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REAL OUTPUT AND OIL PRICE UNCERTAINTY IN AN OIL-PRODUCING COUNTRY

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ABSTRACT

We assess the effects of oil price uncertainty on Nigeria's real output from the first quarter of 1980 to the first quarter of 2019. We achieve this objective by decomposing oil price uncertainty into positive and negative uncertainties. We then quantify the responses of output to these uncertainties. Using the conditional variance of real returns in composite refiners' acquisition cost of crude oil as our measure of oil price uncertainty, we find that positive uncertainty leads to a decline in output, whereas negative uncertainty leads to a rise in output. The response of output to these uncertainties is asymmetric.

Keywords: Oil price uncertainty; Real output; Oil-producing country; Nigeria.
JEL Classification: E23; E32.

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I. INTRODUCTION

We assess the effects of oil price uncertainty on the real output of Nigeria, an oil-producing country. Unexpected changes in oil prices introduce another source of concern for all countries, especially since such changes have become pronounced in recent years (Chuku et al., 2011). Oil, hydroelectric power, and natural gas are the main sources of energy and thus count among the core drivers of the real economy. Hence, volatility in oil prices is a major issue for policymakers. Elder and Serletis (2010) elaborate on the theoretical transmission channels of real oil price shocks to the rest of the economy. They note that real oil price shocks transmit directly to real balances and monetary policy. An increase in oil prices leads to a rise in the overall price level and then to a drop in the real money balance held by households and firms, which, in turn, depresses aggregate demand. In addition, changes in oil prices induce income transfer. For example, if oil prices increase, incomes are transferred from oil-importing to oil-exporting countries, and vice versa.

Nigeria is an oil-producing country whose economic activities are largely driven by oil revenues (Ayadi, 2005). The economy depends largely on oil, so shocks to oil prices can have extensive ramifications to its fundamentals. For example, oil accounted for over 90% of Nigeria's export revenues and over 90% of its foreign exchange earnings in 2004 alone. In addition, over 80% of government revenue comes from oil (Ayadi, 2005). Since the country exports oil, increases in oil prices should generate savings to ensure high investment levels and sustainable growth (Chuku et al., 2011; Iwayemi and Fowowe, 2011). Iwayemi and Fowowe (2011) argue that, because Nigeria exports oil, positive shocks to oil prices should directly translate into faster economic growth. However, this is not the entire story. As Chuku et al. (2011) observe, apart from being an oil exporter, Nigeria also imports oil. Hence, the appropriate effect of oil price shocks could lie somewhere in between. Nigeria imports most of its technology-oriented goods, such as home appliances, televisions, cars, and computers. These goods are mostly produced using oil-intensive plants and should therefore become more expensive as oil prices increase. The implication is that positive oil price shocks lead to imported inflation and the depletion of external reserves due to currency depreciation, both unfavorable indicators for real output growth. Positive oil price shocks have the potential to generate a boom in the oil sector, as well as the potential for a Dutch disease problem, thereby shrinking productivity in the rest of the economy.

Prior to the 1970s, oil prices were quite stable. In the 1970s, conversely, oil prices experienced a rapid increase, rising from their previous levels of about $40 per barrel to slightly above $100 per barrel. At the turn of the 1980s, these prices dropped to nearly $20 per barrel and persisted at this level until around 2001 (Hamilton, 2009). Oil prices started rising faster toward the peak of the recent housing market bubble in the United States (i.e., around 2006) and reached an all-time high of $145 per barrel during the peak of the recent financial crisis (Hamilton, 2009). The volatility and sharp rises in oil prices have reignited the literature on the role of oil prices in the real economy. This literature dates far back to seminal papers such as those of Hamilton (1983, 1988), Mork (1989), Lee et al. (1995), and Hooker (1996). These studies have generally found an inverse relation between oil price shocks and the real economy, and thus provide comprehensive policy insights; see also Narayan et al. (2014) and Narayan and Sharma (2011).

Recently, these findings have been corroborated by, for example, Hooker (2002), who finds positive oil price shocks drove up US core inflation rates, depressing productivity before 1981; Barsky and Kilian (2004); and Edelstein and Kilian (2009), who find similar evidence. In particular, Barsky and Kilian (2004), and Edelstein and Kilian (2009) find that oil price shocks significantly affect the real economy through a supply channel by increasing the cost of production, which then reduces production. Later, Hamilton (2009) also finds this to be the case, with oil price shocks exerting a negative and significant impact on the US economy.

Other studies find that, apart from oil price changes, oil price volatility does not bode well with the real economy. For example, Elder and Serletis (2010) find oil price uncertainty to affect the US economy negatively and significantly. They analyze the real options and investment model, by looking at consumption patterns under the uncertainty of future returns, and find oil price volatility to reduce some components of aggregate investment. Their finding is generally consistent with real options theory, which argues that firms can delay or even abandon their investments in an environment, whereby future returns become increasingly uncertain as the degree of uncertainty amplifies. This view is shared by older studies, such as those of Bernanke (1983) and Pindyck (1991), and a study by Lee et al. (2011), who assess the effects of oil price shocks on firms' investment decisions in the US manufacturing sector. Lee et al. (2011) find firm stock price volatility alongside future oil price uncertainty to negatively affect firms' investment decisions for at least the first and second years after the initial shock.

A number of studies have investigated the effects of oil price shocks on various macroeconomic variables in the case of Nigeria. For example, Ayadi et al. (2000) examine the impact of the energy (or oil) sector on the Nigerian economy, including the financial markets, using standard vector autoregression (VAR) and find the energy sector exerts significant influence on the economy. In addition, Ayadi (2005) analyzes the relation between oil price changes and economic development via industrial production with standard VAR and finds that an increase in oil prices does not lead to an increase in industrial production in Nigeria. Recent studies have revisited the issue. For example, Chuku et al. (2011) assess the relation between oil price shocks and current account dynamics in Nigeria using a standard VAR and find oil price shocks to have a significant short-run effect on current account balances. Moreover, Iwayemi and Fowowe (2011) find oil price shocks to have a weak impact on most macroeconomic variables in Nigeria.

The major limitation of these studies is that they fail to account for the observed volatility in oil prices, and therefore neglect an important transmission channel. Our paper can be seen as an important improvement on these studies. In particular, our paper is an extension of studies on oil price shocks and the real economy. It is closely related to the work of Elder and Serletis (2010), who examine the role of oil price uncertainty in the real economy for the United States. Unlike their study, however, we consider an oil-producing economy that is also an oil importer. Specifically, we analyze the effect of oil price uncertainty on the real output. We then determine whether the real output responds asymmetrically to oil price shocks.

The majority of studies tend to examine the effects of oil price shocks on the real economy within single-equation models. These models do not account for oil price volatility (or any kind of volatility, for that matter), which is said to have amplified since the early 1970s. Historical events suggest that particular time series, such as those of oil prices, exhibit different volatilities and, more frequently than not, time-varying volatilities (Fama, 1965). These studies' failure to account for such volatilities can lead to underestimation of the impact of oil price changes on the real economy. Models that are suited to handle such volatilities have been proposed by Bollerslev (1986) and extensions thereof.

Our paper addresses this issue by using a model that accounts for reverse causality, as well as volatility/uncertainty in oil prices. Our model decomposes oil price uncertainty into two components, *positive* and *negative* uncertainties. The model's key property is that it allows us to explore differences in oil price uncertainties. That is, we are able to estimate and observe whether oil price uncertainties have symmetric effects. This improvement is particularly useful to policymakers, because the standard VAR simulates the response of the real economy to oil price shocks—positive or negative—by permitting conditional means of the variables in the model to interact, thereby excluding other transmission channels. Our augmented VAR model, in contrast, offers the policymaker standard VAR transmission channels and an additional channel with which to assess the response of the real economy to oil price shocks, namely, the volatility channel as indexed by the decomposed general autoregressive conditional heteroskedastic (GARCH) measure of uncertainty.

The remainder of the paper is organized as follows. Section II presents our model. Section III describes the data and the empirical results. Section IV concludes the paper.

II. MODEL SPECIFICATION

A. VAR Model of Oil Price Uncertainty and Output

We analyze the impact of oil price uncertainty on output using the following VAR model:

$$X_t = \beta_1 X_{t-1} + \beta_2 X_{t-2} + \cdots + \beta_q X_{t-q} + u_t \tag{1}$$

where X_t represents an n×1 vector containing the output and measures of oil price uncertainty, β_i is an n×n parameter to be estimated, u_t denotes an error term whose variance–covariance matrix is Σ, and q and t are lag and time subscripts, respectively.

We identify oil price shocks through the error term u_t. The practical way of identifying these shocks remains a debatable topic. Suppose that we normalize u_t into v_t (i.e., $E[v_t v_t']=I_n$). Then a matrix A exists such that $u_t=Av_t$. The jth column of A is the instant effect of the jth innovation on all the variables. The innovation is one standard error in size (Iyke, 2018; Juhro and Iyke, 2019). The matrix A is restricted such that we have the variance–covariance matrix

$$\Sigma = E[u_t u_t^{'}] = AE[v_t v_t^{'}]A^{'} = AA^{'} \tag{2}$$

This equation implies that $n(n\text{-}1)/2$ degrees of freedom are left in the model. This is not sufficient to identify shocks to u_t. We identify the oil price shocks by restricting A to be a Cholesky factor of Σ; that is, we apply a recursive ordering of Y_t.

B. Computing Positive and Negative Oil Price Uncertainties

We compute the indicator of oil price uncertainty using the GARCH model (Iyke and Ho, 2018a). Specifically, we estimate the variance of the first difference of the logarithm of real oil price, $opr_t = ln(op_t)\text{-}ln(op_{t\text{-}1})$, or oil price returns from the GARCH(1, 1) model

$$opr_t = \tau_0 + \tau_1 opr_{t-1} + \varepsilon_t \tag{3}$$

where opr is oil price returns, which is stationary by construction; τ is the mean value of oil price returns; τ_0 and τ_1 are parameters of the model; and ε_t is the error term with zero mean and a conditional variance of known form σ_t^2, which is the measure of oil price uncertainty. The functional form of σ_t^2 is modeled as

$$\sigma_t^2 = \overline{\omega} + \alpha_1(\varepsilon_{t-1}^2 - \overline{\omega}) + \beta_1(\sigma_{t-1}^2 - \overline{\omega}) \tag{4}$$

where $\overline{\omega}$, α_1, and β_1 are parameters of the model.

We compute increases (positive changes) and decreases (negative changes) in oil price uncertainty by decomposing oil price uncertainty into positive and negative partial sums as follows (see Iyke and Ho, 2018b)

$$opu = opu_0 + opu_t^+ + opu_t^- \tag{5}$$

where opu_t^+ and opu_t^- are, respectively, the partial sums of the positive and negative changes in opu, oil price uncertainty. They are defined formally as

$$\begin{aligned} pou = opu_t^+ &= \sum_{j=1}^{t} \Delta opu_j^+ = \sum_{j=1}^{t} \max(\Delta opu_j, 0) \\ nou = opu_t^- &= \sum_{j=1}^{t} \Delta opu_j^- = \sum_{j=1}^{t} \max(\Delta opu_j, 0) \end{aligned} \tag{6}$$

III. DATA AND EMPIRICAL RESULTS

We measure the price of oil as the composite refiners' acquisition cost of crude oil, which is compiled by the US Department of Energy. This measure is calculated as the weighted average of domestic and imported crude oil costs, including transportation and other fees paid by refiners. This price index therefore measures the price of crude oil as an input to production. Since this price index takes into account the cost of imported oil, it measures oil prices more broadly than domestic price measures, such as the West Texas Intermediate crude oil price, which is the price paid to US producers (Elder and Serletis, 2010).

We arrive at our final measure for the real oil price by deflating the RAC of crude oil by the US gross domestic product (GDP) deflator, which is available from the website of the Federal Reserve Bank of St Louis. We measure the real output by the real GDP. The data on real GDP are obtained from the Central Bank of Nigeria. The original data are in the local currency (i.e., naira). We convert these figures from naira to US dollars by multiplying the real GDP (in naira) by the dollar–naira exchange rate, obtained from the Central Bank of Nigeria. The growth rates are in natural logarithms.

Our sample begins in the first quarter of 1980 and ends in the first quarter of 2019 (i.e., 1980:1–2019:1). Consistent with other studies (e.g., Iyke and Ho, 2018a), we measure oil price uncertainty as the conditional variance from a GARCH(1, 1) model of oil price returns, as described above.

We begin by testing for the stationary properties of real oil prices and real output using two tests: the Phillips–Perron and the Dickey–Fuller generalized least squares tests. The tests show that both variables are stationary in the first difference (see Table 1). Hence, we use the first differences of the variables, which are, by definition, the real oil price returns and the real output growth. Figure 1 shows the plots of the variable levels, as well as their first differences. Real output has been considerably lower in the 2000s because the dollar–naira exchange rate has been high during this period.

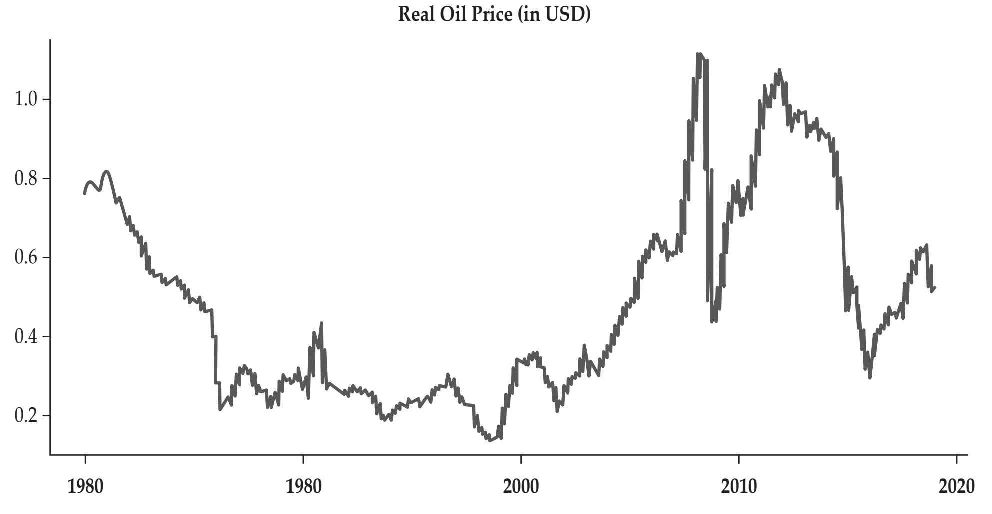
Table 1.
Tests for Stationarity

The table shows the results of the PP and DF-GLS stationarity tests. The null hypothesis is that variables are non-stationary. The reported test statistics are compared with the PP and DF-GLS critical values. The variables are in logarithms: their first differences represent growth (returns). The *** and * represent, respectively, 1% and 10% significance levels. NA denotes not applicable. The sample period is 1980:01 to 2019:01.

Variable	Panel A: Level			
	Intercept		Intercept and Trend	
	PP	DF-GLS	PP	DF-GLS
Real Oil Price	-1.963	-1.433	-2.249	-1.679
Real Output	-1.873	-1.158	-2.886	-2.843*
	Panel B: First difference			
	Intercept		Intercept and Trend	
	PP	DF-GLS	PP	DF-GLS
Real Oil Price	-9.196***	-8.572***	-9.214***	-8.681***
Real Output	-8.631***	-9.973***	-8.584***	NA

Figure 1. Real Oil Price and Real Output

This figure shows plots of the variables in their levels, as well as their first differences. The first differences are necessary since the variables are not stationary. By construction, the first differences represent real oil price growth/returns and real output growth. The sample period is 1980:01 to 2019:01.



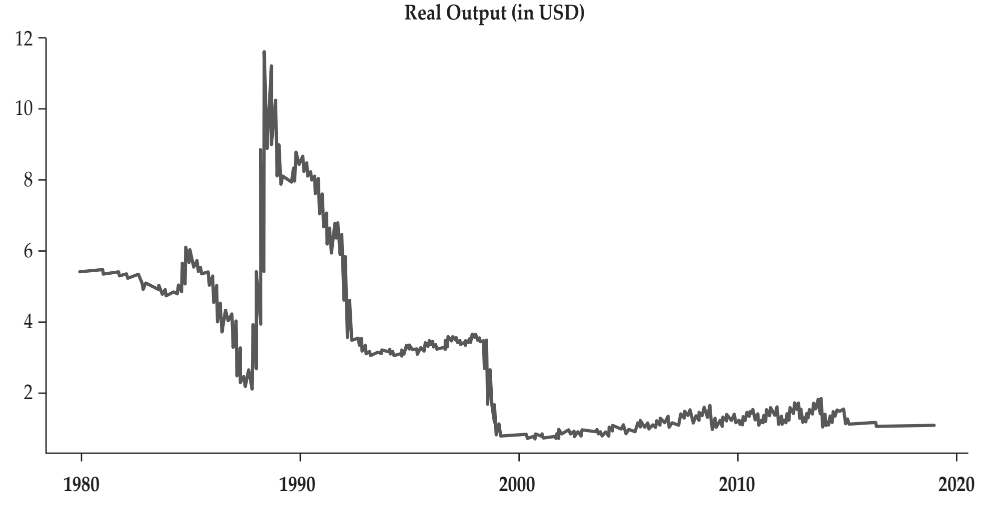
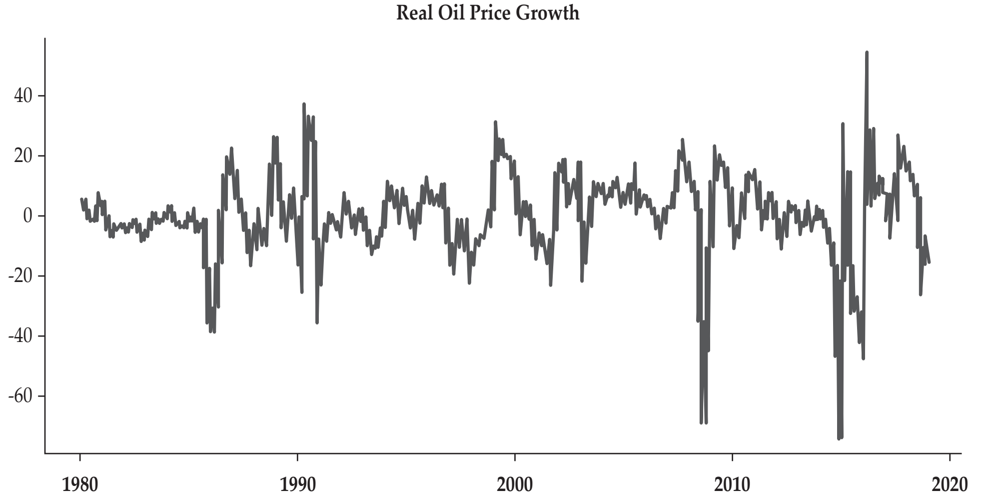
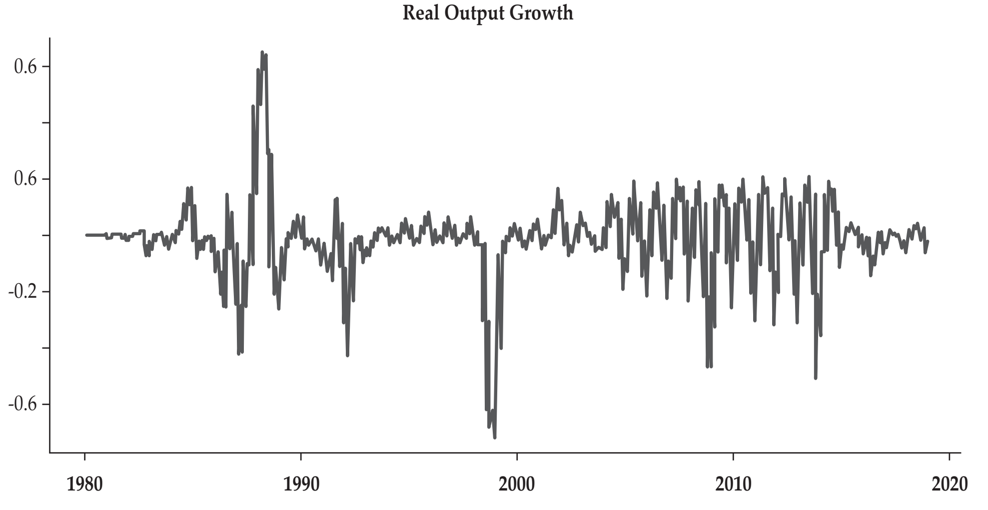


Figure 1. Real Oil Price and Real Output (Continued)





In addition to the stationarity tests, we perform lag selection tests. This allows us to include the appropriate lags in our model. The lag selection is based on the final prediction error, the Akaike information criterion, the Schwarz information criterion, and the Hannan–Quinn information criterion. The results are shown in Table 2. We find that a maximum of five lags is permissible in our analysis. However, since the data are quarterly, we include four lags in our estimations.

Table 2.
Lag Length Selection

The table shows the results of the lag selection tests. LR, LogL, FPE, AIC, SIC, and HQ are, respectively, the sequential modified Likelihood Ratio test statistic (each test at 5% level), Log-likelihood, Final prediction error, Akaike information criterion, Schwarz information criterion, and Hannan-Quinn information criterion. * and NA indicate lag order selected by the criterion and not applicable, respectively. The sample period is 1980:01 to 2019:01.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3578.590	NA	2.92E+17	48.729	48.790	48.754
1	-2839.780	1437.411	1.42E+13	38.800	39.044	38.899
2	-2827.469	23.450	1.36E+13	38.755	39.182	38.928
3	-2813.418	26.191	1.27E+13	38.686	39.296	38.934
4	-2771.022	77.293	8.07E+12	38.232	39.025*	38.554*
5	-2761.208	17.492*	7.99E+12*	38.221*	39.197	38.617
6	-2756.802	7.672	8.52E+12	38.283	39.443	38.754
7	-2751.673	8.724	9.01E+12	38.336	39.678	38.881
8	-2747.301	7.257	9.62E+12	38.399	39.924	39.019

Because the variables in our model could be cointegrated, we proceed to test for cointegration. We apply Johansen cointegration tests after restricting the number of lags to four. The results are reported in Table 3. Using both the *trace* and the *maximum eigenvalue* tests, we see that the variables are cointegrated. Specifically, there are at most two cointegration relations. This implies that, if output and oil prices diverge due to a sudden oil price or output shock, they tend to converge in the long run, because a common force is pulling them toward a common path.

Table 3.
Test for Cointegration

The table reports the results of the Johansen's Maximum-eigen value and Trace tests for cointegration. No. of CE(s) indicates the number of cointegration relations or equations. The * denotes rejection of the null hypothesis at the 0.05 level and ** denotes MacKinnon-Haug-Michelis (1999) p-values. The sample period is 1980:01 to 2019:01.

Hypothesized				
		Panel A: Trace test		
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.264	70.249	29.797	0.000
At most 1 *	0.129	24.314	15.495	0.002
At most 2	0.023	3.567	3.841	0.059
		Panel B: Maximum-eigen value test		
None *	0.264	45.935	21.132	0.000
At most 1 *	0.129	20.747	14.265	0.004
At most 2	0.023	3.567	3.841	0.059

Since the variables are cointegrated, equation (1) will not account for the short-run deviation of variables from equilibrium. Hence, we proceed by converting equation (1) into a vector error correction model. Because we are only concerned with the reaction of output to oil price uncertainty, we report only the real output equation. Table 4 shows the estimated error correction model for real output. Note that a maximum of four lags is included in the model. We see that positive oil price uncertainty (i.e., positive changes in uncertainty) has a negative impact on real output, while negative oil price uncertainty (negative changes in uncertainty) has a positive impact. The error correction term is negative and statistically significant, which suggests convergence. That is, 37% of the deviation of the output and oil price from equilibrium is corrected each quarter.

Table 4.
Estimates of The Error Correction Model

The table reports the estimates of a vector error correction model (VECM) version of Equation (1). Standard errors and *t*-statistics are in the round and square brackets, respectively. Δ is the first difference operator. The estimation period is 1980:02 to 2019:01.

	Lags			
Variable	**1**	**2**	**3**	**4**
Δ Real Output	-0.548	-0.621	-0.506	-0.092
	(0.105)	(0.101)	(0.099)	(0.088)
	[-5.237]	[-6.148]	[-5.093]	[-1.052]
Δ Positive Real Oil Price Uncertainty	-0.007	-0.008	-0.004	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
	[-3.344]	[-4.159]	[-2.119]	[-0.353]
Δ Negative Real Oil Price Uncertainty	0.010	0.021	0.009	0.005
	(0.007)	(0.007)	(0.007)	(0.007)
	[1.398]	[2.948]	[1.343]	[0.786]
Error Correction Term	-0.374			
	(0.101)			
	[-3.710]			
Adjusted R-squared	0.545			

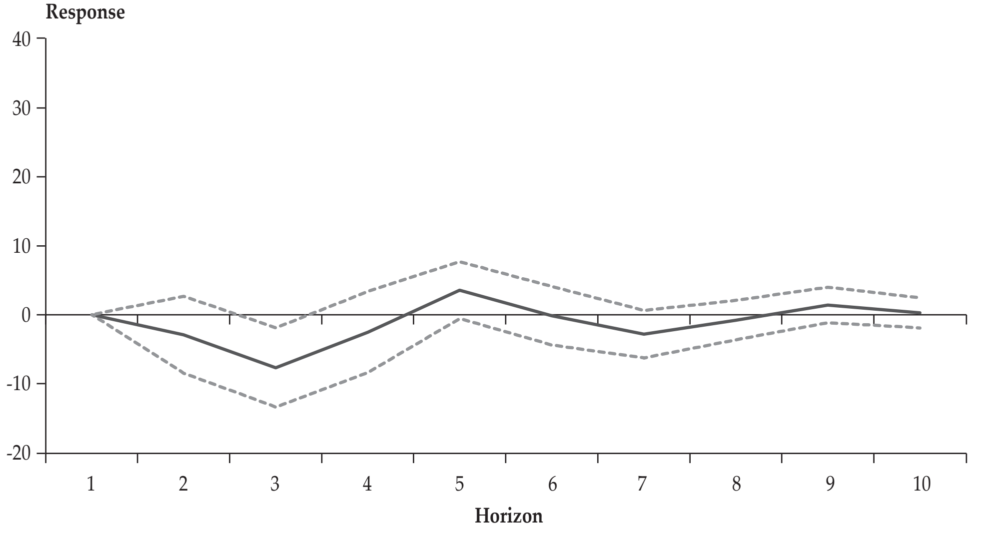
While the estimated error correction model above suggests that oil price uncertainties have an asymmetric impact on output, the picture is still unclear. We therefore proceed to generate the impulse responses following shocks to positive and negative oil price uncertainties (i.e., positive and negative changes in oil price uncertainty).

Aside from imposing lower triangularity on A in the fashion outlined in equation (2), we obtain our impulse response functions (IRFs) using 1,000 Markov chain Monte Carlo draws, a horizon of 10 quarters ahead, and four lags. The shock is one standard error in size, which confines the IRFs to the 16% and the 84% quantiles. The IRFs are displayed in Figure 2.

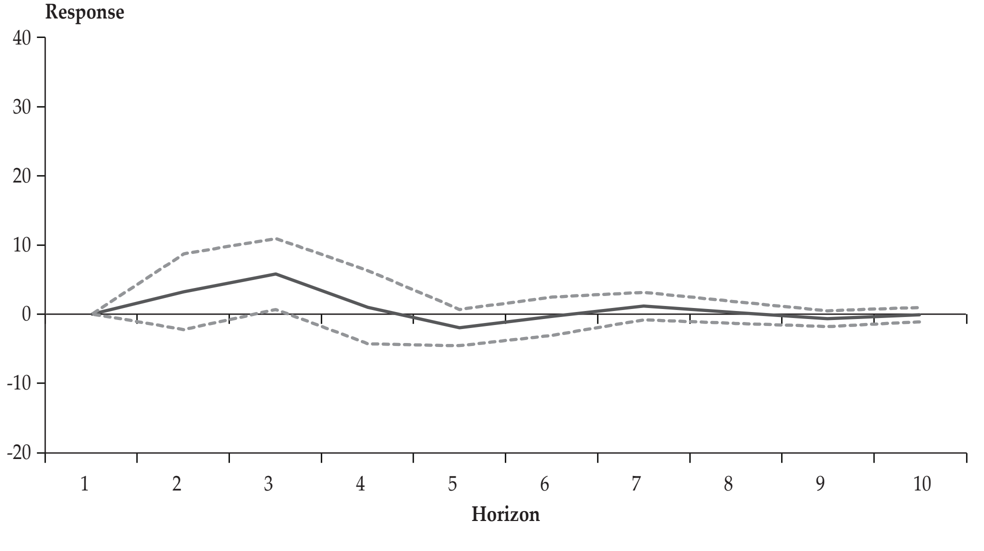
Figure 2. Impulse Responses of Real Output to Positive and Negative Oil Price Uncertainties

The figure shows the impulse responses obtained from our model. We imposed lower triangularity on *A* in a fashion outlined in Equation (2). The impulse responses are generated based on 1000 Markov Chain Monte Carlo (MCMC) draws, a horizon of 10-quarters ahead, and 4 lags. The shock is one standard error in size (i.e. Cholesky one standard deviations), confining the impulse responses to the region of 16% and the 84% quantiles. The estimation period is 1980:02 to 2019:01.

Response to Positive Oil Price Uncertainty



Response to Negative Oil Price Uncertainty



A positive (negative) oil price shock, which leads to a sudden rise (fall) in oil price uncertainty, has a significant and immediate impact on real output. Sudden positive changes in oil price uncertainty lead to a fall in real output of 8% from baseline by the third quarter. Real output climbs back to its baseline during the fourth quarter and then rises above it by 4% in the fifth quarter ahead. Real output then falls by 3% below its baseline in the seventh quarter. Beyond this point, the impact of the shock is not substantial. The impact disappears by the 10th quarter (see Figure 2).

By contrast, sudden negative changes in oil price uncertainty lead to a rise in real output, up to the third quarter. That is, real output increases by 6% at the end of the third quarter. Real output then declines to its baseline and below by the fourth quarter. The impact of the oil price shock (i.e., one that affects negative changes in oil price uncertainty) disappears by the sixth quarter.

Generally speaking, since the response of real output to a positive uncertainty is not a mirror image of the response to negative uncertainty, we can conclude that the impacts are asymmetric. We carry out a robustness check of our results by converting the series into domestic currency, the naira. The results—not tabulated here to conserve space but available upon request—are qualitatively similar to those presented here. Specifically, we find the variables are cointegrated, sudden positive changes in real oil price uncertainty have a negative impact on real output, and sudden negative changes in real oil price uncertainty have a positive impact on real output following the shock. The impacts are asymmetric.

IV. CONCLUSION

In this paper, we assessed the effects of oil price uncertainty on the real output in Nigeria during the period 1980:1–2019:1. The theory posits a negative response of the real economy to oil price uncertainty. Studies have often narrowed the empirics to non–oil-producing countries, which is why we pursued the issue by considering an oil-producing country, Nigeria. We attained this objective by employing a VAR model that accounts for two components of oil price uncertainty. That is, we decompose oil price uncertainty into positive and negative uncertainties. Positive uncertainty measures positive changes in oil price uncertainty, while negative uncertainty measures negative changes in oil price uncertainty. The decomposed uncertainty measure is obtained from the conditional variance of a GARCH(1, 1) model of oil price returns. We find that real output tends to respond negatively to positive real oil price uncertainty, and positively to negative real oil price uncertainty. The responses of real output following positive and negative real oil price uncertainties are asymmetric. Our results remained robust to denominating the series in local currency. Our empirical results on oil price uncertainty fairly reflect the two main characteristics noted in the relation between real output and oil prices. In the mid-1980s, the sharp decline in oil prices failed to generate the rapid output growth predicted by theory. Similarly, the episode of sharp increases in oil prices from 2002 to 2008 failed to generate the recession expected in many countries.

REFERENCES

Ayadi, O.F. (2005). Oil Price Fluctuations and the Nigerian economy. *OPEC Energy Review*, 29, 199–217.

Ayadi, O. F., Chatterjee, A., and Obi, C. P. (2000). A Vector Autoregressive Analysis of an Oil-Dependent Emerging Economy – Nigeria. *OPEC Review*, 24, 329–349.

Barsky, R.B., and Kilian, L. (2004). Oil and the Macroeconomy since the 1970s. *Journal of Economic Perspectives*, 18, 115–134.

Bernanke, B.S. (1983). Irreversibility, Uncertainty, and Cyclical Investment. *Quarterly Journal of Economics*, 98, 85–106.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31, 307–327.

Chuku, C.A., Akpan, U.F., Sam, N.R., and Effiong, E.L. (2011). Oil price shocks and the dynamics of current account balances in Nigeria. *OPEC Energy Review*, 35, 119–139.

Edelstein, P., and Kilian, L. (2009). How Sensitive Are Consumer Expenditures to Retail Energy Prices? *Journal of Monetary Economics*, 56, 766–79.

Elder, J., Serletis, A. (2010). Oil Price Uncertainty. *Journal of Money, Credit and Banking*, 42, 1138–1159.

Fama, E.F. (1965). The Behavior of Stock Market Prices. *Journal of Business*, 38, 34–105.

Hamilton, J.D. (1983). Oil and the Macroeconomy since World War II. *Journal of Political Economy*, 91, 228–48.

Hamilton, J.D. (1988). A Neoclassical Model of Unemployment and The Business Cycle. *Journal of Political Economy*, 96, 593–617.

Hamilton, J.D. (2009). Causes and Consequences of the Oil Shock of 2007–08. San Diego. *Brookings Papers on Economic Activity*, Spring 2009 University of California.

Hooker, M.A. (1996). What Happened to the Oil Price–Macroeconomy Relationship? *Journal of Monetary Economics*, 38, 195–213.

Hooker, M.A. (2002). Are Oil Shocks Inflationary? Asymmetric and Nonlinear Specifications Versus Changes in Regime. *Journal of Money, Credit and Banking*, 34, 540–561.

Iwayemi, A., and Fowowe, B. (2011). Impact of Oil Price Shocks on Selected Macroeconomic Variables in Nigeria. *Energy Policy*, 39, 603–612.

Iyke, B. N. (2018). Assessing the Effects of Housing Market Shocks on Output: The Case of South Africa. *Studies in Economics and Finance*, 35(2), 287-306.

Iyke, B. N., & Ho, S. Y. (2018a). Real Exchange Rate Volatility and Domestic Consumption in Ghana. *The Journal of Risk Finance*, 19(5), 513-523.

Iyke, B. N., & Ho, S. Y. (2018b). Nonlinear Effects of Exchange Rate Changes on the South African Bilateral Trade Balance. *The Journal of International Trade & Economic Development*, 27, 350-363.

Juhro, S. M., & Iyke, B. N. (2019). Monetary Policy and Financial Conditions in Indonesia. *Buletin Ekonomi Moneter dan Perbankan*, 21, 283-302.

Lee, K., Shawn, N., Ratti, R.A. (1995). Oil shocks and the macroeconomy: the role of price variability. *Energy Journal*, 16, 39–56.

Lee, K., Kang, W., Ratti, R.A. (2011). Oil Price Shocks, Firm Uncertainty, and Investment. *Macroeconomic Dynamics*, 15 (3), 416–436.

Mork, K.A., (1989). Oil and the macroeconomy. When Prices Go Up and Down: An Extension of Hamilton's Results. *Journal of Political Economy*, 97, 740–744.

Narayan, P.K., Sharma, S., Poon, W.C., and Westerlund, J. (2014) Do Oil Prices Predict Economic Growth? New Global Evidence. *Energy Economics*, 41, 137-146.

Narayan, P.K., and Sharma, S.S. (2011) New Evidence on Oil Price and Firm Returns. *Journal of Banking and Finance*, 35, 3252-3262.

Pindyck, R.H. (1991). Irreversibility, Uncertainty, and Investment. *Journal of Economic Literature*, 29, 110–148.