Evidence on the Role of Oil Prices in Venezuela's Economic Performance

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A. Introduction

The sharp swings in its economic performance and oil prices in the last 40 years of the twentieth century make Venezuela a natural laboratory for investigating the relationship among oil prices, government revenue, government spending, and economic performance in an oil exporting country. Casual observation of the various trends in real oil prices, GDP growth, investment and government revenue and spending would seem to suggest a close relationship among these variables. However, a more careful look shows the pattern of interaction among these variables is not that obvious. A number of researchers have attempted to assess the role that changing oil prices have played in determining investment, economic growth and government policies in Venezuela, with some differing conclusions.

Bourguignon and Gelb (1988) suggest that the stagnation of the Venezuelan economy started after 1978, coinciding with the second oil shock in 1979. According to their calculations, the non-oil sector did not seem to gain from the 1970s windfall. They further argue that inappropriate economic policies resulted in steep declines in private investment and massive capital flight. Combined with a large upsurge in consumption during the decade of revenue windfall, these effects meant that Venezuela was subject to severe internal and external imbalances that ultimately lead to its decline in economic performance.

Rodriguez and Sachs (1999) calibrate a dynamic general equilibrium model for the Venezuelan economy. They show that Venezuela, like other economies highly dependent on oil revenues,

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"overshot" its steady state, and its decline in economic performance reflected its converging to the steady state from above. In other words, Venezuela could temporarily support unsustainable levels of consumption and investment per capita, but eventually per capita income declined to its steady state levels.

Cuevas (2002) decomposes real oil prices and GDP into common stochastic trend and cycle processes for the period from 1970 to 2000. He finds a strong association, at the trend and cycle frequencies, between the two variables. He also shows that this association has weakened considerably during the past two decades suggesting that oil cannot serve as an engine for future growth in Venezuela.

Hausmann (2003) develops a neo-classical model for Venezuela with perfect capital mobility in which lower oil income lowers the demand for non-traded goods resulting in lower capital per worker and output per worker. Hausmann's calculations indicate that this effect accounts for only half the drop in per worker output. He then argues that rest of the decline comes from increased country risk driving up real interest rates, resulting in lower desired capital stock, and investment.

In this paper we take a new approach to understanding the role of oil prices in Venezuela's economic performance from 1950 to 2001. We produce empirical evidence on the relationship among oil prices, government revenue and spending, investment and GDP growth in both the long and short run. We estimate a Cointegrated Vector Autoregression (CVAR) model that has the distinct advantage of simultaneously modeling both the short run and long relationship among key economic variables.

In the next section, we briefly discuss the CVAR methodology and explain why it is particularly applicable to the research at hand. That is followed by a description of the data and variables used in the empirical analysis. The next two sections look at the long-run and short-run results, respectively. We finish with a conclusion.

B. Methodology

We wish to investigate the role of oil prices in both determining Venezuela's economic growth trends, a long-run performance issue and determining the dynamic reaction of Venezuela's economy to

oil price shocks, a short-run performance issue. Both the short-run and long-run relationships among key macroeconomic and oil prices variables provide insight into how exporting countries should react (and have reacted) to increases and decreases in real oil prices. Long-run relationships among macroeconomic variables are typically investigated by analyzing the existence of cointegrating relationships that govern their long-run equilibrium performance. Relatively short-run dynamics have often been investigated by estimating of VARs, which allow for complex dynamics at business cycles frequencies.

More recently, econometricians have begun to combine these two approaches in the CVAR approach. In contrast to the traditional approach of estimating a VAR in first differences, which discards the information contained in the long-run relationship among the macro variables, the CVAR approach uses the information in the cointegrating relationships to improve the specification of the dynamic VAR. Specifically, the CVAR model, by allowing for the possibility of equilibrium corrections, takes into account the long-run relationship among the system's (or macroeconomic) variables.

The first step in the CVAR approach is to investigate the order of integration among the macro variables and then, if applicable. test the cointegration hypothesis (Johansen (1995)). Then, to uniquely identify the detected cointegrating vectors, a reduced rank, CVAR is estimated in levels. This step entails imposing two sets of restrictions. First, imposing the rank restriction insures that the cointegration space imposed on the VAR is such that the restricted long-run matrix is identified for a specific rank. Second, imposing and testing identifying restrictions from economic theory on the cointegrating coefficients allows the unique identification of the cointegrating space. Once the cointegrating relationships are estimated, a CVAR in first differences, including the error correction terms, is estimated. The vector error correction model (VECM) provides information on the short-run dynamics. In many instances a parsimonious VECM provides more accurate insights into the nature of those dynamics.

In sum, we estimate a four equation CVAR in real investment, real government consumption, real government revenue and real GDP. In addition to these endogenous variables we include real oil prices. Real oil prices are set outside the Venezuelan economy and are taken as exogenous. To account

for the possibility that the second moment of oil prices is important for economic performance, we also include the conditional standard deviation of oil prices (as calculated from a GARCH(1,1) model) as an exogenous variable. Finally, a deterministic trend and three dummy variables are included. We include a dummy for the two oil shock years, 1974 and 1979 and, as a preliminary test of asymmetry, include a dummy for years in which the real price of oil falls. The form of the CVAR we estimate is thus given by:

$$y_t = \sum_{i=1}^{n} \lambda_i y_{t-i} + \sum_{s=0}^{p} \beta_s \rho_{t-s} + \sum_{m=0}^{q} \gamma_m \sigma_{t-m} + \delta \bar{Z}_t + \zeta_t$$

C. Variables and Data

We interested in analyzing the relationship among oil prices, government fiscal variables, investment, and real economic growth, see Figure 1. Thus the variables that we include in our analysis are real investment, real government consumption, real government revenues, real GDP and real oil prices. Each of these variables is defined in the following table. All data were obtained from the IFS and annual, covering the 1950-2001 period. The Venezuelan consumer price index was used to deflate the series as the GDP deflator was not available for the whole period.[2]

Variable	Definition
Investment	Log real investment, defined as gross fixed capital formation deflated by the consumer price index
Govt. Consumption	Log real government consumption. It includes expenditure incurred by general government on consumption goods and services deflated by the consumer price index
Govt. Revenue	Log real government revenues. it comprises of all non-repayable government receipts other than grants deflated by the consumer price index
Real GDP	Log real gross domestic product (deflated by the consumer price index)
Oil Prices	Log real oil prices defined as world average crude oil prices (in US$) deflated by US producer price index.

D. Long-Run Results[3].

[2] World crude oil prices were not available from the IFS for the years 1950 and 1951. World prices for those two years were extrapolated (backward) using the growth rate of Venezuela's crude oil prices.

[3] Full results from all tests are available from the authors upon request.

We start with the estimation of the CVAR, in levels, specified above, with n=p=q=4. Model reduction tests indicate that two lags of each variable are appropriate. F-tests on the significance of each regressor are used to eliminate any insignificant exogenous variables. These tests indicate that the second lag on all exogenous variables, the current value of the conditional standard deviation of oil prices, the current value of the negative oil price change dummy, the 1979 dummy and the deterministic trend are individually insignificant and are dropped.[4]

The results of the cointegration analysis from Table 1indicates the presence of two cointegrating vectors. Identification of the equilibrium relations are provided in Table 2.We identify the first vector so as to represent the long-run equilibrium relation between government revenue and government consumption. GDP appears to be weakly exogenous with respect to this relation and the exogenous oil prices are found to be cointegrated with the fiscal variables. Therefore, given the level of economic activity and oil prices, the equilibrium level of government revenues and government consumption are simultaneously determined. Equilibrium revenues increase with higher output, higher oil prices, and the need to finance higher government consumption.

The second cointegrating vector is interpreted as the long-run equilibrium relationship between GDP and investment. Oil prices are significant in the second vector, as well, and are thus cointegrated with GDP and investment. Investment is found to be weakly exogenous with respect to real GDP. This vector thus indicates that investment and oil prices together determine the long-run level of real GDP. Equilibrium long-run output increases with higher levels of investment and higher oil prices.

E. Short Run Results

The short-run dynamics for Venezeula are estimated using the error correction representation of the model that includes first differences for the four endogenous variables, an equilibrium error

[4] Note that the insignificance of the current values for the conditional standard deviation of oil prices implies that the second moment only has short-run effects. Since a cointegration relation is a “static” equilibrium relation, only current values can be restricted to lie in the cointegrating space and the conditional standard deviation will not enter the cointegating vectors and will appear only in the error correction model.

correction term represented by the lagged cointegrating vectors and current changes in oil prices. In addition, the lagged level for the conditional standard deviation of oil prices is included. (See Table 3.)

Our first short-run result is that the cointegrating vectors are significant the error correction model, indicating significant transitional dynamics. Thus, the estimation of a CVAR provides not only long-run results but also improves the specification of the short-run dynamics. The pattern of short run dynamics is identified by sequentially eliminating insignificant regressors and then estimating the resulting model with FIML.

Short run growth in real GDP is not affected by either of the fiscal variables or by investment but is affected by both representations of oil prices. Increases in the level of oil prices have a positive effect on GDP in the short run, but increased variance in oil prices reduces the short-run growth in real GDP. In contrast, real GDP has a positive short-run impact on the other three endogenous variables with an increase in GDP driving up government revenues, government consumption and investment. Thus, changes in oil prices have a indirect effect on these three variables through their impact on real GDP. In addition, oil prices have a direct dynamic effect on government revenues. An increase in oil prices drives up government revenues but an increase in the variance of oil prices actually reduces government revenues. Given that Venezuela nationalized its oil industry in 1975 and that oil revenues account for over 60 percent of the government's budget, this additional direct effect is not surprising.

F. Conclusion

Our empirical analysis revealed an important role for oil price changes in influencing Venezuela's economic performance in both the long run and the short run. Higher oil prices and higher investment lead to higher long run level of output. Therefore, the slow down of the Venezuelan economy in the 1980's and 1990's can be attributed both to the decline in oil prices and the decline in investment. Moreover, we find that investment responds negatively to higher oil prices in the long run. This means that the direct effect of oil price changes on the economy are partially offset by a compensating effect in investment. Our results also show that while oil price shocks have a direct effect on GDP growth,

government revenue and government consumption do not directly affect real GDP in either the long or short run. Venezuela does suffer from 'the natural resource curse.'

We find that in the long run, higher government revenues lead to higher government consumption. Thus, oil prices have a positive effect on government consumption in the long run. In addition, in the short run, oil prices will have an indirect effect on government consumption, through their direct impact on real GDP. Higher oil prices induce higher growth rates and the latter leads to higher government consumption.

Finally, we find some evidence that a higher variance in oil prices has a negative impact on short-run economic performance. Both real GDP and government revenues are negatively influence by a higher conditional variance in oil prices. This is partially offset by a positive response in investment to a higher conditional variance in oil prices.

Figure 1: Variables in Levels (Logarithms): 1950-2001

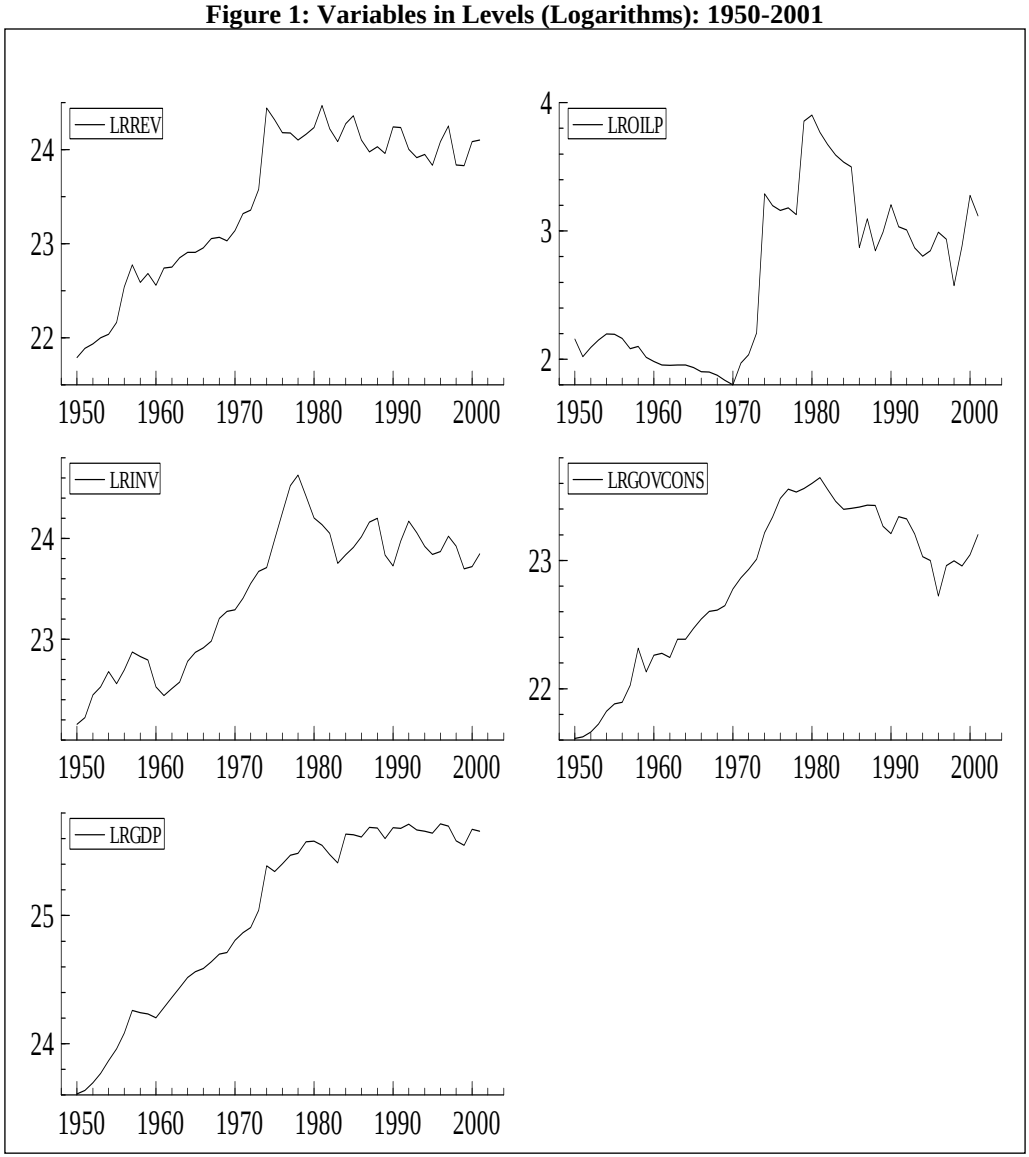

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Table 1: *Determining the rank of Cointegration*				
Rank	**eigenvalue**	**Log likelihood**	**H0:rank<=**	**Trace test [Prob]**
0		220.39	0	79.41[0.00] ***
1	0.61	243.19	1	33.82 [0.02] **
2	0.36	254.13	2	11.94 [0.16]
3	0.21	259.75	3	0.692 [0.41]
4	0.01	260.10		

*** Significant at the 1% level.

** Significant at the 5% level.

The estimated final VAR (2) system has four variables in real terms: government revenues, government consumption, investment, and GDP. Other right hand side variables include oil prices (entered in the cointegrating space), first lag of oil prices, first lag of the negative shock dummy, first lag of uncertainty, 1974 dummy, and a constant.

Table 2: *Parameters of the Identified Cointegrating Relations*[1]		
Variable	**CIa Government Fiscal**	**CIb Output/Capital**
Beta		
Revenues	1	---
Investment	---	-0.4162 (0.2085)
Gov. consumption	-0.4848 (0.0821)	---
GDP	-0.5516 (0.0687)	1
Oil prices	-0.4184 (0.0927)	-1.2115 (0.3842)
Alpha		
Revenues	-0.3321 (0.1071)	---
Investment	0.3836 (0.1155)	---
Gov. consumption	0.4352 (0.1260)	-0.1361 (0.0427)
GDP	---	-0.0695 (0.0178)

1. Standard errors are in parentheses.

Table 3: Final Vector Error Correction Model

	ΔRev	ΔInv	ΔGDP	ΔGovCons
ΔRev_1	-0.183*			
ΔInv_1	-0.462***	0.316***		
ΔGDP_1	0.793***	0.514***		0.388**
ΔGovcons_1				-0.196*
ΔOilP	0.283***		0.171***	
NegShock	-0.078***			
Volatility	-2.364***	1.294*	-0.724**	
Dum74	0.45***		0.128*	
CI_a	-0.123***	0.056*		0.421***
CI_b			-0.198*	-0.086***

log-likelihood 223.804878 -T/2log|Omega| 496.241076
no. of observations 48 no. of parameters 22
LR test of over-identifying restrictions:
Chi^2(22)= 25.901 [0.2559]
Vector Portmanteau(6): 78.4956
Vector EGE-AR 1-2 test: F(32,119)= 1.1512 [0.2881]
Vector Normality test: Chi^2(8) = 11.890 [0.1562]
Vector hetero test: F(180,152)= 0.79412 [0.9312]
*** significant at the 1% level
** significant at the 5% level.
* significant at the 10% level

The original VECM had four variables in first differences: government revenues, government consumption, investment, and GDP. Other right hand side variables include the change in oil prices, first lag of the negative shock dummy, first lag of volatility, 1974 dummy, and a constant. The sample is from 1952 to 2001. The theory of reduction in the general-to-specific approach was used to develop the parsimonious final model.