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Abstract

In 1973-1974, the U.S. faced the so-called "Energy Crisis" due to the Arab oil embargo and a quadrupling of world crude oil prices by OPEC. This led the U.S. to use a" Price Control" policy in the domestic energy market. The effects of such policy are explored and well documented. However, the responses of OPEC producers to such a policy need further attention. This paper examines the effects of these price controls on OPEC's extraction path. It also examines the relation between the harm function and the change in OPEC production. The results show some evidence that OPEC did respond differently to price controls applied by the U.S. For some periods it cut production, while in other periods production levels increased. The results also show some evidence regarding Wirl (2008) that OPEC includes political support as part of its objective function when it comes to oil extraction.

Keywords: OPEC, Price Controls, Energy Economics, Oil
JEL Classification: C01, C20, Q30, Q40

I. Introduction

Gasoline is one of the major fuels consumed in the U.S. and the main product refined from crude oil. Over the last 20 years, changes in crude oil prices have explained 85 percent of the changes in the price of gasoline in the U.S. This indicates that the world price of crude oil is the primary explanatory factor of the price of gasoline.

In 1973-1974, the U.S. faced the so-called "Energy Crisis" due to the Arab oil embargo and a quadrupling of world crude oil prices by OPEC. This crisis caused dramatic social, political, and economic changes, and led the U.S. to use a "Price Control" policy in the domestic energy market. Under these price control policies, the U.S. set different oil prices to insulate the U.S. economy and market participants from the dramatic increase in foreign oil prices.

A large literature has looked at the welfare losses of price controls in energy markets. Agarwal and Deacon (1985) looked at the petroleum industry price and allocation controls in the U.S. during the I970's, and they found that regulations consistently kept price below marginal cost, causing the overall volume of refined product output to be excessive and this led to inefficient distribution of the product to consumers. Camm (1983) discussed the impacts of the price control policy on gasoline customers. He shows that customers were paying higher prices than the regulated prices due to the long time wait and cost of wasted time. Frech and Lee (1987) showed how to ration a good across markets (rationing-by-queuing.), while doing the least harm to consumer welfare. They provide empirical estimates from U. S. gasoline crises of 1973-1974 and 1979 of the extra welfare losses caused by misallocation of gasoline between urban and rural markets. Smith and Phelps (1978) looked at the impact of price controls on U.S. domestic oil production. They showed that price

controls during 1974-76 have generated a perverse supply curve such that future increases in real world oil prices will transfer proportionately more U. S. income to OPEC than past price increases. Kalt (1981) showed that price controls have an ambiguous effect on total domestic output. This is due to the fact that price controls can either raise or lower the value of current rents relative to the value of future rents, causing the time path of extraction from existing reserves to be ambiguous. Also price controls reduce the absolute present value of the streams of rents going to producers, resulting in reduction in exploration and development of new reserves. Kalt found that price controls caused a deadweight loss to the U.S. economy ranging from $1-5 billion yearly.

On the whole, the effects of price controls on crude oil producers and refiners in the U.S. have been explored and well documented (Kalt, 1981). However, the responses of OPEC producers to such a policy need further attention. This paper tests empirically the effect of the U.S. price control policies on OPEC's decisions, and explores if OPEC's behavior was affected by these policies, particularly the oil extraction decisions of OPEC. This paper is organized as follows: Section II gives a brief description of the history of oil price control policies in the U.S. Section III examines the effects of these price controls on OPEC. Section IV reports the findings of the relation between the harm function and the change in OPEC's production, and finally, Section V concludes.

II. The History of Oil Price Control Policies in the U.S.

Kalt (1981) explored and well documented the U.S. price controls and regulations imposed on refined products and crude oil, and their significant negative effects on oil producers and consumers alike. He shows that the period for these controls extends from 1970 – 1991. These policies started with the Economic Stabilization Act of 1970. Phase I of

this Act lasted from August to November 1971; Phase II lasted from November 1971 to January 1973; and Phase III lasted from January 1973 to August 1973. By the end of 1973, the Economic Stabilization Act of 1970 created pressures on the petroleum industry, and these pressures lead to the Emergency Petroleum Allocation Act (EPAA). The EPAA was used till February 1976 where the Energy Policy and Conservation Act (EPCA) was an amendment to the EPAA which took effect in February 1976. The EPCA formally expired in September 1981, as the Congress did not make an effort to reauthorize the program.

To replace the EPAA/EPCA, the Crude Oil Windfall Profit Tax (WPT) was enacted in April 1980. The name of this tax was a bit misleading, as this was not a tax on profits, but rather an excise tax on domestic oil production, effective March 1, 1980. The Windfall Profit Tax was scheduled to expire over 33 months, after January 1988, no later than January 1991.

III. The Effects of the U.S. Price Controls on OPEC

The major issue in this section is to examine how OPEC responded to the price controls adopted by the U.S. In other words, did OPEC cut production during the time periods in which the U.S. adopted the price control policies, or these policies had no effect at all on OPEC's oil extraction decisions?

OPEC's oil production and reserves are the levels reported by OPEC in its Annual Statistical Bulletin for different years (1989-2007). OPEC's Annual Statistical Bulletin provides data about world energy markets. It contains statistical data regarding the oil and gas activities of OPEC's member countries (Algeria, Angola, Ecuador, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela), as well as the global petroleum industry in general. It also provides comprehensive and detailed data on upstream and downstream activities, and the global flows of oil and gas, in addition

to basic financial data about some of the world's largest oil and gas companies. Crude oil production and exports for OPEC Members from 1970 – 2007 are in 1,000 b/day.

To explore the response of OPEC to the U.S. price controls, we start by detrending the secular production levels of OPEC. This is done by regressing OPEC's production levels from 1960 to 2007 on a time index, ranging from linear up to a sixth order polynomial. Then, by calculating the Schwarz Information Criteria (SIC), the best detrending model will be identified as the one with the minimum SIC.[1] Using this criterion, the secular production trend was best captured by a sixth order polynomial trend.

The residuals from this trend capture the effects of the unobservable factors on production levels such as cost, expectations and more, including the response of OPEC to the price control policies. Now, one can argue that these residuals may be used to show and test the impact of the price control policies on OPEC's production. The residuals from this trend are displayed in Figure 1. The plotted residuals show some evidence that the production levels were lower in years 1975, 1976, 1979, 1981-1986, and 1988, when compared to years before and after. This is how one can attribute the negative deviations from the secular trend for these years. Now, do these reductions in OPEC production reflect responses to the price controls or not? To test what we observe from the plotted residuals, a relationship between these residuals and the price control periods should be estimated. This means we need to regress these residuals on the price control periods. To be able to do so, one needs to include five dummy variables for these periods, where each equals one if it is the year or years in which the specific price control was applied, and zero otherwise (e.g. for the period 1970, D_1

[1] The Schwarz Information Criterion (SIC) has been widely used for model identification in time series and linear regression. SIC is an index used as an aid in choosing between competing models. It was proposed as a method for choosing between different models with different numbers of parameters, in order to determine which is the "best fit" to the observed data.

= 1 for this year, and zero otherwise. For the period 1971-1972, D_2 = 1 for this period, and zero otherwise).

Figure 1 is here

Following these notions, our model regresses the residuals, plotted in Figure 1, on five dummies matching the periods when price controls were applied, and OPEC's reserves in year (t), with a constant.

$$Resid_t = \alpha_0 + \alpha_1 R_t + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_4 + \alpha_5 D_5 + \alpha_6 D_6 \quad (1)$$

where, $Resid_t$ is the residuals from the regression of the production levels from 1960 to 2007 on a time index, R_t is OPEC's reserves in year (t), D_1 is a dummy variable for the period 1970 (the base and is dropped), D_2 is a dummy variable for the period 1971-1972, D_3 is a dummy variable for the period 1973, D_4 is a dummy variable for the period 1974-1975, D_5 is a dummy variable for the period 1976-1979, and D_6 is a dummy variable for the period 1980-1988. The results are reported in Table 1.

Table 1 is here

In Table 1, the difference between the coefficients of any two consecutive dummies can be interpreted as the difference between the levels of production, on average. The reported coefficients show some evidence that the production levels of OPEC were affected by the price controls policies for some periods.

For the period 1971-1972, the average loss in production amounts to approximately 1196 (1000 barrel/day) with respect to the previous period in which price controls were used, and 3637 (1000 barrel/day) with respect to the following period, and both differences are statistically significant (different from zero).

For 1973, OPEC increased production, according to the estimated coefficients. The average increase in production amounts to approximately 3637 (1000 barrel/day) with respect to the previous period, and to 2183 (1000 barrel/day) with respect to the following period, and both differences are statistically significant (different from zero). This result seems odd, given that 1973 is the year in which Arab members of OPEC banned exports to western countries and the U.S. due to the 1973 war. One explanation for this could be that the war did not occur until October of that year. So perhaps these countries, in earlier parts of 1973, were planning for the war and increasing oil output to support such activities. This might have led them to expand extraction at the beginning of 1973, and perhaps that's what the coefficient is capturing.

This argument can be supported by the estimates on the 1974-1975 periods, when production is lower than in the previous or following time periods. The Arab members of OPEC were perhaps still using the ban, and were also responding to the U.S. price control policies. The average loss in production amounts to approximately 2183 (1000 barrel/day) with respect to the previous period, and to 3822 (1000 barrel/day) with respect to the following period. Both differences are statistically significant (different from zero). OPEC's production levels increased for 1976-1979, and were not affected by the U.S. price control policies. This indicates that OPEC members were trying to recover their foregone revenues to address growth needs inside their countries. Finally, the estimated coefficients show some evidence that OPEC responded by cutting production when the U.S. implemented the "Windfall Profit Tax", from 1980-1988. OPEC cut production by 5593 (1000 barrel/day) on average, and this difference is statistically significant. This result is supported by the work of Karp and Newbery (1991), where they found that OPEC will initially have a lower share of

current production than of current reserves when the U.S. and other large importers all impose optimal import tariffs. However, through this period (1980-1988), oil prices were decreasing (see Figure 2 in the appendix) and these cuts could have been made by OPEC to help prices increase, rather than the decline is a response to the Windfall Profit Tax.

This section shows some evidence that OPEC did respond differently to price controls applied by the U.S. For some periods it cut production, while in other periods production levels increased. Although, these increases or decreases are not related only to the price control policies, it still explains some of the variation in production levels.

IV. Relation between Harm Function and Residuals

OPEC includes Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela. Following the approach suggested by Wirl (2008), these countries can be divided into allies and adversaries, in terms of their relations with the West. Countries like Indonesia, Kuwait, Nigeria, Qatar, Saudi Arabia, and United Arab Emirates are seen as allies to the European countries and the U.S. Countries like Iran, Algeria and Venezuela are considered to be anti-West (until 2003, Iraq and Libya considered to be in this group). Following Wirl (2008), the hypothesis in this paper is that OPEC countries do not pursue strict profit maximization. Indeed, they also seek political support among their people. These countries realize that the Wes depends on OPEC's oil; this gives them some power of influence. The people of these countries frequently express anti-Western sentiments.[2] For this reason, OPEC countries in need of popular domestic support may take production decisions to gain such support. The statements and interviews that we read and watch for Ahmadi Nejad of Iran and Chavez of Venezuela are good examples of these policies. Even countries considered to be allies must still secure the support of their

[2] They disagree primarily with the American and European policy toward the Arab-Israeli conflict.

people, some of whom also have anti-Western sentiments. Such countries (allies) may adopt a moderate anti-Western policy. With the political consideration in mind, OPEC countries will be assumed to maximize the net present value of benefits, where benefits are derived from oil profits as well as political support, based on the degree to which the west is harmed.

Following Wirl (2008), let the political support among citizens of the country be S_t. Political support is a function of the adverse effect on the West of higher oil prices, so S_t is the harm function.[3] This harm function depends on the quantity of oil extracted and supplied to the market, and on an indicator, α_t, that measures the desire of OPEC to harm the West.

The harm function can be written as: $S_t = f(q_t, \alpha_t)$ (2)

OPEC is able to harm the western countries and the U.S. by cutting production and raising the price. Recall that OPEC has direct control over quantity not price, as the latter is determined in the market.

The political support (S_t) will increase as (q_t) is cut or if the desire to harm (α_t) is stronger. This means:

$$\partial S_t / \partial q_t < 0 \quad (3)$$

$$\partial S_t / \partial \alpha_t > 0 \quad (4)$$

Using these notions, a simple form of the harm function with appropriate properties is:

$$S_t = \alpha_t / (1 + q_t) \quad (5)$$

Equation (5) implies that the harm decreases when OPEC increases quantities (one in the denominator avoids the case of infinity when quantity is zero). Also the harm increases with a higher desire to harm, α_t. If OPEC has no desire to harm anyone, then α_t = zero and

[3] Citizens of the Middle East and some Latin Americans believe that the US policy is targeting them, and that it ignores the good aspects of their countries. This is why most of them consider themselves to be "Anti West".

the harm function vanishes, meaning that OPEC just maximizes profits like any other producer in any market with no other considerations in mind.

Since one of the factors that might affect the secular trend for OPEC's production levels is this desire to harm the west, we can obtain an estimate of α_t by estimating the relationship:

$$Resid_t = \alpha_0 + \alpha_1 \{1/ (1 + q_t)\} \quad (6)$$

and taking the estimate of α_1 as a measure of α_t. This relationship also explores the relation between the residuals and the harm function. The idea is that the harm function might have affected OPEC's decisions regarding oil extraction. If this is the case, then one should expect to find a relation between these residuals and the harm function. The estimates of the regression are reported in Table 2.

Table 2 is here

The results show that the coefficient for the harm function is negative and a large number, although it is not significant. This is consistent with the results found in Kisswani (2009), where the net present value of profits increases with a large value of the harm indicator, α_t. The regression outcome here also provides some evidence that OPEC considers the harm function when it comes to oil extraction. This part provides some evidence that OPEC members did consider the support of their citizens in deciding on production levels, and this support, which is represented by the harm function, needed OPEC to cut production as a response to the U.S. price controls.

V. Conclusions

The arguents in this paper provide some evidence that OPEC did respond to the price controls applied by the U.S., but not in a uniform way. For some periods it cut production,

while in other periods production levels increased. Since this is the case, the U.S. may consider different policies to address high oil prices, especially since price control policies also have adverse effects on welfare. Also the analysis gives some support to the idea that OPEC members consider the support of their citizens when deciding on production levels. However, most of those citizens are to be Anti-Western. Therefore, the U.S. and the West should review their policy in the region to improve relations with OPEC's governments.

Beside they need to communicate better with the people of OPEC countries, since they are the main drivers of the harm function that results in restrictions on oil output and higher market prices.

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Figure 1: Average Residuals Plot

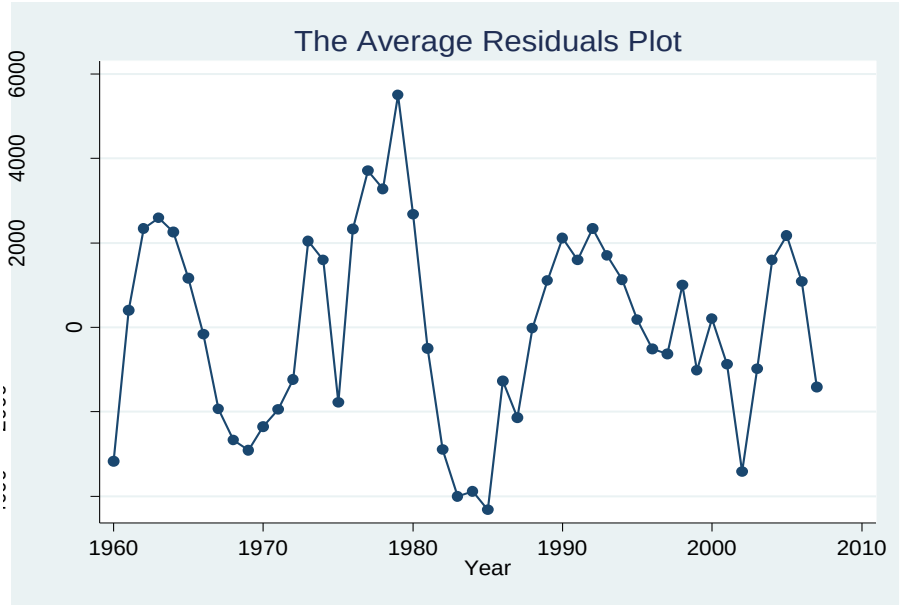

TABLE 1: Regression of Residuals on OPEC Reserves and Price Control Dummies

Variable	Coefficient	Robust Std. Err.	t - values
OPEC's reserves	0.0007	0.001	0.49
Dummy for 1971-1972	-1539.34***	600.76	-2.56
Dummy for 1973	2097.37***	582.46	3.97
Dummy for 1974-1975	-85.21	1371.69	-0.06
Dummy for 1976-1979	3736.75***	804.84	4.64
Dummy for 1980-1988	-1856.53**	865.51	-2.15
Constant	-343.42	1066.62	-0.32
R-squared	0.39		
Number of observations	48		

-The dependent variable is the residuals of regressing the production levels from 1960 to 2007 on a time index. The table reports the coefficients of the regression of these residuals on the five dummies and OPEC's reserves, with a constant.
- Year 1970 is the base.
-Robust standard errors and t-values are reported in the table.
*** Significant at the 1% level.
** Significant at the 5% level.

TABLE 2: Regression of Residuals on Harm Function

Variable	Coefficient	Robust Std. Err.	t - values
$1/ (1 + q_t)$	- 2.37 e+07	1.78e+07	-1.33
Constant	1146.75	863.31	1.33
R-squared	0.04		
Number of observations	48		

-The dependent variable is the residuals of regressing the production levels from 1960 to 2007 on a time index. The table reports the coefficients of the regression of these residuals on the harm function, with a constant.
-Robust standard errors and t-values are reported in the table.

Appendix: Figure 2