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Fiscal Policy and Economic Cycles in Oil-Exporting Countries

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Fiscal Policy and Economic Cycles in Oil-Exporting Countries

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Abstract

This paper empirically assesses the impact of oil price shocks on the underlying non-oil economic cycle in oil-exporting countries. Panel VAR analysis and the associated impulse responses indicate that in countries where the oil sector is large in relation to the economy, oil price changes affect the economic cycle only through their impact on fiscal policy. Once fiscal policy changes are removed, oil price shocks do not have a significant independent effect on the economic cycle.

JEL Classification Numbers: E32, E62, Q33, Q43

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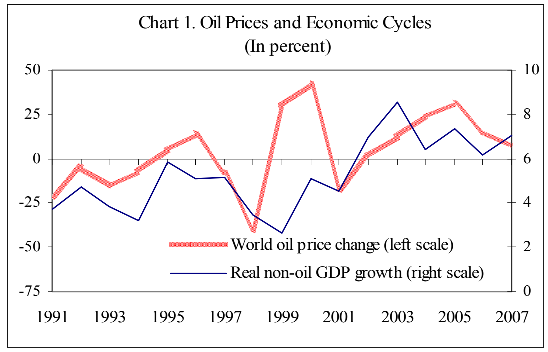
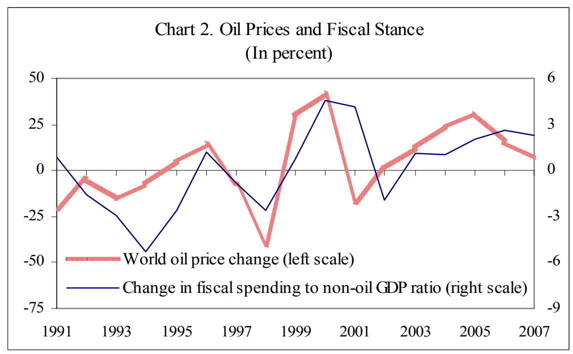
I. INTRODUCTION

Macroeconomic performance in oil-exporting countries depends largely on developments in world oil prices. Economic growth, even the growth of non-oil output, has tended to pick up during periods of high oil prices and slow down when prices have fallen. Pooled data from 10 oil-exporting countries indicate a strong and statistically significant correlation—about 0.4—between real non-oil GDP growth and oil price changes over the past decade and a half (Chart 1).[2] The correlation has been even stronger in countries where the oil sector accounts for a relatively large share of the economy.[3]



Although the channels by which oil prices may affect non-oil output have not been systematically documented, several studies have argued that variations in the fiscal policy stance—which in turn reflects changes in oil price-driven fiscal revenue—have exacerbated output cycles.[4] The data indeed show a high correlation between spending and oil prices—around 0.6 during 1991–2007 (Chart 2).



An interesting question, therefore, is whether world oil price changes exert an independent influence on economic activity in oil-exporting countries, possibly through confidence effects and/or their effect on the monetary/financial situation, or if their impact on the economic cycle only comes through their effect on fiscal policy. The answer is important in determining if the "underlying" economic cycle—the output cycle that would have obtained in the absence of changes in the fiscal policy stance—

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[2] The sample includes countries where the oil sector accounts for a sizable share of the economy and data are available back to at least 1990. The sample comprises Algeria, Iran, Kuwait, Libya, Nigeria, Norway, Oman, Saudi Arabia, United Arab Emirates (UAE), and Yemen.

[3] Empirical evidence on the effects of movements in commodity prices or the terms of trade on output cycles is well documented. See, for example, Agénor, McDermott, and Prasad (1999).

[4] See, for example, Balassone and Kumar (2007). Also, Baldini (2005) finds that the main fiscal variables for Venezuela exhibit strong procyclicality. Other studies, including Saez (2004) and Kumah and Matovu (2005), assess the impact of commodity price movements on fiscal policy in commodity-exporting countries.

is related to oil price swings and, if so, whether the economic cycle has been amplified by fiscal policy reactions to the oil price shocks.

This paper seeks to disentangle the effects of fiscal policy on the economic cycle in oil-exporting countries to ascertain whether public spending is procyclical. This is done by estimating impulse responses to oil price shocks based on panel VARs of a three-variable system—oil prices, fiscal stance, and output. These impulses, which incorporate the feedback effects of oil price changes on fiscal policy, are then compared with impulses generated from an alternate VAR specification in which fiscal policy is assumed to be exogenous and therefore unresponsive to oil price shocks.

The analysis finds that, apart from their effect on fiscal policy, oil prices do not independently influence underlying non-oil output, especially in countries where the oil sector accounts for a relatively large share of economy. Fiscal policy is the mechanism by which oil price shocks are transmitted to the non-oil economy. This result is even stronger in countries where, in addition to a large oil sector, public spending is relatively important in total spending. Thus, oil price shocks do not have a significant effect on output in oil-dominated economies in the absence of a fiscal response to the shocks. An important implication of this result is that fiscal policy tends to be procyclical because it *drives* the output cycle. Fiscal policy changes do not, however, amplify an already-existing, independent relationship between oil prices and non-oil output.

The remainder of the paper is organized as follows: Section II describes the data and summarizes the key empirical facts about output cycles and the fiscal policy stance in oil-exporting countries. Section III documents the relation between oil price changes, on the one hand, and output and fiscal cycles on the other. The results from the panel VAR and impulse response framework are presented in Section IV. Sensitivity checks and extensions are discussed in Section V. Section VI concludes.

II. Data and Cyclical Properties

The oil-producing countries analyzed here account for a large share of global oil supply. The 10 economies in the sample were responsible for about 40 percent of the world's oil output in 2007 and almost 50 percent of world oil exports. In terms of global proven oil reserves, the sample's share is above 50 percent. The data used in the analysis are drawn from *International Financial Statistics*, supplemented by data from published IMF country staff reports and from country desks' databases.[5]

[5] See Appendix A for details.

The importance of oil in each economy varies widely across the sample. In relation to overall GDP, the share of the oil sector ranged from about 20 percent in Iran, Norway, and Yemen to almost one half in Kuwait (Table 1). Similarly, the share of oil revenue in overall fiscal receipts varied from about 17 percent in Norway to around 80 percent in Oman and Saudi Arabia. On the basis of these ratios, the sample was partitioned into two groups—economies that are highly dependent on oil (Algeria, Kuwait, Libya, Nigeria, Oman, Saudi Arabia, and UAE) and those with low or medium dependence (Iran, Norway, and Yemen). The size of government—measured as the ratio of public spending to non-oil GDP—was generally large in most countries in the sample, and tended to be highest in the Gulf Cooperation Council (GCC) countries—Kuwait, Oman, Saudi Arabia, and UAE. Thus, the "high-oil" group was further partitioned into the GCC and non-GCC.

Table 1. Size of the Oil Sector and Public Spending (1990-2007)

Country	Share of nominal oil GDP in total GDP		Share of oil revenue in total fiscal revenue		Ratio of public spending to non-oil GDP	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Iran	0.18	0.06	0.57	0.11	0.26	0.05
Norway	0.19	0.05	0.17	0.08	0.55	0.03
Yemen	0.23	0.11	0.57	0.17	0.41	0.11
Algeria	0.31	0.08	0.65	0.08	0.44	0.06
U.A.E.	0.33	0.07	0.64	0.17	0.53	0.15
Nigeria	0.35	0.06	0.76	0.08	0.45	0.19
Saudi Arabia	0.40	0.07	0.78	0.08	0.60	0.09
Libya	0.42	0.18	0.68	0.17	0.71	0.35
Oman	0.44	0.06	0.81	0.04	0.78	0.07
Kuwait	0.48	0.06	0.69	0.08	0.89	0.28

Sources: IMF country staff reports and country desks' databases.

Economies with greater dependence on oil have generally been associated with higher output volatility and shorter cycles. As countries' oil output is constrained by capacity and/or Organization of Petroleum Exporting Countries (OPEC) production targets, the relevant measure of the economic cycle in oil-exporting countries relates to non-oil output.[6] As Table 2 indicates, economic volatility—as measured by the coefficient of variation of real non-oil output—has been substantially greater in the highly oil-dependent countries, and especially large in the GCC countries in the sample (with the exception of Saudi Arabia). Similarly, the average cycle duration in economies with a high dependency on oil has tended

[6] Non-oil output is defined as total output excluding oil (and gas) related activities. The definition and quality of data related to the non-oil sector varies across countries in the sample and generally includes some oil-related activities, such as petrochemicals and fertilizers.

to be substantially shorter than in low/medium oil-dependent countries.[7] Among the high-oil group, the GCC countries have had the shortest average cyclical duration. Thus, the relation between oil prices and the output cycle may differ not only across the low/medium-oil and high-oil groups, but across the GCC and non-GCC groups as well.

Table 2. Output Cycle Duration and Volatility 1/

Country	Sample Period	Cycle Duration (average; years)	Coefficient of Variation
Iran	1980-2007	6.1	2.5
Norway	1980-2007	11.3	1.5
Yemen	1990-2007	5.3	2.1
Algeria	1990-2007	4.5	2.1
U.A.E.	1980-2007	3.6	11.5
Nigeria	1981-2007	4.5	6.4
Saudi Arabia	1980-2007	5.0	3.4
Libya	1990-2007	5.3	8.2
Oman	1990-2007	5.0	23.2
Kuwait	1983-2007	4.0	29.5

1/ Cycles were obtained by applying the Hodrick-Prescott filter to real non-oil GDP. Cyclical peaks (troughs) are defined such that the previous and subsequent years' values are lower (higher) than that of the current year. The first and last peaks define the adjusted sample, and the average peak-to-peak duration is the adjusted sample length divided by the number of peaks minus one. The average trough-to-trough duration is defined analogously. The average cycle duration is the average of the peak-to-peak and trough-to-trough durations. The coefficient of variation is the standard deviation of real non-oil output divided by its mean over the sample period.

Variations in the fiscal policy stance have also tended to be larger in countries where the oil sector is large. The standard deviation of the fiscal spending and non-oil revenue ratios (in relation to non-oil GDP) have been markedly higher in the high-oil group of countries. By the same token, the fiscal impulse (the methodology for measuring the impulse is outlined below) has been more volatile in the high-oil group (Table 3). Indeed, with the exception of Algeria, all the countries in the high-oil group have experienced greater volatility in their fiscal impulse than all the countries in the low/medium-oil group.

[7] By way of comparison, Hoffmaister and Roldós (1997) report that the standard length of post-World War II business cycles in advanced economies has been 2–8 years, while business cycles in developing countries have tended to have shorter duration and greater amplitude. Hoffmaister and Roldós (1997) also note differences in cyclical properties across developing countries, particularly that cycles in Asia and Latin America have different sources and respond differently to nominal shocks. Baldini (2005) finds that the average duration of the non-oil output cycle in Venezuela was 2–3 years.

Table 3. Fiscal Volatility
(Standard deviation)

Country	Sample period	Fiscal Impulse	Non-oil Revenue to Non-oil GDP	Public Spending to Non-oil GDP
Iran	1980-2007	0.04	0.02	0.07
Norway	1980-2007	0.02	0.02	0.03
Yemen	1990-2007	0.05	0.02	0.11
Algeria	1990-2007	0.02	0.01	0.06
U.A.E.	1991-2007	0.05	0.03	0.15
Nigeria	1988-2005	0.13	0.02	0.15
Saudi Arabia	1980-2007	0.10	0.03	0.18
Libya	1990-2007	0.13	0.02	0.35
Oman	1990-2007	0.05	0.01	0.05
Kuwait	1986-2007	0.30	0.14	0.41

In summary, the data appear to suggest that oil-exporting economies are exposed to greater volatility, both of the economic cycle and the fiscal stance. Whether it is the volatility of oil prices or of fiscal policy, or both, that explains the cyclical volatility—and the associated implications—is the subject of analysis in the remainder of the paper.

III. Oil Prices, Output Cycles, and Fiscal Policy

Economic output in oil-exporting countries is strongly affected by oil prices. The data indicate a positive correlation between the growth rates of real non-oil output and oil prices for virtually all countries, which is statistically significant for about one-half of them (Table 4). Among countries in the high-oil share group, the correlation is high and significant for the majority of countries. At the same time, a strong relation is evident between the fiscal stance—both the public spending ratio and the fiscal impulse—and oil prices. Again, countries in the high-oil group tend to exhibit a higher correlation. It should be noted that the small sample period limits the statistical significance of the country-specific correlations. As will be evident below, pooled correlations are generally stronger.

Table 4. Correlations of Economic Cycles and Fiscal Policy with Oil Prices 1/

Country	Non-oil GDP	Fiscal Impulse	Public spending to non-oil GDP
Iran	0.44 **	0.25	0.19
Norway	-0.17	-0.32	-0.13
Yemen	0.05	0.57**	0.60**
Algeria	0.30	0.33	0.18
U.A.E.	0.41 *	0.15	0.38
Nigeria 2/	0.42**	0.26	0.22
Saudi Arabia 2/	0.36 *	0.60**	0.60**
Libya 2/	0.56**	0.46*	0.31
Oman 2/	0.51 **	0.44*	0.58**
Kuwait	0.25	0.20	0.33

1/ Correlation of each variable with oil price changes.
2/ Correlation with lagged changes in oil prices.

* denotes significance at 10 percent, ** at 5 percent.

The correlations point to an interesting question—do oil prices exert an independent influence on economic activity, or does the effect come only through variations in the fiscal position? In this connection, it is worth noting that Norway, where concerted institutional arrangements are in place to insulate fiscal spending from oil revenue (and therefore oil price) developments,[8] is a clear exception to the pattern of correlations. This may well be due to countercyclical fiscal spending variations in response to oil price changes.

At a first pass, simple panel regression results suggest that oil prices do not exert an independent, direct effect on the underlying economic cycle once fiscal policy variations are controlled for. A simple panel fixed effects specification of the form:

$$\Delta y_t^{NO} = \alpha + \gamma \Delta p_t^o + u_t , \qquad (1)$$

where y^{NO} is (the log of) real non-oil output and p^O is (the log of) the world oil price, was estimated. The results, reported under column labeled I in Table 5, indicate a high degree of explanatory power. However, the magnitude and significance of the estimated coefficient for oil prices weaken substantially under a more general formulation of the form:

[8] See, for example, Rossi, Jafarov, and Leigh (2007) for a description of Norway's oil fund and fiscal rules.

$$\Delta y_t^{NO} = \alpha + \beta \Delta \left(\frac{G}{Y^{NO}} \right)_t + \gamma \Delta p_t^o + \varepsilon_t, \tag{2}$$

where G and Y^{NO} are government spending and non-oil output, respectively, especially for the high-oil and GCC groups (columns II in Table 5). Moreover, an F-test of the restriction γ=0 (reported in the second-to-last row) cannot be rejected for the high-oil and GCC groups, and is rejected only at the 10 percent significance level for full sample. By contrast, F-tests of the restriction β=0 (reported in the last row) are strongly rejected for the full sample and for the high-oil and GCC groups (see also columns III in Table 5).

Table 5. Panel Fixed Effects Estimation Results 1/

	Full Sample			High Oil Share			GCC		
	I	II	III	I	II	III	I	II	III
Δp^O	0.037 **	0.030 *		0.056 ***	0.030		0.057 **	0.016	
	0.017	*0.016*		*0.021*	*0.019*		*0.025*	*0.027*	
$\Delta(G/Y^{NO})$ 2/		0.059 **	0.059 **		0.096 ***	0.098 ***		0.098 ***	0.100 ***
		0.030	*0.030*		*0.033*	*0.033*		*0.038*	*0.037*
c	0.055 ***	0.056 ***	0.057 ***	0.067 ***	0.090 ***	0.091 ***	0.063 ***	0.095 ***	0.096 ***
	0.007	*0.007*	*0.007*	*0.013*	*0.011*	*0.012*	*0.011*	*0.012*	*0.012*
R-sqr	0.230	0.298	0.283	0.242	0.392	0.379	0.306	0.443	0.439
Adj. R-sqr	0.181	0.246	0.234	0.188	0.337	0.329	0.261	0.388	0.394
F-stat (Δp^O)		3.52 *			2.38			0.57	
F-stat ($\Delta(G/Y^{NO})$)		4.02 **			8.64 ***			6.87 ***	

1/ Dependent variable is the first difference of the log real non-oil GDP. Country dummies are not reported. Standard errors are in italics. Results are robust to including additional explanatory variables (lagged changes in non-oil GDP and oil GDP growth), as well as using lagged oil prices instead of contemporaneous.
2/ The lagged value is used for the ratio of expenditures to non-oil output to correct for endogeneity.
*denotes significance at 10 percent, ** at 5 percent, *** at 1 percent.

These results do not appear sensitive to a broader definition of the fiscal stance. Adapting the methodology described by Chand (1993), the cyclically-adjusted fiscal balance (*cab*) for an oil-exporting country (where oil revenue and oil output may arguably be assumed exogenous, at least in the short run) may be calculated as:

$$cab_t^{NO} = \frac{R_t^{NO}}{Y_t^{NO}} - \frac{G_t}{Y_t^{NO}} \frac{Y_t^{NO}}{Y_t^{*,NO}}, \tag{3}$$

where $\frac{R^{NO}}{Y^{NO}}$ and $\frac{G}{Y^{NO}}$ are the ratios of non-oil revenue and spending to non-oil GDP, and Y^{NO} and $Y^{*,NO}$ are, respectively, actual and potential real non-oil output.[9] The fiscal impulse (*imp*) may then be defined as:

$$imp_t = -\left(cab_t^{NO} - cab_{t-1}^{NO}\right). \tag{4}$$

It may be noted that a positive fiscal impulse corresponds to a decline in the cyclically-adjusted balance (*cab*). Estimation results of equation (2) using the fiscal impulse (Table 6) in place of government spending are very similar to those in Table 5.

Table 6. Panel Fixed Effects Estimation Results /1

	Full Sample			High Oil Share			GCC		
	I	II	III	I	II	III	I	II	III
Δp^O	0.037 **	0.030 *		0.056 ***	0.030		0.057 **	0.025	
	0.017	*0.016*		*0.021*	*0.019*		*0.025*	*0.022*	
imp 2/		0.082 ***	0.079 ***		0.115 ***	0.114 ***		0.114 ***	0.116 ***
		0.031	*0.031*		*0.033*	*0.033*		*0.036*	*0.036*
c	0.055 ***	0.056 ***	0.057 ***	0.067 ***	0.087 ***	0.088 ***	0.063 ***	0.084 ***	0.086 ***
	0.007	*0.006*	*0.006*	*0.013*	*0.011*	*0.011*	*0.011*	*0.011*	*0.011*
R-sqr	0.230	0.330	0.315	0.242	0.429	0.416	0.306	0.513	0.504
Adj. R-sqr	0.181	0.283	0.268	0.188	0.377	0.369	0.261	0.471	0.469
F-stat (Δp^O)		3.78 *			2.51			1.24	
F-stat (*imp*)		6.97 ***			11.89 ***			10.04 ***	

1/ Dependent variable is the first difference of the log real non-oil GDP. Country dummies are not reported. Standard errors are in italics. Results are robust to including additional explanatory variables (lagged changes in non-oil GDP and oil GDP growth), as well as using lagged oil prices instead of contemporaneous.
2/ The lagged value is used for the fiscal impulse to correct for endogeneity.
*denotes significance at 10 percent, ** at 5 percent, *** at 1 percent.

Thus, the evidence so far seems to support the view that oil prices do not exert a direct influence on activity, apart from their potential effect on the fiscal stance, especially in high-oil-share economies. To examine this more systematically, and to address the question of whether the fiscal stance serves as a transmission channel for oil price shocks, a dynamic panel vector autoregression (VAR) framework is specified next.

IV. Panel VAR Framework

In order to analyze the dynamic effects of changes in world oil prices on the fiscal stance and the economic cycle, a reduced form panel VAR of the following form was estimated:

[9] Potential output was obtained by applying the Hodrick-Prescott (HP) filter.

$$z_{n,t} = C_1 z_{n,t-1} + C_C f + u_{n,t}, \tag{5}$$

where z_{nt} is a 3×1 vector of dependent variables for country n at time t, C_C is a 3×N matrix of fixed effects, N is the number of countries in the sample, f is an N×1 vector of country dummies, and C_1 a matrix of coefficients for the dependent variables. The dependent variables are the first difference of (the log of) real non-oil output (Δy^{NO}), the change in the ratio of government spending to non-oil GDP ($\Delta(G/Y^{NO})$), and the first difference of (the log of) the world oil price (Δp^O). Given the relatively short time period of available data (1990–2007 for most countries in the sample), and in view of the annual data frequency, the specification included only one lag of each of the variables.

The VAR results are in line with those obtained in the panel fixed effects specification above. In particular, (lagged) changes in the public spending ratio and in oil prices are significant determinants of the non-oil output cycle, although oil prices are only marginally significant for the high-oil group and not significant for the GCC (Table 7).[10] Moreover, oil prices significantly affect the fiscal stance, for the full sample as well as each of the sub-samples, and the estimated effect is larger for the high-oil group (and larger still for the GCC group).

Table 7. VAR Results

	Full Sample		High Oil Share		GCC	
	Δy^{NO}	$\Delta (G/Y^{NO})$	Δy^{NO}	$\Delta (G/Y^{NO})$	Δy^{NO}	$\Delta (G/Y^{NO})$
Δy^{NO}	0.239	-0.398	0.178	-0.430	0.085	-0.690
	0.070	0.229	0.082	0.289	0.107	-0.430
$\Delta(G/Y^{NO})$	0.083	-0.032	0.108	-0.052	0.097	-0.082
	0.029	0.095	0.033	0.115	0.038	-0.153
Δp^O	0.024	0.159	0.023	0.225	0.018	0.293
	0.015	0.049	0.020	0.070	0.027	-0.106
c	0.052	-0.010	0.083	-0.027	0.088	-0.012
	0.009	0.029	0.014	0.048	0.015	-0.059
R-squared	0.356	0.137	0.410	0.165	0.451	0.189
Adj. R-squared	0.302	0.065	0.354	0.085	0.387	0.094

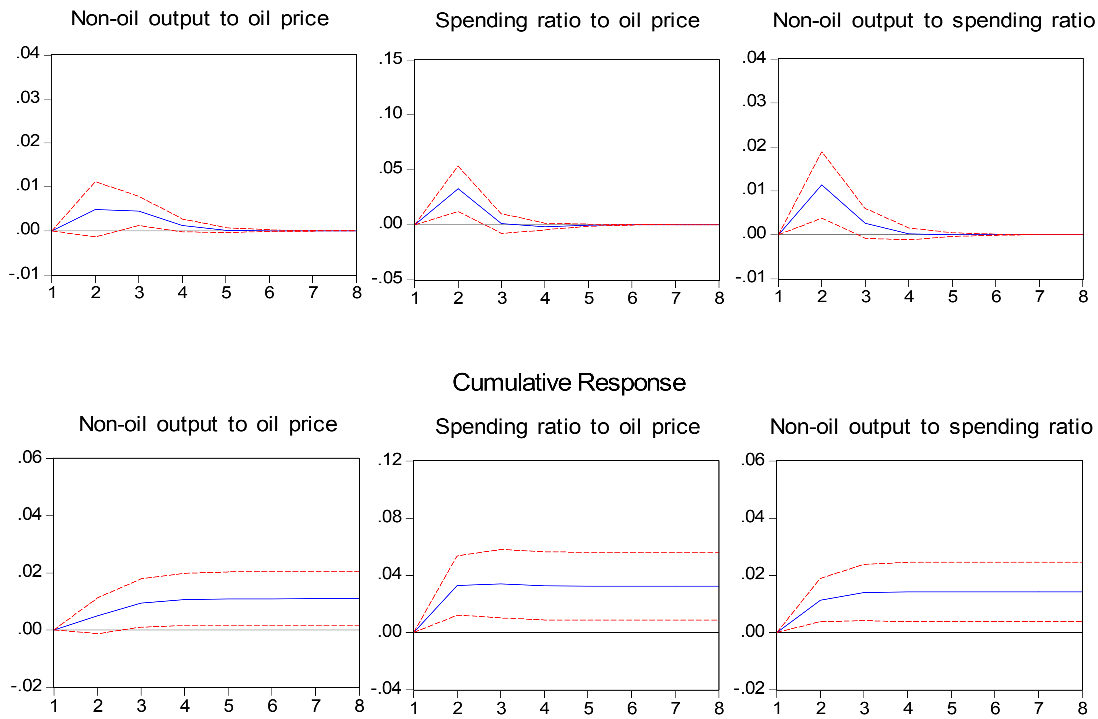
Note: The first number in each cell corresponds to the coefficient estimate; the second is the estimated standard error. Coefficient estimates for country dummies are not reported.

[10] Appendix B summarizes the unit root tests for the variables used in the VAR.

Impulse responses illustrate the significant effects of oil price shocks on the economic cycle and fiscal policy. The ordering of the variables in the VAR is chosen to highlight the dynamic effects. Thus, non-oil output is ordered first, followed by government spending, and oil prices are last.[11] As Chart 3 shows, a one standard deviation shock to the oil price results in a significant increase in non-oil output and public spending. Moreover, shocks to public spending have a positive effect on output.

Chart 3. Impulse Responses (Full Sample)

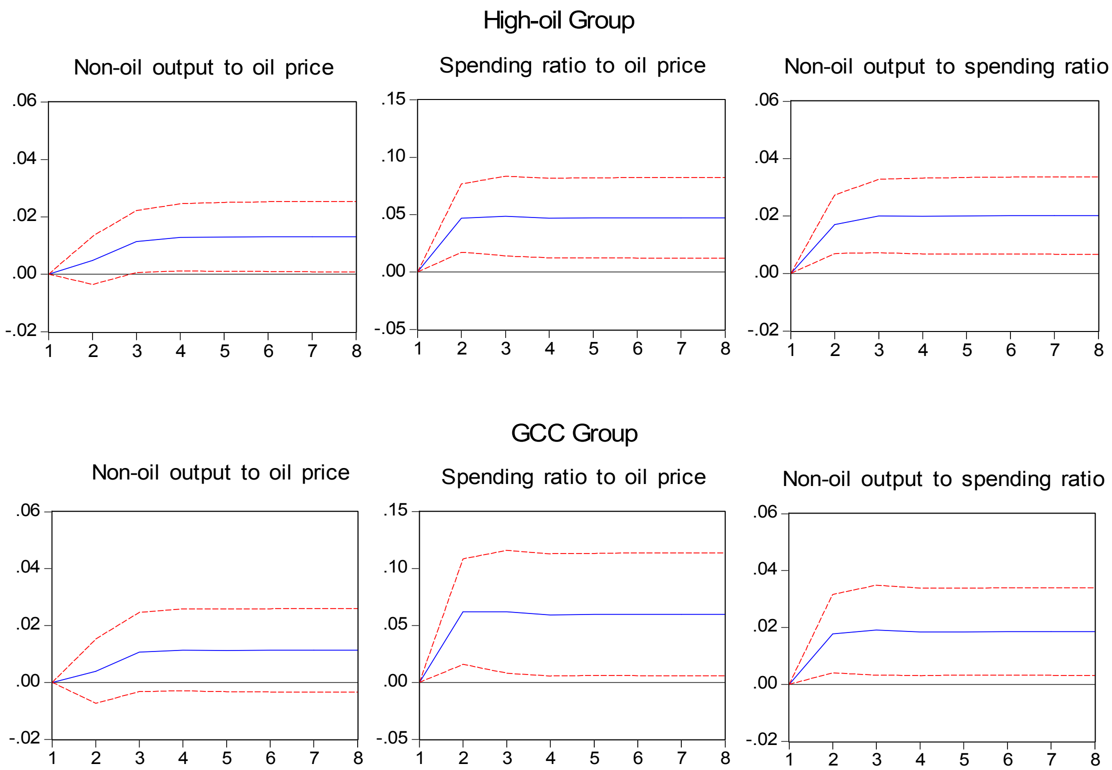
Response



Oil prices do not appear to influence the economic cycle in countries where the oil sector represents a large share of the economy and public spending is high in relation to total spending. The responsiveness of output to oil price shocks weakens as the sample is reduced to the high-oil group, and is not significantly different from zero for the GCC group (Chart 4). The impulse responses in Chart 4 also indicate that oil prices significantly affect public spending and, as might be expected for countries where public spending is relatively important, spending shocks have a significant impact on the output cycle.

[11] The lack of significance of spending in explaining non-oil output in the VAR—at least for the high-oil and GCC groups—seems to support this ordering.

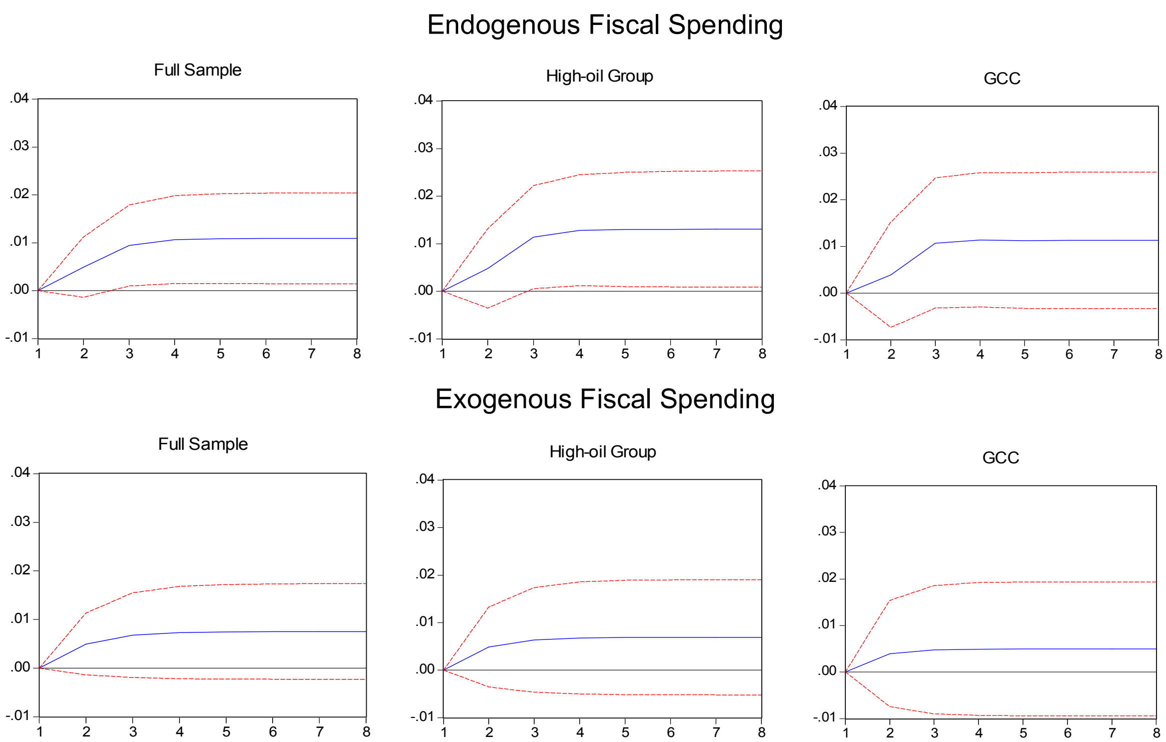
Chart 4. Impulse Responses
(Accumulated response)



The impulse response framework is modified to assess whether the impact of oil price shocks on the economic cycle in the full sample operates directly or if the effect arises through variations in fiscal policy. This is done by shutting down the fiscal channel in the transmission of oil price shocks, which amounts to assuming that fiscal spending is exogenous in the impulse responses. Thus, the modified impulse response captures only the direct effect of oil price shocks on output, while the effect that comes via changes in public spending—which in turn may affect output—are set to zero.

The modified impulse responses show that if the fiscal stance is not changed in response to oil price shocks, there is no impact of the shocks on the economic cycle. As Chart 5 indicates, the response of non-oil output to a one standard deviation oil price shock is not different from zero at the 5 percent significance level for the full sample. The results for the high-oil and GCC groups show not only that the impact is insignificantly different from zero, but its estimated mean magnitude is also lower.

Chart 5. Impulse response of Non-oil Output to Oil Price Shock
(Accumulated response)



The bottom line, then, is that oil price changes do not have a significant *independent* effect—whether directly or through confidence and/or monetary and financial effects—on the underlying economic cycle in oil-exporting countries. However, movements in oil prices tend to be associated with changes in the fiscal stance, which in turn does affect the economic cycle. The intuition underlying this empirical finding possibly stems from the fact that oil revenue principally accrues to the government in these countries. If the government responds to higher oil prices by saving the additional income (and accumulating assets abroad), the impact on the domestic non-oil economy—including potential confidence and financial effects—would be zero. On the other hand, if the government responds by increasing spending, output would clearly be affected, especially in countries where public spending is large in relation to the size of the economy. Indeed, in the GCC countries, state oil companies are responsible for all oil production and, therefore, all oil income goes to the state. Thus, in these countries especially, it is not surprising that changes in oil prices (and hence oil income) do not affect the rest of the economy in the absence of fiscal policy (spending) changes.

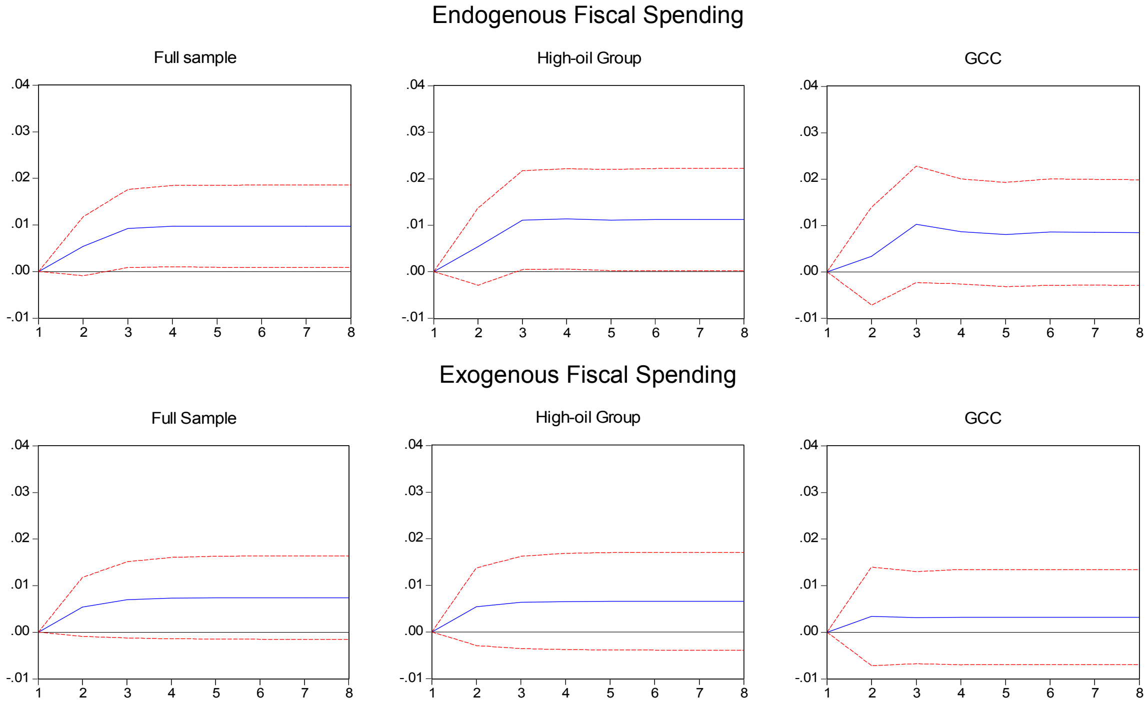
V. Sensitivity Checks and Extensions

The main empirical results from the VAR and impulse response framework withstood various sensitivity checks and extensions. Small changes in the sample period and the addition of one more lag in the VAR did not affect the findings. The main extensions involved the use of the fiscal stimulus in place of changes in the government spending ratio, the addition of real oil output changes to the VAR specification, and the use of an alternative measure of the cyclical component of non-oil output. In all cases, the impulse responses yielded very similar results to the basic model described above.

Using the fiscal impulse as the measure of fiscal policy changes potentially broadens the channels by which fiscal shocks may be transmitted to the economy. The fiscal impulse, as outlined in Section III, captures changes in the spending ratio as well as non-oil taxation (through changes in the non-oil revenue ratio). In addition, this specification allows a check of the possibility that oil prices affect the fiscal stance through their effect on activity (see equation (3) above, which indicates that, for a given spending ratio, a larger deviation of actual output from potential would magnify the fiscal impulse).

The results are very similar to those obtained in the specification with the government spending ratio. In particular, for the full sample and the high-oil group, oil price shocks have marginal significance in influencing output when fiscal policy is endogenous (Chart 6). However, in the absence of fiscal policy changes, oil price shocks do not significantly affect output in any of the groups. Moreover, the impulse responses indicate that lagged output changes are not a significant determinant of the fiscal impulse, implying that the possibility that oil prices may affect the fiscal stance via their effect on output is not an issue.

Chart 6. Impulse Responses with Fiscal Impulse Specification
(Accumulated response)



The only point of departure from the results of the previous section is that broadening the sample period—to include data covering 1980–89 for three countries (Iran, Norway, and Saudi Arabia)—yields a significant, albeit small, direct effect of oil price shocks on output for the full sample, even when the fiscal channel is closed. This may be due to the existence of significantly different oil price shock transmission channels in the 1980s, a period in which oil prices trended downward, including a large negative price shock in the mid-1980s. Alternatively, the quality of the data from that period may be weaker. Either way, since the results for the high-oil and GCC groups are unaffected by the change in the sample period, the conclusion that oil price shocks do not have a significant direct effect on the underlying non-oil economic cycle in countries where the oil sector is large stands.

Another extension involved the introduction of an additional variable—oil output—in the VAR. As noted above, countries' oil output in the short run is constrained either by capacity or OPEC targets (or both). Thus, oil output was treated as exogenous in the extended VAR specification.[12] Once again, the results conformed closely with those under the basic model in Section IV. While the explanatory power of the VAR equations improved somewhat, oil

[12] It turned out that allowing oil output to be endogenous, and ordering it just before oil prices in the impulse responses, did not affect the results.

price shocks continued to have an insignificant—or marginally significant for the full sample—effect on non-oil output when fiscal policy was held fixed.

Lastly, HP-filtered non-oil output was used as an alternative measure of the cyclical component of output in the basic VAR model. In this specification, the main result was even stronger—oil price changes did not have a significant impact on the output cycle for the full sample or for the high-oil and GCC groups, even when fiscal policy was allowed to respond to the shocks. This finding, however, is subject to the criticism that applying the HP filter to relatively short time series may have exacerbated the filter's sensitivity to the endpoint problem and possibly produced inaccurate measures of the output cycles.

VI. Conclusions

The analysis provides strong empirical support against the view that fiscal policy reactions to oil price shocks amplify the underlying business cycle in oil-exporting countries, especially in countries where the size of the non-oil sector is relatively small. There may be a number of good reasons why oil-exporting countries should be careful in ramping up spending in response to an increase in oil prices, but concern that it might add to cyclical pressures is not one of them. In countries where public spending occupies a large share of the economy, spending increases will almost by definition increase the cyclical component of output. Whether or not such spending variations coincide with oil price changes will not affect the degree of cyclical pressure. Indeed, timing spending increases to coincide with oil price downturns (rather than upswings) may well produce financing pressures in addition to cyclical pressures.

This is not to say, however, that fiscal expansion is an optimal response to positive oil price shocks in oil-exporting economies. Such a determination would require an assessment of the costs associated with increased cyclical pressure against the benefits of greater spending, both of which likely would depend on the magnitude and expected persistence of the price shock. While balancing such considerations is clearly beyond the scope of this paper, the foregoing analysis indicates that the costs—at least those related to cyclical stability—will not be any larger during period of high oil prices.

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APPENDIX A. DATA SOURCES AND DESCRIPTIONS

Variable	Description	Sources
p_t^O	World oil price, defined as a natural log of real annual average petroleum spot price	IMF, International Financial Statistics (IFS)
y_t^{NO}	Real non-oil output, defined as a natural log of real non-oil GDP[1]	Country desk data.
G/Y_t^{NO}	Fiscal spending, defined as a ratio of central government expenditure to nominal non-oil GDP[1]	IMF IFS, and country desk data. Government expenditure for Norway is based on general government data. For UAE the government expenditure contains consolidated accounts of the federal government, and the emirates Abu Dhabi, Dubai, and Sharjah.
R_t^{NO}/Y_t^{NO}	Non-oil revenue, defined as a ratio of nominal non-oil revenue nominal non-oil GDP[1]	IMF IFS, and country desk data. Non-oil revenue for UAE is based on consolidated accounts of the federal government, and the emirates Abu Dhabi, Dubai, and Sharjah.

[1] The definition and quality of data related to the non-oil sector varies across countries in the sample, and may include some oil-related activities.

APPENDIX B. UNIT ROOT TESTS

Augmented Dickey-Fuller (ADF) tests for unit roots were performed for y^{NO} and G/Y^{NO} for each country, and for oil prices. For all the time series, except Yemen (Y^{NO}) and Iran (G/Y^{NO}), we were not able to reject the presence of a unit root (Table B1). We also found that oil prices follow a random walk, which conforms with previous empirical analyses of oil prices (e.g., Okogu (2004)).[1] Next, Johansen's log likelihood test was used to check for cointegration among p^O,y^{NO}, and G/Y^{NO}. As expected, there was no evidence of uniform cointegrating relationships across countries. The tests supported one cointegrating equation only for Norway, Saudi Arabia, and UAE.[2]

ADF tests were then used to check for unit roots in the differenced data (Δy^{NO}, $\Delta G/Y^{NO}$, and *imp*) with a constant term in the specification. All first differences were found to be stationary, except for Oman and UAE (Δy^{NO}) and Norway and Libya ($\Delta G/Y^{NO}$). In these cases, where the null hypothesis of a unit root could not be rejected, the cause was likely to be the small sample size, which makes the test imprecise. We then took two measures to control for the consistency of our estimates given these test results. First, we tested the error terms of country-specific, equation-by-equation estimations for stationarity and found that the error terms were stationary in all cases, and white noise in most cases. Second, for every panel estimation we performed a robustness check by excluding from the panel the subsample of countries that did not pass the ADF test for differenced data, and then reestimated the panel. Both sets of results were very close, qualitatively and quantitatively.

Table B1. ADF Unit Root Test

	Time period		y^{NO}		G/Y^{NO}		Δy^{NO}		$\Delta(G/Y^{NO})$		*imp*	
Country			Test statistic	DA	Test statistic	DA	Test statistic	DA	Test statistic	DA	Test statistic	DA
Algeria	1990	2007	-0.43	1	-0.97		-3.54 *	1	-6.27 ***		-3.54 **	1
Iran	1980	2007	-1.94	1	-3.27 **		-6.94 ***	2	-2.65 *		-4.79 ***	
Kuwait	1985	2007	-1.10		-1.49	2	-4.70 ***		-4.32 ***	1	-4.11 ***	1
Libya	1990	2007	-1.43		1.65		-9.71 ***	2	-2.25		-3.31 *	1
Nigeria	1981	2007	-0.64		-2.14		-5.19 ***		-3.63 **		-3.51 **	1
Norway	1980	2007	-2.02	1	-2.50	2	-3.13 *	1	-2.46		-4.31 **	2
Oman	1990	2007	-0.92		-1.43	1	-2.78		-4.37 ***		-4.24 **	
Saudi Arabia	1980	2007	-1.48	1	-2.18		-4.52 ***		-4.76 ***		-5.20 ***	
UAE	1990	2007	-2.41		-2.12	1	-0.62		-7.83 ***		-5.70 ***	
Yemen	1990	2007	-4.97 ***	1	-0.71		-7.91 ***	1	-4.54 ***		-5.30 ***	1

Note: DA stands for degree of augmentation.
* denotes significance at 10 percent, ** at 5 percent, *** at 1 percent.

[1] The presence of a unit root could not be rejected for the log level of oil prices (p^O), but was rejected for first differences (Δp^O). The test statistics equalled –1.77 (p^O) and –4.92*** (Δp^O), respectively.

[2] The results are based on both trace and maximum eigenvalue statistics with 5 percent significance level.