Determination of Crude Oil Consumption in India

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Abstract

Recent upheaval in the crude oil price in international market has created renewed interest in the data analysis. But even before this, the energy reports generated internationally have squarely yelled about growing crude oil consumption in India and China. India's share of global demand rises to 8% in 2035, accounting for the second largest share of the BRIC countries with China at 26%, Russia 5%, and Brazil 3%.The object of this paper is to find out whether the price changes and income changes have the same impact on the elasticity of consumption as shown in the theory of elasticity of demand. The yearly data used are from 1985 to 2013.The log value of consumption, income and the adjusted inflation price gives the best results. The coefficient values have been estimated for price and income elasticity.

Keywords:

Crude Oil, Consumption, India

Introduction

While the crude oil consumption has always been a matter of concern internationally, it has direct implication for self sufficiency, overall prices and for the balance of payments. Recent upheaval in the crude oil price in international market has created renewed interest in the data analysis. But even before this, the energy reports generated internationally have squarely yelled about growing crude oil consumption in India and China. The rising population and higher growth trajectory has put this demand on international map. India was the fourth-largest consumer of crude oil and petroleum products in the world in 2013, after the United States, China, and Japan. The country depends heavily on imported crude oil, mostly from the Middle East.

The three startling remarks about projection of India 's demand for future in coming twenty years are as following :

(i) India's share of global demand rises to 8% in 2035, accounting for the second largest share of the BRIC countries with China at 26%, Russia 5%, and Brazil 3%.

(ii) India's demand growth of 128% outpaces each of the BRIC countries as Russia (+14%), China (+60%) and Brazil (+72%) all

expand more slowly. India's growth is almost double the non-OECD aggregate of 63%.

(iii) India's energy production as a share of consumption declines from 59% today to 56% by 2035; imports rise by 143%. (BP Energy Outlook 2035).

Similar concerns have been echoed by International Energy Association and US energy Information and other global reports.

The object of this paper is to find out the association between growth in income and the energy price .The research question is to estimate the validity of the statement that price elasticity of crude oil consumption is negative and the income elasticity is positive.

Research Hypothesis

$H_0$1. The price elasticity of demand is negative and significant

H_1.1. The price elasticity of demand is positive and significant

H_o.2 The income elasticity of demand is positive and significant

$H_1$2. The price elasticity of demand is negative and significant

Review of Literature

Several studies on India use the ordinary least square (OLS) method (Goldar and Mukhopadhyay 1990; Rao & Parikh 1996; Parikh et al., 2007), but most variables involved are actually non-stationary. Other studies that used co-integration techniques focused on petroleum derivatives (Ramanathan 1999; Ghosh 2010; Chemin 2012) or on demand for imported oil only (Ghosh 2009). Thus, none of these studies estimates and forecasts the total crude oil demand for India. The studies that estimate imported crude oil demand (Ghosh 2009) used, with data until 2005–06. Pradeep Agrawal (2012) empirically estimated demand relations for crude oil, diesel, and petrol for India using the ARDL co-integration procedure and data from 1970 to 2011. These estimations show the income elasticity of about 1 for crude oil and diesel and 1.39 for petrol. The price elasticity of the petroleum products was found to be negative and statistically significant in all the models. The values of price elasticity estimates were found to be -0.41, -0.56 and -0.85 for crude oil, diesel, and petrol respectively, While the absolute value is less than one that inelastic the sign shows the inverse relationship between price rise and demand.

Data

For uniformity the data used are from Energy Statistics 2014 and its prior editions. In case of adjusted inflation price of crude oil the data are from Index Mundi. It may be acknowledged that international crude oil price data do not fully reflect the price behavior for the simple reason that several adjustments are made in fixing the price.

Summary Statistics, using the observations 1985 – 2013

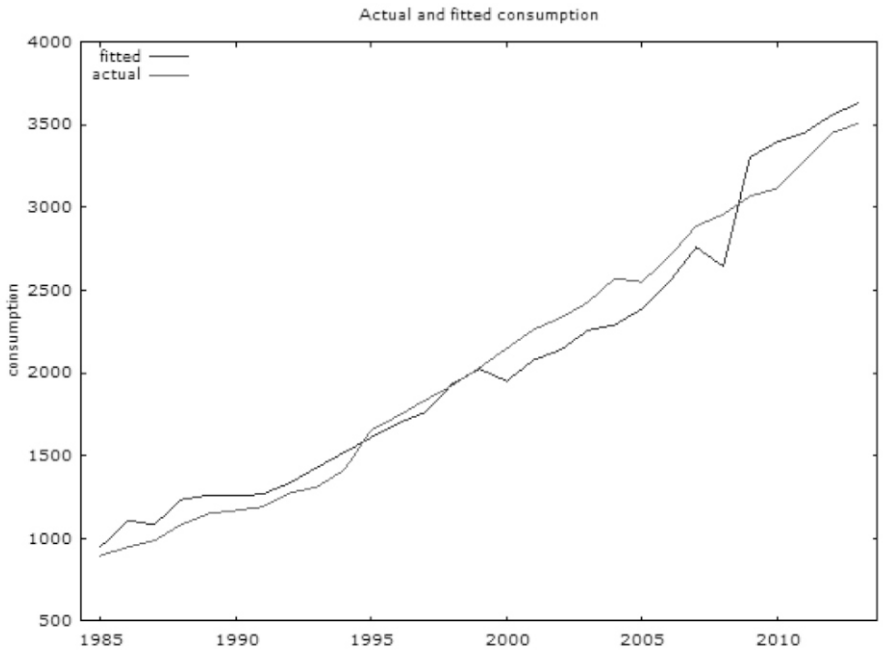
Variable	Mean	Median	Minimum	Maximum
Reserves	5.36413	5.60635	3.50000	7.99710
Production	665.568	661.420	534.000	782.340
consumption	2064.53	2031.25	894.900	3509.00
Nominalprice	36.6762	23.0000	11.9100	91.4800
InflationAdjusyedPrice	47.2155	35.5500	17.2600	100.010
PCINNP	22177.7	20079.0	12095.0	39904.0
Variable	**Std. Dev.**	**C.V.**	**Skewness**	**Ex. kurtosis**
Reserves	1.01209	0.188677	0.398414	0.527339
Production	58.4482	0.0878170	0.115065	0.180980
consumption	830.729	0.402382	0.180061	-1.25816
Nominalprice($)	26.5740	0.724557	1.05374	-0.405856
InflationAdjusyedPrice($)	24.2479	0.513558	0.882616	-0.570873
PCINNP	8838.14	0.398516	0.722700	-0.771556

The summary statistics indicate that production and consumption have normal distribution but Reserves and prices and per capita income are skewed. Also there is Excess Kurtosis (> 3) in each of these variables. We examine the crude oil consumption as dependent variable and per capita income and nominal price as repressors. Both the sign are statistically significant.

Model 1: OLS, using observations 1985-2013 (T = 29)
Dependent variable: consumption

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-232.105	115.004	-2.0182	0.05400	*
PCINNP	0.121084	0.00942236	12.8507	<0.00001	***
Nominal_price	-10.5987	3.13375	-3.3821	0.00229	***

Mean dependent var	2064.527	S.D. dependent var	830.7289
Sum squared resid	700213.8	S.E. of regression	164.1076
R-squared	0.963763	Adjusted R-squared	0.960975
F(2, 26)	345.7479	P-value(F)	1.86e-19
Log-likelihood	-187.4810	Akaike criterion	380.9619
Schwarz criterion	385.0638	Hannan-Quinn	382.2466
rho	0.660907	Durbin-Watson	0.681402

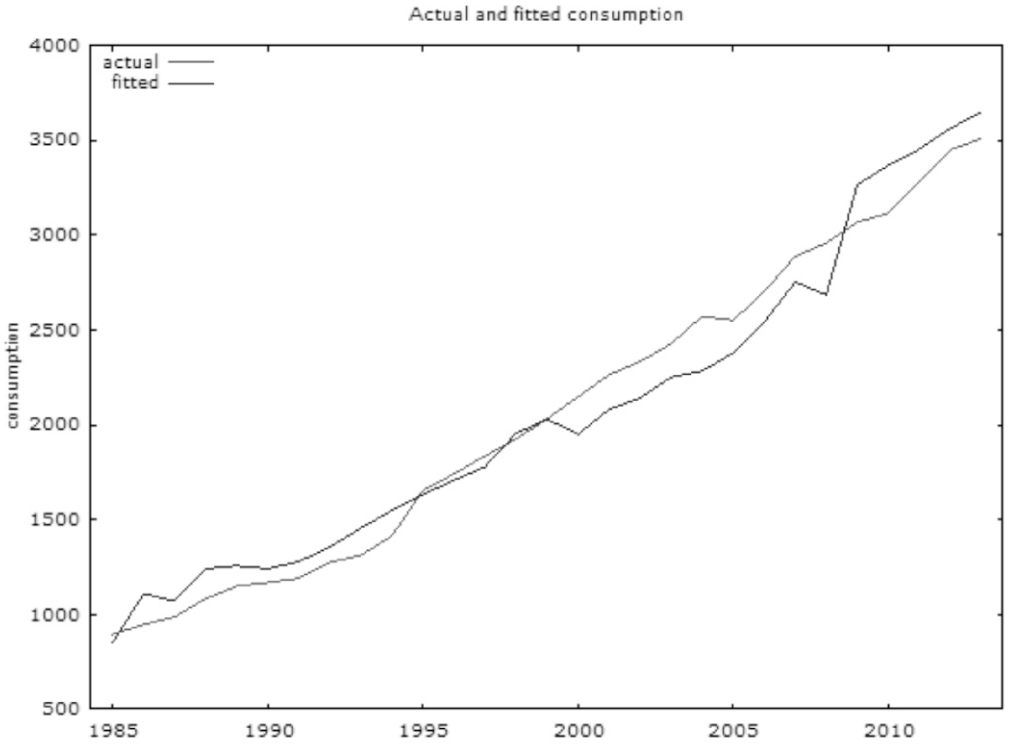


From the model one it is obvious that the per capita income has positive and price has negative sign.R-Square is sufficiently high.Though DW statistic is low.

Model 2: OLS, using observations 1985-2013 (T = 29)
Dependent variable: consumption

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	4.27255	82.1937	0.0520	0.95894	
PCINNP	0.110539	0.00627453	17.6171	<0.00001	***
Inflation Adjusted Price	[illegible]	2.28701	−3.6232	0.00124	***

Mean dependent var	2064.527	S.D. dependent var	830.7289
Sum squared residual	669989.9	S.E. of regression	160.5268
R-squared	0.965327	Adjusted R-squared	0.962660
F(2, 26)	361.9313	P-value(F)	1.05e-19
Log-likelihood	−186.8412	Akaike criterion	379.6824
Schwarz criterion	383.7843	Hannan-Quinn	380.9670
rho	0.695536	Durbin-Watson	0.617639

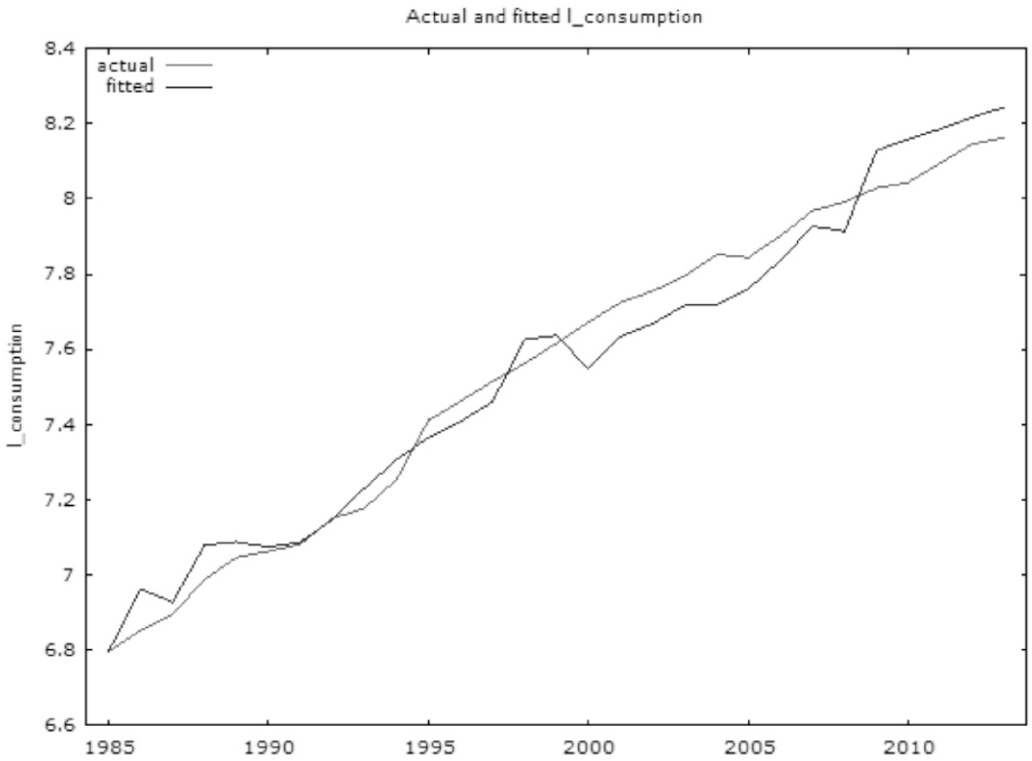


Model 2 denotes inflation adjusted price. The model is slightly improved as far as Akaike and other criterion are concerned. However the predictive ability is hardly improved in this model as compared to model 1 above.

Model 3: OLS, using observations 1985-2013 (T = 29)
Dependent variable: l_consumption

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−6.02301	0.692683	−8.6952	<0.00001	***
l_PCINNP	1.44244	0.0841815	17.1348	<0.00001	***
l_Nominalprice	−0.224841	0.0492504	−4.5653	0.00011	***

Mean dependent var	7.546872	S.D. dependent var	0.432760
Sum squared resid	0.158264	S.E. of regression	0.078020
R-squared	0.969819	Adjusted R-squared	0.967498
F(2, 26)	417.7375	P-value(F)	1.72e-20
Log-likelihood	34.40719	Akaike criterion	−62.81438
Schwarz criterion	−58.71250	Hannan-Quinn	−61.52972
rho	0.634979	Durbin-Watson	0.741173

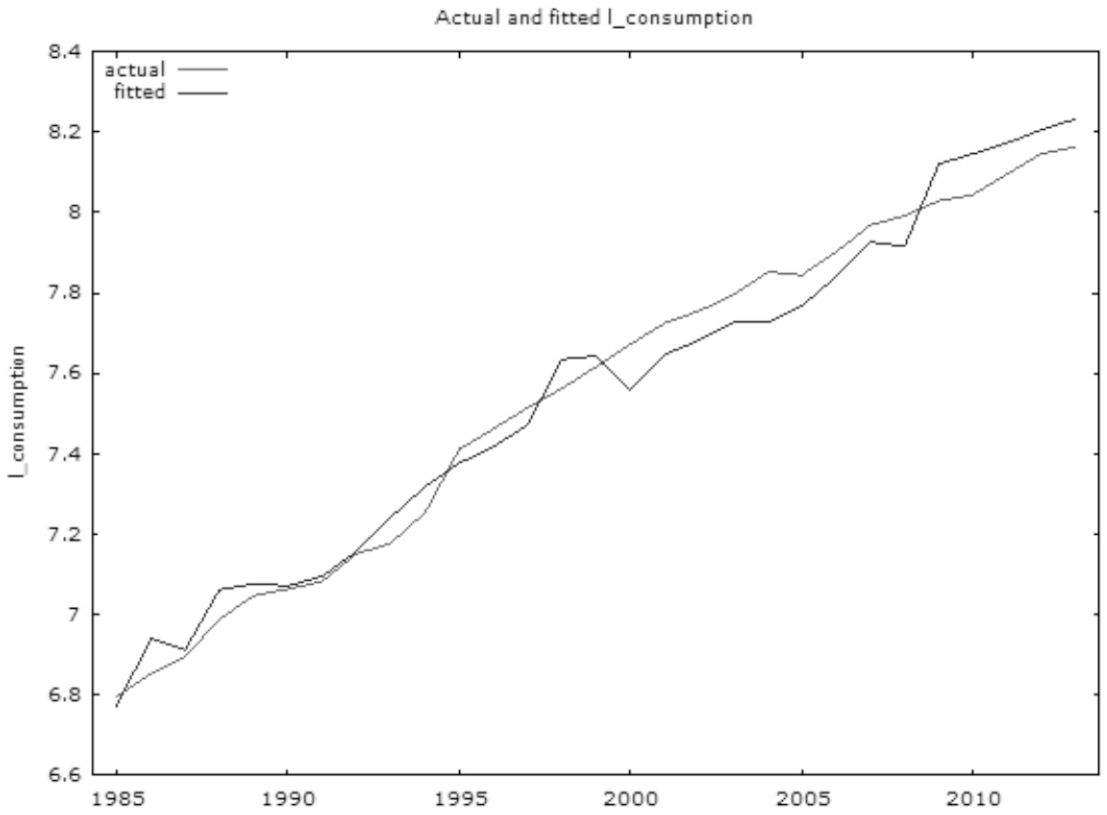


Model 3 is Double log model, with the same set of variables. From this the price elasticity and the income elasticity of consumption can be directly read out. The Akaike and other criterion have improved greatly. The DW statistic has slightly improved.

Model 4: OLS, using observations 1985-2013 (T = 29)
Dependent variable: l_consumption

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−4.60602	0.408795	−11.2673	<0.00001	***
l_PCINNP	1.30804	0.0508049	25.7463	<0.00001	***
l_InflationAdjusyedPrice	−0.225224	0.0401918	−5.6037	<0.00001	***

Mean dependent var	7.546872	S.D. dependent var	0.432760
Sum squared resid	0.129148	S.E. of regression	0.070479
R-squared	0.975372	Adjusted R-squared	0.973477
F(2, 26)	514.8442	P-value(F)	1.23e-21
Log-likelihood	37.35508	Akaike criterion	−68.71015
Schwarz criterion	−64.60826	Hannan-Quinn	−67.42549
rho	0.574011	Durbin-Watson	0.852549



In model 4 the variable choosen are the same as in model 2 that is inflationary adjustement price. There is again an improvement in the model. This model stands the best as far as predictive ability is concerned. The DW statistic too has improved.While the sign and value of the price change remain almost the same , ther is decline in income elasticity of demand . This might be the result of common trend in the inflation and income variables.Since these are yearly data much conversion of income and price takes place within a year therefore lagged data have not been used .

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