Research on International Crude Oil Price Forecasting Model

Hengyu Lyu, Yuwen Chang

PetroChina Research Institute of Petroleum Exploration & Development, Beijing 100083, P. R. China

Abstract: The international crude oil price has the important economic significance and the political significance, the crude oil price forecast research has the far-reaching significance. There are many influencing factors of international crude oil prices. In this paper, we select the main influencing factors as predictors, and use Matlab programming method combined with BP (Back Propagation) neural network modeling to predict the WTI international oil price finally. In addition, the use of Eviews9.0, the establishment of ARIMA (Autoregressive Integrated Moving Average Model), the same forecast WTI oil prices. The two forecasting methods have the same forecasting trend and have some guidance and guidance on the international crude oil price forecasting research.

Keywords: WTI Oil Price; Trendency Prediction; BP model; ARIMA model

1. INTRODUCTION

In general, oil price data, unstable time series of data, short-term forecasting or long-term forecasting, and various economic models all have certain shortcomings. In this forecasting process, using Matlab software programming, a single hidden layer BP neural network model was established to train WTI oil prices from 2003 to 2015, and forecast the 2016 oil price.

BP neural network, which is multi-layer feed-forward error feedback neural network, is one of the most extensive and influential artificial neural networks. The standard neural network is based on a learning rule, using gradient descent method, the weighted function of nonlinear differentiable multi-layer neural network. That is, the network usually consists of input layer, output layer and several hidden layers, each layer consists of several nodes, each node represents a neuron, the upper node and the lower node are connected by the right, the layer and the layer Between the nodes using fully interconnected connection, there is no link between nodes in each layer. Network learning can be divided into two stages: the first stage is to input known learning samples, and the neural network is calculated backward from the first layer of the network by setting the network structure and the weight and the closed value of the previous iteration Output. The second stage is to modify the weight and the value of the interpretation, from the last layer forward calculation of the weight and closed value of the total error gradient, according to the weight and closed value of each modification.

Data selection and processing

Combined with the three-factor analysis method and the data correlation, the main factors influencing the WTI are the selection of the world crude oil demand, the world crude oil supply, the U.S. Cushing crude oil inventory and the US dollar index parameters. The specific data in Appendix A.

The following analysis of various factors.

The world crude oil supply and demand and the relationship between the WTI is not clear enough, so to make the relationship between supply and demand and WTI. Supply and demand and WTI have a good correlation. It is clear from the figure that WTI oil prices all the way down when the demand exceeds supply in 2014.

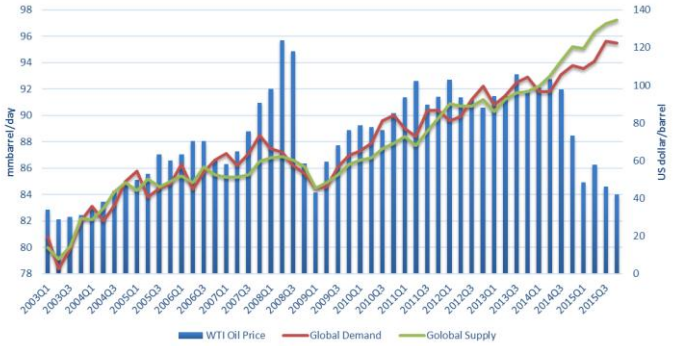

Figure 1 World supply and demand and WTI oil prices

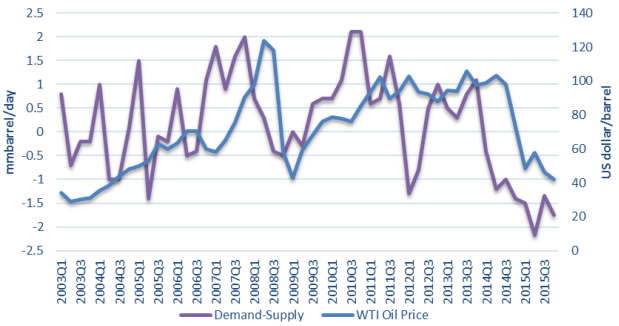

Figure 2 World crude oil supply and demand and WTI prices

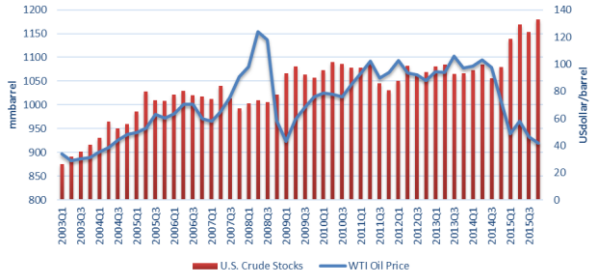

Figure 3 US crude oil inventories and WTI oil prices

Similarly, WTI oil prices showed a sharp decline as inventories of Cushing in the United States soared in 2014. Cushing's inventory began to be affected by the US's energy independence strategy in 2014. The sharp increase in shale oil and gas production has directly led to an increase in the market share of U.S. crude oil.

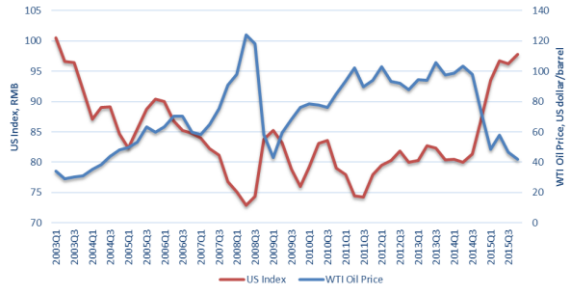

Figure 4 US dollar index and WTI oil prices

The negative correlation between the dollar index and the WTI oil price is also the most significant financial factor affecting WTI oil prices.

Due to the inability to find data directly related to the WTI crude oil cost, and from the previous analysis, it has been learned that with the development of good and high-quality oil and gas resources, unconventional oil and gas resources newly discovered have taken up a great deal The proportion of exploration and development of its difficulty, high cost. At the same time, it can be seen from the examples of shale oil and gas resources in the United States that exploration of shale oil and gas from the 1980s to the early 21st century has greatly reduced the rise of new technologies (horizontal well drilling and volumetric fracturing) Shale oil and gas development costs.

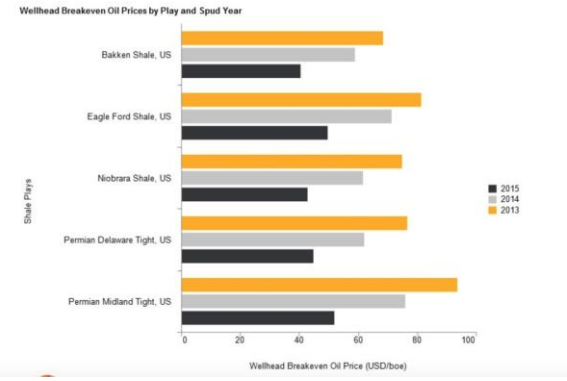

Figure 5 US shale oil and gas profit and loss oil price (Rystadenergy)

Data preprocessing: In order to avoid the situation of big data eating small data, all data are normalized and the initial weight of each influencing factor is balanced.

2 BP MODEL ESTABLISHMENT AND RESULT FORECAST

According to the size of data samples, select three layers (input layer: 4 input; hidden layer: 10 neurons; output layer: 1 output) BP neural network model. Matlab program in Appendix B.

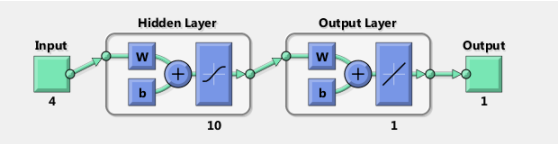

Figure 6 BP neural network model

Since the sample belonged to a small sample, 70% of 52 samples were taken as Training, and Validation and Testing were 15% each.

After BP modeling, millions of learning feedback, select the optimal model.

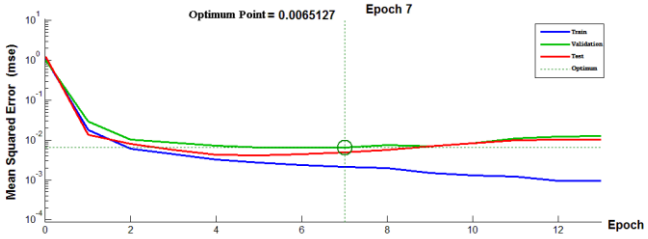

Figure 7 the mean square error of the best

After BP modeling, the training group, validation group, test group, and the fitting of all samples are as follows.

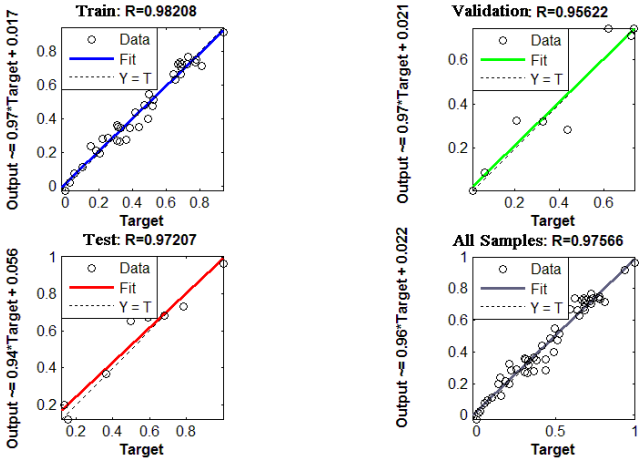

Figure 2. 8 Sample Fitting

Based on the 2016 forecast data and the established BP neural network model, WTI oil price forecast is made.

The 2016 results predicted by the BP neural network model show that the end of the year oil prices over 60 US dollars per barrel, and that the forecast trend has a certain reference value.

The final model fitting results as shown below:

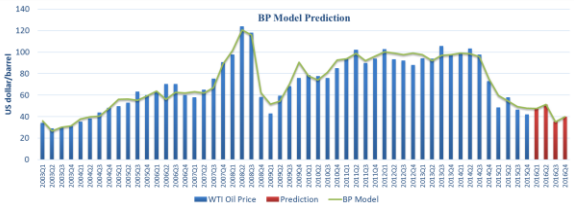

Figure 9 WTI Oil Price Fitting and Forecast

3 ARIMA MODEL ESTABLISHMENT AND RESULT FORECAST

First, select the data analysis of stability, and correlation. Decided to take the logarithm of the data, do first-order difference. Through this process, WTI oil price data is stable. Specific parameters are as follows.

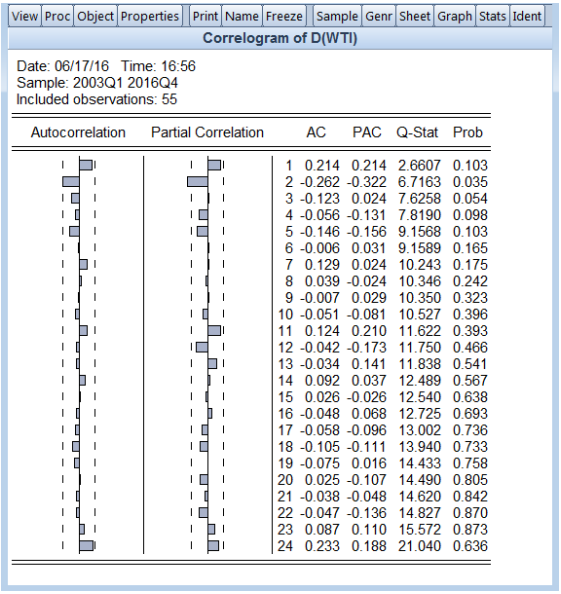

Figure 10 WTI Stationarity Analysis

After the data is processed, the input data needs to be selected just like the BP neural network model, and the input parameters with higher correlation and better cointegration are input as the final variables as well. These are: World Energy Demand, World Energy Supply, US Dollar Index, US Cushing Crude Reserves.

By predicting residuals for AR and MA, the prediction model and the results are as follows.

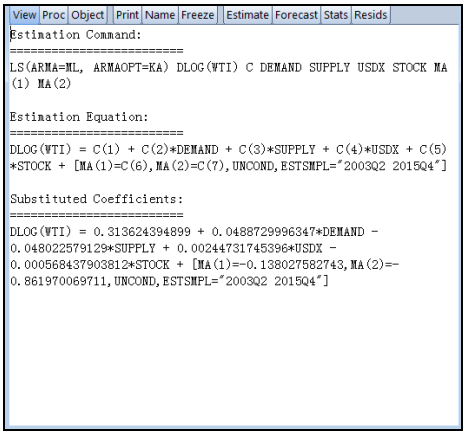

Figure 11 ARIMA model

Based on the above results, we conclude that ARIMA accurately matches the WTI data from 2003 to 2015 and forecasts the 2016 WTI oil price based on the forecast of the 2016 input parameters (the same as the BP neural network model 2016 forecast). The forecast results are shown in the following figure.

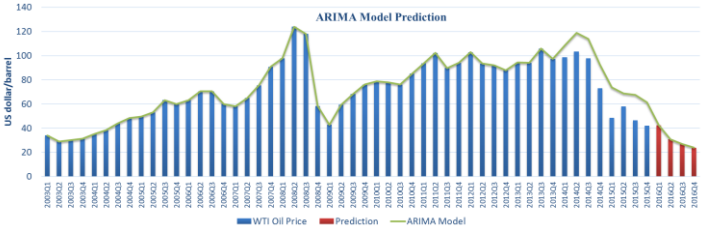

Figure 12 WTI Oil Price Prediction of ARIMA Model

Table 1 Prediction Results Comparison between BP Model and ARIMA Model

Time	BP	ARIMA
2016Q1	47.61377	42.45466
2016Q2	51.30823	30.76808
2016Q3	35.17226	26.97298
2016Q4	39.99691	23.88852

4 CONLUSION

In this paper, by analyzing the influencing factors of WTI crude oil prices, we establish BP model and ARIMA model to forecast WTI. By comparison, it is found that BP model predicts higher than ARIMA model predicts. The forecast result is based on the prediction method and model, which is not the content of this paper for the forecast of supply and demand, cost, finance and other factors. It should be pointed out that all the forecast models are based on the forecast of WTI oil prices, but none of them can accurately predict the future international crude oil supply and demand and the dollar index. This article predicts the model and the forecast tendency result, may as the reference, provide the support basis.

REFERENCES

[1] Liu Jinpei, Lin Sheng. A Nonlinear Time Series Prediction Model and Prediction of Crude Oil Price [J] .Management Science, 2011, 06: 104-112.

[2] relaxation. Speculation on the impact of international oil prices [D]. Shanghai Academy of Social Sciences, 2009.

[3] XIONG Xiong, LI Xuan.Study on the Prediction of International Crude Oil Price [J]. Journal of Chongqing University of Technology (Natural Science), 2016, 01: 48-53.

[4] YIN Jia-yin, TANG Bao-jun. Analysis of the Impact of Major Global Oil Events on International Oil Prices [J]. China Energy, 2016, 02: 20-24.

[5] Zhao Lutao, Jiang Shouming. 2016 International Crude Oil Price Analysis and Trend Forecasting [J]. Journal of Beijing Institute of Technology (Social Sciences Edition), 2016 ,02: 8-12.

[6] Zhou Detian, Yu Haiyan. Journal of Henan University of Science and Technology, 2016,04: 611-617. Research on the Impact of International Oil

Price Fluctuation on Domestic Price Level - An Empirical Analysis Based on VAR Model [J].
[7] Yu Tao. Review of 2015 International Crude Oil Market and Prospects for 2016 [J]. Modern Commerce, 2016,11: 104-106.
[8] He Xiaowei, Guo Hong.Analysis of the Influencing Factors of International Crude Oil Price and Countermeasures [J]., 2016,04: 39-50 + 132.
[9] Jing Keyao, Jiang Zhenqiang, Hu Yan, Meng Xin.Effects of low oil prices on the benefits of domestic and foreign oil companies and countermeasures [J]. Contemporary Petroleum & Petrochemical, 2016,03: 1-7.
[10] Zhang Maorong, Chen Qingyi. Reasons and effects of the agreement reached by the four major oil-producing countries on "freezing" [J] .Annual Report for Research, 2016,03: 41-47 + 57.
[11] Lu Xiao. International oil price fluctuations on China's economic impact and transmission mechanism [D]. China University of Mining and Technology, 2015.
[12] Guo Qi. International crude oil price formation mechanism and the fluctuation factor analysis [D]. Tianjin University, 2010.
[13] Hu Yue, Li Mei, Zhou Yanwei.Application comparison of gray model and time series analysis in refined oil prices [J]. Examination Weekly, 2015,77: 196.