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Oil Prices and the Fiscal Policy Response in Oil-Exporting Countries

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Abstract

This paper empirically investigates the role that oil prices play in determining fiscal policy in oil-exporting countries. We derive and estimate a fiscal policy equation that links government spending not only to oil price shocks, but also to oil price volatility and the skewness of oil price changes. We find that in the long run, higher oil prices induce larger government size. In the short run, however, government expenditures rise less than proportionately to the increase in oil revenues, reflecting increasing prudence in fiscal policy in oil producing countries. This result is robust to using a variety of specifications of the oil price shock, and to using different sample periods.

1. Introduction

Fiscal dependence on the hydrocarbon sector and a relatively weak non-oil tax base renders fiscal management highly challenging in oil-exporting countries. The history of oil price shocks since the first oil shock in the 1970s suggests that oil price cycles are unpredictable and that oil prices are volatile. This translates into uncertainty about future government revenues. In contrast, a trend of rising oil prices tends to alleviate the immediate pressure on the fiscal authority to adjust fiscal policy and reduces the urge for fiscal prudence. These features can have important implications on the macroeconomic performance and stability of these economies.

In dealing with such challenges, most oil producers have sovereign wealth funds that act as a savings and a stabilization fund. The main purpose of these funds is to hedge against the volatility of oil prices and the depletion of the resource in the future. Experiences of many oil producers have shown that managing these funds is challenging, even under the most prudent fiscal rules such as in Norway (Davis et al., 2001; Ossowski et al, 2008; Ploeg and Harding, 2009).

Understanding the responses of government spending to the changes in oil prices and their increasing volatility can therefore inform policy makers on the importance of stabilization funds and the extent to which these funds have succeeded in insulating spending from the volatile revenues. To shed some light on the degree of prudence of fiscal policy in oil-producing countries, our paper derives and estimates a fiscal policy reaction function -- in terms of government expenditures relative to GDP-- for a panel of sixteen oil-producers. Our main objective is to study the fiscal implications of not only changes in oil prices, but also their high volatility and asymmetric distribution.

A number studies have investigated the optimal fiscal policy for oil-exporting countries (See: Hausmann et al., 1993; Liuksila et al., 1994; Steigum and Thøgersen, 1995; Chalk, 1998; Engel and Valdes, 2000; Leigh and Olters, 2006; Pieschacon, 2008; and Ploeg and Venables, 2009). Fewer studies, however, investigated how fiscal policy in such countries actually responds to oil price shocks and volatility. Similarly, some studies concluded that oil prices influence fiscal policy and that can be a key propagation mechanism for transmitting oil price shocks to the domestic economy (Husain et al, 2008; Pieschacon, 2009; Arezki and Ismail, 2010). Ossowski et al (2008) emphasizes the trade-offs between increasing spending -- in response to higher oil prices -- and the institutional ability to effectively and efficiently absorb such an increase. They find that while the latest oil boom (2004-2008) allowed oil-producing countries to increase public spending, these countries had relatively low indices of government effectiveness. In addition, some studies provided evidence on the procyclicality of government expenditures in oil producing countries (Fasino and Wang, 2002; Husain et al., 2008; Villafuerte and Lopez-Murphy, 2010). One major reason is that, in many oil-producing countries, fiscal policy is guided by the public policy objective of creating more public sector employment and increasing the citizen's incomes as a means of sharing the oil revenue (Chemingui and Roe, 2008).

Our study extends the above-mentioned literature by taking a more general approach to capturing the policy response to oil shocks in that it identifies three channels through which fiscal policy reacts to oil prices: (i) oil price shocks; (ii) oil price volatility; and (iii) the skewness of oil price changes. To get to that specification, we first develop a dynamic general equilibrium model in which the social planner's long run objective is to maximize the present value of the expected utility from the country's future oil revenue stream. We show that government spending not only responds to oil price shocks, but also to oil prices volatility and the skewness of oil price changes. We then empirically estimate these responses and discuss their policy implications.

The remainder of this paper is organized as follows. The next section presents the theoretical model and derives a fiscal policy reaction function. In section three, we present the empirical model and methodology and describe the data. Section four presents the empirical results. Section five concludes.

2. The Theoretical Model

Our objective is to investigate the fiscal policy response to changes in oil prices in oil exporting countries by estimating an empirical policy equation. Such a task first requires constructing a theoretical framework to understand how policymakers will respond to oil price changes in an intertemporal framework. We start with a dynamic representative agent model with a social planner determining optimal government expenditures and then use this model to derive a fiscal policy reaction function. We then use that theoretical equation as the basis for specifying our empirical fiscal policy equation. In what follows we summarize the main features of the model.[1] Our goal is to derive a policy equation to which identifies the ways in which oil price changes can affect policy formation. We then use the model to estimate and interpret the impact of oil prices on fiscal policy.

The model has a household sector and a government sector, tied together with goods and asset market equilibrium conditions. Production in the economy consists of oil output and non-oil output. The private sector output fluctuates in response to changes in real oil prices reflecting the fact that despite diversification efforts, the non-oil sector in oil exporting countries closely follows the ups and downs in oil revenues. All oil revenue goes to the government, so real oil output represents government revenues.

There is one, infinitely-lived, risk-averse, individual agent that can either consume or accumulate assets in the form of government bonds. The private sector can import (export) consumption goods such that the trade balance is zero at the beginning of every period. The private agent maximizes her expected life-time utility from the future consumption stream subject to an intertemporal budget constraint. Finally, the government finances its spending through revenue from oil and borrowing on financial markets and faces a conventional intertemporal budget constraint.

A social planner maximizes utility from government spending subject to the intertermporal budget constraint. The model is closed with two equilibrium conditions, one for the goods market and one for the financial market.

In order to derive the government's fiscal reaction function, we start with the Euler equations for consumption and government spending. Both variables co-vary in response to the exogenous common oil price shock. Solving the two Euler equations along with the equilibrium conditions dictating the time path of government spending yields an equation in the gross growth of government spending as a function of the government's discount rate, $\tilde{\rho}$, the private discount rate, $\tilde{\beta}$, the growth in consumption, g_t^C, and the variance of oil price shocks, $\sigma_{\tilde{p}_t}^2$:

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[1] The full model and the derivation of the equations are presented in an appendix available from the authors upon request.

$$E_t \ln(1+g_t^G) = \tilde{\beta} - \tilde{\rho} + E_t \ln(1+g_t^C) - \frac{\rho\alpha\delta}{\beta}\sigma_{\tilde{p}_t}^2 \quad (1)$$

Carroll and Kimball (1996) and (2001), show that a log-linearized Euler equation would miss important parameters of the distribution of future income, namely all the non-linear parameters. Therefore to capture potential nonlinear effects of higher order terms of the distribution of oil prices which might affect government spending, we employ a third order Taylor approximation to equation (1). In addition, we replace the unobservable expectations for government and consumption growth with their realizations: $g_t^G = \bar{g} + \delta\,\tilde{p}_t$ for government spending and $g_t^C = \bar{g}_{yp} + \alpha\,\tilde{p}_t$, for consumption; where $\bar{g}$ and $\bar{g}_{yp}$ represent the deterministic portions of government spending and consumption growth, respectively and $\tilde{p}$ is the oil price shock. These two steps yield equation (2) as follows:

$$g_t^G = (\tilde{\beta} - \tilde{\rho}) + g_{ypt} + (\delta + \alpha)\tilde{p}_t + \left[\frac{\delta^2}{2} - \frac{\beta\alpha^2 + 2\rho\alpha\delta}{2\beta}\right]\sigma_{\tilde{p}t}^2 + \frac{\alpha^3 - \delta^3}{3}\lambda_{\tilde{p}t} \quad (2)$$

$\lambda_{\tilde{p}} = E[\tilde{p}]^3$ is a measure of the skewness of oil price shocks.

Equation (2) serves as the basis of our empirical investigation in the subsequent sections. It specifies that the expected growth of government expenditure is determined by: (i) the growth rate of the non-oil sector; (ii) changes in oil prices; (iii) the volatility of oil prices as measured by their variance; and (iv) the skewness of oil price changes.

3. The Empirical Methodology and Data

Our baseline model includes three classes of explanatory variables which affect the growth in government spending and size. First, country-specific effects, such as the differential between the private sector and the government discount rates. The second group of variables captures the effect of the growth in the non-oil private sector. The empirical model captures this effect by including a set of variables that represent the major factors that determine growth in the private sector output. In particular, we include private investment in capital goods (measured by gross capital formation minus government gross capital formation- as a ratio of GDP), human capital accumulation (measured by school enrolment ratios), openness to trade (measured by the sum of imports and exports relative to GDP), and inflation (measured by the growth in the CPI).

The third group, which is central to our investigation, is the set of variables associated with oil prices. The model includes three different channels through which oil prices affect fiscal policy: oil price shocks, the volatility of oil prices, and the skewness of oil price shocks.

In order to focus on the policy implications of our model, we also control for the differences in institutional qualities and exchange rate regimes. So, we use an index that measures the quality of civil institutions and the respect for private liberties, and a fixed exchange rate regime indicator. In addition, we allow for the lagged response of government spending to the model's explanatory variables and for time-specific shocks that are common to all countries.

3.1 The Econometric Methodology

Consider the following dynamic panel-data model:

$$g_{it}^{G} = \alpha g_{it-1}^{G} + X_{it}B + W_{it}\Gamma + \eta_i + \tau_t + \xi_{it} \tag{3}$$

Where, X_{it} is a vector of oil price variables and their lags, W_{it} is a vector of control variables and their lags, η_i is an unobserved time-invariant country-specific effect, τ_t is time-specific country-common shock and ξ_{it} is an error term. Β and Γ are vectors of coefficients to be estimated, and α captures the adjustment to previous period's growth in spending.

A major concern in estimating the above model is that some explanatory variables in the fiscal response equation, such as private investment and inflation, could be endogenously determined. In dealing with endogeneity, one serious problem is the difficulty of finding *good* instruments. Therefore, we employ the dynamic GMM difference estimator developed by Arellano and Bond (1991) which generates internal instruments utilizing the appropriate lags of the instrumented variables. In addition, the GMM estimation pools the data utilizing the full panel dimension; and hence does not place restrictions on the length of each individual time series in the panel.

Despite the above-mentioned advantages and flexible framework, the dynamic panel GMM approach has important shortcomings. First, it pools the individual groups, allowing only the intercepts to vary across groups. But, as argued by Pesaran and Smith (1995), Im, Pesaran, and Shin (2003), and Pesaran, Shin, and Smith (1997 & 1999), the assumption of homogeneity of slope parameters may not be appropriate when the time dimension of the panel is not short. In addition, the GMM difference technique purges any potential long-run relationship among the model's variables. This can be of particular significance to our investigation since government spending and oil prices are potentially related through a long run common trend that guides their movements in the long run.

Because of these potential drawbacks, we also follow a second estimation approach that allows for a long-run relation between government expenditure and the explanatory variables, in addition to heterogeneity in the slope parameters. Among the few techniques offered by the recent literature on dynamic heterogeneous panels is Pesaran, Shin, and Smith's (1997 & 1999) Pooled Mean-Group estimator (PMG). The PMG estimator will allow us to determine whether a long-run relationship exists between government spending and oil prices and estimate the speed of adjustment back to equilibrium for each individual group, and to check the robustness of our core short run results after taking into account panel heterogeneity and after removing cross section interdependence

We use the PMG to estimate the following error correction model:

$$g_{it}^{G} = \Phi_i S_{i,t-1} + \sum_{s=1}^{n} \lambda_{is}^{'} g_{i,t-s}^{G} + \sum_{j=1}^{m} \delta_{ij}^{'} \Delta X_{i,t-j} + \gamma_i^{'} Z_{it} + \mu_i + \varepsilon_{it}$$

and,

$$S_{i,t-1} = G_{i,t-1} - \theta^{'} X_{i,t-1} \qquad (4)$$

where, G_{it} is government spending (as a ratio of GDP) and g_{it}^{G} is its growth; $S_{i,t-1}$ is the deviation from long run equilibrium at any period for group *i*, and Φ_i is the error-correction (speed of adjustment) coefficient. The vector $\theta^{'}$ captures the long-run coefficients of interest which do not vary across groups; these coefficients represent government expenditure's *long run* elasticity with respect to each variable in $X_{i,t-1}$ where the latter is a vector of variables that is expected to affect government spending growth both in the short run and in the long run.[2] The short run responses of the *X* variables are captured by the vector $\delta^{'}$; Z_{it} is a vector of control

[2] Fitting the model to each individual group, the PMG requires sufficiently long individual series. But, since the longest series in our panel covers 33 years, we use the results from our previous GMM estimations to reduce the model and estimate a parsimonious error correction model.

variables that is expected to affect government size growth only in the short run and γ' is its short run coefficients.[3] μ_i is group-specific effects and ε_{it} is the error term.

3.2 The Data

Our sample comprises 16 oil-exporting countries: Algeria, Bahrain, Cameroon, Colombia, Egypt, Indonesia, Iran, Kuwait, Malaysia, Mexico, Nigeria, Norway, Oman, Syria, UAE, and Venezuela. The annual-frequency data covers all or part of the period 1972-2007, depending on data availability. Data on government spending, budget surplus, and government's gross capital formation are obtained from the IMF's *GFS*. Country scores on civil liberties are obtained from the annual *Freedom in the World survey*, available from Freedom House.[4] The rate of inflation, GDP, gross fixed capital formation, school enrolment ratios, and imports and exports ratios are obtained from the World Bank's *WDI*. The exchange rate regime dummy takes the value one when a country adopts a fixed exchange rate regime and zero otherwise. This indicator is constructed based on the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*. Finally, the world's average monthly, quarterly, and yearly crude oil prices for the extended period 1957-2008, are obtained from the IMF's *IFS*.

The annual real oil prices are used to construct the changes in oil prices as our baseline measure of oil price shocks.[5] In addition, the literature on oil price shocks offers some well known specifications of the shocks. We thus also use the specifications suggested by Lee, Ni, and Ratti (1995) and Hamilton (1996 and 2003). First, we reconstruct Lee, Ni, and Ratti's (1995) "standardized oil price increase", using the monthly oil price data in a GARCH (1, 1) model.

. Second, we use quarterly oil prices to identify Hamilton's "net oil price increase" as the max $\{0, p_t - \max(p_{t-1}, p_{t-2}, p_{t-3}, p_{t-4})\}$. So, a shock in the current quarter is identified when there is a net price *increase* this quarter over the *highest* price that prevailed in the previous four quarters. The yearly shocks are then defined as the highest such a net increase in the four quarters of that particular year. Finally, for the volatility explanatory variable we use the

[3] Two points are worth noting. First, the vector z will only include all other variables that are not in *X*, but were found significant from the GMM difference estimations. Second, this vector will be lagged one time period to deal with the potential endogeneity of some explanatory variables such as openness and inflation.
[4] The description and the survey are available at: http://www.freedomhouse.org/template.cfm?page=15 .

[5] On the yearly frequency, the percentage change in oil prices is serially uncorrelated and is stationary.

(monthly) conditional standard deviation generated from the above GARCH (1, 1) model. The yearly-frequency is the maximum conditional standard deviation in the 12 month of a particular year. We also use the monthly real oil prices to construct a yearly measure of skewness of oil price changes that varies across years.

4. The Empirical Results

We first present the results obtained from the GMM dynamic panel estimation followed by the long run evidence and the results from the PMG heterogeneous panel estimation. Tables 1 and 2 present the results from the GMM difference estimation.[6] All estimations include one lag in differences.[7]

The first column of table 1 shows the results from the estimation of our baseline model. In the subsequent estimation (column 2), we extend the model to control for the differences in the qualities of civil institutions, inflation, and the exchange rate regime. Across the specifications checks, we find the following general results for the oil price variables. First, we find that a positive oil price shock leads to a decline in the ratio of government spending relative to the size of the economy. We discuss this result in detail below, but note that this result does *not* mean that higher oil revenues lead to lower absolute levels of government spending. Rather it means that some of the additional revenue from an oil price increase goes to improve the fiscal balance. Next, we find evidence that an increase in the volatility of oil price changes reduces government spending relative to GDP. This is consistent with a prudence motive on the part of government policymakers. Finally, we find that fiscal policy does respond to the positive skewness in oil price changes. This means that government spending relative to the size of the economy increases as positive oil price changes are expected more than negative changes.

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[6] For all estimations the Arellano-Bond test for second order serial correlation is insignificant; hence the null of no second-order autocorrelation cannot be rejected. Similarly, the Sargan test is insignificant suggesting the validity of the instruments.

[7] One concern in estimating the model for the extended period 1972-2007 is the stability of the parameters. That is: the short run responses could be driven by the response to few extremely large positive price shocks. Therefore, we check the robustness of our results by considering the sub-period of relatively low oil prices and negative shocks: (1982-2003). In so doing, we exclude the periods of surging oil prices in 1970s and after 2003. The results from this subperiod confirm our results for the full period.

We discuss the policy implications of these results below but we first briefly review the results for the control variables. Higher inflation has a relatively small, but significant, negative effect on spending growth. Also better quality of civil institutions lowers the growth in government size. This may be because governments in countries with stronger institutions and rule of law are more likely to be more accountable to the public, and to have more transparent spending. Openness to trade has a positive effect on government spending. The choice of exchange rate regime also plays a significant role in determining fiscal policy outcomes in oil exporting countries. Countries which adopted fixed exchange rates experienced, on average, faster growth in government spending relative to GDP.[8] Lastly, changes in private capital formation and school enrolment ratios do not seem to trigger any significant short run responses in government spending and both variables are dropped from all subsequent estimations.

4.1. Policy Implications of the Estimated Model.

Because we have taken a broad approach to estimating the relationship between oil price and fiscal policy, we can produce some interesting insights into the challenging policy choices faced by oil-producing countries. A primary concern for fiscal policy in these countries is determining how much of current oil revenue should be spent on current government expenditure and how much should be "saved" for future policy actions.[9] Fiscal policy in at least some oil producing countries has begun to focus on the concept of the long-run sustainability of the policy with the goal of preparing the economy for the periods after depletion of oil reserves For example, oil-producing countries showed more prudence in response to the positive price shocks in the 2000s which occurred after a long period of low real oil prices. In the most extreme version of this approach, the "bird-in-the-hand" approach, all oil revenue is "saved" in the form of financial assets and only the return on these assets is spent. Not that if this policy were to be followed, then there would be virtually no change in current expenditure from a positive oil price shock despite a positive long-run relationship between oil prices and spending levels. Medas and Zakharova (2009) argue that Norway, for example, follows this approach. A less extreme and

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[8] The conventional wisdom is that fixed exchange rate regimes induce fiscal prudence which is essential to defend the peg and prevent balance of payments deterioration. See, Tornell and Velasco (2000) for a different view.

[9] In this context, government "saving" takes the form of improving the fiscal balance of the overall and/or non-oil government budget.

more broadly discussed approach is the permanent oil income model, which is the fiscal policy analog to the permanent income model of consumption. In this approach, only the "permanent" portion of an oil revenue increase is consumed in the current period with the rest saved for expenditures in future years.

The negative coefficient that we find on oil price changes in our empirical model reflects this choice of how to respond to oil shocks among oil-exporting countries. A positive oil price change will increase GDP and government revenue. The government then must choose how much of the revenue generated by the oil price increase will be "spent," in the form of an increase in current expenditures. The impact of that choice will be reflected in the ratio of government expenditures to GDP, which is the dependent variable in our policy equation. Our estimated negative coefficient implies that oil producing countries do "save" a portion of the additional revenues generated by an oil positive price shock and even though government expenditures rise, they do not rise as fast as GDP. Thus, our results are consistent with previous analyses that found fiscal policy to be procyclical in oil producing countries (a rise in oil prices stimulates both GDP and government expenditure). In addition, our results imply that government spending does not fall as fast as oil revenues following an oil price decline as governments attempt to sustain social spending and public sector employment.

To gain additional policy insight, we simulate our model to identify the key factors that determine how much of the additional oil revenue is "saved." We find that the higher the dependence of an oil producer's economy on the oil sector, the more a current price increase will be reflected in higher current expenditure. In addition, this effect is magnified when government expenditures are large relative to GDP. For example, if we calibrate the model for Norway, it predicts that Norway "saves" virtually all of the additional revenue generated by a positive oil price shock, which is entirely consistent with its "bird-in-the-hand" approach to sustainability. Of course, this is possible for Norway because it has a sizeable non-oil sector that it uses to finance a relatively high level of government expenditure. Kuwait, in contrast, is very dependent upon oil and our model predicts that it would increase current spending by about 18 percent of the revenue generated by the oil shock. This is well above the percentage implied by the permanent income model and raises questions about the sustainability of fiscal policy.

In addition, countries that spend a large portion of the revenues generated by positive oil shocks increase their vulnerability to oil price declines. Because they have a relatively small buffer, oil price declines require these countries to either sharply cut government expenditures during recession or run substantial budget deficits which put additional pressure on future oil revenues. Because of the historical volatility in oil prices, reducing the responsiveness of current government expenditures to oil price shock not only enhances the likelihood of achieving sustainability but also fulfills a precautionary motive for fiscal policy.[10]

Next, we probe deeper into the effect of the volatility of oil prices on fiscal policy. Our initial results found a modest negative response to an increase in oil price volatility, reflecting a degree of risk aversion by fiscal policy authorities. We also consider a non-linear relationship between government spending and volatility. In particular, we test two hypotheses. The first is that government spending may respond differently to higher volatility at different levels of inflation. The second hypothesis is that a fixed exchange rate regime may induce fiscal prudence the greater is the level of oil price volatility. To do this, we add two interaction terms to the model; the first is between inflation and volatility and the second is between the fixed exchange rate dummy and volatility. The results are shown in column (3) of Table 1. The interaction term of inflation and oil price volatility turned out to be insignificant, while the interaction term between the fixed exchange rate dummy and volatility is significantly negative. This result indicates that countries which adopt a fixed exchange rate regime are more prudent when oil prices become more volatile, especially at periods of low oil prices.[11]

4.2. Checking the Robustness of the Results.

We now turn our attention to checking the robustness of our results to the change in the specification of the oil price shocks. Table 2 presents the results from replicating the estimation using alternative oil price variables. In column (1) we use the simple log difference in oil prices as our baseline oil price shock. The underlying assumption of using this linear definition is that

[10] Our model produces one additional piece of evidence on the precautionary motive. We test for whether the responsiveness in spending depends upon the state of the budget by including a dummy variable that is positive if the government's budget was in surplus the year before the oil price shock. Column (3) of Table 1 shows that the coefficient on the dummy variable is positive and significant, signifying the government spending response more to an oil price increase when the fiscal balance is positive than it does when the fiscal balance is negative. This suggests that when they are running fiscal deficits, oil producing countries are more likely to use additional oil revenues to improve their fiscal balance.

[11] This effect is robustly significant in all estimations where only the sub-period of 1982-2003 is considered.

government spending responds symmetrically to both negative and positive changes. In the subsequent columns (2) and (3) we use Hamilton's shocks, and Lee-Ni-Ratti's shocks, respectively. In columns (4) and (5) we split the simple changes into positive changes and negative changes, respectively. While the first three specifications assume that only positive shocks matter, the fourth maintains the opposite assumption.

All results, regardless of the specification, show government size responding negatively to oil price shocks in the short run.[12] With one exception, the core results remain significant and with the appropriate sign. Volatility, however, seems to lose its significance. Finally, the evidence from Table 2 does not suggest any significant asymmetric fiscal responses to oil price shocks.

4.3. Long Run and PMG Results

We consider panel heterogeneity and the potential long run equilibrium relations in this section. We first conduct panel unit root tests which are presented in Table 3. Maddala and Wu's (1999) test, which is sensitive to the existence of cross-sectional dependence, indicates that all variables are non-stationary in levels except for private investment to GDP ratio and the inflation rate which appear to be stationary. However, after removing the effect of cross-sectional correlation among groups, Pesaran's (2007) cross-sectional IPS test can not reject the null of non-stationarity for all variables. Both panel unit root tests reject the null of unit root for all variables in first differences, indicating stationarity in first differences. Therefore, we conclude that all variables are integrated of the first order in levels and are stationary in first difference. We thus proceed to testing for cointegration.

[Insert Table 4]

[12] We, also perform a battery of robustness checks. In particular, we check the results' sensitivity to the volatility generated regressor (the *conditional* standard deviation from a univariate GARCH (1,1) model). As an alternative measure of volatility, we consider the yearly *unconditional* standard deviation of the changes in oil prices in the 12 month pertaining to that specific year. We also slightly alter the definition of skewness. We use the non-overlapping yearly skew of past year's 12 month oil price changes instead of the overlapping 36 month. None of these changes significantly alter our core results. In addition to the year dummies that pick the effects of time-specific country common shocks, we include a dummy for countries heavily dependent on oil in the sample. This indicator was highly insignificant and its inclusion did not disturb the results. We then replicate Table 2 for the sub-sample 1982-2003. Again, all core results still hold.

The results from testing alternative cointegrating vectors are presented in Table 4. All four tests, strongly support a cointegration relation between government spending and oil prices. In addition, the panel tests and one out of the two group-mean tests provide evidence that there is a long run cointegtration relation between government spending and the quality of civil institutions. For all other variables, the tests can not reject the null of no cointegration. Therefore, we consider two possible cointegrating vectors in the PMG estimation. The first includes government spending to GDP ratio, real oil prices, and civil liberties, and the second excludes civil liberties.

The results from estimating the error correction model in (4) are presented in Table 5. Of particular interest are the long run estimates and the error correction coefficients. The PMG estimations confirm that government spending ratio, oil prices, and the qualities of civil institutions are cointegrated. Both cointegration coefficients as well as the short run error correction coefficient are significant at the one percent level and have the expected signs. In the long run, higher oil prices are associated with larger government size. This is consistent with both the "bird in the hand" and permanent oil income model approaches to fiscal sustainability. Conversely, the better the qualities of civil institutions, the smaller is the size of the government.

Worth noting, the PMG short run coefficients are simple averages of the coefficients obtained from fitting the model to each individual country in the panel; hence these results should be taken cautiously since some groups have a relatively short series. However, the results from the GMM model relating to the oil price variables are all strongly confirmed. In the short run government size responds negatively to a positive oil price shock. But, since government spending and oil prices are tied together with a long run relation, the resulting short run disequilibrium will gradually lead to a correction mechanism back to the long run equilibrium. This is entirely consistent with a sustainability approach to fiscal policy.

5. Conclusion

In this paper we empirically investigate the role that oil prices play in determining fiscal policy in oil producing countries. We expand on previous research by examining three channels through which oil prices could affect fiscal policy: through their changes, through their volatility, or through their skewness. We find that all three channels help explain fiscal policy.

Our estimated policy function suggests that fiscal policy in oil producing countries has begun to focus on the concept of the long-run sustainability of the policy with the goal of preparing the economy for the periods after depletion of oil reserves. Consistent with previous research, we find fiscal policy to be procyclical in oil producing countries (a rise in oil prices stimulates both GDP and government expenditure) but we go a step further and find that the size of the government spending increase does not match the oil revenue increase. This means that the size of government relative to the economy falls after positive oil price shocks. We also find that the higher the dependence of an oil producer's economy on the oil sector, the more a current price increase will be reflected in higher current expenditure.

In addition, we find some evidence that oil price volatility might induce some fiscal prudence, particularly under a fixed exchange rate regime. Finally, our results show that the positive skewness of the changes in oil price has a positive short run effect on government size. When governments anticipate more positive shocks in the future, this may result in a faster growth in current government spending.

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Table 1: Short run effects: Dynamic GMM Difference estimation (1972-2007)

Variable	(1)	(2)	(3)	(4)
Real Oil Price Growth t	**-0.516 *****	**-0.428*****	**-0.416*****	**-0.343*****
	(-3.83)	**(-3.75)**	**(-3.57)**	**(-2.84)**
Real Oil Price Growth t -1	0.047	0.044	0.029	-0.060
	(0.38)	(0.33)	(0.23)	(-0.46)
Volatility of Oil Prices t	-0.383	**-0.617***	-0.204	-0.024
	(-1.07)	**(-1.65)**	(-0.42)	(-0.04)
Volatility of Oil Prices t-1	**-1.06****	**-0.716***	**-0.952***	-0.608
	(-2.23)	**(1.80)**	**(-1.83)**	(-1.25)
Skewness of shocks t	0.**053****	**0.050****	**0.050****	0.030
	(2.20)	**(2.34)**	**(2.25)**	(1.22)
Skewness of shocks t-1	0.017	0.012	0.018	0.029
	(0.82)	(0.66)	(0.72)	(1.29)
Openness t	**0.281 *****	**0.306*****	**0.304*****	**0.292*****
	(4.36)	**(5.24)**	**(5.48**)	**(5.07**)
Openness t -1	0.122	0.161	0.144	0.131
	(1.29)	(1.46)	(1.38)	(1.19)
Private Investment t	0.004	-0.010		
	(0.07)	(-0.18)		
Private Investment t-1	-0.001	0.017		
	(-0.02)	(0.33)		
Education t	0.126	0.160		
	(0.78)	(0.96)		
Education t-1	-0.111	-0.084		
	(-0.85)	(-0.72)		
Civil institutions t		**-0.058*****	**-0.057*****	**-0.056*****
		(-4.03)	**(-4.21)**	**(-2.97)**
Civil institutions t-1		0.004	0.002	-0.014
		(0.27)	(0.16)	(-0.63)
Inflation t		**-0.002*****	**-0.002****	**-0.002*****
		(-3.12)	**(-2.22)**	**(-2.56)**
Inflation t-1		-0.001	-0.001	-0.000
		(-0.90)	(-0.94)	(-1.02)
Fixed exch. rate regime t		**0.076***	**0.117****	**0.108***
		(1.64)	**(1.97)**	**(1.63)**
Fixed exch. rate regime t-1		-0.009	-0.026	0.018
		(-0.21)	(-0.59)	(0.60)
Inflation X Volatility t			-0.005	
			(-0.80)	
Inflation X Volatility t-1			0.005	
			(0.65)	
Fixed Exch. X volatility t			**-0.423****	-0.373
			(-2.12)	(-1.36)
Fixed Exch. X volatility t-1			0.052	-0.179
			(0.20)	(-0.72)
L1. Surplus Dummy t				**0.102****
				(2.47)
L1. Surplus Dummy t-1				0.053
				(1.01)
Surplus X institutions t				0.005
				(0.56)
Surplus X institutions t-1				0.002
				(0.55)
Lagged Dependent	-0.090	-0.061	-0.058	-0.046
	(-1.05)	(-0.69)	(-0.64)	(-0.42)
Time Dummies	Yes	Yes	Yes	Yes
No. Observations	392	392	392	352
Sargan Test (chi2)	39.45	31.52	38.09	39.00
AR (2) Test (z stat)	-0.02	-0.34	0.14	0.19

Note: Heteroskedastic robust Z-values are in parenthesis. ***, **, ** correspond to coefficient significant at the 1%, 5%, and 10%, respectively.

Table 2: Different Oil Price Shock Specifications

Short run effects: Dynamic GMM Difference estimation (1972-2007)

Variable	Dependent variable : Government Expenditure Growth (% of GDP)				
	(1) Changes	(2) Hamilton	(3) Lee-Ni-Ratti	(4) Positive	(5) Negative
Oil Price shocks t	**-.278*****	**-.228****	**-.151*****	**-.311*****	**-.382*****
	(-4.08)	**(-2.08)**	**(-2.94)**	**(-3.41)**	**(-5.10)**
Oil Price shocks t-1	**-.144***	.051	.027	.110	-.065
	(-1.77)	(0.43)	(0.47)	(1.35)	(-63)
Volatility of Oil Prices t	.025	.133	.	**.612****	-.132
	(0.65)	(0.22)		**(2.29)**	(-0.42)
Volatility of Oil Prices t-1	-.261	-.459		-.072	.1000
	(-0.97)	(-0.86)		(-0.33)	(0.62)
Skewness of shocks t	.010	.021	-.003	-.004	.008
	(0.47)	(1.17)	(-0.25)	(-0.36)	(0.68)
Skewness of shocks t-1	**.034***	**.038***	**.016 ***	**.019****	**.030*****
	(1.78)	**(1.69)**	**(1.84)**	**(2.00)**	**(3.31)**
Openness t	**.289*****	**.288*****	**.233*****	**.252*****	**.285*****
	(4.55)	**(5.06)**	**(3.37)**	**(4.00)**	**(4.45)**
Openness t -1	.121	.132	.083	.057	.134
	(1.06)	(1.21)	(0.80)	(0.53)	(1.21)
Civil institutions t	**-.054*****	**-.054*****	**-.048*****	**-.046*****	**-.057*****
	(-2.88)	**(-2.89)**	**(-2.50)**	**(-2.56)**	**(-2.96)**
Civil institutions t-1	-.012	-.014	-.001	-.004	-.005
	(-0.50)	(-0.57)	(-0.06)	(-0.19)	(-0.19)
Inflation t	**-.001*****	**-.002****	**-.002*****	**-.002****	**-.002****
	(-2.55)	**(-2.39)**	**(-2.40)**	**(-2.45)**	**(-2.94)**
Inflation t-1	-.001	-.001	-.001	-.001	-.001
	(-0.93)	(-1.13)	(-0.57)	(-0.42)	(-0.72)
Fixed exch. rate regime t	**.104***	**.108***	.030	.061	**.109***
	(1.66)	**(162)**	(0.47)	(.96)	**(1.65)**
Fixed exch. rate regime t-1	.019	.022	.018	.034	.014
	(0.66)	(0.76)	(0.37)	(1.31)	(0.51)
Fixed Exch. X volatility t	-.380	-.380		-.376	-.417
	(-1.36)	(-1.35)		(-1.27)	(-1.46)
Fixed Exch. X volatility t-1	-.198	-.196		-.175	0.099
	(-0.81)	(-0.81)		(-0.71)	(-1.46)
L1. Surplus Dummy t	**.079*****	**.076*****	**.096*****	**.089*****	**.088*****
	(4.24)	**(4.92)**	**(4.25)**	**(4.05)**	**(4.10)**
L1. Surplus Dummy t-1	**.048****	**.044****	**.056*****	**.056*****	**.054*****
	(2.35)	**(2.23)**	**(2.88)**	**(2.67)**	**(268)**
Lagged Dependent	-.034	**-.050**	.040	.026	-.002
	(-0.30)	**(-0.44)**	(0.41)	(0.26)	(-.02)
Year Dummies	Yes	Yes	Yes	Yes	Yes
No. Observations	352	352	352	352	352
Sargan Test (chi2)	35.45	33.25	31.92	36.0	38.64
AR (2) Test (z stat)	0.23	0.17	0.09	0.19	0.28

Note: Robust standard errors are used. Z-values are in parenthesis. ***, **, **correspond to significance at the 1%, 5%, and 10%, respectively.

Table 3: Unit Root Tests

Variable	CIPS test[1]			Fisher Test[2]		
	Level		Difference	Level		Difference
	No trend	*Trend*	*No trend*	*No trend*	*Trend*	*No trend*
Government Expenditure/GDP (log)	-0.901	0.194	-9.435***	38.689	40.719	157.50***
Inflation Rate	-0.807	0.648	-10.07***	155.47***	105.49***	190.91***
Civil Liberties and Rule of Law	3.369	1.899	-2.119**	48.04**	36.48	138.56***
Private Investment/GDP (log)	-0.119	1.234	-7.175***	54.59***	48.07**	153.10***
Openness (log)	4.022	4.048	-7.781 ***	30.07	33.41	104.34***
School Enrolment Ratio (log)	0.134	0.263	-5.417 ***	21.205	18.54	119.04***
	ADF Test			Phillips-Perron test		
	Level		Difference	Level		Difference
Real Oil Prices (log)	***No Trend***	***Trend***		***No Trend***	***Trend***	
	-1.049	-1.727		-1.690	-2.128	-18.97***

1. Pesaran (2007). Z[t-bar] statistics reported.
2. Maddala and Wu (1999). χ^2 statistics reported . Two lags are included. P-values are in parenthesis. ***, **, ** correspond to significant at the 1%, 5%, and 10%, respectively

Table 4: Panel Cointegration Tests[1]

Normalized variable: Total Government Expenditure/GDP Ratio

Covariates	**(1)** ***Pα***	**(2)** ***Pt***	**(3)** ***Gα***	**(4)** ***Gt***
Real Oil Prices	-9.401***	-11.826***	-8.601***	-2.496***
	(-4.658)	(-6.071)	(-1.072)	(-3.199)
Civil Liberties and Rule of Law	-10.759***	-12.064***	-9.978	-2.686**
	(-1.191)	(-4.133)	(1.196)	(-1.571)
Private Investment/GDP	-7.669	-9.225	-8.490	-2.3.9
	(0.825)	(-0.887)	(2.072)	(0.283)
Openness	-8.956	-9.547	-9.041	-2.343
	(-0.015)	(-1.255)	(1.747)	(0.115)
Inflation	-8.751	-8.621	-9.195	-2.701*
	(0.118)	(-0.196)	(1.657)	(-1.648)
School Enrollment	-9.867	-9.688	-9.725	-2.770*
	(-0.609)	(-1.302)	(1.345)	(-1.987)
Real Oil prices and Civil liberties	-9.678**	-11.137***	-9.536	-3.300***
	(0.432)	(-3.203)	(2.015)	(-3.310)

Westerlund (2007). Ho: no cointegration. All ECMs include one lag and one lead. Z-values are in parenthesis. ***, **, ** correspond to significant at the 1%, 5%, and 10%, respectively based on the robust p-values (critical values bootstrapped).

Table 5: Error Correction Model (PMG estimations, 1972-2007)

Variable	(1)	(2)
Long Run Cointegrating Vectors:		
Normalized variable: Government Expenditure (% GDP)		
Real Oil Prices	**.27*** **	**.27*** **
	(9.78)	**(8.84)**
Civil institutions	**-.07*** **	
	(-2.50)	
Short run dynamics (mean countries)		
Dependent variable : Government Expenditure Growth (% of GDP)		
Error Correction$_{t-1}$	**-.26*** **	**-.27*** **
	(-4.43)	**(-4.56)**
Δ Real Oil Price$_{t-1}$	**-.24*** **	**-.24*** **
	(-2.92)	**(-3.01)**
Δ Civil institutions$_{t-1}$	-.03	-.04
	(-0.89)	(-1.23)
Volatility of Oil Prices$_{t-1}$	.14	.14
	(0.50)	(0.51)
Skewness of shocks$_{t-1}$	**.03*** **	**.03*** **
	(2.64)	**(2.52)**
Openness$_{t-1}$	.006	.008
	(0.03)	(0.04)
Inflation$_{t-1}$	.001	.001
	(0.21)	(0.24)
Fixed exch. rate regime dummy$_t$	.041	**.041***
	(1.56)	**(1.64)**
Fixed Exch. dummy$_t$ X volatility$_{t-1}$	**-.54***	**-.51***
	(-2.39)	**(-2.36)**
Previous Year Surplus dummy$_t$	.02	.02
	(0.69)	(0.65)
Lagged Dependent	-.008	.002
	(-0.13)	(0.03)
Year Dummies	No	No
No. Observations	391	391
Log Likelihood	472.84	471.12

Note: Robust standard errors corrected for cross country correlations are used. Z-values are in parenthesis. ***, **, **correspond to significant at the 1%, 5%, and 10%, respectively.