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Abstract

We examine the behavior of expenditure policy during boom-bust in commodity price cycles, and its implication for real exchange rate movements. To do so, we introduce a Dutch disease model with downward rigidities in government spending to revenue shock. This model leads to a decoupling between real exchange rate and commodity price movement during busts. We test our model's theoretical predictions and underlying assumptions using panel data for 32 oil-producing countries over the period 1992 to 2009. Results are threefold. First, we find that change in current spending have a stronger impact on the change in real exchange rate compared to capital spending. Second, we find that current spending is downwardly sticky, but increases in boom time, and conversely for capital spending. Third, we find limited evidence that fiscal rules have helped reduce the degree of responsiveness of current spending during booms. In contrast, we find evidence that fiscal rules are associated with a significant reduction in capital expenditure during busts while responsiveness to boosts is more muted. This raises concerns about potential adverse consequences of this asymmetry on economic performance in oil-producing countries.

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I. INTRODUCTION

Resource-rich countries often experience large movements in their exports receipts as a result of sharp swings in commodity prices. Governments in resource rich countries are recipient of income flow from natural resource, and thus play an important role in how the resource related revenue is used and distributed.[1] In turns, those decisions may impact the competitiveness of those resource rich countries. The present paper investigates the behavior of expenditure policy during boom-bust in commodity price cycles and its implication for real effective exchange rate (REER) movements.

More specifically, the present paper documents and explains the limited downward adjustment in REER during commodity price busts. Figure 1 and Figure 2 in Appendix A show the evolution of the logarithm of the real effective exchange rate and the oil export unit value for respectively Nigeria and Venezuela over the period 1992 to 2009. The real exchange appreciates when the oil export unit value increases, as shown in Figures 1 and 2. The latter illustrates a well-documented phenomena often referred to as Dutch disease. In contrast, Figures 1 and 2 also show that oil price busts were not accompanied by commensurate decreases in the real exchange rate. To the extent of our knowledge, this phenomenon has not been studied.

This phenomenon is most likely rooted in political pressures that governments in resource rich countries face. Those pressures are such that it may be far easier to increase public expenditure during commodity price booms than to cut public expenditure during commodity price busts. In other words, bias in the fiscal response to commodity price shocks may explain the tendency for the level of the REER to remain elevated in commodity rich countries following a decrease in commodity prices. For the most part, commodity-rich countries continued to accumulate debt as public expenditure failed to adjust sufficiently downwards following commodity price decreases, as documented in Arezki and Bruckner (2010).

The implication of this asymmetry on the REER stems from the higher import content of public capital expenditure, and thus the limited impact of such expenditure on exchange rate appreciation relative to current expenditure such as on wage, subsidies and services. The higher domestic content of current expenditure spending however also means it is more susceptible to interest group lobbying, and the wage bill and subsidies particularly may be difficult to adjust downward due to the adverse impact this may have on the vulnerable segment of the population. Thus, commodity rich countries going through a commodity price bust may rely more on cuts in capital expenditure than in current expenditure. This results in a lesser adjustment to the real exchange rate than would have been the case under a more symmetric pattern of adjustment in public expenditure. In turn, this may have adverse consequences on non-resource tradable production, which

[1] Governments are often involved in the natural resource sector either through taxation, the sale of licenses to foreign companies, or more directly through government owned company.

may negatively affect the economic performance of resource rich countries over the medium- and long-term.

To illustrate that phenomenon more formally, this paper introduces a Dutch disease model with downward stickiness in public expenditure to revenue shock. This model leads to a decoupling between REER and commodity price movement during busts. We test our model's theoretical predictions and underlying assumptions using panel data for 32 oil-producing countries over the period 1992 to 2009. Results are threefold. First, we find that change in current spending have a bigger impact on the change in REER compared to capital spending. Second, we find that current spending is downwardly sticky, but increase in boom time and conversely for capital spending. Third, we find limited evidence that fiscal rules have help reduced the degree of responsiveness of current spending during booms. In contrast, we find evidence that fiscal rules are associated with a significant reduction in capital expenditure during busts while responsiveness to boosts is more muted, which raises concerns about potential adverse consequences on economic performance in oil-producing countries.

This paper is related to the literature on the Dutch disease. The theoretical literature on the Dutch disease has mainly focused on the implications of resource booms on the REER, as opposed to the implications of resource busts that we explore in this paper.[2] The most basic static Dutch disease models distinguish two effects namely the "spending effect" and "relocation effect". First, the spending effect relates to higher domestic incomes as a result of the boom leading to extra-expenditure on both traded and non-traded goods. In a small open economy, the price of traded goods is determined by international market conditions and so does not rise despite the extra-domestic spending; in contrast, the price of non-traded goods is set in the domestic market, and thus does rise. The higher relative price of non-traded goods makes domestic production of traded-goods less attractive, and so their output declines. A second effect emerges if, in addition, the booming sector shares domestic factors of production with other sectors, so that its expansion tends to bid up the prices of these factors. The resulting resource movement effect reinforces the tendencies towards appreciation of the REER (i.e. a rise in the relative price of non-traded goods and services) and a squeeze on tradable goods sector, a result commonly termed Dutch disease.

The empirical evidence for the Dutch disease are rather mixed and is mostly based on country case studies. Cross-country studies which found mixed evidence of the Dutch disease include Gelb and al. (1988), and Spatafora and Warner (1995). These studies find no evidence of Dutch disease in the manufacturing sector using various samples of oil-exporting countries. In contrast, Ismail (2010a) finds evidence of Dutch disease using industry sector data for oil-exporting countries, but with a relatively slow path of industrial adjustement to oil shocks.[3] Moreover, Ismail (2010b) finds no evidence that the slow response may be explained by capital adjustment costs.

[2] See Corden and Neary (1982), Corden (1984) and van Wijnbergen (1984) for early contributions.

[3] Rajan and Subramanian (2005) found some evidence that aid causes real appreciation and a relative shrinkage of the labor-intensive tradable sector in aid-receiving countries.

This paper examines the consequences of another rigidity, that is stickiness in public expenditure response to revenue shock.

This paper is also related to the literature on the political economy of fiscal policy. Most noticeably, Alesina and Perrotti (1994) provide a survey of the literature on politico-institutional determinants of the government budget.[4] They show evidence that the accumulation of large budget deficit in OECD during the 80s and 90s cannot be explained by standard models such as the 'tax smoothing' model. However, Alesina and Perrotti (1994) show that political economy models are better suited in explaining such developments. They thus argue that the design of fiscal institutions should account for those politico-institutional factors. More specifically, asymmetries in fiscal response to cyclical effects is examined in some work related to the deficit ceiling under the Stability and Growth Pact adopted by European Union member countries. Balasosone and Francese (2004) finds in a sample of OECD countries that budgetary balances were deteriorating in contraction and not improving in expansion. Melitz (2000) finds evidence in a sample of OECD countries that automatic stabilizers are weak relative to discretionary fiscal policy and finds periods of expansion to be accompanied by increased government expenditure.

The focus of our paper is exclusively on oil-producing countries. Oil-producing countries face large shocks due to the relative importance of the size of oil exports receipt to the size of these economies. As a result, oil-producing countries may face greater challenges than other countries, when adjusting to these fluctuations, given the stickiness in public expenditure. Also, focusing on oil-rich countries rather than all resource-rich countries ensures the relative homogeneity in the effects of boom-bust commodity price cycle on the REER and the expenditure composition. Indeed, a recent literature has shown the importance of not pooling commodities when analyzing the effects of resource rents on economic growth, as documented in Isham et al. (2005).

The remainder of the paper is organized as follows. Section II presents the theoretical model of Dutch disease with stickiness in government expenditure; Section III explains our estimation strategy and main empirical results; and Section V concludes.

II. Theoretical Model

In order to illustrate the impact of asymmetrical governments' fiscal responses to external shocks on the REER, we build a Dutch disease model with stickiness in government current spending. This stickiness may be explained by the costliness of fiscal adjustment politically, especially in the case of current expenditure cuts. Moreover, downward fiscal adjustment may be more difficult due to the presence of various groups that exert active lobbying toward the government, or where rent-seeking behavior is widespread. Also, downward fiscal adjustment may be a source of concern because of potential consequences on the vulnerable segment of the population, in

[4] See Eslava (2006) for a survey of the more recent work on the political economy of fiscal policy.

the absence of appropriate social safety nets. Thus our model includes two asymmetries; one asymmetry is between capital expenditure and harder-to-cut current spending in response to revenue shocks, and the other asymmetry is between the upward and downward flexibility of current spending. We model this rigidity in government's fiscal response using quadratic costs of adjustment.[5]

A. Assumptions

We consider a small open economy with two goods, a tradable good and a non-tradable government provided service. Consumption of tradable goods is without rigidity and free to adjust to shocks. We will assume that the government decides between two types of expenditure in its fiscal policy, current expenditure on non-tradable services and tradable capital goods. The idea that current expenditure typically have higher non-tradable content is not new. Eaton and Kortum (2001) has shown that most of the world's capital goods are produced in a small number of countries. Also, current expenditure transfers wealth to households through the public wage bill and subsidies, that in turn have a stronger impact on demand for non-tradable goods.

Moreover, we assume that non-tradables, which in our model are only provided by the government, are subject to convex costs of adjustment that may be with a directional bias. We normally expect the bias to be downwards implying that public expenditures on civil service, and other current expenditure, are more costly to reduce than to increase. This cost is what gives rise to smoothing of current expenditure adjustment. The real effective exchange rate in the model is the shadow price of non-tradable government provided services relative to the world price of tradable goods. Appendix B describes in greater details the structure of the model and Figure 3 and Figure 4 illustrate the results of our model simulations.

B. Structure

The key component of the model that illustrates the stickiness in fiscal policy is given by the social planner problem

$$\max \int_0^\infty \frac{C_t^{1-1/\sigma} + \psi G_t^{1-1/\sigma}}{1-1/\sigma} \exp(-\rho t)dt$$

subject to the intertemporal budget constraint.

$$\dot{F} = rF_t + p_t G_t + \omega(\dot{G} - \nu)^2/2 + C_t - T_t - E_t N_t$$

[5] Engel and Valdés (2000) also uses quadratic costs of adjustment to model fiscal policy frictions.

Where C and G are respectively the government consumption of tradable and non-tradable goods, ρ is the discount rate, σ is the elasticity of substitution, F is the stock of debt, r is the interest rate, p is the relative price of non-tradable goods (i.e the real exchange rate), T is the production of tradables, and N_t is the value of natural resource wealth at time t.

The parameters ω scales the quadratic costs of adjustment and as ω increases, adjustments become smoother leading to higher persistence in non-tradable current expenditure as fiscal policy adjusts to shocks. The parameter ν introduces a persistent bias towards positive growth in government current expenditure, when $\nu > 0$. For the special case, when $\omega = 0$ and $\nu = 0$ we get the benchmark permanent income hypothesis model with no persistence or asymmetry in fiscal adjustment as G adjusts instantly.

C. Results of Model Simulations

The model illustrates asymmetry and smoothness in the adjustment in government non-tradable goods spending. One particular feature, however, is that slow government non-tradable adjustment tends to crowd in/out capital expenditure since in the short-term tradable consumption is free to adjust pro-cyclically to shocks. In the case of a persistent expansionary fiscal policy (i.e $\nu > 0$) the result is that government current spending permanently crowds out capital expenditure, leaving C lower in steady state.

In order to illustrate the impact of a permanent shock in resource price to the model, we simulate the model under the following parameters. We assume $\alpha = 0.6$, $\beta = 0.5$. Moreover, we assume $\psi = 0.5$ and $r = \rho = 0.04$, $\omega = 0.5$, and the coefficient of relative risk aversion, $\sigma = 2$. We express the present value of the resource as

$$E_t N_t^p = E_t \int_t^{\infty} \mathscr{P}_t \mathscr{N}_t exp(-\rho t) dt$$

Where $\mathscr{P}_t$ is the resource price and $\mathscr{N}_t$ is the extracted quantity at time t. We assume in this simulation that a permanent shock in the permanent price takes place after which the price remains constant, adjusting directly from $\mathscr{P}^*$ to $\mathscr{P}^{**}$ at $t = 0$. We also assume that there is no uncertainty to the resource deposit.Thus the increase in the present value of the resource stock is

$$N_t^p = (\mathscr{P}^{**} - \mathscr{P}^*) \int_t^{\infty} \mathscr{N}_t exp(-\rho t) dt = \varepsilon_p \int_t^{\infty} \mathscr{N}_t exp(-\rho t) dt$$

We now consider the dynamics between the two steady states. Since there is no rigidity to tradable consumption, C jumps upon anouncement of the new price to the new steady state C^{**}. $rN_t^p - rF^t$ jumps upon the anouncement of the new price to the new steady state value as well with

$\mathscr{W}_t = rN_t^p - rF^t$ remaining constant throughout as government borrows and save against the value of the resource deposit so as to keep the expression constant. This is while crowding out the consumption of tradable goods as the non-tradable sector smoothly expands towards the new steady state.

In this simulation, we normalize the total stock of natural resource $\int_t^\infty \mathscr{N}_t exp(-\rho t)dt = 10$ (equal to 10 years of full employment in one sector). We start at $\mathscr{P}^* = 1$ with the economy at steady state. We simulate the model for the case when there is no asymmetry between upward and downward adjustment (i.e $\nu = 0$), and for a case with asymmetry. Moreover, without loss of generality, we assume here that the government started with zero net foregin debt. For the simulation results without and with asymmetry (using $\nu = 0$ and $\nu = 0.2$ respectively) in response to a positive (negative) resource price shocks (i.e $\varepsilon_p = 0.5$ (-0.5))), see Figure 3 and Figure 4 in Appendix C.

The results show that, in the case of existence of asymmetry between upward and downward adjustment, the steady state values for non-tradable spending and the REER are elevated relative to the case without such asymmetry. Additionally, the results also show that the decline in spending on non-tradables and the REER following a resource price bust is lower under asymmetry. On the other hand, capital (tradable) spending is more sensitive to revenue shocks. Thus, the asymmetry results in shifting the weight of adjustment towards capital (tradable) goods leaving current (non-tradable) expenditure less affected.

We now turn to testing the underlying assumption of the above model and its theoretical predictions. We first present our data and our empirical strategy.

III. Data and Empirical Strategy

A. Data

The table in Appendix D provides a description of the variables used in our empirical analysis. In the following, we will focus on the variables originating from a recently released dataset on oil-producing countries. The other variables used in our analysis are standard ones, and their description is thus circumscribed to Appendix D. We use Villafuerte et al.'s (2009) dataset for two main variables namely government spending composition and country specific oil price available for 32 oil-producing countries between 1992 to 2009. The data was collected through IMF internal surveys of country desk economists for all oil-producing countries, where fiscal oil revenue accounted for at least 20 percent of total fiscal revenue in 2004 and for which sufficient information was available.[6] The sample period and country coverage of Villafuerte et al. (2009) in turn dictates the size of the overall sample used in this paper.

[6]The countries included in the sample are Algeria, Angola, Azerbaijan, Bahrain, Bolivia, Brunei, Cameroon, Chad, Republic of Congo, Ecuador, Equatorial Guinea, Gabon, Indonesia, Islamic Republic of Iran, Kazakhstan,

Our measure of oil price is the oil export unit value taken from Villafuerte et al. (2009). Specifically, the unit export value of oil was constructed using the international crude oil price interacted with a country-specific discount factor that captures the quality of crude oil extracted from a given country. The oil export unit value can therefore be decomposed into two components: (i) the international crude oil price that is common to all oil producing countries, and (ii) the country-specific discount factor that captures the quality of crude oil driven by (exogenous) geological factors. Because we control in our empirical analysis for common year fixed effects (see Section [3] below), identification of the impact of oil price on outcome variables comes from the interaction between the international oil price and the country-specific discount factor. Any variation in oil price that are exclusively due to variation in the international oil price will therefore be fully captured by the common year fixed effect.

We also use government current and capital spending taken from Villafuerte and al. (2009). We argue that such distinction between current and capital spending allows us to proxy the spending content of each category in tradable and non-tradable goods. In turn, the spending content in non-tradable mediates the relationship between spending and real exchange rate. As stated earlier, the import content of current spending is likely to be limited. Current spending consists in wage bill, subsidies and services that are likely to be directed toward non-tradable goods, which supply is likely to be inelastic at least in the short term. In contrast, the import content of capital spending is likely to be relatively larger.

B. Empirical Strategy

In the following, we describe our empirical strategy to isolate the boom-bust cycle on spending, and its implication for REER. First, describing our methodology to distinguish booms and busts. Second, we describe the empirical model specification and estimators used in this paper.

C. Price Decomposition

In order to account for the asymmetrical response of the REER to oil price boom-bust cycles, we use a price decomposition drawn from the energy demand literature that emphasizes the asymmetrical responses of energy demand to price increases and decreases.[7] We use the following three-way decomposition of the oil export unit value: the cumulating series of increases in the maximum historical price, the cumulating series of price cuts, and the cumulating series of price

Kuwait, Libya, Mexico, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, Sudan, the Syrian Arab Republic, Timor-Leste, Trinidad and Tobago, United Arab Emirates, Venezuela, Vietnam, and the Republic of Yemen.

[7]For background, see Dargay (1992), Gately (1992, 1993).

recoveries (sub-maximum increases in price). The decomposition is as follows:

$$oev_{i,t} = oevmax_{i,t} + oevmin_{i,t} + oevrec_{i,t}$$

where $oevmax_{i,t}$ consists in the cumulative increases in maximum historical oil unit export value for country i at time t; it is monotonically non-decreasing that is $oevmax_{i,t} \geqslant 0$. $oevmin_{i,t}$ consists in the cumulative decreases in oil unit export value; it is monotonically non-increasing that is $oevmin_{i,t} \leqslant 0$. $oevrec_{i,t}$ consists in the cumulative sub-maximum increases in oil export value; it is monotonically non-decreasing that is $oevrec_{i,t} \geqslant 0$. For illustration purposes, Figure 5 in Appendix E depicts the dynamic of the logarithm of the oil export unit value *oev* and its decomposition into three price series over time.

D. Specifications and Estimators

We now explain our estimation strategy that allows us to estimate the effect of country-specific changes in the three components of oil price on country-specific changes in government spending.[8] We distinguish between two types of changes in the logarithm in spending, $\Delta ln(spending)$, namely current spending, $\Delta lncep$, and capital spending, $\Delta lncax$. Specifically, we estimate the model:

$$\Delta ln(spending)_{it} = \alpha_i + \gamma_t + \beta_{max}\Delta ln(oevmax)_{it} + \beta_{min}\Delta ln(oevmin)_{it} + \beta_{rec}\Delta ln(oevrec)_{it} + \gamma X_{it} + u_{it}$$

where α_i are country fixed effects that capture unobservable time-invariant country characteristics, and γ_t are year fixed effects that capture shocks common to all countries such as global business cycles. The parameter estimates β_j for $j \in \{max, min, rec\}$ reflects therefore the marginal effect that country-specific changes in the logarithm of oil price components have on country-specific changes in spending. Other control variables X_{it} varying at the country-year level that we include in our empirical analysis, as a robustness check, are the first difference in logarithm of GDP, $growthppp$, which controls for the change in overall economy income; and lagged difference in logarithm spending $\Delta ln(spending)_{t-1}$, which allows for persistence in omitted variables. We present estimates using least squares estimation but also system-GMM estimation (Blundell and Bond, 1998) to deal with possible biases arising from the estimation of dynamic panel data models in the presence of fixed effects. The error term unit is clustered at the country level and may hence be arbitrarily serially correlated within countries.

With regard to the coefficients associated with the oil unit export value sub-components, we expect that:

[8] The discussion of the strategy to estimate the effect of country-specific changes in the two components of government spending, namely current spending, *lncepus*, and capital spending, *lncax*, on the change in the logarithm of real effective exchange rate, *lnereer*, is very similar to that one and is thus omitted.

$\beta_{max} > 0$ that is spending responds to change in *oevmax*.

$\beta_{min} > 0$ that is spending responds to change in *oevmin*; It should be noted that $oevmin < 0$.

$\beta_{rec} > 0$ that is spending responds to change in *oevrec*.

Normally we would expect that, in absolute values, $\beta_{rec} < \beta_{min} < \beta_{max}$. That is, we expect that overall spending to rise more rapidly when oil price rises than it would decrease when oil falls, and rise most rapidly when a new maximum in oil price is reached. Also, we would expect that current spending would respond less to new lows than capital spending. We now turn to the estimation results.

IV. Estimation Results

A. Composition of Spending and the Real Exchange Rate

Table 1 summarizes our estimation results of the link between within-country variation in the two components of spending and within-country variation in REER. Column (1) shows the least squares estimates, where control variables are country fixed effects as well as year fixed effects (both jointly significant at the 1 percent level). The obtained point estimate on measure of change in current spending is 0.242, which is statistically significant at the 1 percent level. The obtained point estimate on measure of change in capital spending is about 0.055, which is statistically significant at the 5 percent level. Because higher real effective exchange index indicates an appreciation of the currency, the point estimate in column (1) implies that a 1 standard deviation increase respectively in current and capital spending lead to an increase in the real effective exchange by respectively about 0.33 and 0.13 standard deviations. In columns (2) and (3), we show that this link between current spending and REER remains statistically significant when controlling for lagged value in current spending (to account for the non-contemporaneous effect of current spending on real exchange rate) and within-country variation in the level of income per capita. However, columns (2) and (3) confirms that the impact of change in capital spending on REER is much smaller than for current spending, the former becomes statistically insignificant when controlling for lagged spending in column (2). Those results confirm that increases in spending associated with non-tradables, namely current spending, are associated with higher increases in the level of REER.[9]

We furthermore document the robustness of our static panel estimates to dynamics in REER by including the lagged change in real exchange rate as an additional control, see columns (4) and (5). We present both least squares estimates as well as system-GMM (Blundell and Bond, 1998)

[9] For equations (1) to (3), we are able to reject that the coefficient associated with current expenditure variable is equal to the coefficient associated with capital expenditure at least at the 95 percent confidence level.

estimates as least squares estimates of dynamic panel data models are biased in the presence of country fixed effects.[10] We find, however, that regardless of whether least squares or system-GMM estimation is used that the lagged dependent variable enters as statistically significantly positive, implying an impact of a shock to REER at time t would take about 0.9 years to dissipate by one-half for oil exporters. We also find that within-country increases in current spending continue to exhibit statistically significant and larger effects than capital spending on within-country changes in the level of real exchange rate.[11]

B. Boom and Bust Cycle and Spending Responses

We now turn to exploring the behavior of those two components of spending in response to boom and bust cycle in oil price. Table 2 and Table 3 summarize our estimation results of the link between within-country variations in the three components of oil price on within-country variations in respectively current and capital spending. Column (1) and (2) in both Tables 2 and 3 show the least squares estimates and columns (3) in both tables shows the estimates using system-GMM estimation. Column (2) includes as additional control the changes in GDP in purchasing power parity. Column (3) includes as additional control a lagged dependent variable. In Table 2, the obtained point estimates on the changes in new highs in oil price range from 0.277 in column (3) to 0.376 in column (2), which are statistically significant at the 10 percent and 5 percent level respectively. The obtained point estimates of the changes in the other two components of oil price have the expected relative values but are not statistically significant. In Table 3, the obtained point estimates on the change in new lows in oil price range from 0.840 in column (3) to 1.507 in column (1). The obtained point estimates of the change in the other two components are not statistically significant. Those results suggest that current spending increase significantly when the oil price reaches new highs but does not significantly decrease when the oil price reaches new lows. In contrast, capital spending decreases when the oil price reaches new lows, but does not significantly increase when the oil price reaches new highs.

C. Fiscal Rules and Government Spending

As a result of past episodes of excessive spending following oil price shocks, several oil-producing countries have committed to impose numerical constraints on various budget aggregates (e.g. pri-

[10] A further advantage of the system-GMM estimation is that the use of past first differences as instruments for the levels of the right-hand-side variables reduces concerns that estimates on our coefficients (for current and capital spending and GDP) are biased due to their endogenous response to within-country changes in REER. First order and second order serial correlation tests and the Hansen test on over-identifying moment conditions indicate that the estimated models are correctly specified.

[11] We have also checked whether our results are sensitive to outliers by applying the Grubbs test. Dropping those observations deemed as outliers by the Grubbs test yielded statistically significant point estimates on current spending that were quantitatively larger than the estimates reported in Table 1 (results not shown).

mary (structural) deficit, debt, expenditure, etc..) that we refer to as fiscal rules.[12] These rules may impact the degree to which expenditure can adjust to oil prices. Fiscal rules may cushion the impact of oil prices on fiscal policy depending on the degree of government's commitment to those rules. However, political pressure or creative accountive as pointed by Milesi-Ferretti (2003) may hinder the effectiveness of those rules in cushioning the impact of oil shock on the economy. It is therefore an empirical question to test whether those rule have been effective for oil producing countries. We expect consolidation measures to force cuts both in current and capital expenditure. We also expect cuts to be higher in capital expenditure due to the ease of these cuts relative to current expenditure as discussed above.

In the following, we allow for heterogeneity in the effect of the boom and bust cycle in oil price on spending. Indeed, we explore whether the existence of fiscal rules affects the relationship between government spending and boom and bust cycle in oil price. To do so, we used a dummy taken from Ossowski and al. (2007) that takes the value of 1 if any fiscal rules are in place and 0 otherwise. We calculate the average of that dummy variable over the sample period in order to perform a sample split using a cut-off of 0.5 over the sample period. Tables 4 to 7 show the results of the same regressions performed previously for two country groups depending on whether they have in place fiscal rules. Those results present limited evidence that fiscal rules tend to reduce the increase in current spending during booms. The comparison of column (3) in Tables 4 and 5 shows that the coefficient associated with the oil price new highs is positive and statistically significant for countries with no fiscal rules but is not statistically significant for countries with fiscal rules. Tables 6 and 7 shows the results our estimation of the impact of boom and bust cycles on capital spending for the two groups of countries. Results suggest that countries with fiscal rules significantly reduce their capital spending during busts as shown in Table 7, where the coefficients associated with our measure of new lows are systematically significant at the 1 percent significance level. For countries with no fiscal rules, we find that during busts those countries have reduced capital spending, but results are less robust as shown in column (1) of Table 6, where the coefficient associated with our measure of new highs is not statistically significant.[13] These results suggest that the implementation of fiscal rules in oil-producing countries has resulted in limited results in terms of reduction in current spending during booms, but it may have led to systematic reduction of capital spending during busts. This evidence can be a source of concern for oil-producing countries that crucially need investment to diversify their economies away from oil production, and would benefit from a reversal of the Dutch disease in the wake of an oil bust.

[12]See Ossowski and al. (2008) for a description of fiscal institutions in oil-producing countries.

[13]In order to formally test whether the estimated coefficient associated with oevmin in the sample of countries without fiscal rule is significantly different from the estimated coefficient in the sample of countries with fiscal rule, we applied a generalized form of the Chow test that allows for arbitrary within-country serial correlation of the error term. The results of the tests suggest that we could not reject that the the coefficients associated with oevmin in tables 6 and 7 are the same.

D. Endogeneity Issues

In the following, we discuss the issue of simultaneity bias that may arise in the REER equation that was estimated above. Indeed, an appreciation in the REER reflects a change in relative price between tradables and non-tradables. As a result of the change in relative prices, the government will buy less of non-tradables for the same unit of tradables. If the substitution effect dominates the income effect, the government spending will be tilted toward more tradable/capital goods. That is likely to cause a bias downward in the least square estimation of the coefficient associated with current spending in the REER equation presented in the previous section. In order to address that issue, we used instrumental variables techniques.[14] Our estimation of the spending behavior in response to boom and bust cycle in oil price provides natural instruments for current and capital spending in the REER equation. Namely, we use *oevmax* to instrument current spending and *oevmin* to instrument capital spending. The results of the second stage do not provide evidence of a causal impact of spending on real effective exchange rate. However, various F-tests indicates that the instruments used in the first stage are weak thus casting doubts on the validity of such estimation results.

V. Conclusion

We examine the behavior of expenditure policy during boom-bust cycle, and its implication for REER movements. To do so, we introduce a Dutch disease model with downward stickiness in government current spending, which we assume is non-tradable intensive relative to capital expenditure. In turn, this model leads to a relative decoupling between real exchange rate and commodity price movement during busts. We test our model's theoretical predictions and underlying assumptions using panel data for 32 oil producing countries over the period 1992 to 2009. Results are threefold. First, we find that within-country variation in current spending have a stronger impact on the within-country variation in REER compared to capital spending. Second, we find that current spending is downwardly rigid, but increase in boom time and conversely for capital spending. Third, we find mixed results showing that fiscal rules have helped reduce the degree of responsiveness of current spending during booms. In contrast, we find evidence that fiscal rules are associated with a significant reduction in capital expenditure during busts while responsiveness to boosts is more muted. This raises concerns about potential adverse consequences on the long-term economic performance of oil-producing countries. Moreover, the lack of downward adjustment in real effective exchange rate during commodity busts may have consequences on the economic performance of resource rich countries.

[14] Lagged values used as instrument for our control variables in the GMM estimations may not satisfy the exclusion restriction, especially in light of the potential rigidity in government spending.

One possible recommendation for policy makers would be to limit increases in across the board spending during boom times. That limitation would render less difficult curbing spending during bust times. In fact, many resource rich countries have put in place fiscal institutions to help rein their government spending during boom times. However, policy makers should tailor those new fiscal institutions to account for the rigidity in current spending during busts. That will avoid the crowding out of capital spending that is crucially needed in many of those resource rich countries. It should be noted, however, that the effectiveness of those fiscal institutions relies crucially on the ability of governments in resource rich countries to design and put in place checks and balances to prevent rent seeking (see Keefer and Knack (2007)) and limit creative accounting (see Milesi-Ferretti (2003)).

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APPENDIX A. ILLUSTRATION OF PERSISTENCE OF REAL EXCHANGE RATE EVOLUTION DURING OIL BOOMS AND BUSTS

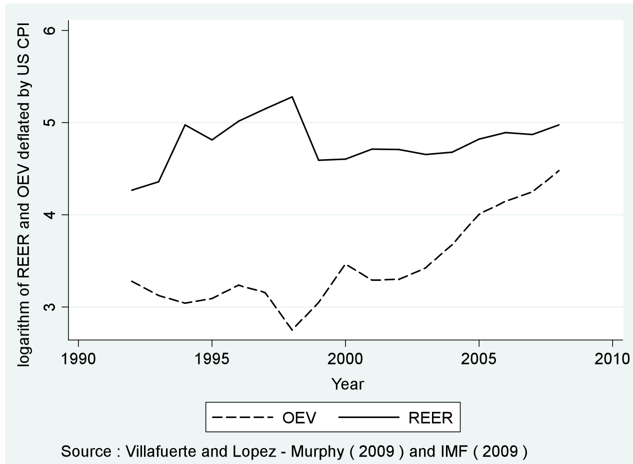


Figure 1. Evolution of Nigeria's REER and Oil Export Unit Value

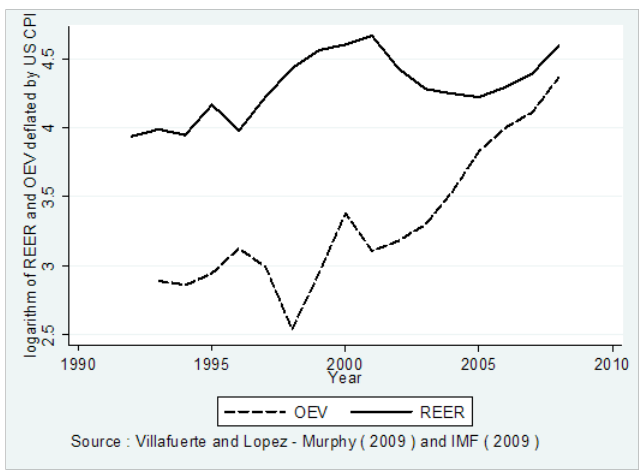


Figure 2. Evolution of Venezuela's REER and Oil Export Unit Value

Appendix B. Model

B.1. Production

We consider a small open economy with two goods, a tradable good and non-tradable government provided services. Production can be described as follows.

$$\begin{aligned} T_t &\equiv L_{T,t}^{\beta} \\ G_t &\equiv L_{G,t}^{\alpha} \\ L_{T,t} + L_{G,t} &\equiv 1 \end{aligned}$$

We normalize the tradable world price as 1 and assume that the government non-tradable good costs p which can be offered free to the households or consumed as a public good. In this small open economy, since G is the non-tradable good, its price p is the real exchange rate. The market clearing condition for labor is given by.

$$p_t \alpha L_{G,t}^{\alpha-1} = \beta L_{T,t}^{\beta-1}$$

B.2. Fiscal Policy

We assume that the social planner solves this problem.

$$\max \int_0^{\infty} \frac{C_t^{1-1/\sigma} + \psi G_t^{1-1/\sigma}}{1-1/\sigma} \exp(-\rho t) dt$$

subject to the intertemporal budget constraint.

$$\dot{F} = rF_t + p_t G_t + \omega(\dot{G} - \nu)^2/2 + C_t - T_t - E_t N_t$$

Where F_t is the stock of external debt for the economy and N_t is resource windfall at time t. The intuition behind $\omega(\dot{G} - \nu)^2/2$ is that it is the political costs of adjustment of fiscal policy, with ν being the downward bias of costs of adjustment that results in a higher cost of cutting fiscal policy than for raising it.

The Hamiltonian for the model is constructed as

$$\mathscr{H}_t(C_t, G_t, F_t) = \frac{C_t^{1-1/\sigma} + \psi G_t^{1-1/\sigma}}{1-1/\sigma} + \lambda_t [rF_t + p_t G_t + \omega(\dot{G}_t - \nu)^2/2 + C_t - T_t - E_t N_t]$$

The above results in the following first order condition.

$$G_t^{-1/\sigma} + \lambda(p_t + \omega(\dot{G}_t - \nu) + \frac{\beta(1-G_t^{1/\alpha})^{\beta-1} G_t^{\frac{1-\alpha}{\alpha}}}{\alpha}) = 0$$

$$C_t^{-1/\sigma} + \lambda_t = 0$$

$$\dot{\lambda} = \lambda_t(\rho - r)$$

To simplify the expression above note that $p_t = \chi(G_t) = \frac{\beta(1-G_t^{1/\alpha})^{\beta-1} G_t^{\frac{1-\alpha}{\alpha}}}{\alpha}$This leads to

$$G_t = (\frac{\psi}{2p_t + \omega(\dot{G}_t - \nu)})^{\sigma} C_t$$

The model is based on the permanent income approach to the current account. Here we assume $\rho = r$ such that there is no consumption tilting (i.e $\dot{C} = 0$). In this model, following the announcement of a permanent increase in the resource price, the present value of windfall flows rise, causing the government to increase G however it does so over time so as to limit the adjustment costs of public finance. To finance the expenditure the government first accumulates debt against the collateral of resource deposits, then accumulate surpluses large enough so as to have an asset stock whose return pays for the steady state government expenditure and import consumption.

In the long run, after the resource depletes (i.e $N_t = 0$), $p^* G^* + \frac{\omega \nu^2}{2} + C^* - T^* = -rF^*$. Due to the absence of consumption-tilting, We also have

$$p_t G_t + \omega(\dot{G} - \nu)^2/2 - T_t = -rF^* - C^*$$

substituting in the labor market clearing condition we get

$$p_t G_t + \omega(\dot{G} - \nu)^2/2 - (1 - G_t{}^{1/\alpha})^{\beta} = -rF^* - C^*$$

with the general path of fiscal adjustment given by

$$p_t G_t + \omega(\dot{G} - \nu)^2/2 - (1 - G_t{}^{1/\alpha})^{\beta} = rN_t^p - rF_t - C_t$$

where N_t^p is the present value of the current natural resource deposit given by $\int_t^{\infty} N_t exp(-\rho t) dt$.

This means that the path of adjustment in fiscal policy shows stronger adjustment in the beginning and flattening near the end (concave adjustment in the case of resource boom, and convex in the case of resource bust). In the case of a downward adjustment to N_t^p , when $\nu > 0$, the movement in left hand side is more limited in the short term than it would have been for an upward adjustment.

By extension the same asymmetry in adjustment follows to downward adjustment in p_t. This is clear from differentiating the labor market clearing condition, which shows an appreciating real exchange rate with the increase in the government non-tradable expenditure.

Lets assume the country starts at $t = 0$ with $F = 0$. Then at the steady state, as the resource depletes, the sovereign fund should equal the present discounted value of the deposit at $t = 0$, meaning $rF^* = rN_0^p$. This means that the steady state, upon substitution of the production function for T and the market clearing condition into the Hamiltonian's first-order conditions, can be described by

$$G^* = \frac{rN_t^p - \frac{\omega v^2}{2} + (1 - G^{*1/\alpha})^\beta}{(\frac{\psi}{2p_t - \omega v})^\sigma + p^*} \tag{1}$$

$$C^* = \frac{rN_t^p - \frac{\omega v^2}{2} + (1 - ((\frac{\psi}{2p^* - \omega v})^\sigma C^*)^{1/\alpha})^\beta}{(\frac{\psi}{2p^* - \omega v})^\sigma + 1} = (\frac{2p^* - \omega v}{\psi})^\sigma G^* \tag{2}$$

Upon Substituting in equation (1) and equation (2), we get

$$p^* = \frac{\beta(1 - G_t^{1/\alpha})^{\beta - 1} G_t^{\frac{1-\alpha}{\alpha}}}{\alpha} \tag{3}$$

Now we consider the implementation of the resource price into the model. Lets say the resource price rises due to a permanent shock (here we abstract from global supply and global demand driven shocks, since the model is of a small open economy). The direct effect of a resource price permanent increase (decrease) is an increase (decrease) in N_t^p, which subsequently leads to higher (lower) government public spending, consumption and the real exchange rate.

The solution plots over time

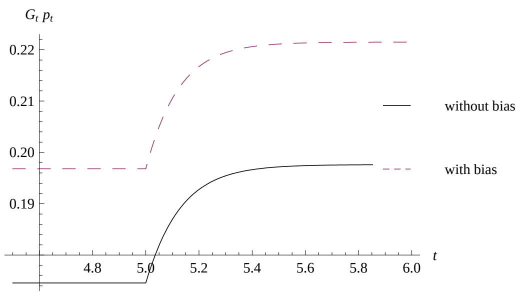
$$\frac{\beta(1 - G_t^{1/\alpha})^{\beta - 1} G_t^{\frac{1-\alpha}{\alpha}}}{\alpha} + \omega(\dot{G} - v)^2/2 - (1 - G_t^{1/\alpha})^\beta = \mathscr{W}^{**} - C^{**}, G_0 = G^*$$

Where $\mathscr{W}^{**}$ is the post-shock the amoritized present value of the country's rent on resource wealth net of debt, and C^{**} is the steady state of tradable spending post-shock.

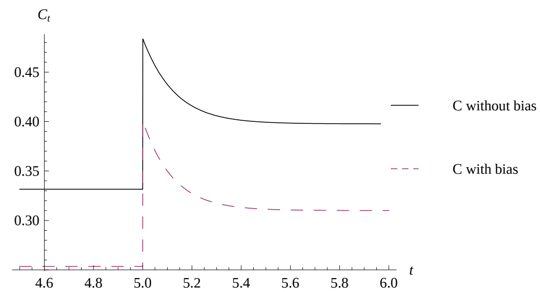
APPENDIX C. SIMULATION RESULTS

C.1. Positive Impulse to Natural Resource Price

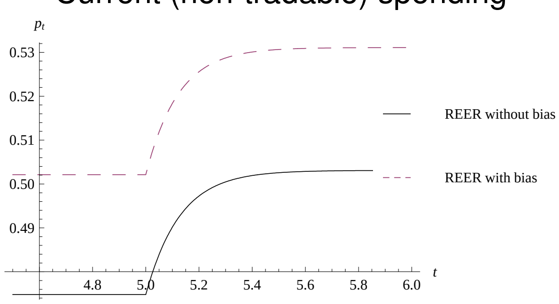
Figure 3. Adjustment to a 50 Percent Permanent Windfall Increase



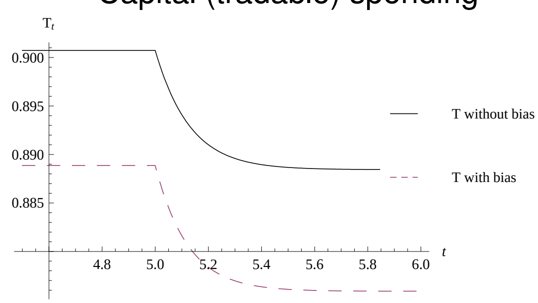
Current (non-tradable) spending



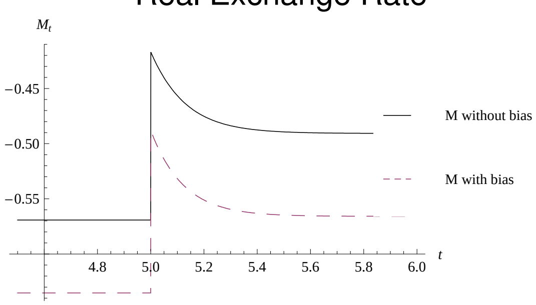
Capital (tradable) spending



Real Exchange Rate



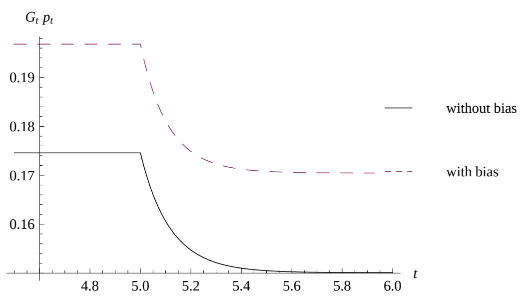
Non-Mineral tradables production



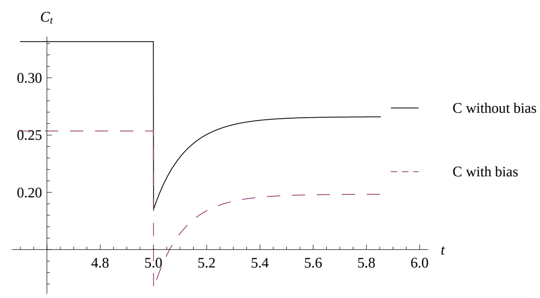
Imports

C.2. Negative Impulse to Natural Resource Price

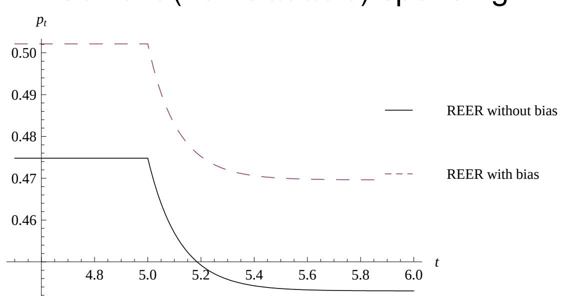
Figure 4. Adjustment to a 50 Percent Permanent Windfall Decrease



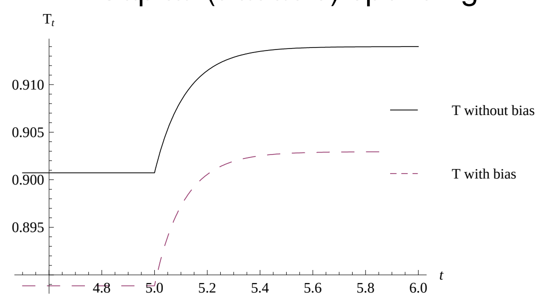
Current (non-tradable) spending



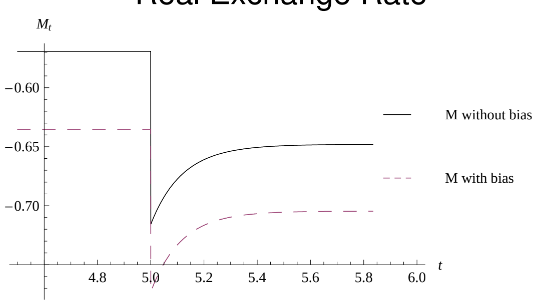
Capital (tradable) spending



Real Exchange Rate



Non-Mineral tradables production



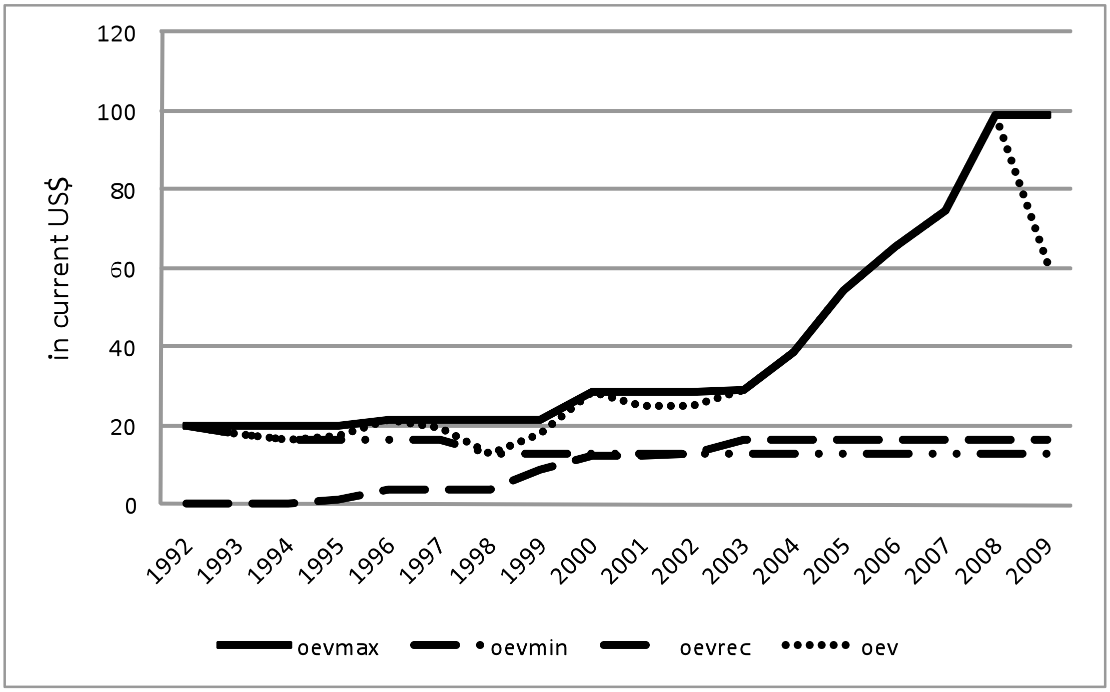
Imports

Appendix D. Data Sources

Code	Description	Source
oev	Oil export unit value (US$/barrel)	Villafuerte and Lopez-Murphy (2009)
cepus	Central government current (primary) expenditures (US$)	Villafuerte and Lopez-Murphy (2009)
cepusppp	Central government current (primary) expenditures (Constant International US$ PPP adjusted)	Villafuerte and Lopez-Murphy (2009) and World Bank (2009)
caxus	Central government capital expenditures (US$)	Villafuerte and Lopez-Murphy (2009)
fiscalrule	Fiscal rule is captured by a dummy variable that takes value of 0 if fiscal institution original dummy is on average below 0.5. The variable is equal to 1 if fiscal institution dummy is on average above 0.5.	Ossowski and al. (2008)

APPENDIX E. PRICE DECOMPOSITION

Figure 5. Decomposition of the Oil Export Unit Value



APPENDIX F. RESULTS

Table 1. The Effect of Government Current and Capital Expenditures on the Real Effective Exchange Rate

	D.lnereer				
VARIABLES	(1)	(2)	(3)	(4)	(5)
	LS	LS	LS	LS	GMM-SYS
D2.lnereer				0.471^{***} (0.0206)	0.461^{***} (0.0196)
D.lncepus	0.242^{***} (0.0703)	0.278^{***} (0.100)	0.237^{***} (0.0701)	0.0909^{*} (0.0527)	0.0837^{*} (0.0440)
D2.lncepus		-0.0270 (0.0494)			
D.lncaxus	0.0545^{**} (0.0221)	0.00464 (0.0308)	0.0550^{**} (0.0223)	0.0212 (0.0164)	0.0243^{*} (0.0202)
D2.lncaxus		0.0114 (0.0105)			
growthpcppp			0.131 (0.158)		
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	449	420	421	424	424
R-squared	0.220	0.254	0.231	0.600	
Number of countries	31	31	31	31	31

Note: Robust standard errors in parentheses, $***\ p < 0.01$, $**\ p < 0.05$, $*\ p < 0.1$

Table 2. The Effect of Oil Unit Export Value's Components on Government Current Spending

	D.lncepusppp		
VARIABLES	(1)	(2)	(3)
	LS	LS	GMM-SYS
D2.lncepusppp			0.465^{***}
			(0.00877)
D.lnoevmax	0.338^{*}	0.376^{**}	0.277^{*}
	(0.169)	(0.176)	(0.152)
D.lnoevmin	0.121	0.152	0.0128
	(0.279)	(0.292)	(0.174)
D.lnoevrec	0.00103	0.00289	−0.000177
	(0.00984)	(0.0105)	(0.00640)
growthppp		0.362^{*}	
		(0.209)	
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	388	388	366
R-squared	0.100	0.109	
Number of countries	31	31	31

Note: Robust standard errors in parentheses, $***\ p < 0.01$, $**\ p < 0.05$, $*\ p < 0.1$

Table 3. The Effect of Oil Unit Export Value's Components on Government Capital Spending

	D.lncaxus		
VARIABLES	(1)	(2)	(3)
	LS	LS	GMM-SYS
D2.lncaxus			0.430^{***}
			(0.0163)
D.lnoevmax	-0.0247^{*}	0.204	0.248
	(0.434)	(0.437)	(0.284)
D.lnoevmin	1.306^{***}	1.507^{***}	0.840^{***}
	(0.378)	(0.427)	(0.310)
D.lnoevrec	−0.00214	0.00713	−0.00708
	(0.0260)	(0.0249)	(0.0211)
growthppp		1.677^{***}	
		(0.451)	
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	452	394	430
R-squared	0.165	0.186	
Number of countries	31	31	31

Note: Robust standard errors in parentheses, $*** \ p < 0.01$, $** \ p < 0.05$, $* \ p < 0.1$

F.1. Results for Country Grouping by Fiscal Rule

Table 4. The Effect of Oil Unit Export Value's Components on Government Current Spending For Countries with No Fiscal Rules

	D.lncepusppp		
VARIABLES	(1)	(2)	(3)
	LS	LS	GMM-SYS
D2.lncepusppp			0.464^{***} (0.00908)
D.lnoevmax	0.358 (0.302)	0.404 (0.301)	0.574^{**} (0.257)
D.lnoevmin	0.0365 (0.349)	0.00723 (0.332)	0.141 (0.180)
D.lnoevrec	−0.00680 (0.0216)	−0.00469 (0.0211)	0.0106 (0.0117)
growthppp		0.226 (0.168)	
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	189	189	179
R-squared	0.081	0.086	
Number of countries	15	15	15

Note: Robust standard errors in parentheses, $***\ p < 0.01$, $**\ p < 0.05$, $*\ p < 0.1$

Table 5. The Effect of Oil Unit Export Value's Components on Government Current Spending For Countries with Fiscal Rules

	D.lncepusppp		
VARIABLES	(1)	(2)	(3)
	LS	LS	GMM-SYS
D2.lncepusppp			0.490***
			(0.00741)
D.lnoevmax	0.289	0.312	−0.00497
	(0.201)	(0.215)	(0.0935)
D.lnoevmin	0.207	0.489	−0.503
	(0.445)	(0.530)	(0.451)
D.lnoevrec	0.00959	0.0115	−0.0125**
	(0.0130)	(0.0166)	(0.00489)
growthppp		0.770*	
		(0.425)	
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	192	192	180
R-squared	0.185	0.220	
Number of countries	15	15	15

Note: Robust standard errors in parentheses, $***\ p < 0.01$, $**\ p < 0.05$, $*\ p < 0.1$

Table 6. The Effect of Oil Unit Export Value's Components on Government Capital Spending For Countries with No Fiscal Rules

	D.lncaxus		
VARIABLES	(1)	(2)	(3)
	LS	LS	GMM-SYS
D2.lncaxus			0.473***
			(0.0163)
D.lnoevmax	0.611	0.964	0.502
	(0.823)	(0.849)	(0.617)
D.lnoevmin	1.429	1.289*	0.814*
	(0.818)	(0.663)	(0.460)
D.lnoevrec	0.00129	0.0141	−0.00954
	(0.0288)	(0.0317)	(0.0246)
growthppp		1.544**	
		(0.604)	
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	209	193	199
R-squared	0.185	0.204	
Number of countries	15	15	15

Note: Robust standard errors in parentheses, $***\ p < 0.01$, $**\ p < 0.05$, $*\ p < 0.1$

Table 7. The Effect of Oil Unit Export Value's Components on Government Capital Spending For Countries with Fiscal Rules

	D.lncaxus		
VARIABLES	(1)	(2)	(3)
	LS	LS	GMM-SYS
D2.lncaxus			0.436^{***}
			(0.0278)
D.lnoevmax	-0.536	-0.309	0.0125
	(0.603)	(0.515)	(0.241)
D.lnoevmin	1.112^{***}	1.890^{***}	1.018^{***}
	(0.225)	(0.578)	(0.194)
D.lnoevrec	-0.0136	-0.00667	-0.00398
	(0.0470)	(0.0419)	(0.0301)
growthppp		2.078^{**}	
		(0.767)	
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	235	194	223
R-squared	0.217	0.268	
Number of countries	15	15	15

Note: Robust standard errors in parentheses, $*** \ p < 0.01$, $** \ p < 0.05$, $* \ p < 0.1$