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Contents

Section 1 Economics and Geography

Oliynyk Viktor, Sumy State University
Ph.D., Associate Professor, Department of
Economics and Management;

Forecasting financial and economic indicators using regression analysis.

Abstract: In this paper we consider the problem of obtaining non-linear regression equation to find the energy prices. To receive these equations is historical observation period. To predict oil prices for 2011-2014, GG, obtained by the regression equation with a coefficient of multiple correlation equal to $R = 0{,}991$.

Keywords: regression, model, factor analysis, forecasted price.

JEL classification codes: C02; C61; E31.

Introduction

Several methods of calculation of forecasted world price on energy carriers are examined. Analytic calculation and official data on the Internet (1,2,3,4) are used as historic statistic data. It is possible to use the algorithm can be used for calculation of forecasted price of different energy resources (gas, solid fuels, biofuels, electricity, etc.). Suggested method allows to use unlimited quantity of investigated factors and required quantity of countries and regions. Elements of factor analysis can be used for selection of significant indicators when large number of variables are inputted. Some approaches of energy price calculation are examined.

A. Let we have a historic period. As result of numerical analysis we get appropriate regression model [5].

$$Y = a_0 + \sum_{i=1}^{n} a_i x_i + \sum_{i=1}^{n}\sum_{j=1}^{n} a_{ij} x_i x_j$$

where Y - energy price;

a_0, a_i, a_{ij} - regression equation coefficients;

x_i - dimensionless factor;

n - quantity of factors.

Dimensionless factor that is used in the equation is calculated by following formula:

$$x_i = \frac{z_i - \bar{z}_i}{\tilde{z}_i}$$

where z_i - real value of i - factor;

$\overline{z_i}$ - average value of i - factor;

$\widetilde{z}_i$ - average linear deviation of i- factor.

Method of factor exclusion from initial quadratic form is used for formation of regression equation. As well as indicator of significant increase of residual dispersion, critical value of some statistic indicator (e.g. Student's criterion) for appropriate coefficients of regression equation can be used as criterion for a final equation.

Thus we get regression equation. It is required to substitute appropriate factor indicators during the period for calculation of forecasted energy price. If we have forecasted indicators for selected countries and regions it is possible to get corresponding price values. Average world price on energy is calculated regarding obtained local prices of some countries and regions. Several variants of calculation can be used: get world price as average result of local price values; average price is got regarding weight of each country and region.

As well as a separate investigated factor (e.g. production), a group of factors can be used as weight characteristic. Comparing the actual values of prices over the historical period and obtained by the regression equation, we can evaluate the quality of the model and make appropriate adjustments in determining the projected energy prices. This model provides a forecasted price in any period.

B. Consider the model of finding energy prices based on the values of factor figures for the previous period. Here we use the methods for finding the regression equation proposed in the model A. The difference from model A is that for calculation the price in a future period, historical data from previous periods is used. In this approach, we can find prices for only the next period. This model can exist, since it uses only real data in predicting.

C. Consider a model with the use of factor analysis [6]. First use of factor analysis is necessary in order to analyze a large number of factors and identify groups of factors. Upon receipt of the regression equation to find the energy prices, you can use a large number of factors. Increasing the number of factors does not always lead to improving the quality equation. You can use factor analysis to combine the factors into independent groups. You can then carry out regression analysis on the following areas.

1. In each group are several major factors and they make a regression equation. Convenience of this approach is that we work with real parameters, which

are financial and economic sense. The disadvantage of this approach is that the formation of prices cannot be considered a generic factor, consisting of several real-world factors. This factor can significantly affect the price of primary energy.

2. We use regression analysis with respect to the elements of the integral factors obtained by factor analysis. The advantage of this approach is that the number of independent factors was reduced to a few pieces (initially there may be several hundred). Then you can apply the methods outlined in the model, and integral factors into account all of the original factors. The disadvantage of the model is that the resulting regression equation uses generalized factors that have no real financial and economic values. Therefore, in order to take advantage of these equations, it is necessary to use many of the original real-world factors. Price energy source, obtained in accordance with this equation will have real value.

Some numerical calculations.

As an example, we find that the projected average annual price for oil Weekly Europe (UK) Brent Blend Spot Price FOB [2] in the interval 2011-2014 years. The initial data for the calculation will take the value of the historical period 1996 to 2010 years. with an interval of 1 year. For this we use the following factors are:

1. GDP (Current Prices, US$ Billion)
2. Inflation (End of Year Change %)
3. Unemployment Rate (% of Labor Force)
4. Current Account Balance (US$ Billion)
5. Value of Oil Imports US$ Billions
6. Value of Oil Exports US$ Billions
7. Total Oil Supply (Thousand Barrels Per Day)
8. Total Petroleum Consumption (Thousand Barrels Per Day)

Getting the regression model will produce the following algorithm. 1. As an initial regression model chosen factor figures for 42 countries around the world. The resulting regression equation has a coefficient of multiple correlation is equal to 0,76 (R = 0,76).

2.By process of elimination, we obtain a regression equation with a coefficient of multiple correlation equal to 0,991 (R = 0,991). As a criterion to exclude the country from the regression equation using the following indicators:

$$A = \sum_{j=1}^{m} \left| Y_j - Y_j^* \right| \to \max$$

where Y_j - the historical value of energy prices in the j-period;

Y_j^* - price value in the *j*-period, according to the obtained regression analysis.

3. A result we obtain 8 countries, the historical data of which we use in further calculations: Kuwait, Mexico, Nigeria, Qatar, Russia, United Arab Emirates, United Kingdom, United States. After a numerical study, we find the following coefficients of regression model (Tables 1,2):

Table 1 Values of the coefficients of linear variables

	a_0	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8
The coefficient value (t-criteria of Student)	60,135 (29,2)	-46,222 (5,47)	0	0	28,063 (7,63)	56,117 (14,83)	22,082 (20.1)	-18,874 (6,03)	47,289 (6,02)

Table 2 The values of the coefficients of the nonlinear variables $x_i \; x_j \; (i, j = \overline{1,8})$

	1	2	3	4	5	6	7	8
1	0	0	32,899 (6,79)	-20,696 (7,77)	-15,270 (7,96)	0	15,516 (3,77)	-11,565 (3,81)
2	-	0,166 (2,43)	0	0	0	1,322 (2,70)	-1,519 (2,15)	0
3	-	-	0	-9,327 (3,72)	-8,247 (4,14)	-3,119 (3,89)	14,553 (11,72)	-40,209 (8,70)
4	-	-	-	-7,204 (6,32)	-4,616 (3,64)	0	5,500 (2,51)	0
5	-	-	-	-	0	0	0	0
6	-	-	-	-	-	-0,547 (2,40)	-2,85 (2,17)	0
7	-	-	-	-	-	-	-5,696 (5,99)	0
8	-	-	-	-	-	-	-	0

Multiple correlation coefficient obtained by the regression equation is equal to 0,991 (R=0,991). The quality of the equation we estimate using the F-criterion of Fisher (F=203,95). The resulting regression equation characteristics suggest a qualitative description of the source data.

Table 3 Average values of model variables

	1	2	3	4	5	6	7	8
$\overline{z_i}$	1898,274	7,079	3,687	-51,788	29,352	37,767	3619,123	3396,229
$\widetilde{z}_i$	2442,430	5,834	2,583	104,626	42,240	25,292	2482,879	4064,758

Using data from Tables 1,2,3, we obtain the regression equation to determine the average cost of oil such as Europe (UK) Brent Blend Spot Price FOB. For the practical use of this equation it is required to have the appropriate summary measure. Screenings of gross errors of the mean values of oil conducted in accordance with the following algorithm [8]. For a small number of tests (N <25), use the method of calculating the maximum relative deviations:

$$\frac{|z_k - \bar{z}_k|}{\sigma_k} \le \tau_{1-p} \quad ,$$

where $\sigma_k = \sqrt{\frac{\sum_{i=1}^{n}(z_i - \bar{z}_i)^2}{n-1}}$ - standard deviation; τ_{1-p} - statistic value that is calculated at a confidence level $q = 1 - p$. In the dropout rate of gross errors using a significance level q = 0,95.

We plot the average change in oil prices to historic range, as well as the price of oil, obtained using the regression equation in the interval 2011-2014 years (figure 1, table 4).

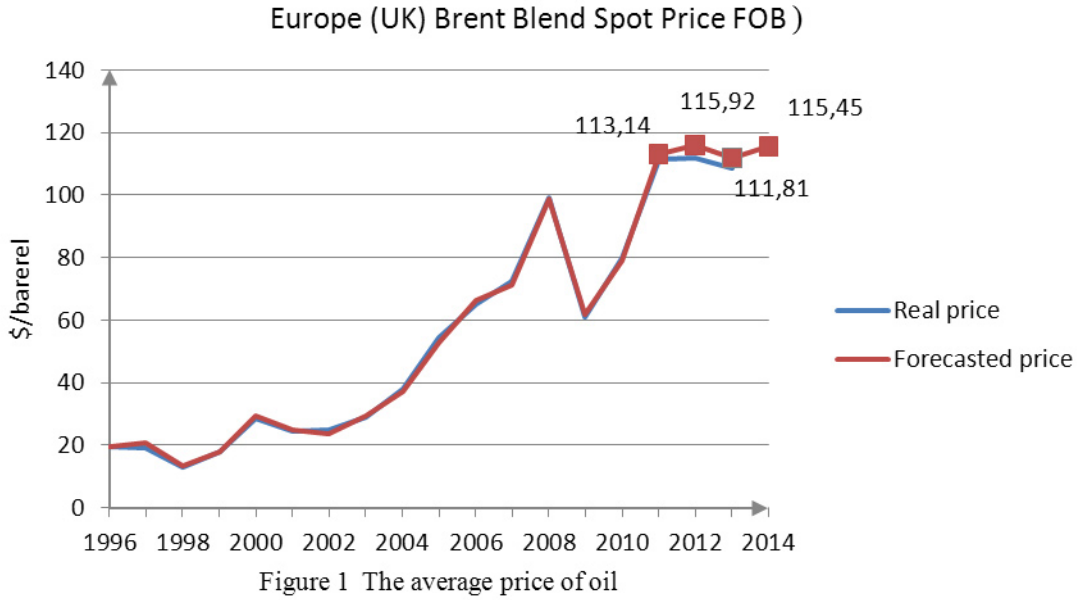

Figure 1 The average price of oil

Table 4 Forecast (real) annual average oil price, $ / barrel

№	Type of oil	$ / barrel			
		2011	2012	2013	2014
1	Europe (UK) Brent Blend Spot Price FOB	113,14 (111,38)	115,92 (111,67)	111,81 (108,62)	115,45

The quality of the resulting model can be assessed only on the results of reliable data, which will be known at the end of the period.

This algorithm can be used to obtain predicted prices for any type of energy source. One year interval was taken for the historical period investigation. You can reduce the interval of the

study (month, quarter). In this case it is necessary to know the values of selected indicators for the countries studied with the required intervals. By increasing the number of countries and the factors involved in building the model, as well as reducing the interval study, one can obtain a more adequate model.

Obtained with the help of regression analysis predicted the price of energy on the proposed methodology above, we can optimally manage the financial assets of the company if we obtain with the help of regression analysis predicted the price of energy on the previously proposed methodology.

Conclusion

An algorithm of finding energy prices using a nonlinear multivariate regression analysis is examined. The numerical implementation of this equation is shown. Found projected oil prices in the range of 2001 - 2014 GG. The data obtained are in good agreement with real values.

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