPB) improves by at least 2 percent of GDP or a period of two consecutive years in which the CAPB improves by at least 1.5 percent of GDP in both years.

Ardanaz et al. (2021) adopt a similar definition but reduce the thresholds of changes in cyclically adjusted primary balances (CAPBs) to 1.5 and 1.25 respectively, aiming to be less demanding and thereby increase the number of observations. However, both definitions overlook instances where governments implement gradual but sustained adjustments following initial, larger adjustments of two percentage points. They also disregard adjustments that start with modest magnitudes but progress consistently until achieving significant accumulated changes.

To encompass these overlooked fiscal adjustments, the proposed definition establishes that a fiscal adjustment occurs when the CAPB-to-GDP ratio shows improvement and, upon cessation of improvement, the accumulated change is at least two percentage points. Table A.1 provides an illustrative example of 16 years of CAPB-to-GDP ratio, annual changes (Δ CAPB), and accumulated changes. The proposed definition allows the inclusion of the same episodes identified by Alesina and Ardagna (1998) and Ardanaz et al. (2021), while also considering adjustments that start gradually but culminate in significant overall changes.

Identifying the periods in which governments made discretionary changes in taxes and government spending primarily motivated by a desire to reduce the budget deficit and not by a response to prospective economic conditions could help determine if oil shocks are a factor that significantly affects the probability of successfully implementing such changes. In fact, Pescatori et al. (2011) realized a huge effort to identify the motivation and budgetary impact of fiscal policy changes by examining policy documents for 17 OECD economies during 1978-2009; later, David and Leigh (2018) complemented this work by doing the same for 14 Latin American and Caribbean economies during 1989-2016. However, the data available from this action-based approach is not quite enough to do a robust and consistent econometric analysis as proposed in this research.

Nevertheless, the proposed definition of "fiscal adjustment" provides a reasonable approximation of the fiscal consolidation events identified using the action-based approach. To assess the effectiveness of each fiscal adjustment definition in capturing these episodes, we compute performance metrics using a confusion matrix for binary classification, as shown in Table 1. This table compares the fiscal adjustment episodes identified by the action-based approach with those inferred from the CAPB. The goal is to minimize both Type I and Type II errors, thereby accurately identifying periods of fiscal adjustment and non-adjustment using the proposed CAPB measure.

Table 1 Confusion Matrix

		CAPB approach	
		Fiscal adjustment	**No fiscal adjustment**
Action-based approach	**Fiscal adjustment**	**True positive (TP)**	**False negative (FN)**
	No fiscal adjustment	**False positive (FP)**	**True negative (TN)**

Note: The table shows the confusion matrix between the action-based and CAPB approaches.

Two of the most common performance measures are signal-to-noise ratio (SNR) (equation 1) and total misclassification error (TME) (equation 2). SNR maximizes the percentage of true positives versus the noise (i.e., the proportion of false positives). Ideally, SNR should be above 1 to send more positive signals than noise. On the other hand, TME seeks to minimize the total number of errors sent to the system (i.e., the closer the indicator is to 0, the better). There is a preference in the literature for TME over SNR, based on the size of the total errors produced and the preference for assigning a higher weight to avoid false-negative signals (see, for example, Valencia et al., 2022; Hernández de Cos et al., 2014; Berti et al., 2012; or Baldacci et al., 2011).

$$SNR = \frac{TP}{TC} * \left[\frac{FP}{TNC}\right]^{-1} \tag{1}$$

$$TME = \frac{FN}{TFA} + \frac{FP}{TNFA} \tag{2}$$

Table 2 summarizes the confusion matrix and the performance indicators for each CAPB approach relative to the episodes of fiscal adjustment identified by the action-based approach. Although it is not perfect, both performance metrics indicate that the proposed definition is better at capturing fiscal adjustment episodes. The SNR shows that our definition is more than 1.5 times better at predicting the action-based episodes than the Alesina and Ardagna (1998) definition and with less noise. Also, the TME indicates that the proposed definition has 35 percentage points less of errors than Alesina and Ardagna's (1998) definition.

The fact that the true positives are almost 60 percent of action-based episodes shows that we are capturing the discretionary changes in fiscal policy that improve the CAPB, while relatively high false positives indicate that we are considering all those episodes that were not discretional but led to significant rises in the CAPB. In the context of oil shocks, considering non-discretional fiscal adjustments is desirable because oil shocks could lead to the improvement of government finances through automatic mechanisms, such as an unexpected rise in fiscal revenues.

Table 2 Action-Based and CAPB Approaches

Definition	Description	TP	FP	FN	TN	TFA	TNFA	SNR	TME	1-TME
Alesina and Ardagna (1998)	1. The CAPB improves by 2 pp. **or** 2. The CAPB improves for two consecutive years by at least 1.5 pp.	20	21	114	399	134	420	2.99	0.90	0.10
Ardanaz et al. (2021)	1. The CAPB improves by 1.5 pp. **or** 2. The CAPB improves for two consecutive years by at least 1.25 pp.	33	34	101	386	134	420	3.04	0.83	0.17
Proposed definition	1. The CAPB improves constantly. **and** 2. When the CAPB stops increasing, the accumulated changes are at least 2 pp.	77	53	57	367	134	420	4.55	0.55	0.45

Note: The table shows the results of the confusion matrix and the performance measures for each CAPB definition relative to the action-based episodes of fiscal adjustment. True Positive (TP), False Positive (FP), False Negative (FN), True Negative (TN), Total Fiscal Adjustments (TFA), Total No Fiscal Adjustments (TNFA), Signal-to-Noise Ratio (SNR), Total Misclassification Error (TME).

3 How to Identify Oil Demand and Supply Shocks?

Oil price shocks affect a range of macroeconomic variables, and their impact can be greater for commodity-exporting countries. Nevertheless, the oil price is driven by different demand and supply shocks. Demand or supply factors will have different effects on macroeconomic variables because the origin of these shocks may be correlated with other macroeconomic variables. For example, if the oil price is changing due to aggregate global demand changes, this will not only have an impact on the oil price but could further affect a country's GDP. There is extensive literature identifying the sources of shocks to the oil price, starting with Kilian (2009).

Kilian (2009) identifies three types of shocks that can explain the overall oil price movements. First, "oil supply shocks" are defined as unpredictable innovations in global oil production. Second, innovations to global real economic activity that cannot be explained based on oil supply shocks are referred to as "aggregate demand shocks". Finally, innovations to the real oil price that cannot be explained based on oil supply shocks or aggregate demand shocks are called "oil-specific demand shocks". Kilian (2009) shows that the oil-specific demand shocks represent exogenous shifts in precautionary demand. In a set of following papers, Kilian and Murphy (2012, 2014) argue that there is a need to include potential changes in oil inventory that can have effects on the oil price. Increased oil production in month t does not have to be consumed that month but might instead go into inventories.

Kilian and Murphy (2014) identify four equations that can be used to determine the movements in the price of oil: (i) the supply of oil, (ii) the determinants of world economic activity, given the price of oil, since it is widely used in many production processes, (iii) the demand for oil, and (iv) the changes in oil inventory. Based on the first specification from Kilian and Murphy (2014), Baumeister and Hamilton (2019) extend their analysis to estimate the structural shock using Bayesian methods. To identify the four shocks underlying the oil price movements, the authors use the following observable variables to determine the four basic equations to be estimated. First, they use monthly world oil production data measured in thousands of barrels of oil per day from the U.S. Energy Information Administration (EIA). Second, the price of oil is defined as the nominal spot oil price for West Texas Intermediate (WTI) deflated by the U.S. consumer price index. For the world aggregate production, the authors create their own measure of economic activity using the global economic activity from the OECD's industrial production index. Finally, following Kilian and Murphy (2012), to identify the oil inventories the authors use monthly U.S. crude oil stocks in millions of barrels from the EIA and multiply the U.S. crude oil inventories by the ratio of OECD inventories of crude petroleum and petroleum products to U.S. inventories of petroleum and petroleum products.

Moreover, they use the following four equations that represent the structural model:

$$q_t = \alpha_{qp} p_t + b'_1 x_{t-1} + u_{1t} \tag{3}$$

$$y_t = \alpha_{yp} p_t + b'_2 x_{t-1} + u_{2t} \tag{4}$$

$$q_t = \beta_{qy} y_t + \beta_{qp} p_t + \Delta i_t + b'_3 x_{t-1} + u_{3t} \tag{5}$$

$$\Delta i_t = \varphi_1 q_t + \varphi_2 y_t + \varphi_3 p_t + b'_3 x_{t-1} + u_{4t} \tag{6}$$

Where q_t is the rate of monthly world crude oil, y_t is a measure of aggregate economic activity, p_t is the log difference in the real price of oil, and Δi_t is the change in OECD inventories as a fraction of last period's oil production in global inventories of oil. Equation (3) is the oil supply curve, in which α_{qp} is the short-run price elasticity of supply. Oil supply is also presumed to be influenced by lagged values of all the variables over the preceding two years, with $x_{t-1} = (\boldsymbol{y'}_{t-1}, \boldsymbol{y'}_{t-2}, \dots, \boldsymbol{y'}_{t-24}, 1)$.[4] Equation (4) models the determinants of economic activity with the oil prices given by α_{yp}. Equation (5) governs oil demand, where β_{qp} is the short-run price elasticity of demand. Finally, equation (6) represents the oil inventory demand. The authors provide updated results to their estimations; we take to do our empirical analysis on the effects of those oil shocks on the different fiscal and macroeconomic variables across countries. Here u_{1t} , u_{2t} , u_{3t}, and u_{4t} represent shocks to oil supply, economic activity, oil-specific demand, and a separate shock to inventory demand, respectively.

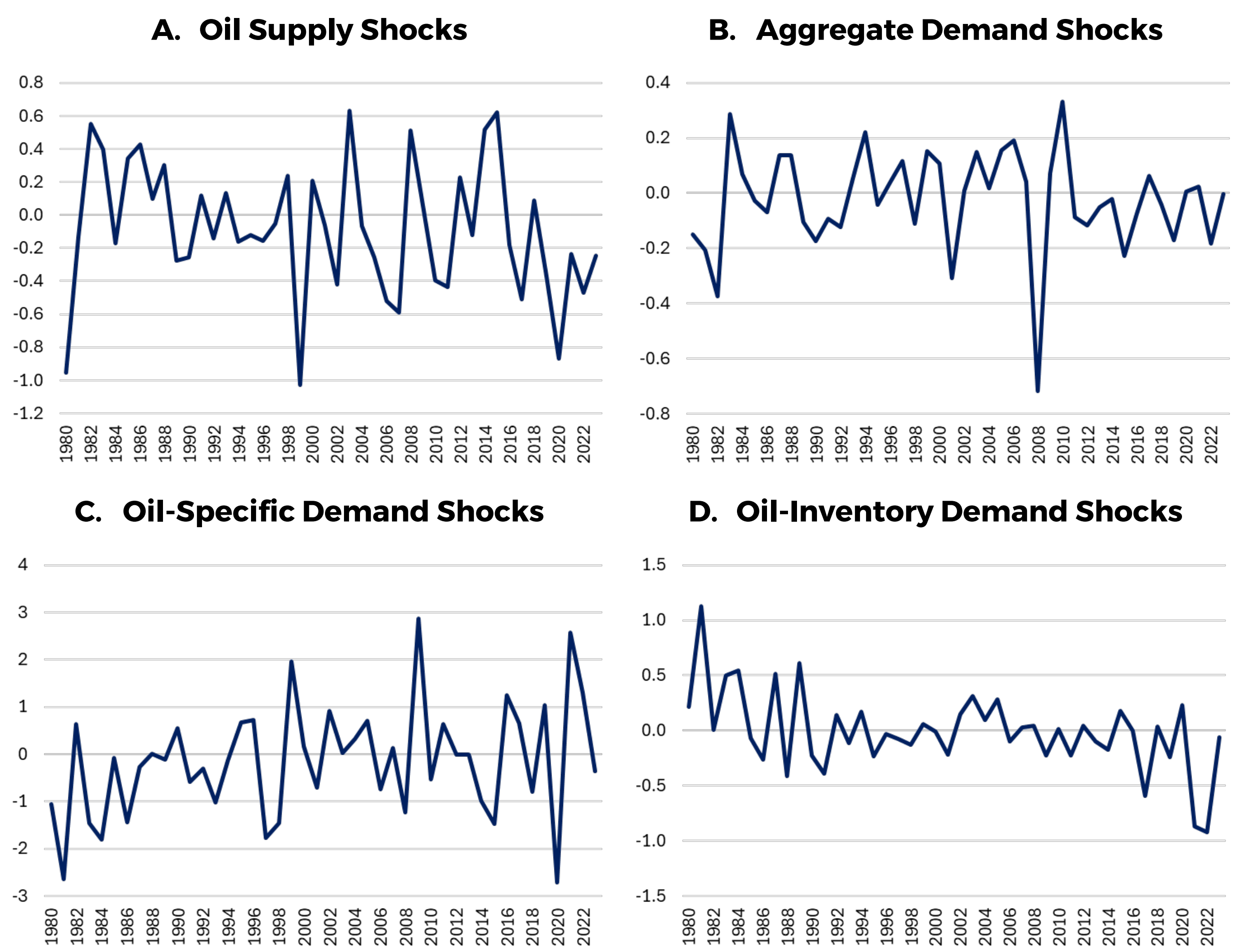
Figure 1 shows the results of their empirical estimates for oil supply, aggregate demand, oil-specific demand, and oil-inventory demand shocks. The figure shows that the oil-specific demand shocks are the most volatile shocks and have the largest overall magnitudes. On average, they make the largest contribution to oil price changes. The overall results show that during the COVID-19 crisis, the drop in the oil price was mainly driven by the oil supply shock and the oil-specific demand shocks. Although there is a decline in the aggregate demand shock, we see that its contribution is much smaller than the other two shocks. During the global financial crisis, the aggregate demand shock was very volatile, with a very sharp drop in 2008 at the onset of the crisis; it was also accompanied by a negative oil-specific demand shock.

Baumeister and Hamilton (2019) estimate posterior structural impulse-response functions (IRFs) to understand the effect of the estimated structural shocks on the observed variables. They find that an oil supply shock reduces oil production and increases the oil price at impact, while a shock to oil consumption demand increases production and raises the price.[5] The effect on impact is practically zero but

[4] We define $\boldsymbol{y_t} = (q_t, y_t, p_t, \Delta i_t)$ to be the vector of observables.
[5] Figure 8 in their paper shows the estimated IRFs.

accumulates over time. This conclusion is consistent with many studies going back to Hamilton (1983), where the author's estimate implies that a reduction in oil production that raises the oil price by 10 percent would lower world economic activity by 0.5 percent after a year. By contrast, if oil prices rise because of a shock to consumption demand, there seems to be no effect on subsequent economic activity. Kilian (2009) and Kilian and Murphy (2012, 2014) reached a similar conclusion. An increase in oil prices that results from an increase in inventory demand alone, which we interpret as a speculative demand shock, has a persistent effect on both inventories and prices and a negative effect on economic activity as well.

Figure 1 Supply and Demand Shocks



Source: Authors' calculation based on data from Baumeister and Hamilton (2019).
Note: Figure 1 plots the yearly average of each shock estimated by Baumeister and Hamilton (2019).

4 Empirical Approximation

4.1 Impact of Oil Shocks on Fiscal Adjustment Probability

To estimate the impact of oil shocks on the probability of a fiscal adjustment, the literature mostly relies on the common logit model, which estimates the probability of the occurrence of an of the event of fiscal adjustment (FA) conditional on strictly exogenous variables, as described in the next equation:

$$P(FA_{it}|\alpha_i, \boldsymbol{X}_i) = \frac{exp\left[\alpha_i + \boldsymbol{x'}_{i,t-1}\boldsymbol{\eta}\right]}{1 + exp\left[\alpha_i + \boldsymbol{x'}_{i,t-1}\boldsymbol{\eta}\right]} \tag{7}$$

Where α_i is the country's fixed effects, $\boldsymbol{x'}_{i,t-1}$ is a vector of one-year lagged exogenous covariates, including oil demand ($D_{i,t-1}$) and supply shocks ($S_{i,t-1}$), and a base set of control variables such as real GDP growth, real depreciation, debt-to-GDP ratio, and the average of governance indicators. For the joint probability of $\boldsymbol{FA}_i$, this model implies that:

$$P(\boldsymbol{FA}_i|\alpha_i, \boldsymbol{X}_i) = \frac{exp(\alpha_i FA_{i+})\, exp\left[\sum_t (FA_{it}\boldsymbol{x}_{i,t-1})'\,\boldsymbol{\eta}\right]}{\prod_t \left[1 + exp\left(\alpha_i + \boldsymbol{x'}_{i,t-1}\boldsymbol{\eta}\right)\right]} \tag{8}$$

Where $FA_{i+} = \sum_t FA_{it}$. However, the probability that a country will make a fiscal adjustment also depends on whether it has made an adjustment in the past. This has not been considered in the literature and could bias the estimates. In order to control for the dependence of the fiscal adjustment on the state, we implement the exponential quadratic (QE) model proposed by Bartolucci and Nigro (2010).

The QE model is a binary panel data model that allows for state dependence and unobserved heterogeneity beyond the effect of available covariates. This model approximates a dynamic logit model, but it is easier to estimate using conditional likelihood, and like the dynamic logit model, the parameters are interpreted in terms of log odds ratios (Bartolucci and Nigro, 2012, Bartolucci, Nigro, and Pigini, 2015). The model directly formulates the conditional distribution of $\boldsymbol{FA}_i$, as follows:

$$P(\boldsymbol{FA}_i|\alpha_i, \boldsymbol{X}_i, FA_{i0}) = \frac{exp\left[FA_{i+}\alpha_i + \sum_t FA_{i,t}\boldsymbol{x'}_{\boldsymbol{i,t-1}}\boldsymbol{\eta_1} + FA_{iT}\left(\phi + \boldsymbol{x}'_{i,T}\boldsymbol{\eta_2}\right) + FA_{i*}\gamma\right]}{\sum_z exp\left[z_+\alpha_i + \sum_t z_t\boldsymbol{x'}_{\boldsymbol{i,t-1}}\boldsymbol{\eta_1} + z_T\left(\phi + \boldsymbol{x}'_{i,T}\boldsymbol{\eta_2}\right) + z_{i*}\gamma\right]} \tag{9}$$

Where α_i is the country fixed effects, $\boldsymbol{X}_i = (\boldsymbol{x}_{i1}, \dots, \boldsymbol{x}_{i,T-1})$ for $i = 1, \dots, N$ and $t = 1, \dots, T$. The sum $\sum_z$ ranges over all possible binary response vectors $z = (z_1, \dots, z_T)'$. Moreover, $z_+ = \sum_t z_t$ and $z_{i*} = FA_{i0}z_1 + \sum_{t>1} z_{t-1}z_t$. The denominator does not depend on $\boldsymbol{FA}_i$; it is simply a normalizing constant that is denoted by $\mu(\alpha_i, \boldsymbol{X}_i, FA_{i0})$. The first-order effect for FA_{it} is equal to $\alpha_i + \boldsymbol{x'}_{i,t-1}\boldsymbol{\eta_1}$, to which is added $\phi + \boldsymbol{x}'_{i,t}\boldsymbol{\eta_2}$ when $t = T$. Vector $\boldsymbol{\eta_1}$ collects the regression parameters associated with the covariates including the parameters of interest β_1 and β_2 for the effect of oil supply and demand shocks. The parameter γ measures the true state dependence and is interpreted as log odds ratio between each pair of consecutive response variables. Using equation (9) and some simple algebra, we have:

$$\log\frac{P\left(FA_{it} = 0\middle|\alpha_i, \boldsymbol{X_i}, FA_{i,t-1} = 0\right)P\left(FA_{it} = 1\middle|\alpha_i, \boldsymbol{X_i}, FA_{i,t-1} = 1\right)}{P\left(FA_{it} = 0\middle|\alpha_i, \boldsymbol{X_i}, FA_{i,t-1} = 1\right)P\left(FA_{it} = 1\middle|\alpha_i, \boldsymbol{X_i}, FA_{i,t-1} = 0\right)} = \gamma \tag{10}$$

The parameters for the unobserved heterogeneity are removed by conditioning on the sums of the response variables over time to obtain the following expression:[6]

$$P(\boldsymbol{FA}_i|\, \boldsymbol{X}_i, FA_{i0}, FA_{i+}) = \frac{exp\left[\sum_t FA_{i,t}\boldsymbol{x'}_{\boldsymbol{i,t-1}}\boldsymbol{\eta_1} + FA_{iT}\left(\phi + \boldsymbol{x}'_{i,T}\boldsymbol{\eta_2}\right) + FA_{i*}\gamma\right]}{\sum_{\boldsymbol{z}:\, z_+ = FA_{i+}} exp\left[\sum_t z_t\boldsymbol{x'}_{\boldsymbol{i,t-1}}\boldsymbol{\eta_1} + z_T\left(\phi + \boldsymbol{x}'_{i,T}\boldsymbol{\eta_2}\right) + z_{i*}\gamma\right]} \tag{11}$$

The parameter vector $\theta = (\boldsymbol{\eta}'_{\boldsymbol{1}}, \phi, \boldsymbol{\eta}'_{\boldsymbol{2}}, \gamma)$ can be estimated by Composite Marginal Likelihood (CML) maximizing the conditional log-likelihood based on equation (11).

$$l(\theta) = \sum_i \boldsymbol{I}(0 < FA_{i+}) \log P(FA_i|X_i, FA_{i0}, FA_{i+}) \tag{12}$$

The resulting estimator computed using a simple Newton-Raphson algorithm is $\sqrt{n}$-consistent, and $\sqrt{n}\left(\hat{\theta} - \theta_0\right) \xrightarrow{d} N(0, I_0^{-1})$ with $I_0 = E_0[S|\boldsymbol{X}_i, FA_{i0}, FA_{i+}]$ whose sample counterpart is given by:

[6] See Bartolucci and Nigro (2010) for further details on this derivation.

$$\hat{I} = \frac{1}{n}J(\hat{\theta}) = \frac{1}{n}\sum_{i}\hat{S}(\boldsymbol{X}_i, FA_{i0}, FA_{i+}) \tag{13}$$

Following the baseline specification, we then include interaction terms. Since fiscal consolidations occur at different frequencies depending on the state of the economy, we then run the regressions interacting each oil shock with the business cycle. Studies such as Drazen and Grilli (1990) argue that reforms are more likely when "things are going badly," and von Hagen and Strauch (2001) find that fiscal adjustments are more likely to be successful when the domestic economy is in a cyclical downturn.

Interactions for emerging markets and commodity exporters are also included. Emerging market economies are generally less stable than advanced economies, while commodity exporters are more susceptible to the effects of commodity shocks, given that their fiscal revenues and expenditures will likely change depending on the type of shock they are facing.

Following Gomez-Gonzalez, Valencia, and Sánchez (2022), we argue that fiscal rule implementations do not immediately affect a country's macroeconomic stability. Governments take time to adjust their budgets to the conditions imposed by a fiscal rule; hence, a positive effect of fiscal rule implementations on macroeconomic stability takes some time, around five years. We interact with the shocks of whether a country has implemented a fiscal rule within the last five years, as well as with the quality of the fiscal rule. Gomez-Gonzalez, Valencia, Sanchez, (2024) show that fiscal rules enhance debt management and fiscal sustainability.

4.2 Data

We use an unbalanced panel encompassing 33 advanced economies and 52 emerging markets spanning the period from 1980 to 2023. This comprehensive dataset compiles information from various sources: (i) fiscal and macroeconomic aggregates primarily sourced from the IMF (2023); (ii) controls such as international reserves and commodity rents sourced from the World Bank (2023); (iii) additional indices from a variety research that have continuously updated the data, such as Kaufmann and Kraay (2023), Chinn and Ito (2006), and Scartascini, Cruz, and Keefer (2021); and (iv) data on fiscal rules published by Davoodi et al. (2022).

Table 3 summarizes all the variables used in this study, their respective sources, and key descriptive statistics. It is noteworthy that even with the proposed less-demanding definition of fiscal adjustment, about 20% of the sample consists of episodes of fiscal adjustment, highlighting the challenges associated with achieving a meaningful change in the fiscal stance. With respect to oil shocks, aggregate demand shocks exhibit greater volatility, ranging from -2.7 to 2.9, compared to oil-specific demand shocks, which range from -0.7 to 0.3.

Furthermore, half of the sample includes episodes in which economic activity exceeds its potential (i.e., "boom" episodes). This allows us to understand how governments react differently to oil shocks depending on the stage of the business cycle in which economies find themselves. Oil exporters account for 20 percent of the sample, underscoring the concentrated nature of oil supply and the significant impact that shocks in a few countries can have on the international oil price, as recent events such as the Ukraine-Russia war have shown (Zhang et al., 2023).

The dataset includes information on countries with and without fiscal rules, as well as periods during which countries transitioned to the adoption of at least one rule. Half of the sample consists of years in which countries implemented fiscal rules. This allows us to examine different dynamics associated with fiscal rules and their potential role in mitigating volatility due to oil shocks.

Table 3 Sources and Statistics

Variable	Description	Source	Mean	Std. Dev.	Min	Max
Fiscal Adjustment	1 if fiscal adjustment.	IMF (2023)	0.2	0.4	0	1
Oil supply shock	Supply shocks that increase oil prices.	Baumeister and Hamilton (2019)	0.1	0.4	-0.6	1.0
Aggregate demand shock	Aggregate demand shocks that increase oil prices.	Baumeister and Hamilton (2019)	0.1	1.2	-2.7	2.9
Oil-specific demand shock	Oil-specific demand shocks that increase oil prices.	Baumeister and Hamilton (2019)	0.0	0.2	-0.7	0.3
Oil-inventory demand shock	Oil-inventory demand shocks that increase oil prices.	Baumeister and Hamilton (2019)	-0.1	0.3	-0.9	1.1
Growth	Real GDP growth.	IMF (2023)	3.1	4.1	-29.1	62.3
Real depreciation	(1+depreciation) / (1+inflation).	IMF (2023)	1.0	0.1	0.6	2.4
Debt	Gross debt % GDP, General Government.	IMF (2023)	56.0	35.9	0.1	349.9
WGI	Average of Worldwide Governance Indicators.	Kaufmann and Kraay (2023)	0.5	0.8	-1.3	1.9
Financial openness	Financial openness index.	Chinn and Ito (2006)	0.7	0.3	0.0	1.0
Current account	Current account balance % GDP.	IMF (2023)	-1.3	6.2	-68.8	30.2
International reserves	Total reserves minus gold % GDP.	World Bank (2023)	16.3	18.0	0.1	142.5
Commodity rents	Oil, mineral, and gas rents % GDP.	World Bank (2023)	2.1	4.4	0	34
Polarization	Polarization between the executive party and the four principal parties of the legislature.	Scartascini, Cruz, and Keefer (2021)	0.9	0.9	0	2
Boom	1 if real GDP is above IMF's estimated potential GDP.	IMF (2023)	0.5	0.5	0	1
Oil exporters	1 if average net exports of oil are larger than 0.	IMF (2023)	0.2	0.4	0	1
Fiscal rule	1 if the country had at least one rule in t-5.	Davoodi et al. (2022)	0.5	0.5	0	1
Expenditure rule	1 if the country had at least one expenditure rule in t-5.	Davoodi et al. (2022)	0.2	0.4	0	1
Balance rule	1 if the country had at least one balance rule in t-5.	Davoodi et al. (2022)	0.5	0.5	0	1
Debt rule	1 if the country had at least one debt rule in t-5.	Davoodi et al. (2022)	0.3	0.5	0	1

Note: The table summarizes the description, sources, and summary statistics of the variables used in the research. The high growth rates, which reached 62.3 percent correspond to the period 2020-2023 in which Guyana generated strong accelerations due to large oil discoveries.

5 Results

This section discusses the main results of the paper. First, before jumping to the results from the regression analysis we show graphically how demand and supply shocks are correlated with fiscal adjustment. We then discuss the main findings of the paper and then delve into different specifications to highlight the mechanisms present.

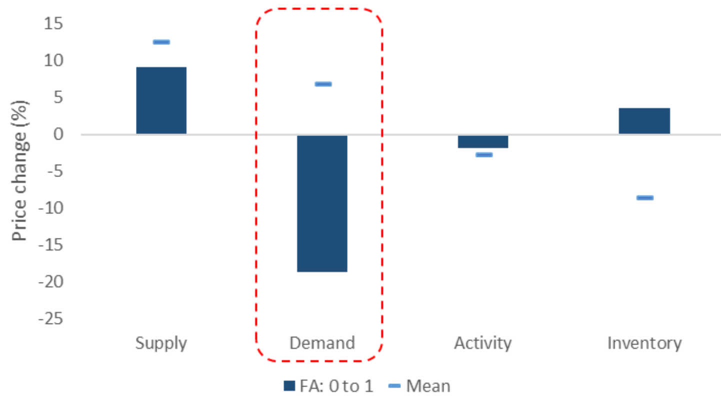
5.1 Correlations

Figure 2 shows the correlations between oil demand and supply shocks with an indicator of whether the country is undergoing a fiscal adjustment. We calculate the average for the entire sample for each shock which are represented by the lines in the plot. We then estimate the average shock in $t-1$ for three scenarios: i) when a country transitions from not having a fiscal adjustment to having a fiscal adjustment (Figure 2 Panel A), ii) when a country transitions from undergoing a fiscal adjustment to not having a fiscal adjustment (Figure 2 Panel B), and iii) when a country continuous to have a fiscal adjustment (Figure 2 Panel C).

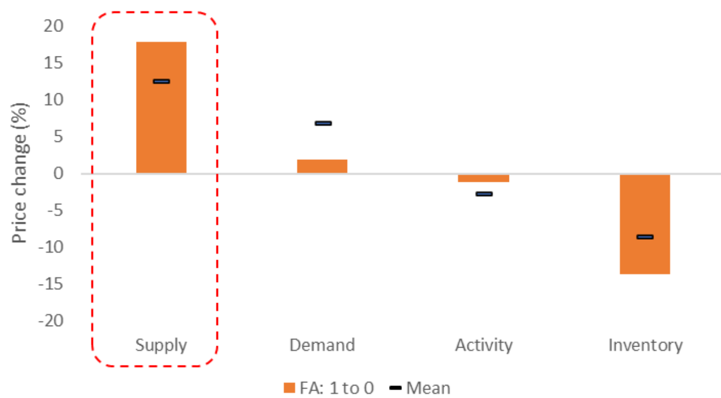
The plots show that the year before starting a fiscal adjustment (Panel A), oil demand shocks are below their historical average, suggesting a strong correlation between oil demand shocks and the adoption of fiscal adjustments. Panel B shows that there is a negative correlation between oil supply shocks and the implementation of fiscal adjustments. Specifically, the year prior to transitioning from having undergone a fiscal adjustment to no longer having one, the average supply shock is above the sample average suggesting the existence of the negative correlation. Finally, Panel C shows that in the period prior to continuing a fiscal adjustment the average oil specific demand shocks and aggregate demand shocks are above the sample average. This fact reinforces the idea of a positive correlation between demand shocks and the adoption of a fiscal adjustment.

Figure 2 Fiscal Adjustment Episodes and Oil Shocks, Graphical Correlation

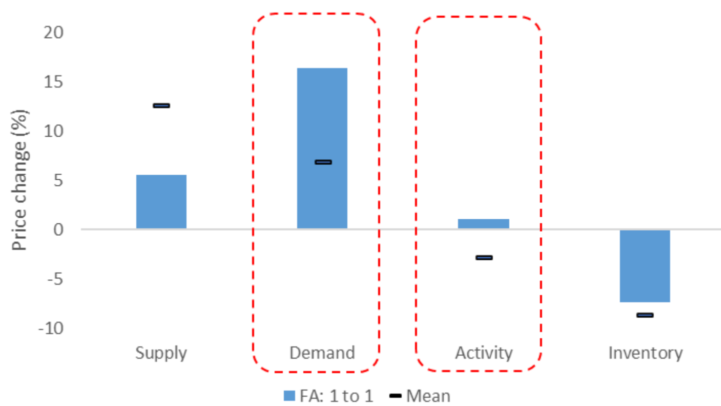
A. No Fiscal Adjustment to Fiscal Adjustment



B. Fiscal Adjustment to No Fiscal Adjustment



C. Fiscal adjustment to Fiscal Adjustment



Note: FA = 1 indicates fiscal adjustment, FA = 0 indicates no fiscal adjustment. The graphs show the average oil shock (bars) in the year prior to a FA state transition (0 to 1, 1 to 0, or 1 to 1) as well as the historical average for each shock (line).

5.2 State Dependence and Oil Shock Effects

Table 4 presents the results from the QE regression. Given the state-dependent nature of the analysis, conditioned on experiencing a fiscal adjustment in the previous period, the first coefficient is the lag of the dependent variable. The findings indicate that a fiscal adjustment in the preceding period increases the probability of a fiscal adjustment occurring in the current period. Conversely, an oil supply shock, which raises oil prices, tends to reduce the probability of a fiscal adjustment. The coefficient for oil-specific demand and aggregate demand shocks is positive, suggesting that when oil price increases are driven by demand shocks or heightened economic activity, the likelihood of a fiscal adjustment also rises. The analysis suggests that the context and cause of oil price increases are crucial in understanding their impact on fiscal adjustment. Supply-side shocks, such as disruptions in oil supply, are associated with a reduced likelihood of fiscal adjustment. Conversely, demand-driven oil price increases, reflecting broader economic activity, are linked to a higher likelihood of governments undertaking fiscal adjustment measures.

Table 4 QE Regression Results

	Baseline	Financial Openness	Current Account	International Reserves	Commodity Rents	Political Polarization
Fiscal adjustment =L	3.152***	3.347***	3.166***	3.13***	3.324***	3.534***
	(0.156)	(0.169)	(0.158)	(0.157)	(0.166)	(0.213)
Oil supply shock =L	-0.698***	-0.823***	-0.718***	-0.7***	-0.796***	-0.724***
	(0.177)	(0.182)	(0.18)	(0.179)	(0.179)	(0.269)
Oil-specific demand shock =L	0.131*	0.096	0.12	0.128*	0.129*	0.108
	(0.072)	(0.074)	(0.073)	(0.073)	(0.073)	(0.103)
Aggregate demand shock =L	2.364***	2.518***	2.578***	2.416***	2.303***	2.913***
	(0.464)	(0.492)	(0.478)	(0.471)	(0.482)	(0.582)
Oil-inventory demand shock =L	-0.08	0.525	-0.131	-0.002	0.628*	-0.1
	(0.3)	(0.348)	(0.306)	(0.307)	(0.344)	(0.409)
Observations	1,944	1,819	1,917	1,904	1,851	1,366
Countries	85	83	85	84	85	78

Note: The table shows the QE regression estimation of oil shock effects on fiscal adjustment probability. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses.

Columns (2) to (6) display the results when the regression incorporates additional control variables as robustness checks to mitigate omitted variable bias. Column (2) includes financial openness, suggesting that countries with fewer capital controls may be more affected by oil price shocks due to international market reactions. Including this control does not alter the results.

Column (3) includes the current account, which controls for potential financial flows between countries correlated with oil price shocks. The results remain consistent with the baseline specification, indicating no significant impact from the current account.

Column (4) includes international reserves, considering possible government buffers against oil price fluctuations that could influence fiscal adjustment likelihood. The results show consistency with the baseline, indicating that international reserves do not affect the probability of fiscal adjustment.

Column (5) accounts for government commodity rents, which can be influenced by oil price movements. Including this variable reveals that changes in commodity rents do not alter the likelihood of fiscal consolidation, maintaining consistency with the baseline results. Finally, column (6) controls for political polarization as an alternative governance indicator.

Overall, the inclusion of additional control variables does not change the main regression results. The findings consistently show that a supply shock decreases the probability of a fiscal adjustment, while a demand shock increases it. In the Appendix (Table A.2) the same regression is shown but using probit and logit models. The overall results go in the same direction as the results from the QE regression. However, the oil inventory demand shocks are significant, which is at odds with the results in Table 4. The difference between the results may be due to estimation bias in the logit and probit models which is caused by the inclusion of the lagged dependent variable, a bias that is accounted for in the QE model.

5.3 Heterogeneous Effects of the Business Cycle

Considering that the probability of undertaking a fiscal adjustment may vary based on the state of the economy, we estimate equation (11) by examining the interaction between oil supply and demand shocks and the business cycle. For clarity, we define a “bust” as a period of economic downturn, where current GDP is below potential GDP, and a “boom” as a period of economic upswing, where current GDP is above potential GDP. Potential GDP is estimated using the Hodrick-Prescott (HP) filter.

Column (1) of Table 5 presents the regression results. When accounting for the state of the economy, the effects of oil supply and demand shocks differ notably. Implementing a fiscal adjustment is generally more challenging during economic downturns or busts due to potential negative impacts on economic growth (Guajardo et al., 2014; Jordà and Taylor, 2015). However, oil demand shocks continue to positively influence fiscal adjustments even during busts, acting as a buffer in economic downturns. Conversely, during economic booms, the positive effect of demand shocks is reduced.

In contrast, oil supply shocks show a different pattern. During busts, oil supply shocks negatively affect the probability of a fiscal adjustment, but this effect is less pronounced compared to periods of economic boom. This can be attributed to increased revenues from rising oil prices during supply shocks, which enable governments to spend more.

Table 5 QE Regression Results Conditional on the State of the Economy

		Baseline	Financial Openness	Current Account	International Reserves	Commodity Rents	Political Polarization
	Fiscal adjustment =L	3.216***	3.326***	3.239***	3.213***	3.313***	3.501***
		(0.167)	(0.177)	(0.17)	(0.167)	(0.175)	(0.221)
Bust	Oil supply shock =L	-0.406*	-0.588**	-0.43*	-0.449*	-0.552**	-0.371
		(0.23)	(0.239)	(0.233)	(0.232)	(0.238)	(0.367)
	Oil-specific demand shock =L	0.105	0.097	0.084	0.1	0.117	0.047
		(0.087)	(0.089)	(0.088)	(0.087)	(0.088)	(0.125)
	Aggregate demand shock =L	2.769***	2.869***	2.953***	2.824***	2.854***	3.462***
		(0.713)	(0.735)	(0.728)	(0.716)	(0.735)	(0.886)
	Oil-inventory demand shock =L	0.265	0.226	0.186	0.213	0.336	0.157
		(0.41)	(0.468)	(0.415)	(0.411)	(0.46)	(0.565)
Boom	Oil supply shock =L	-1.452***	-1.197***	-1.504***	-1.439***	-1.182***	-1.087***
		(0.328)	(0.328)	(0.334)	(0.33)	(0.331)	(0.392)
	Oil-specific demand shock =L	0.202	0.004	0.208	0.191	0.048	0.09
		(0.129)	(0.139)	(0.132)	(0.13)	(0.139)	(0.16)
	Aggregate demand shock =L	2.538***	2.505***	2.787***	2.501***	2.436***	2.727***
		(0.583)	(0.581)	(0.607)	(0.583)	(0.584)	(0.697)
	Oil-inventory demand shock =L	-0.584	0.687	-0.677	-0.536	0.579	-0.666
		(0.47)	(0.59)	(0.482)	(0.478)	(0.586)	(0.673)
	Observations	1,797	1,697	1,770	1,792	1,712	1,275
	Countries	77	76	77	77	77	72

Note: The table shows the QE regression estimation of oil shock effects on fiscal adjustment probability, interacting with the economic cycle. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses.

The baseline results use the HP filter to capture the GDP cycle for a country. There have been numerous criticisms regarding the estimation of the HP filter (Hamilton, 2018). To verify that the results are not biased due to the estimation of the business cycle, in the Appendix we show the baseline results while implementing several ways to estimate the GDP cycle for a country (Table A.3). Three different methodologies are used to estimate the business cycle (Baxter and King, 1999; Christiano and Fitzgerald, 2003; Hamilton, 2018). All the results remain regardless of the type of filter implemented. The effect of oil supply shocks on the probability of a fiscal adjustment are less pronounced during busts compared to periods of economic boom. The effect of oil demand shocks positively influences fiscal adjustments, but during economic busts the positive effect of demand shocks is reduced.

5.4 Exposure to Shocks in Emerging Markets and Advanced Economies

The baseline specification includes both advanced and emerging market economies. However, these two groups differ significantly in their economic structure and fiscal conditions. Table 6 presents the results when oil supply and demand shocks interact with a dummy variable indicating whether a country is an emerging market or an advanced economy.

Both emerging markets and advanced economies exhibit a similar overall response to oil supply and aggregate demand shocks concerning the probability of a fiscal adjustment. Specifically, oil supply shocks decrease the likelihood of fiscal consolidation, while aggregate demand shocks are associated with a higher probability of fiscal adjustment. Notably, emerging markets show an additional positive response to oil-specific demand shocks, likely due to increased government revenues.

Table 6 QE Regression Results, Country Groups

		Baseline	Financial Openness	Current Account	International Reserves	Commodity Rents	Political Polarization
	Fiscal adjustment =L	3.148***	3.351***	3.163***	3.124***	3.323***	3.502***
		(0.155)	(0.169)	(0.158)	(0.157)	(0.166)	(0.205)
Advanced	Oil supply shock =L	-0.598**	-0.787***	-0.632**	-0.614**	-0.708***	-0.773**
		(0.264)	(0.267)	(0.266)	(0.263)	(0.263)	(0.392)
	Oil-specific demand shock =L	0.081	0.039	0.073	0.072	0.071	-0.023
		(0.103)	(0.104)	(0.103)	(0.103)	(0.102)	(0.137)
	Aggregate demand shock =L	2.723***	2.683***	2.754***	2.721***	2.569***	4.194***
		(0.695)	(0.726)	(0.694)	(0.694)	(0.711)	(0.885)
	Oilinventory demand shock =L	-0.001	0.969*	-0.081	-0.023	0.936*	0.641
		(0.466)	(0.545)	(0.472)	(0.465)	(0.533)	(0.629)
Emerging	Oil supply shock =L	-0.771***	-0.848***	-0.781***	-0.766***	-0.862***	-1.048***
		(0.235)	(0.24)	(0.24)	(0.241)	(0.238)	(0.354)
	Oil-specific demand shock =L	0.178*	0.156	0.164	0.183*	0.188*	0.169
		(0.099)	(0.102)	(0.101)	(0.101)	(0.101)	(0.137)
	Aggregate demand shock =L	2.066***	2.394***	2.407***	2.126***	2.077***	3.142***
		(0.618)	(0.663)	(0.648)	(0.631)	(0.649)	(0.789)
	Oil-inventory demand shock =L	-0.092	0.285	-0.133	0.044	0.466	-0.062
		(0.38)	(0.441)	(0.391)	(0.396)	(0.442)	(0.518)
	Observations	1,944	1,819	1,917	1,904	1,851	1,366
	Countries	85	83	85	84	85	78

Note: The table shows the QE regression estimation of oil shock effects on fiscal adjustment probability by country groups. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses.

5.5 Heterogeneous Effects of Oil Importers and Exporters

Oil exporters are particularly susceptible to significant fluctuations in their national accounts when oil prices change. Consequently, oil exporters experience more pronounced volatility in response to oil price changes resulting from supply and demand shocks. To test the heterogeneous effect between importers and exporters we interact the oil shocks variables with a dummy equal to one when a country is on average a net oil exporter, and zero otherwise (i.e. an oil importer country). Table 7 presents the results. The findings indicate that the probability of a fiscal adjustment in oil exporters is more sensitive to oil supply and demand shocks.

For oil importers, a supply shock in oil, which increases prices, is associated with a reduced probability of fiscal adjustments. This outcome aligns with governments increasing expenditures due to rising oil prices, making them more vulnerable as oil importers. Conversely, when oil price increases are driven by demand factors, the probability of a fiscal adjustment rises. This is consistent with the nature of oil demand shocks, which can stem from increases in world demand or specific oil demand. As demand from oil importers strengthens, governments do not need to boost expenditure to compensate for the rise in oil prices. Similar patterns emerge for oil exporters, though the magnitude of the effects is higher. Oil supply shocks, which result in higher prices due to lower production, reduce the likelihood of a fiscal adjustment as revenue collections decrease. Conversely, aggregate demand shocks significantly increase the probability of a fiscal adjustment compared to oil importers. However, oil inventory demand shocks have a negative effect, as highly volatile price increases and a momentary boost in revenues make it more challenging to implement a fiscal adjustment.

Table 7 QE Regression Results, Commodity Importers and Exporters

		Baseline	Financial Openness	Current Account	International Reserves	Commodity Rents	Political Polarization
	Fiscal adjustment =L	3.175***	3.382***	3.187***	3.156***	3.361***	3.595***
		(0.157)	(0.171)	(0.159)	(0.158)	(0.168)	(0.218)
Importers	Oil supply shock =L	-0.664***	-0.801***	-0.683***	-0.667***	-0.777***	-0.651**
		(0.194)	(0.199)	(0.198)	(0.197)	(0.196)	(0.293)
	Oil-specific demand shock =L	0.158**	0.118	0.142*	0.157*	0.15*	0.092
		(0.08)	(0.082)	(0.081)	(0.081)	(0.08)	(0.114)
	Aggregate demand shock =L	1.907***	2.008***	2.122***	1.952***	1.763***	2.472***
		(0.499)	(0.533)	(0.513)	(0.508)	(0.517)	(0.629)
	Oil-inventory demand shock =L	0.359	1.132***	0.265	0.495	1.187***	0.588
		(0.34)	(0.395)	(0.348)	(0.351)	(0.391)	(0.46)
Exporters	Oil supply shock =L	-0.859**	-0.901**	-0.868**	-0.861**	-0.896**	-0.935
		(0.413)	(0.424)	(0.415)	(0.413)	(0.426)	(0.652)
	Oil-specific demand shock =L	0.014	0.011	0.024	0.009	0.022	0.164
		(0.163)	(0.168)	(0.164)	(0.163)	(0.169)	(0.21)
	Aggregate demand shock =L	4.977***	5.308***	5.171***	4.94***	5.393***	5.176***
		(1.23)	(1.267)	(1.254)	(1.227)	(1.301)	(1.568)
	Oil-inventory demand shock =L	-1.76***	-1.757**	-1.634**	-1.759***	-1.611**	-2.862***
		(0.65)	(0.759)	(0.663)	(0.649)	(0.793)	(0.924)
	Observations	1,944	1,819	1,917	1,904	1,851	1,366
	Countries	85	83	85	84	85	78

Note: The table shows the QE regression estimation of oil shock effects on fiscal adjustment probability by net oil exporter or importer countries. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses.

5.6 The Stabilizing Role of Fiscal Rules

Fiscal rules play a crucial role in stabilizing government fiscal balances. Gomez-Gonzalez, Valencia, and Sanchez. (2022, 2024) emphasize that fiscal rules are a significant determinant of fiscal stability, indicating that having a fiscal rule in place reduces the necessity for fiscal adjustments. In our analysis, we estimate equation (11), interacting the supply and demand shocks with an indicator of whether the country has a fiscal rule in place. The results of this regression are presented in Table 8. The asymmetric effect of supply and demand shocks persists without a fiscal rule. Oil supply shocks reduce the likelihood of a fiscal adjustment, while oil-specific and aggregate demand shocks increase the probability of adjustments in public finances. Moreover, fiscal rules function as a stabilization mechanism against shocks. Having a fiscal rule in place neutralizes the negative effect of supply shocks, though it also eliminates the positive effect of oil-specific demand shocks. Nonetheless, aggregate demand shocks still increase the probability of achieving a fiscal adjustment. These findings underscore that fiscal rules are associated with decreased volatility in fiscal balance. This reduced sensitivity can contribute to more stable fiscal conditions. The observed probabilities emphasize the importance of fiscal rules in moderating the impact of external shocks on a country's fiscal position. Fiscal rules constrain fiscal policy discretion and promote fiscal discipline, which preserves fiscal space (Eyraud et al., 2018).

Table 8 QE Regression Results, Fiscal Rules

		Baseline	Financial Openness	Current Account	International Reserves	Commodity Rents	Political Polarization	IMF Program
	Fiscal adjustment =L	3.183***	3.367***	3.163***	3.208***	3.344***	3.552***	3.21***
		(0.158)	(0.17)	(0.16)	(0.162)	(0.168)	(0.215)	(0.161)
No Rule	Oil supply shock =L	-0.802***	-0.83***	-0.798***	-0.847***	-0.853***	-0.858**	-0.806***
		(0.29)	(0.291)	(0.289)	(0.29)	(0.292)	(0.4)	(0.286)
	Oil-specific demand shock =L	0.249**	0.237**	0.247**	0.258**	0.264**	0.264*	0.245**
		(0.114)	(0.117)	(0.114)	(0.115)	(0.116)	(0.149)	(0.114)
	Aggregate demand shock =L	1.28*	1.627**	1.211*	1.421**	1.318*	1.92**	1.277*
		(0.689)	(0.73)	(0.691)	(0.703)	(0.712)	(0.844)	(0.689)
	Oil-iInventory demand shock =L	0.254	0.336	0.413	0.308	0.467	0.108	0.259
		(0.486)	(0.542)	(0.504)	(0.492)	(0.54)	(0.624)	(0.487)
Fiscal Rule	Oil supply shock =L	0.145	-0.043	0.132	0.182	0.043	0.212	0.166
		(0.362)	(0.36)	(0.359)	(0.359)	(0.36)	(0.514)	(0.357)
	Oil-specific demand shock =L	-0.196	-0.226	-0.2	-0.232	-0.214	-0.273	-0.224
		(0.142)	(0.147)	(0.144)	(0.145)	(0.144)	(0.188)	(0.144)
	Aggregate demand shock =L	1.892**	1.608*	2.091**	2.027**	1.745*	1.716	2.131**
		(0.908)	(0.953)	(0.915)	(0.926)	(0.932)	(1.115)	(0.915)
	Oil-inventory demand shock =L	-0.538	0.258	-0.689	-0.739	0.204	-0.376	-0.72
		(0.616)	(0.719)	(0.635)	(0.628)	(0.699)	(0.828)	(0.624)
	Observations	1,944	1,819	1,917	1,904	1,851	1,366	1,927
	Countries	85	83	85	84	85	78	84

Note: The table shows the QE regression estimation of oil shock effects on fiscal adjustment probability by having or not a fiscal rule in place. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses.

Caselli and Reynaud (2020) show that IMF programs coincide with episodes of fiscal consolidation and might therefore be correlated with the introduction of fiscal rules. To verify that our results on fiscal rules are due to the introduction of a fiscal rule and not any other measure that can be introduced in an IMF program column (7) in Table 8 shows the results when controlling for the presence of IMF programs. The baseline results remain consistent with the introduction of the dummy variable. The results suggest that regardless of the presence of an IMF program, fiscal rules play a stabilizing role in achieving a fiscal adjustment in front of oil shocks.

Diverse types of fiscal rules aim to stabilize public finances, each employing distinct mechanisms. Some rules establish paths for primary or structural balances, others define ceilings for expenditure, and some limit the levels of debt that can be acquired. As each rule targets different fiscal aggregates, their effectiveness as stabilizers in the face of oil shocks varies. Table 9 illustrates the heterogeneous effects of oil shocks on the probability of fiscal adjustments, both with and without the diverse types of fiscal rules.

Table 9 QE Regression Results, Types of Fiscal Rules

		Balance	Expenditure	Debt
	Fiscal adjustment =L	3.172***	3.209***	3.161***
		(0.158)	(0.162)	(0.157)
No Fiscal Rule	Oil supply shock =L	-0.689***	-0.817***	-0.791***
		(0.256)	(0.216)	(0.233)
	Oil-specific demand shock =L	0.193*	0.263***	0.185*
		(0.104)	(0.087)	(0.094)
	Aggregate demand shock =L	1.334**	1.698***	2.037***
		(0.629)	(0.496)	(0.578)
	Oil-inventory demand shock =L	0.23	0.194	-0.012
		(0.438)	(0.367)	(0.386)
Fiscal Rule	Oil supply shock =L	-0.029	0.167	0.195
		(0.35)	(0.409)	(0.353)
	Oil-specific demand shock =L	-0.128	-0.606***	-0.133
		(0.138)	(0.168)	(0.14)
	Aggregate demand shock =L	2.086**	3.813***	0.842
		(0.9)	(1.256)	(0.933)
	Oil-inventory demand shock =L	-0.503	-1.97***	-0.29
		(0.612)	(0.703)	(0.616)
	Observations	1,944	1,944	1,944
	Countries	85	85	85

Note: The table shows the QE regression estimation of oil shock effects on fiscal adjustment probability by type of fiscal rule. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses.

Results in column (1) suggest that fiscal rules defining a balanced target can neutralize the negative effect of supply shocks while leveraging aggregate demand shocks to facilitate fiscal adjustments. Conversely, expenditure rules (column 2) tend to be less effective in managing shocks, as oil-specific and oil-inventory demand shocks reduce the likelihood of achieving a fiscal adjustment. Finally, results in column (3) indicate that debt rules are highly inflexible. While they manage to neutralize the negative effects of oil supply shocks, they also negate all the positive effects that demand shocks might bring.

6 Robustness Checks

This section discusses additional robustness checks on the baseline regression. First, we document how bootstrapping to account for additional variation that can stem from the estimation error does not alter our main results. Second, we discuss other methods used to estimate oil demand and supply shocks and use those estimates to run the baseline regression, finding no significant differences in our results. Finally, we account for global factors that might affect the estimate of the effect of oil demand and supply shocks on the probability of fiscal adjustments.

6.1 Bootstrapping

The oil shocks studied are not directly observable because they are estimated through econometric modeling (see section 4.1). These estimated series of shocks could introduce additional noise due to estimation error in the QE regression, affecting the confidence intervals and, consequently, the inference (Kilian, 2009). The empirical literature has addressed the generated regressor problem by re-estimating the confidence intervals through bootstrapping methods (see, for example, Rueda-Lobato and Torres Garcia, 2024). We ran 1,000 bootstrap samples using nonparametric bootstrapping (Davison and Hinkley, 1997; Canty and Ripley, 2024).

Table 10 summarizes the results of the bootstrapping correction for the effects of oil shocks on the probability of fiscal adjustment. The effects of oil supply shocks, oil-specific demand, and aggregate demand shocks retain their original sign and significance, although the effect of aggregate demand shocks is slightly reduced. On the other hand, oil-inventory demand shocks, which were not statistically significant in the original estimation, become significant and positive after the bootstrapping adjustment of the confidence intervals. The asymmetry between the impact of supply and demand shocks on the likelihood of fiscal adjustment remains: oil supply shocks hinder fiscal adjustments, while demand shocks increase the probability of improving public finances. See Figure A.1 for the estimated distribution and its comparison with the initial coefficient.

Table 10 QE Regression Results, Bootstrapping

	Bootstrapping	Original	Bias	Std. Error	Lower Bound	Upper Bound
Oil supply shock =L	-0.761***	-0.698***	-0.063	0.165	-1.049	-0.490
Oil-specific demand shock =L	0.117***	0.131***	-0.014	0.059	0.019	0.215
Aggregate demand shock =L	1.903***	2.364***	-0.461	0.444	1.176	2.699
Oil inventory demand shock =L	0.954***	-0.08	1.034	0.259	0.544	1.379

Note: The table shows the QE regression estimation of oil shock effects on fiscal adjustment probability, correcting standard errors estimation with 1,000 bootstrapping replicates. *** the coefficient is significative with at least 90 percent confidence.

6.2 Estimation of Oil Shocks

Given that our results are dependent on the estimation of the oil demand and supply shocks, a possibility is that our results hinge on the identification strategy of the shocks. Therefore, as a robustness check we use the shocks estimated by Kim and Vera (2019) to test whether the results here presented depend on the identification strategy. Kim and Vera (2019) estimate the oil shocks following Kilian (2009) and extend them to include the global financial crisis.

Table 11 presents the results for our baseline regression using their estimated shocks. The findings are consistent with our main regression analysis. State dependence on fiscal adjustment remains a significant factor as well as the asymmetry between demand and supply shocks. Oil supply shocks are associated with a lower probability of undergoing a fiscal adjustment while demand shocks are associated with an increase in the probability of undergoing a fiscal adjustment.

Table 11 QE Regression Results, Kim and Vera (2019) Oil Shocks.

	Baseline	Financial Openness	Current Account	International Reserves	Commodity Rents	Political Polarization
Fiscal adjustment =L	2.964***	2.973***	2.972***	2.927***	2.969***	3.354***
	(0.188)	(0.191)	(0.191)	(0.189)	(0.189)	(0.23)
Oil supply shock =L	-1.251**	-1.206**	-1.361***	-1.221**	-1.282***	-1.165**
	(0.496)	(0.505)	(0.507)	(0.499)	(0.497)	(0.574)
Oil specific demand shock =L	0.549**	0.617**	0.583**	0.504*	0.569**	0.848***
	(0.264)	(0.269)	(0.268)	(0.266)	(0.266)	(0.306)
Aggregate demand shock =L	0.313	0.313	0.222	0.326	0.313	0.647**
	(0.246)	(0.25)	(0.252)	(0.247)	(0.247)	(0.29)
Observations	1,927	1,944	1,944	1,331	1,343	1,109
Countries	84	85	85	84	85	78

Note: Table shows the QE regression estimation of oil shocks effects on fiscal adjustment probability with Kim and Vera (2019) shocks estimations. * p-value < 0.1, ** p-value < 0.05, *** p-value > 0.01. Robust standard errors in parenthesis.

6.3 Additional control variables

Finally, columns (2) and (3) in Table A.4. shows the results when controlling for the GeoPolitical Risk Index (Caldara and Iacoviello, 2022) and the federal funds rate. Global factors might change the economic conditions of a country and could affect the probability of undergoing a fiscal consolidation. To account for global conditions, we include the GeoPolitical Risk Index, and the results are shown in column (3). The baseline results remain consistent, finding a significant state dependence as well as an asymmetric relationship between demand and supply shocks. Moreover, Fernandez et al. (2017) indicate that the world interest rate is an important channel via which world shocks are transmitted to open economies. The inclusion of the federal funds rate shows that the baseline results remain consistent. Hence, even in the presence of global shocks that can be captured by the fed fund rate we find the asymmetric relationship between oil supply and demand shocks and the probability of undergoing a fiscal consolidation.

7 Conclusions

The preceding analysis has estimated an exponential quadratic regression model to identify the overall effect of oil supply and demand shocks on the probability associated with undergoing a fiscal adjustment. The findings of this study highlight several important dynamics regarding fiscal adjustments in the context of oil shocks. First, there is a significant state dependence in fiscal policy: undergoing a fiscal adjustment in the previous period increases the probability of a fiscal adjustment in the current period. This suggests a momentum effect, where past adjustments influence current fiscal behavior, potentially due to established policy frameworks or the political will to maintain fiscal discipline.

Second, our analysis reveals an asymmetry in the effects of oil shocks depending on their nature. Specifically, oil supply shocks tend to decrease the probability of fiscal adjustments, whereas oil demand shocks increase it. This asymmetry underscores the differential impact that external economic forces can have on a country's fiscal strategy, depending on whether the shocks are driven by changes in supply conditions or demand dynamics. Policy makers should consider the nature of oil shocks when assessing the will to undergo a fiscal adjustment.

Moreover, the effects of oil shocks on fiscal adjustments are heterogeneous across different phases of the economic cycle. Notably, oil demand shocks have a positive effect on fiscal adjustments even during economic downturns. This countercyclical effect suggests that demand-driven oil price increases can function as a buffer, providing additional revenue that facilitates fiscal adjustments when economic conditions are otherwise challenging.

Our results also indicate that net commodity exporters are more susceptible to the impact of oil shocks than net importers. Net exporters are more negatively affected by oil supply shocks but benefit more from oil demand shocks when making fiscal adjustments. This heightened sensitivity emphasizes the reliance of oil-exporting countries on oil revenues and the significant role that oil market dynamics play in their fiscal stability.

Last, the importance of fiscal institutions is evident from our findings. Fiscal rules can mitigate the volatility caused by oil shocks, with rules that set targets for primary or structural balances being particularly effective. These fiscal rules can neutralize the negative effects of oil supply shocks while allowing countries to leverage demand shocks for necessary fiscal adjustments. By providing a structured approach to managing the fiscal impacts of volatile oil prices, these frameworks enhance fiscal resilience and stability.

The theoretical literature has found some evidence of the effect of oil supply shocks on government finance, output, and inflation (Blanchard and Gali, 2010; Blanchard and Riggi, 2013; Kharroubi and Smets, 2023). Our empirical findings further support these results. We identify structural aspects of an economy that alter the sensitivity of oil shocks on fiscal adjustments, specifically fiscal rules and commodity exporters. Our results should help policy makers make more informed decisions on the appropriateness of a fiscal adjustment given the type of oil shock as well as the phase of the economic cycle.

Overall, our research underscores the complexity of fiscal adjustments in the face of oil shocks, highlighting the roles of past adjustments, the nature of the shocks, the economic cycle, the status as a net exporter or importer, and the robustness of fiscal institutions. These insights contribute to a deeper understanding of how countries can better navigate the fiscal challenges posed by fluctuating oil markets.

References

Abubakar, A. B., Muhammad, M., Mensah, S. (2023). Response of fiscal efforts to oil price dynamics. *Resources Policy*, 81: 103353. https://doi.org/10.1016/j.resourpol.2023.103353

Alesina, A., Ardagna, S. (1998). Tales of fiscal adjustment. Economic Policy, 13(27): 488-545. https://doi.org/10.1111/1468-0327.00039

Alesina, A., Ardagna, S., Perotti, R., Schiantarelli, F. (2002). Fiscal Policy, Profits, and Investment. American *Economic Review*, 92(3): 571-589. https://doi.org/10.1257/00028280260136255

Alesina, A., Favero, C., Giavazzi, F. (2019). Effects of Austerity: Expenditure- and Tax-Based Approaches. *Journal of Economic Perspectives*, 33(2): 141-162. https://doi.org/10.1257/jep.33.2.141

Apeti, A., Basdevant, O., and Salins, V. 2023. Do Fiscal Rules Foster Fiscal Discipline in Resource-Rich Countries? IMF Working Paper WP/23/88. International Monetary Fund, Washington, DC

Al Jabri, S., Raghavan, M., Vespignani, J. (2022). Oil prices and fiscal policy in an oil-exporter country: Empirical evidence from Oman. *Energy Economics*, 111: 106103. https://doi.org/10.1016/j.eneco.2022.106103

Ardanaz, M., Cavallo, E., Izquierdo, A., Puig, J. (2021). The Output Effect of Fiscal Consolidations: Does Spending Composition Matter? IDB. Working Paper IDB-WP-1302. Washington, DC: Inter-American Development Bank. http://dx.doi.org/10.18235/0003881

Baldacci, E., Petrova, I., Belhocine, N., Dobrescu, G., Mazraani, S. (2011). Assessing fiscal stress. IMF Working Paper WP/11/100. Washington, DC: International Monetary Fund.

Banerjee, J. J. (2024). Inflationary oil shocks, fiscal policy, and debt dynamics: New evidence from oil-importing OECD economies. *Energy Economics*, 130: 107249. https://doi.org/10.1016/j.eneco.2023.107249

Bartolucci, F., Nigro, V. (2010). A Dynamic Model for Binary Panel Data with Unobserved Heterogeneity Admitting a √n-Consistent Conditional Estimator. *Econometrica*, 78(2): 719-733. https://doi.org/10.3982/ECTA7531

----------. (2012). Pseudo conditional maximum likelihood estimation of the dynamic logit model for binary panel data. *Journal of Econometrics*, 170(1): 102-116. https://doi.org/10.1016/j.jeconom.2012.03.004

Bartolucci, F., Nigro, V., Pigini, C. (2015). Testing for state dependence in binary panel data with individual covariate by a modified quadratic exponential model. *Econometrics Reviews*, 37(1): 61-88. https://doi.org/10.1080/07474938.2015.1060039

Baumeister, C., Hamilton, J. D. (2019). Structural interpretation of vector autoregressions with incomplete identification: Revisiting the role of oil supply and demand shocks. *American Economic Review*, 109(5), 1873-1910. https://doi.org/10.1257/aer.20151569

Berti, K., Salto, M., LeUyen, M. (2012). An early-detection index of fiscal stress for EU countries. European Commission, DG ECFIN - European Economy. Economic Paper 475. http://dx.doi.org/10.2765/28160

Baxter, M., King R. G. (1999) Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series. *Review of Economics and Statistics* 81(4), 575–593. https://doi.org/10.1162/003465399558454.

Blanchard, O. and Gali, J. (2010): The Macroeconomic Effects of Oil Price Shocks: Why are the 2000s so different from the 1970s? In: The International Dimensions of Monetary Policy, edited by J. Gali and M. Gertler. Chapter 7. http://www.nber.org/books/gert07-1

Blanchard O. and Riggi, M. (2013): "Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices. *Journal of the European Economic Association*, 11(5), 1032-1052.

Caldara, D., Iacoviello, M. (2022). Measuring Geopolitical Risk. *American Economic Review*, 112 (4):1194-1225. https://doi.org/10.1257/aer.20191823

Canty, A., Ripley, B. D. (2024). boot: Bootstrap R (S-Plus) Functions. R package version 1.3-30.

Caselli, F. and Reynaud, J. (2020): Do fiscal rules cause better fiscal balances? A new instrumental variable strategy. *European Journal of Political Economy*, 63, 101873.

Céspedes, L. F., & Velasco, A. (2014). Was this time different? Fiscal policy in commodity republics. Journal of Development Economics, 106, 92–106.

Chinn, M., Ito, H. (2006). What Matters for Financial Development? Capital Controls, Institutions, and Interactions. *Journal of Development Economics*. 81(1): 163-192. https://doi.org/10.1016/j.jdeveco.2005.05.010

Christiano, L., Fitzgerald, T.J. (2003). The bandpass filter. *International Economic Review*, 44 (2): 435-65. https://doi.org/10.1111/1468-2354.t01-1-00076

David, A., Leigh, D. (2018). A New Action-based Dataset of Fiscal Consolidation in Latin America and the Caribbean. IMF Working Paper WP/18/94. Washington, DC: International Monetary Fund.

Davison, A. C., Hinkley, D. V. (1997). Bootstrap Methods and Their Applications. Cambridge, UK: University Press. https://doi.org/10.1017/CBO9780511802843

Davoodi, H., Elger, P., Fotiou, A., Garcia-Macia, D., Lagerborg, A., Lam, R., Pillai, S. (2022). Fiscal Rules Dataset: 1985-2021. Washington, DC: International Monetary Fund.

Devries, P., Guajardo, J., Leigh, D., Pescatori, A. (2011). A New Action-based Dataset of Fiscal Consolidation. IMF Working Paper WP/1/128. Washington, DC: International Monetary Fund.

Drazen, A., Grilli, V. (1990). The Benefits of Crises for Economic Reforms. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w3527

Durand-Lasserve, O., Karanfil, F. (2023). Fiscal policy in oil and gas-exporting economies: Good times, bad times, and ugly times. *Energy Economics*, 126: 105739. https://doi.org/10.1016/j.eneco.2023.106987

Eyraud, L., Debrun, X., Hodge, A., Lledó, V., Pattillo, C. (2018). Second-Generation Fiscal Rules: Balancing Simplicity, Flexibility, and Enforceability. IMF Staff Discussion Note SDN/8/04. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9781484350683.006

Farzanegan, M. R. (2011). Oil revenue shocks and government spending behavior in Iran. Energy Economics, 33(6): 1055-1069. https://doi.org/10.1016/j.eneco.2011.05.005

Giavazzi, F., Pagano, M. (1990). Can Severe Fiscal Contractions Be Expansionary? Tales of Two Small European Countries. Cambridge, MA: National Bureau of Economic Research. http://doi.org/10.3386/w3372

Gomez-Gonzalez, J. E., Valencia, O. M., Sánchez, G. A. (2022). How fiscal rules can reduce sovereign debt default risk. *Emerging Markets Review*, 50: 100839. https://doi.org/10.1016/j.ememar.2021.100839

---------. (2024). Debt affordability in developed and emerging market economies: The role of fiscal rules. *Journal of Economics and Finance*, 48: 377-393. https://doi.org/10.1007/s12197-024-09660-3

Guajardo, J., Leigh, D., Pescatori, A. (2014). Expansionary Austerity? International Evidence. *Journal of the European Economic Association*, 12(4): 949-968. https://doi.org/10.1111/jeea.12083

Hamilton, J. (1983) Oil and the Macroeconomy since World War II. *The Journal of Political Economy*, 91, 228-248. https://doi.org/10.1086/261140

---------. (2018). Why You Should Never Use the Hodrick-Prescott Filter. *The Review of Economics and Statistics*, 100 (5): 831-843. https://doi.org/10.1162/rest_a_00706.

Hernaiz, D., Miller, S. J., Pedroni, P. (2018). A Structural Analysis of Commodity Price Fluctuations and Fiscal Performance. IDB, Discussion Paper No. IDB-DP-00613. Washington, D.C: Inter-American Development Bank. http://dx.doi.org/10.18235/0001272

Hernández de Cos, P., Koester, G., Moral-Benito, E., Nickel, C. (2014). Signaling fiscal stress in the euro area: A country-specific early warning system. Banco de España Working Paper No. 1418. https://dx.doi.org/10.2139/ssrn.2471464

IMF. (2023). World Economic Outlook, October 2023: Navigating Global Divergences. Washington, DC: International Monetary Fund.

Jordà, O., Taylor, A. M. (2016). The Time for Austerity: Estimating the Average Treatment Effect of Fiscal Policy. *The Economic Journal*, 126(590): 219-255. https://doi.org/10.1111/ecoj.12332

Känzig, D. R. (2021). The macroeconomic effects of oil supply news: Evidence from OPEC announcements. American *Economic Review*, 111(4): 1092-1125. https://doi.org/10.1257/aer.20190964

Kharroubi, E. and Smets, F. (2023): Energy shocks as Keynesian supply shocks – implications for fiscal policy. BIS Working Papers, No. 1120. Bank for International Settlements.

Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. American Economic Review, 99(3): 1053-1069. https://doi.org/10.1257/aer.99.3.1053

Kilian, L., Murphy, D. P. (2012). Why agnostic sign restrictions are not enough: Understanding the dynamics of oil market VAR models. Journal of the European Economic Association, 10(5): 1166-1188. https://doi.org/10.1111/j.1542-4774.2012.01080.x

---------. (2014). The role of inventories and speculative trading in the global market for crude oil. *Journal of Applied Econometrics*, 29(3): 454-478. https://doi.org/10.1002/jae.2322

Kim, G., Vera, D. (2019). Recent drivers of the real oil price: Revisiting and extending Kilian's (2009) findings. *Energy Economics*, 82: 201-210. https://doi.org/10.1016/j.eneco.2017.12.020

Kaufmann, D., Kraay, A. (2023). Worldwide Governance Indicators, 2023 Update. https://www.worldbank.org/en/publication/worldwide-governance-indicators

Majumder, M. K., Raghavan, M., Vespignani, J. (2022). The impact of commodity price volatility on fiscal balance and the role of real interest rate. *Empirical Economics* 63: 1375-1402. https://doi.org/10.1007/s00181-021-02168-3

Medina, L. (2016). The effects of commodity price shocks on fiscal aggregates in Latin America. IMF Economic Review, 64(3): 502-525. https://www.jstor.org/stable/45212117

Reyes-Loya, M. L., Blanco, L. (2008). Measuring the importance of oil-related revenues in total fiscal income for Mexico. *Energy Economics*, 30(5): 2552-2568. https://doi.org/10.1016/j.eneco.2008.02.001

Roch, F. (2019). The adjustment to commodity price shocks. *Journal of Applied Economics*, 22(1): 437-467. https://doi.org/10.1080/15140326.2019.1665316

Rueda-Lobato, D., Torres-Garcia, A. (2024). Heterogeneity in the nominal exchange rate response to oil price shocks in oil-exporting countries: A new episode of the 'fear of floating'? Applied Economics Letters, March: 1-5. https://doi.org/10.1080/13504851.2024.2331678

Scartscini, C., Cruz, C., Keefer, P., (2021). DPI2020 Database of Political Institutions: Changes and Variable Definitions. Washington, DC: Inter-American Development Bank. http://dx.doi.org/10.18235/0003049

Schaechter, M. A., Kinda, M. T., Budina, M. N., and Weber, A. (2012). Fiscal rules in response to the crisis: Toward the "Next-Generation" rules: A new dataset. International Monetary Fund. https://doi.org/10.5089/9781475505351.001

Spatafora, N., & Samake, I. (2012). Commodity price shocks and fiscal outcomes. IMF Working Paper WP/12/112. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9781475503333.001

Valencia, O., Díaz, J., Parra, D. (2022). Assessing Macro-Fiscal Risk for Latin American and Caribbean Countries. IDB Working Paper Series No. IDB-WP-1346. Washington, DC: Inter-American Development Bank. http://dx.doi.org/10.18235/0004530

Von Hagen, J., Strauch, R. (2001). Fiscal consolidations: Quality, economic conditions, and success. *Public Choice*, 109: 327-346. https://doi.org/10.1023/A:1013073005104

World Bank. (2023). World Development Indicators. Washington, DC: World Bank.

Zhang, Q., Yang, K., Hu, Y., Jiao, J., & Wang, S. (2023). Unveiling the impact of geopolitical conflict on oil prices: A case study of the Russia-Ukraine War and its channels. *Energy Economics*, 126, 106956. https://doi.org/10.1016/j.eneco.2023.106956

Appendix

Table A.1 Fiscal Adjustment Definitions Example

t	CAPB	Δ CAPB	Δ CAPB accumulated (>0)	Alesina & Ardagna (1998)	Ardanaz et al. (2021)	Proposed definition
0	0.0					
1	-1.5	-1.5		0	0	0
2	-5.0	-3.5		0	0	0
3	-3.8	1.3	1.3	0	1	1
4	-1.3	2.5	3.8	1	1	1
5	-0.8	0.5	4.3	0	0	1
6	-1.3	-0.5		0	0	0
7	-1.2	0.1	0.1	0	0	0
8	-0.6	0.6	0.7	0	0	0
9	0.0	0.5	1.2	0	0	0
10	0.2	0.2	1.4	0	0	0
11	-0.9	-1.0		0	0	0
12	-2.9	-2.0		0	0	0
13	-2.3	0.6	0.6	0	0	1
14	-1.8	0.5	1.1	0	0	1
15	-0.6	1.2	2.3	0	0	1
16	-1.6	-1.0		0	0	0

Note: The table shows the difference in fiscal adjustment episodes captured by the definitions of "fiscal adjustment" from Alesina and Ardagna (1998), Ardanaz et al. (2021), and the one proposed in this study.

Table A.2 Regression Results, Probit and Logit Models

	Probit	Logit	FE - Logit	PA - Probit
Fiscal adjustment =L	3.161***	1.854***	2.645***	1.884***
	(0.140)	(0.078)	(0.095)	(0.064)
Oil supply shock =L	-0.543***	-0.275***	-0.587***	-0.273***
	(0.192)	(0.102)	(0.167)	(0.096)
Oil specific demand shock =L	0.131*	0.065*	0.140*	0.065*
	(0.067)	(0.035)	(0.072)	(0.036)
Aggregate demand shock =L	0.991**	0.474*	1.112*	0.464
	(0.497)	(0.249)	(0.590)	(0.322)
Oil inventory demand shock =L	1.204***	0.733***	1.364***	0.735***
	(0.264)	(0.147)	(0.259)	(0.133)
Observations	1,981	1,981	1,776	1,981
Countries	85	85	76	85

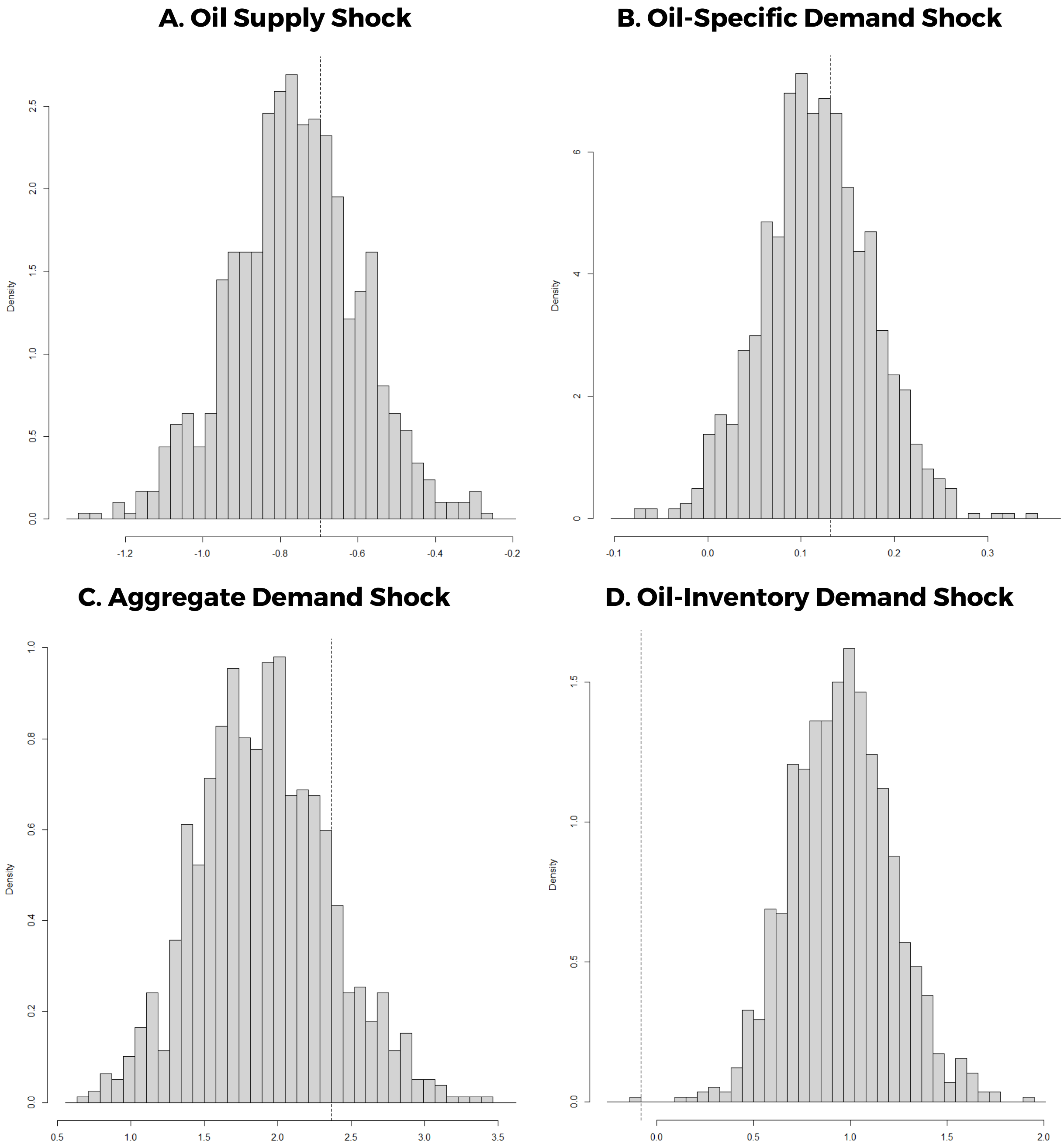
Note: Table shows the logit and probit regressions estimation of oil shock effects on fiscal adjustment probability. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses. FE stands for Fixed-Effects and PA for Population Averaged.

Table A.3 QE Regression Results Conditional on the State of the Economy by Filter

		Hodrick-Prescott	Baxter-King	Christiano-Fitzgerald	Hamilton
	Fiscal adjustment =L	3.216***	3.338***	3.384***	3.332***
		(0.167)	(0.173)	(0.174)	(0.174)
Bust	Oil supply shock =L	-0.406*	-0.458*	-0.651***	-0.575**
		(0.23)	(0.238)	(0.234)	(0.271)
	Oil specific demand shock =L	0.105	0.091	0.084	0.104
		(0.087)	(0.086)	(0.084)	(0.101)
	Aggregate demand shock =L	2.769***	3.029***	3.119***	3.004***
		(0.713)	(0.742)	(0.739)	(0.798)
	Oil Inventory demand shock =L	0.265	0.069	0.164	-0.239
		(0.41)	(0.401)	(0.42)	(0.482)
Boom	Oil supply shock =L	-1.452***	-1.698***	-1.502***	-0.953***
		(0.328)	(0.358)	(0.333)	(0.281)
	Oil specific demand shock =L	0.202	0.249*	0.279**	0.1
		(0.129)	(0.136)	(0.139)	(0.107)
	Aggregate demand shock =L	2.538***	3.482***	3.411***	3.366***
		(0.583)	(0.65)	(0.655)	(0.65)
	Oil inventory demand shock =L	-0.584	-0.944**	-0.988**	-0.489
		(0.47)	(0.472)	(0.453)	(0.419)
	Observations	1,797	1,762	1,766	1,725
	Countries	77	76	76	76

Note: Table 4 shows the QE regression estimation of oil shock effects on fiscal adjustment probability, interacting with the economic cycle. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses. Additional to the HP filter results presented use the filters by: Baxter and King (1999), Christiano and Fitzgerald (2003), Hamilton (2018).

Figure A.1 Bootstrapping Distribution



Note: Figure A.1 shows the distributions estimated with 1,000 bootstrap replicates of oil shock effects on fiscal adjustment. Dotted lines indicate original coefficients.

Table A.4 QE Regression Results, Controlling for Global Factors

	Baseline	**GRP**	**FED interest rate**
Fiscal adjustment =L	3.152***	3.142***	3.179***
	(0.156)	(0.156)	(0.159)
Oil supply shock =L	-0.698***	-0.711***	-0.402*
	(0.177)	(0.179)	(0.207)
Oil specific demand shock =L	0.131*	0.139*	0.112
	(0.072)	(0.074)	(0.072)
Aggregate demand shock =L	2.364***	2.358***	2.29***
	(0.464)	(0.462)	(0.473)
Oil inventory demand shock =L	-0.08	0.014	0.295
	(0.3)	(0.353)	(0.331)
Observations	1,944	1,944	1,944
Countries	85	85	85

Note: Table shows the QE regression estimation of oil shock effects on fiscal adjustment probability. * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. Robust standard errors in parentheses. The IMF program column shows results including IMF program lagged dummy, GRP includes Caldara and Iacoviello (2022) GeoPolitical Risk Index, and the last column includes Federal Funds rate.