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Did the price control achieve its goal?

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Abstract

As a result of the 1973 oil embargo and the subsequent increase of world oil prices, the oil price control program took place in order to reduce the impact of sharply higher external oil prices. In this regard, since the domestic price for oil was below that of the world market, the price control effort seemed to be regarded as successful. Did the oil price control achieve its goal? Maybe not. This study shows that the price control for the domestically produced crude oil was ineffective and enhanced the ability of external suppliers to manipulate prices.

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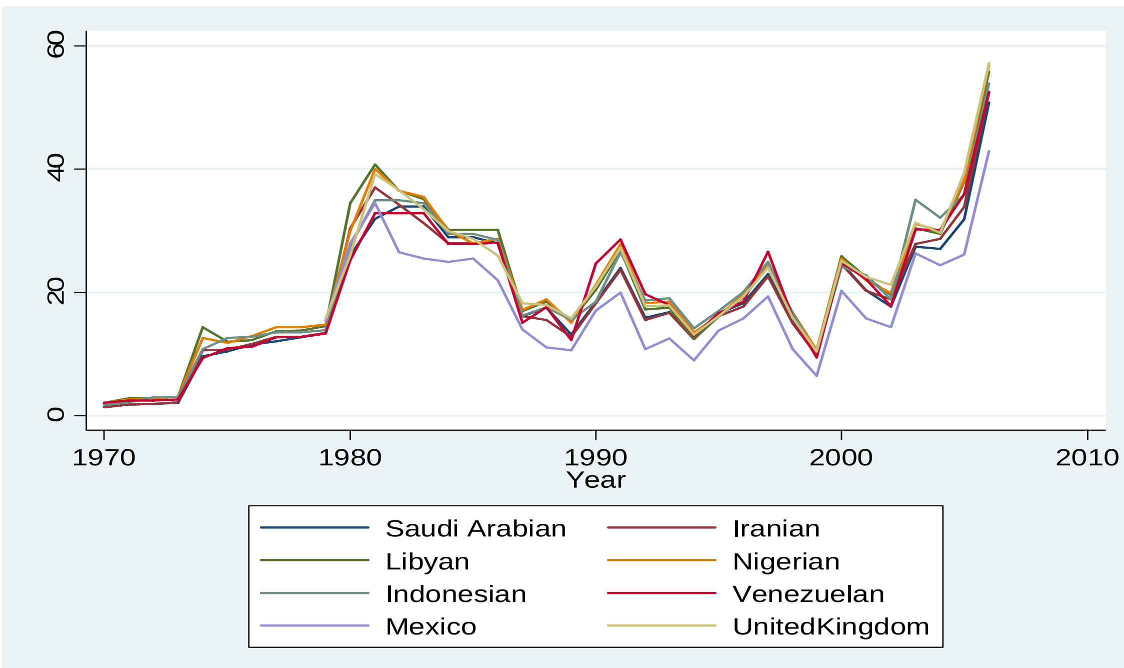
1. Introduction

For any society, energy is a vital element for economic growth especially since the Industrial Revolution. Developed countries are very dependent on nonrenewable natural resources such as oil and gas. With the recent spike in oil price,[1] many U.S. consumers may recall the oil crisis in the 1970s, and call for price controls and special taxes on oil companies (Van Doren and Taylor, 2006). As shown in Graph 1, there were spikes in the world oil price in the mid and late 1970s. The U.S. imposed price control[2] on domestically produced crude oil in an attempt to lessen the impact of the 1973-74 price increase.[3] However, Van Doren and Taylor (2006) argue that the price control actually increased the demand for oil from foreign suppliers.[4] Price control also reduced incentives to increase domestic production whether Organization of the Petroleum Exporting Countries (OPEC) has market power or not.

Graph 1. Crude Oil Prices by Selected Type (1970-2006)

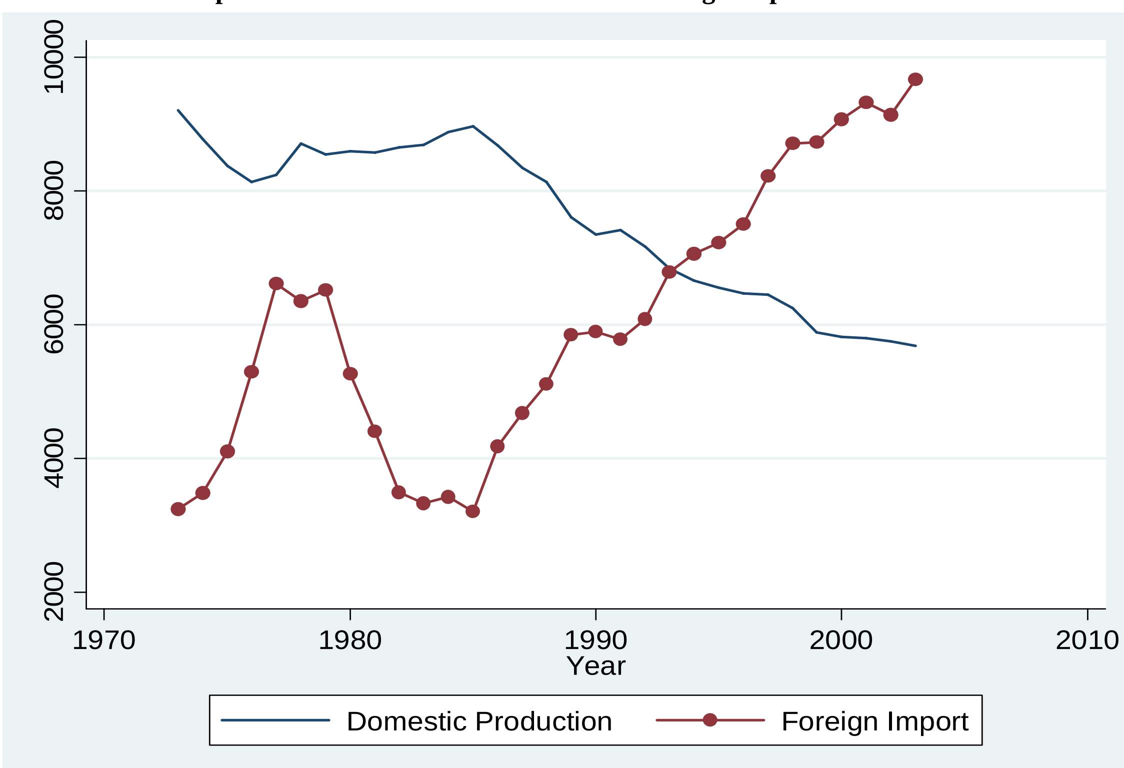


Source: Graph drawn from the Table 11.7 Crude Oil Prices by Selected Type, 1970-2006 at Energy Information Administration website.

[1] Padilla (2005) states that the hike in the world oil price is due to speculation, but not due to a real shortage in oil supply.
[2] The Federal Energy Administration (FEA) has pronounced that "old" oil can sell for no more than $5.25 per barrel (Economic Report of the President, 1976).
[3] The crude oil price control period extended from August 19, 1973 through January 27, 1981. Kalt (1981) shows that from 1974 to 1980, aggregate wealth transfers were estimated to range from $14 billion to $50 billion annually from refiners and end-use consumers with more access to old oil to refiners and end-use consumers with less access to old oil. However, Kalt's analysis assumed that world oil prices were unaffected by U.S. oil price control.
[4] Helbling and Turley (1975) also expected these results at the beginning the price control program. Kalt (1981) also argues that price controls and the incentive to import reduced the incentive to bring new domestic oil to market.

In practice, the oil price control program took place in order to cushion the domestic impact of sharply higher external oil prices. The price control also acted as a conduit to the increase U.S. reliance on foreign sources of oil supply. As indicated in Graph 2, the U.S. consumed approximately 14.70 million barrels per day (MBD), produced approximately 9.64 MBD, and imported about 1.32 MBD (9.01% are imported abroad) in 1970. Until the beginning of 1970s, the U.S. oil consumption relied upon a low level of external oil suppliers. However, in the mid 1970s, oil imports represented about 30-35% of total U.S. consumption. In fact, until late 1971, U.S. government imposed import quotas on petroleum products existed in order to prevent cheap foreign oil from placing domestic oil producers at a competitive disadvantage. From 1980 to 1988, the import rate in domestic petroleum consumption began to decline, and in 1989 reverted back to its 1978 level. In 1975, imported oil sold for $13.93, and "new" domestic oil[5] sold for $8.39 per barrel. Total crude oil used by domestic refiners consisted of about 40% "old" domestic oil,[6] 30% "new" domestic oil, and 30% imports. Then the effective domestic price (EDP) paid by domestic refiners for a barrel of oil is simply the weighted sum of the three prices.[7]

Graph 2. Total Domestic Production and Foreign Import of Crude Oil



Source: Graph drawn from the Table 4.6 (World Petroleum Demand, 1970-2005), Table 4.1c (World Crude Oil Production, 1970-2005) and Table 5.3 (Petroleum Imports by Type, 1949-2005) at Energy Information Administration website.

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[5] Oil produced from both new wells and from old wells in excess of 1972 output.

[6] Oil produced from domestic wells not exceeding the 1972 rate of output from these wells.

[7] For instance, *EDP* under price control is about $8.80 ((5.25*0.4)+(8.39*0.3)+(13.93*0.3)=$8.80) and *EDP* without price control is about $11.16 ((8.39*0.5)+(13.93*0.5)=$11.16). Thus, *EDP* under price control is $2.36 cheaper than *EDP* without price control.

Williams (2005) argues that the price regulation had other effects as well. In the absence of price controls, U.S. exploration and production of crude oil would have been considerably higher. The higher prices faced by consumers would have caused lower rates of consumption. As a consequence, the U.S. would have been less dependent on imports in 1980-1981. Further, Perry (2001) argues that the economic impact of instable oil supply was not the only factor of an increased oil price. For instance, the crude oil price rose to $75 per barrel which drove gasoline prices up to $2.78 per gallon. This caused the nation's bill for products of crude oil to increase by about 7% of gross domestic product (GDP), and the GDP to drop approximately 5%. The recent surge in world oil prices has given fresh impetus to call for the government to impose price controls on oil industry. In this regard, since the domestic price for oil is below that of the world market, the price control effort can be regarded as successful. Did the policy achieve its goal? Maybe not. To our knowledge, there is no rigorous empirical literature that examines whether the price control has actually succeeded in terms of its own purpose. This study shows that the price control for the domestically produced crude oil was ineffective and enhanced the ability of external suppliers to manipulate prices.

The next section of this paper describes the basic model and data. The basic empirical models and testing results are given in Section II and III, and finally, Section IV concludes the paper.

2. Model and Data

This study attempts to test whether the price control in the 1970's made a significant effect on cushioning the domestic impact of sharply higher external oil prices. In particular, we focus on the variations of gasoline prices related with price control on oil industry. In order to examine the speed at which gasoline price rises faster between price controlled and non-controlled crude oil prices, a reduced-form empirical model is set up by driving supply and demand of the gasoline consumption, and by extracting the reduced form equation on the price of gasoline. For each market, the market supply function $Q_t^s(\bullet)$ gives the quantity of oil that price-taking firms would offer at time *t*, while the market demand function $Q_t^d(\bullet)$ gives the quantity of oil that price-taking consumers would purchase at time *t*, both as functions of gasoline price. When the markets are clear, for all markets, the gasoline price (*pg*) acts to equate supply and demand:

$$Q_t^s(pg_t; x_t) = Q_t^d(pg_t; x_t) \quad (1)$$

where, *x* denote a vector of covariates characterizing the market. At time *t*, we can only observe the equilibrium gasoline price pg_t, the equilibrium quantity Q_t and the covariates x_t, but cannot observe either the supply or demand function. In this study, we assume linear types[8] of demand and supply functions for simplicity.[9]

[8] See Angrist et al. (2000) for the consequences of relaxing both the linearity and additivity assumptions.

[9] Model for the petroleum supply is generally linear model. The linear model is the model of choice in the petroleum industry because of given certain production and transportation constraints (EIA, 2003). Linear models are estimated with both level and log variables (Table 1).

Supply side of the oil products are as follow:[10]

$$Q_t^s = \alpha_1 + \alpha_2 PG_t + \alpha_3 PC_t + \alpha_4 PROD_t + \varepsilon_t^s \tag{2}$$

where Q^s = quantity produced, PG = price of gasoline, PC = price of crude oil, $PROD$ = crude oil well productivity and ε^s = error term.

Demand side of the oil products are as follow:[11]

$$Q_t^d = \beta_1 + \beta_2 PG_t + \beta_3 GNE_t + \varepsilon_t^d \tag{3}$$

where, Q^d = quantity consumed, PG = price of gasoline, GNE = gross national expenditure[12] and ε^d = error term. By solving the structural equations (2) and (3) for the gasoline price and quantity as functions of the covariates, we obtain the following reduced-form equations for the linear oil market model:[13]

$$PG_t = \pi_{11} + \pi_{21} PC_t + \pi_{31} PROD_t + \pi_{41} GNE_t + v_{t1} \tag{4}$$

As explained above, in order to see the price regulation effects, dummy variable by considering the different events that occurred in the U.S. oil market is added in the model. Further, we create price regulation and crude oil price interaction dummy variable to see the effect of the interact variable on the gasoline price under regulation and that is not controlled. Finally, we add refining capacity and capacity utilization variables to control for variation in the refining market over time and as an indicator of scarcity in the refining process into the baseline model. Thus, we construct variety of different sets of models as follows;

$$PG_t = \pi_{12} + \pi_{22} PC_t + \pi_{32} PROD_t + \pi_{42} GNE_t + d_1 REG + v_{t2} \tag{5}$$

$$\begin{aligned} PG_t = {} & \pi_{13} + \pi_{23} PC_t + \pi_{33} PROD_t + \pi_{43} GNE_t + d_2 REG \\ & + \pi_{53}(REG * PC) + v_{t3} \end{aligned} \tag{6}$$

$$\begin{aligned} PG_t = {} & \pi_{14} + \pi_{24} PC_t + \pi_{34} PROD_t + \pi_{44} GNE_t + \pi_{54} RC_t + \pi_{64} UC_t \\ & + d_3 REG + \pi_{75}(REG * PC) + v_{t4} \end{aligned} \tag{7}$$

[10] The determinant for the oil supply is price, refinancing capacity and regional effect (EIA, 2003). We use price and productivity of the oil for simplicity. Later, however, we add refinancing capacity and capacity utilization in order to capture the possible effects of the oil supply.

[11] The determinant for the oil demand is price, real income level and demand for crude oil in the previous period (EIA, 2003). We do not include previous demand for the crude oil to avoid the collinearity problem.

[12] GNE is a total of all types of expenditures within the economy (public and private). We use this variable as an income measurement instead of GDP since it is different from GDP because expenditures on imports are included, but exports (goods produced within the economy but sold outside of it) are not.

[13] The order condition states that the number of variables (exogenous and endogenous) excluded (restricted) from any of the equations in the model must be at least the number of endogenous variables minus one. The rank condition states that a necessary and sufficient condition for the identifiability of the first equation is that the rank of $A\varphi_1$ (φ_1 is a column vector whose h^{th} element) must be at least equal to the number of endogenous variables minus one. According to the procedure just described, we conclude that the system of equation is identified.

$$PG_t = \pi_{15} + \pi_{25} PDC_t + \pi_{35} PFC_t + \pi_{45} PROD_t + \pi_{55} GNE_t + \pi_{65} RC_t + \pi_{75} UC_t + d_5 REG + \pi_{85}(REG * PDC) + \pi_{95}(REG * PIC) + v_{t5} \quad (8)$$

where, *REG* = price regulation dummy, *RC* = refining capacity, *UC* = capacity utilization *PDC* = price of domestic crude oil and *PIC* = price of imported crude oil. Most of the events did not affect the regime except for the regulation phases for price control conducted by President Nixon in 1973 and the deregulation in 1981 conducted by President Reagan.[14] From equation (5) to equation (8) are standard dummy variable regression analysis to isolate the effects of the price control by considering intercept change and slope changes. If the price of gasoline rises at a faster rate with the price control than without the price control, the dummy variables, d_s, would be positive.

In this empirical analysis of the price of gasoline, we obtained the data from the standard source: Energy Information Administration (EIA) website and data set spanning the years 1973-2004.[15] For the quantity produced/consumed and price of gasoline,[16] we used U.S. petroleum consumption (million barrels)[17] and real retail gasoline price, respectively.[18] For the control variables, we used data on the following: price of crude oil (real composite refiner acquisition cost),[19] crude oil well productivity (average productivity; barrels per well)[20] and gross national expenditure (percent of GDP).[21] Finally, we constructed this dummy variable by considering the different events that occurred in the U.S. oil market; *d* = 1 when the price control occurred (from 1973 to 1981) and 0 otherwise.

3. Empirical Results

The baseline models, equation (5) and (6) are given in Table 1. The first and third columns show the result of the baseline model with price control dummy variable, and third and forth columns show the result of the baseline model with price control dummy and interaction dummy variables. Table 1 shows that the coefficient for the crude oil well productivity exhibits a small positive number that is statistically significant for most of the cases (both level[22] and log). However, gross national expenditure does not have a significant effect on gas prices for all of the cases since the coefficient for the variable

[14] The Carter Administration began a phased decontrol of oil prices and they were finally dismantled in 1981 under Reagan Administration.

[15] Yearly data is used since most monthly data available from 1980s. Further, even though there was more available data from earlier years, we exclude these prior to 1973 since the object of this study is examining the rate of change for gasoline prices during and after the price control, and data sets include the latest available data.

[16] Obtained from http://www.eia.doe.gov/emeu/steo/pub/fsheets/petroleumprices.xls.

[17] Data is available until 2003 for the quantity produced/consumed variable. Obtained from http://www.eia.doe.gov/emeu/aer/txt/ptb1110.html.

[18] Obtained from http://www.eia.doe.gov/emeu/aer/contents.html.

[19] The composite cost was derived by weighting domestic costs and imported costs on the basis of quantities produced and imported (PDC is refiner acquisition costs for domestic oil and PIC is refiner acquisition costs for imported oil).

[20] Through 1976, average productivity is based on the average number of producing wells. Beginning in 1977, average productivity is based on the number of wells producing at end of year.

[21] Obtained from World Bank (World Development Indicators).

[22] The coefficient associated to the productivity is nearly zero in the baseline case. Thus, interpretations of such small numbers are ambiguous.

shows a small negative number. However, the number that is statistically insignificant at conventional levels implies that gas price is not dependent on national income level.[23] For the price control on crude oil, the result for the dummy variable in Equation (5) is positive and statistically significant at conventional levels (Columns (i) and (iii) of Table 1). However, coefficients of the interactive terms for the price control and crude price in column (ii) and (iv) in Table 1 are not statistically significant. These results indicate that gas price increased in every level of crude oil prices during the price control period, but the effect of crude oil on the gas price was not changed due to the price control. That means, price control on crude oil was ineffective but it resulted in the opposite effect of what policy expected. In addition, the effect of crude oil price on gas price was independent from whether or not the price control took place.

Table 1. Test Results for the Price Control

	Baseline		Natural Log	
Variables	(i)	(ii)	(iii)	(iv)
Price of Crude Oil	3.11**	3.26**	0.46**	0.50**
	(0.11)	(0.17)	(0.03)	(0.03)
Crude Oil Well Productivity	9.4e-09*	7.9E-09	0.21**	0.16*
	(3.6e-09)	(3.6e-09)	(0.07)	(0.08)
Gross National Expenditure	-1.56	-1.65	-0.98	-1.17
	(1.08)	(1.09)	(0.84)	(0.82)
Regulation	26.31**	32.33**	0.14**	0.42*
	(3.22)	(8.09)	(0.02)	(0.17)
Regulation Interact with Price of Crude Oil Price		-0.19		-0.08
		(0.12)		(0.05)
Constant	219.32	229.63	3.53	5.46
	(112.93)	(114.39)	(4.66)	(4.64)
R^2	0.98	0.98	0.97	0.97
Ramsey RESET test	3.77**	3.58*	2.03	7.71**
Breusch-Pagan test	7.35**	6.96**	0.00	0.23
Durbin-Watson *d*	2.14	2.19	1.38	1.59
Breusch-Godfrey	0.44	0.55	0.86	0.45
Jarque Bera Test†	7.55	8.1	6.33	6.57
	(0.67)	(0.78)	(0.79)	(0.88)

Notes: Standard error in parentheses. * and ** denote significant t-value at 5 and 1% levels, respectively. † *p*-value in parentheses. We can notice that the Durbin-Watson test statistics associated to equations (5) and (6), written in log, are in somehow low (smaller than 2): 1.38 and 1.59, respectively. Thus, the residuals in log-equations may be autocorrelated.

In addition, since the total oil supply is made up of domestic and imported crude oil, we composite these two groups in order to see whether domestic or imported crude oil causes a sharp increase in domestic retail gas price. Table 2 provides the estimated results. In particular, the interaction dummies with domestic crude oil are significantly negative but the interaction dummies with foreign crude oil are significantly positive in column (ii), (iii), (v) and (vi) in Table 2. These results show that the spike in domestic gas price came mainly from imported crude oil price increases. This increase may have

[23] Gately and Huntington (2001) show that the income elasticity of oil demand is 0.31 and is ranged from 0.72 to 0.84 for the OECD and non-OECD countries, respectively.

resulted from a significant decrease in the production of domestic crude oil. These findings are not in line with the expected policy proposals. In other words, even though the U.S. government enforced the oil price control program to reduce the impact of sharply higher external oil prices, it led to higher dependence on imported crude oil and the gas price rose at a faster rate under the price control period than non-price control period.

Table 2. Test Results for the Extended Model

	Level			Natural Log		
Variables	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Price of Crude Oil	3.41**			0.42**		
	(0.33)			(0.05)		
Price of Domestic Crude Oil		3.99**	4.25**		0.90**	0.98**
		(0.67)	(0.63)		(0.16)	(0.13)
Price of Imported Crude Oil		-0.64	-1.09		-0.37*	-0.53**
		(0.60)	(0.63)		(0.15)	(0.13)
Crude Oil Well Productivity	4.3E-9	9.9E-9**	-1.1E-9	-0.06	0.21**	-0.06
	(7.6E-9)	(2.9E-9)	(5.8E-9)	(0.12)	(0.06)	(0.09)
Gross National Expenditure	-0.86	-2.26*	-1.20	-0.48	-1.79*	-0.92
	(1.29)	(0.84)	(0.89)	(0.86)	(0.67)	(0.60)
Refining Capacity	-7.1E-9		4.0E-9	0.41		0.34
	(9.0E-9)		(6.5E-9)	(0.27)		(0.21)
Capacity Utilization	-2.1E-9		-1.5E-8	-0.64*		-0.78**
	(1.0E-8)		(8.2E-9)	(0.27)		(0.22)
Regulation	31.80**	33.83**	43.99**	0.54**	0.30**	0.39**
	(10.86)	(5.25)	(7.37)	(0.18)	(0.05)	(0.05)
Regulation Interact with Price of Crude Oil Price	-0.09			-0.1		
	(0.25)			(0.05)		
Regulation Interact with Price of Domestic Crude Oil Price		-0.07**	-0.09**		-0.02**	-0.02**
		(0.02)	(0.02)		(0.01)	(0.00)
Regulation Interact Price of Imported Crude Oil Price		0.06**	0.08**		0. 02*	0.02**
		(0.02)	(0.02)		(0.01)	(0.00)
Constant	208.34	283.19**	263.31**	12.41	7.08	19.10**
	-116.02	-87.05	-81.16	-6.7	-3.72	-4.78
R^2	0.99	0.99	0.99	0.98	0.98	0.99
Ramsey RESET test	9.19**	1.12	3.21*	6.63**	3.26**	2.59
Breusch-Pagan test (Heteroskedasticity)	8.63**	0.01	0.09	0.62	0.08	0.24
Durbin-Watson *d*	2.52	2.04	2.71	2.17	1.50	2.25

Breusch-Godfrey	6.07*	0.06	4.62*	1.37	2.20	0.57
Jarque Bera Test†	12.78	4.99	52.43	12.19	11.60	
	(0.69)	(1.00)	0.00	(0.73)	(0.77)	

Notes: Standard error in parentheses. * and ** denote significant t-value at 5 and 1% levels, respectively. † *p*-value in parentheses.

Each equation, we conduct Ramsey (for a specification error), Breusch-Pagan (heteroskedasticity), Durbin-Watson (autocorrelation), Breusch-Godfrey (cross-correlation) and Jarque Bera (normality) tests. Each test statistic is evaluated at the 5% significance level. The basic sensitivity analysis test results for the baseline model (Equation 4) are provided in Table 3.

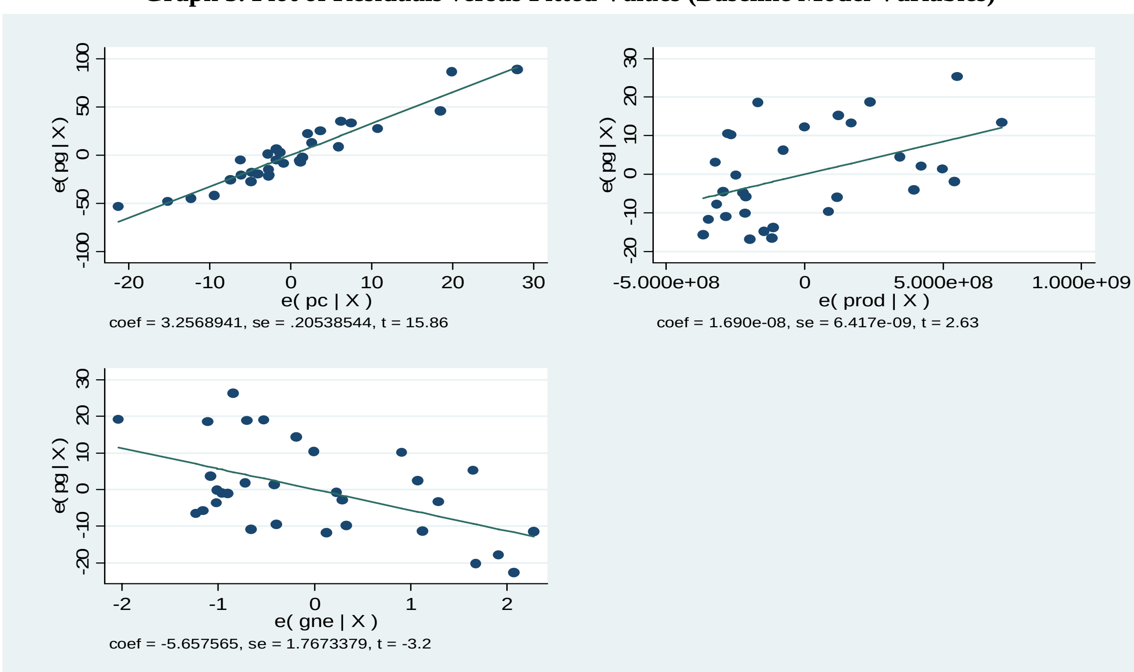
Table 3. Estimation Sensitivity Analysis (Baseline Model)

Variable	Test Statistics	Probability
Chow Test	1.88*	0.16
Breusch-Godfrey LM	14.30**	0.00
Durbin's Alternative	22.28**	0.00
Durbin-Watson *d*	0.62	
Breusch-Pagan (Heteroskedasticity)	1.47**	0.23
Mean VIF	1.52	

Notes: * and ** denote *F* and *Chi square* test statistics, respectively.

In addition, according to the plot of residuals versus fitted values, the plots show all species of possible problems. Since there is a clear upward trend in the first two variables (price of crude oil and crude oil well productivity) and downward trend in the last variable (gross national expenditure), the model specification is quite well fit (shown in Graph 3).

Graph 3. Plot of Residuals versus Fitted Values (Baseline Model Variables)



4. Conclusions

The recent surge in world oil prices has given fresh impetus to call for the government to impose price controls on oil industry. In particular, many U.S. consumers remember the oil shock and the resulting price controls that were set in the 1970s. The question, then, is whether or not the price control policy achieved its goal. In other words, the question is whether the price controlled market price under regulation tends to rise at a slower rate than the price that is not controlled. However, the empirical analysis presented in this study points out that in the U.S., under price regulation; gasoline price is more responsive to changes in crude oil prices than under deregulation. This study also shows that crude price and crude oil well productivity have a positive relationship to gas price. Yet, income level, refining capacity and capacity utilization do not have a significant effect on gas price.

Historically, gas prices have fluctuated over time, and current price level has risen to an unparalleled point and is remaining steady. Since price control can be levied only in U.S. companies, such policy also increases the economic attractiveness of foreign relative to domestic oil. The intended purpose of the price regulation was to reduce domestic oil price from the higher world oil price. Yet the empirical analysis shows that the price regulation on domestic crude oil was in conflict with its stated purpose. More importantly, price controls provided both disincentives to produce oil domestically and incentives to import oil. As imported oil became increasing proportion of total domestic consumption, the effective domestic prices of oil became higher which resulted in the opposite direction from the original policy objective. Eventually, the price controls affected the supply side of U.S. market and aggravated the degree of inefficiency of allocation of resources between domestic oil production and foreign oil. The increase in the prices of foreign oil passed-through to the U.S. market more increasingly with price control than price decontrol. For the oil price spike, there is no unique resolution to such a multifaceted problem, but much can be done toward its resolution.[24]

The effective domestic price of oil will increase as a portion of the imported oil is increased in the total domestic consumption. Further, greater reliance on foreign supply sequentially enhances the vulnerability of the domestic oil price and which results in reduction of domestic oil production. The oil prices would increase at a slower rate as a result of decontrol; incentives for both increased domestic production and reduced imports are provided. Increased domestic production and reduced imports, in turn, would lessen the dependence of domestic oil consumption on foreign suppliers, and hence, be conducive to lower domestic prices for oil in the future.

[24] Dinan and Austin (2002) suggest three policy options order to reduce gasoline consumption; increasing the corporate average fuel economy (CAFE) standards that govern passenger vehicles, raising the federal tax on gasoline, and setting a limit on carbon emissions from gasoline combustion and requiring gasoline producers to hold allowances for those emissions (a policy known as a cap-and-trade program).

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