

Influence of Selected Variables on the Price of Petroleum Products in the Republic of Croatia

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Abstract: *In the last few years there have been great variations in prices of crude oil in the world caused by several reasons: wars in the Middle East, global economic crisis, the Iranian nuclear issue, workers' strikes on platforms, hurricanes that threaten oil rigs, etc. Consequently, the prices of petroleum products have significantly changed mainly increased. As people spend more on fuel, their purchasing power and standard are being reduced, resulting in weakening of their quality of life.*

The formula for calculating the price of petroleum products of the oil company INA, majority-owned by the Republic of Croatia, does not include the price of crude oil - the basic raw material for its production, but it includes the cost of petroleum products in the Mediterranean market. This creates the possibility of manipulating the price of petroleum products in order to achieve extra profits of oil companies.

This paper examines a multiple linear regression model that will try to answer the question as to what extent the trend of crude oil prices on the world market, with USD to HRK exchange rate and VAT rate was statistically significant in the price of Eurosuper 95 in the Republic of Croatia in the period from January 2007 to February 2013.

Keywords: *petroleum products, crude oil, fuel, fuel prices, the price of petroleum products*

Introduction

Crude oil (CO) is a major energy source, which covers one third of the world's energy needs and has daily consumption of approximately 75 million barrels [1, 652]. Since oil takes the first position in the world's energy consumption, ahead of all the other energy sources: natural gas, coal, nuclear energy, water power energy etc., changes of CO price have got a huge impact on the world economy [2, 8-12]. While high price of CO on the world market increases inflation and consequently weakens the economies of the importing countries, low CO price may cause a collapse of the exporting countries' economies. Government budget of Venezuela, Saudi Arabia, Mexico and some other countries are strongly linked to CO prices [1, 652].

Crude oil crisis is a term for disorders that occur in the period of a considerable growth of the crude oil price. There were two oil crisis recorded during the 1970s and both of them caused strong recessions in industrial countries. It is assumed that an oil crisis is going to occur when the demand for oil exceeds the supply.

The first crisis started in autumn of 1973 when the oil exporting countries, united in the Organization of Petroleum Exporting Countries (OPEC), decreased on purpose oil production by 5% in order to increase the oil price. In only a few days the price of CO increased by 70%, resulting in the price increase from 3 USD per barrel to more than 5 USD. During the following year the price of CO on the world market increased to more than 12 USD.

The second crisis was recorded during 1979 and 1980, and it was caused by the decrease in oil production at the time of the Iran – Iraq war. In the 1980s the increased price of CO on the world market was a consequence of OPEC, but after 1980 International Energy Agency (IEA), representing the importing countries, took over a more dominant role in defining the price of CO.

In the period between 2004 and 2008, a huge growth and price variability of CO prices have been recorded. The petroleum product prices were also changing in accordance with that. After reaching its peak of 147 USD per barrel in July 2008, the price of CO fell to less than 35 USD per barrel in December of the same year, and afterwards it varied mostly between 70 and 130 USD. This same

period recorded also fluctuations of the US dollar value up to 30%. Considering that the oil price was very changeable in that period, there might even be a talk of a new, third oil crisis.

As CO is a basic raw material in the production of petroleum products, it is to be expected that, apart from the USD/HRK exchange rate, it will be the main parameter in determination of their price in the Republic of Croatia. However, according to the Oil and Petroleum Products Market Act [3] and Law on Amendments to the Oil and Petroleum Products Market Act [4] the petroleum product price does not include the crude oil price, but the following market elements:

- petroleum product price on the Mediterranean market;
- USD/HRK exchange rate;
- premium of the energy undertakings;
- financial resources for The Croatian Compulsory Oil Stocks Agency (HANDA), the amount of which is determined by the Government of Republic of Croatia, upon proposal of The Croatian Compulsory Oil Stocks Agency (HANDA);
- fees and taxes calculated according to specific regulations [3], [4].

The price of petroleum products is defined in accordance with By-law on petroleum product price forming proscribed by the Ministry of Economy.

Formula to calculate the petroleum product price:

$$C_{\max} = \left(\frac{\sum_{i=1}^n CIF Med_i \cdot T_i}{n} + H \right) \cdot \frac{\rho}{1000} + B + P$$

whereby:

C_{\max} – the highest permitted price expressed in kunas per litre (HRK/l);

CIF Med – midpoint daily stock market price of petroleum products in USD per ton (USD/t) published in “Platt's European Marketscan“;

T – midpoint daily USD/HRK exchange rate posted by the Croatian National Bank on the day for which the midpoint daily stock market price of petroleum products is posted;

i – daily data for the period since the previous price change;

n – number of posted midpoint daily stock market prices of petroleum products ;

ρ – density of the petroleum product (for Otto motor petrol $\rho = 0.755$ kg/l);

H – the compensation fee regarding the financing of HANDA (The Croatian Compulsory Oil Stocks Agency) in kn/t;

B – fee for bio-fuel production incentives in HRK/t;

P – premium of the energy undertakings in HRK/l.

The premium amount is defined at 0.76 HRK/l for petrol and diesel fuels, except for gasoline stations on highways and on the coast which are permitted to form the premium amount themselves.

Retail prices change every 14 days after midnight on Monday to Tuesday, and the highest permitted price change is 3% [4].

Since great fluctuations in petroleum product price were recorded in 2008, numerous media in the Republic of Croatia were very doubtful about the proper calculation and they assumed that oil companies manipulate the price in order to achieve higher profits.

In 2007 Brown and Virmani published the results of an econometric model, which explains that the 98% price variation in USD is a consequence of the price change of CO. This increase in the price of barrel of CO also caused an increase in spot gasoline price by 2.8 cents [5], [2]. This paper is going to estimate the influence of the CO price change on EUROSUPER 95 petroleum product price in the Republic of Croatia. Simple linear regression model is going to reply to the question: How big is the change of EUROSUPER 95 price when the price of a litre of CO is increased by 1 kn. Multiple linear regression model is going to establish to which extent CO price, USD/HRK exchange rate and VAT rate influence the forming of price of EUROSUPER 95 petroleum product.

1. Data and Methodology

The research includes data about the price of EUROSUPER 95 petroleum product, the price of CO and the VAT rate in the period between January 2007 and February 2013. The data on EUROSUPER 95 price ranges have been collected at the Croatian autoclub website. (HAK, Fuel prices) In the analysis we have used the data on price ranges of CO type Brent, which are relevant for the European market [6]. The VAT rate in the Republic of Croatia changed twice within the monitored period: on August 1, 2009 it increased from 22% to 23%, and on March 1, 2012 it increased by 2 more points, to 25%.

In this paper the relation between variables has been explained based on the two regression models.

The first model is the simple linear regression model given by:

$$Y = \beta_0 + \beta_1 X + \varepsilon$$

where Y is the response variable, the variable we wish to explain or predict, X is the independent variable and ε is the error term.

A multiple regression model was also conducted to examine the relationship in this analysis. This model is applied in case that several independent variables affect one response variable. General multiple regression model of a response variable Y on a set of k independent variables X_1, X_2, X_3 is given by:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \varepsilon$$

Where β_0 is intercept of the regression surface and $\beta_i, i = 1, 2, \dots, k$ is the slope of the regression surface with respect to variable X_i . The multiple coefficient of determination R^2 measures the proportion of the variation in the response variable that is explained by the combination of the independent variables in a multiple regression model.

A statistical F-test will be applied to tell us if there is a relationship between the response variable and at least one of the independent variables. Hypothesis test is:

$$H_0: \beta_0 = \beta_1 = \dots = \beta_k = 0$$

$$H_1: \text{Not all the } \beta_i \text{ (} i = 1, 2, \dots, k \text{) are zero.}$$

T-test is applied for each independent variable to tell us whether there is evidence that variable X_i has a linear relationship with Y . Hypothesis test is:

$$H_0: \beta_i = 0$$

$$H_1: \beta_i \neq 0 \text{ [7, p 470-474]}$$

2. Results

Dependency of response variable of the price of petroleum product EUROSUPER 95 per litre on the price of barrel of CO in kuna is shown in Figure 1. For the purpose of simple comparison, both variables are transformed into the standard normal random variable $Z \sim N(0,1^2)$.

Z-values for both variables are calculated based on expression $z_i = \frac{x_i - \bar{x}}{\sigma}$, where \bar{x} is the average variable value in the monitored period and σ is its standard deviation value. Average and standard deviation values are given in Table no. 1.

Table no. 1 Average and Standard Deviation values of EUROSUPER 95 and CO price

Variable	Average	Standard Deviation
EUROSUPER 95 price	8.78	1.25
CO price	477.34	138.55

Source: authors' calculations

The assumption that the price of petroleum product EUROSUPER 95 follows up the price change of crude oil has been graphically presented.

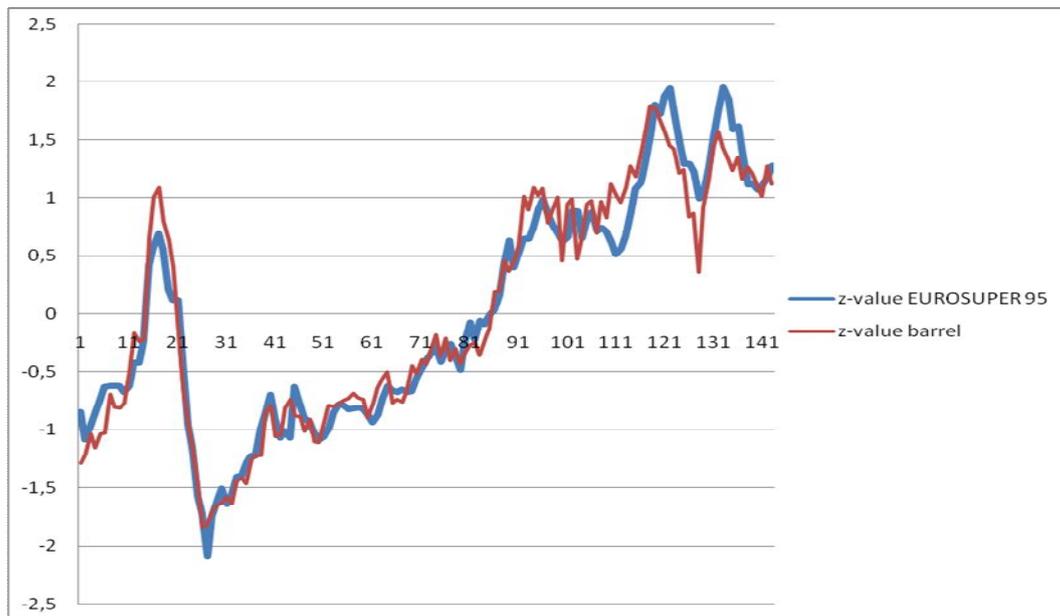


Figure no. 1. Response of EUROSUPER 95 price to CO price

Source: authors' calculations

A linear regression model has been made in order to obtain quantitative data. For the purpose of the model, the CO price per litre in kuna has been calculated, for the period between January 2007 and February 2013 and has been taken as an independent variable in the model. The prices have been calculated on the grounds of fact that the volume of 1 barrel equals the volume of 158.99 litres. The dependant variable is the price of EUROSUPER 95 petroleum product in HRK.

The results of analysis conducted in programme package SPSS20 are as follows:

Table no. 2 ANOVA Table for Simple Linear Regression

Source of Variation	Degrees of Freedom DF	Sum of Squares SS	Mean Square MS	F-ratio	p-value
Regression	1	214,106	214,106	2800.445	0.0000
Error	124	10,780	0,076		
Total	125	166,342			

Source: authors' calculations

Based on Table no. 2 it can be concluded that the independent variable of CO price per litre is statistically significant because of empirical significance value $p = 0.0000$, which is lower than $\alpha = 0.05$.

Table no. 3 Regression Results for Individual Parameters

Variable	Label	Coefficient Estimate	Standard Error	p-value
Constant		4.562	0.083	0.000
CO price (HRK)	X	1.403	0.027	0.000

Source: authors' calculations

Based on the data from Table no. 3 it can be concluded that the independent variable and constant are statistically significant and the equation of simple linear regression model can be drawn up:

$$Y = 4.562 + 1.403 X$$

(0.083) (0.027)

Parameter interpretation:

$$\beta_1 = 1.403$$

In the monitored period between January 2007 and February 2013, the price increase of CO per litre of 1 HRK caused an average price increase of EUROSUPER 95 per litre of 1,403 HRK.

Determination coefficient is $R^2 = 0.952$, which means that 95.2% of price variation of EUROSUPER 95 is explained through CO price change. That amounts to somewhat less than 98%, as it was published in 2007 in the USA [5], [2].

Since the VAT rate changed twice in the monitored period, a multiple regression model has been made.

This model includes three independent variables monitored in the period between January 2007 and February 2012:

1. CO on the European market Brent [6];
2. USD/HRK midpoint exchange rate posted by the Croatian National Bank (Exchange rate list, Croatian National Bank's archive);
3. VAT rate.

The dependant variable is the price of EUROSUPER 95 per litre at INA gasoline stations [8]. Data CO prices and exchange rate were collected on the day prior to the price change of EUROSUPER 95.

Results of the analysis have been obtained through programme package SPSS20 and stepwise method has been used:

Table no. 4 ANOVA Table for Multiple Linear Regression

Source of Variation	Degrees of Freedom DF	Sum of Squares SS	Mean Square MS	F-ratio	p-value
Regression	3	217,426	72,475	1350.356	0.000
Error	139	7,460	0,054		
Total	142	224,886			

Source: authors' calculations

Since the p-value is less than 0.05, we reject the null hypothesis that all three slope parameters are not all zero, in favour of the alternative hypothesis that at least one slope parameter is different from zero.

Table no. 5 Regression Results for Individual Parameters

Variable	Label	Coefficient Estimate	Standard Error	p-value
Constant		-4.653	0.493	0.000
CO price USD	X ₁	0.042	0.001	0.000
Exchange rate USD/HRK	X ₂	0.851	0.066	0.000
VAT rate	X ₃	0.224	0.029	0.000

Source: authors' calculations

From the information in Table no. 5 the null hypothesis can be rejected for all four variables in regression model. Based on t-test with the significant level $\alpha = 0.05$ the p-values for constant, CO price, exchange rate and VAT rate are all lower than 0.05 indicating sufficient evidence for predicting the gasoline price.

All three independent variables and the constant are statistically significant, and therefore the equation of multiple regression model can be drawn up:

$$Y = - 4.653 + 0.042 X_1 + 0.851 X_2 + 0.224 X_3$$

(0.493) (0.001) (0.066) (0.029)

Parameter interpretation:

$$\hat{\beta}_1 = 0.042$$

If the price of barrel of oil increased by 1 USD, and USD/HRK exchange rate and VAT rate stayed unchanged, an average increase of the price of EUROSUPER 95 could be expected, in the amount of 0.042 kn, i.e. 4.2 lipas.

$$\hat{\beta}_2 = 0.851$$

If the USD/HRK exchanged rate increased by 1 kn, and oil price per barrel and VAT rate stayed unchanged, an average increase of the price of EUROSUPER 95 could be expected, in the amount of 0.851 kn, i.e. 85,1 lipas.

$$\hat{\beta}_3 = 0.224$$

The increase of VAT rate by 1%, whereas oil price per barrel and the USD/HRK exchanged rate remain unchanged, causes an average increase of the price of EUROSUPER 95 by 0.224 kn, i.e. 22.4 lipas.

The multiple regression model with all three predictors produced $R^2 = 0.967$, meaning that 96.7% of the variation of gasoline price is explained by the independent variables. This means that 3.3% of the variation of EUROSUPER 95 price remain, and they are not explained by the regression model. This includes the price of storing, season variations, but also potential manipulation of prices done by the oil companies.

Conclusions

Crude oil is one of major energy sources. There are different factors which have an influence on the forming of oil price on the world market, such as: supply and demand correlation, wars in the Middle East, stock confinement, OPEC monopoly pricing, increased demand caused by the huge growth of Chinese and Indian economies, hurricanes and strikes of oil rigs employees, etc. The oil crisis, which has been a cause of large increase and fluctuation of oil price on the world market in recent years, has led to many questions such as the questionability of the formula used for price forming of petroleum products in the Republic of Croatia. In the Republic of Croatia, due to the Oil and Petroleum Products Market Act, it is not the CO price that is used for the formation of petroleum product price, but the petroleum product price on the Mediterranean market. Therefore, certain doubts in the possible manipulating of prices may rise, in order for oil companies to reach higher profits.

This paper has offered the regression model which is used to analyze the influence of fluctuations in CO price on the world market, USD/HRK exchange rate and VAT rate on the price of petroleum products in the Republic of Croatia in the period between January 2007 and February 2013, and the following results have been obtained:

- CO price, exchange rate and VAT rate have statistically significantly influenced fluctuations of EUROSUPER 95 price;
- CO price, exchange rate and VAT rate explain 96.7% of variations in price of EUROSUPER 95;

- increase in price of one litre of CO by one kuna has caused the increase in price of one litre of EUROSUPER 95 by 1.40 HRK.

This paper has offered answers to some relevant questions and has shown that there is a statistically significant influence of CO price on the price of petroleum product EUROSUPER 95. Some future researches ought to be able to explain those 3.3% variations which were not explained by the proposed model. One of phenomena to be explored is a potential asymmetry which occurs while forming petroleum products price. Is it possible that gasoline prices respond more quickly when oil prices are rising than when oil prices are falling?

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