Global Journal of Enterprise Information System

A Non-Statistical Approach to Predict Crude Oil Prices

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Abstract

Oil is one of the important commodities that contribute highly to the advancement of human civilization. Predicting oil prices is one the challenging yet important thing that can affect the short and long term planning for countries as well as various sectors in industry. Most of the attempts to predict oil prices depend on the previous data analysis and evaluation with statistical approach. This paper proposes a non-statistical approach to predict oil prices.

Keywords: crude oil, data fitting, gross domestic production

1. Introduction

Almost all of the civilized world machinery depends on oil as a source of energy. Oil can provide a huge amount of energy yet it cost less compared with other energy sources. Predicting oil prices attracted too much attention in the recent years due to the huge affect of the oil prices on human life. Prediction attempts and approaches for oil prices can be summaries in to three kinds:

- Long term: Long term predictions are an important part in planning the future of countries especially the ones that produce oil.
- Short term (monthly): Stock brokers are interested in short term prediction for oil prices.
- Seasonally prediction: Future contract are dependent on the midterm predictions.

This paper is interested in the seasonally prediction that is important to crude oil future contracts.

The use of statistical approach is so common to predict oil prices the work of (Andreou, Ghysels, & Kourtellos, 2011; Baumeister, & Kilian, 2012; Clark, & McCracken, 2009; Croushore, 2011; Hamilton, 2009) and many other attempts to predict oil prices is an example of using statistical approach to predict oil prices (either by fitting or using statistical methods). This paper develops a non-statistical algorithm to predict oil prices.

1.1 Seasonally Prediction and Data Fitting for Oil Prices

This section investigates the data fitting approach to predict the midterm oil prices. The oil prices compared to the total supply and demand around the world. In addition the gross domestic production (GDP) for the industrial countries is also taken in account.

Table 1 provides the results of applying the 'polynomial surface' (Fang, Li, & Sudjianto, 2005) fitting tool on 2011 data.

The obtained results are not accurate as it can be seen in table 1. Data fitting can be helpful in giving some ideas about the behavior of certain data but can be a huge failure in providing an accurate prediction. The 2D (figure 1–3) and 3D (figure 4–6) fitting graphs can be found.

Table 1: 2011 Prediction using surface fitting

Parameters	Quarters/Annual	Values	Predicted Oil Price ($/barrel)
Demand (million barrels per day)	Quarter 1	87.5	166
	Quarter 2	86.4	−140
	Quarter 3	88.4	65
	Quarter 4	88.8	110
Supply (million barrels per day)	Quarter 1	83.92	137
	Quarter 2	86.5	74
	Quarter 3	87.4	60
	Quarter 4	88.5	120
Global GDP (%)	Annual	4.23	50

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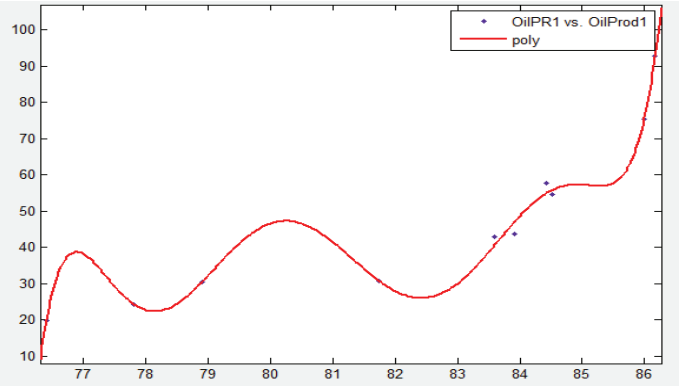

Figure 1. The supply and oil prices polynomial curve fitting of the years' first quarter.

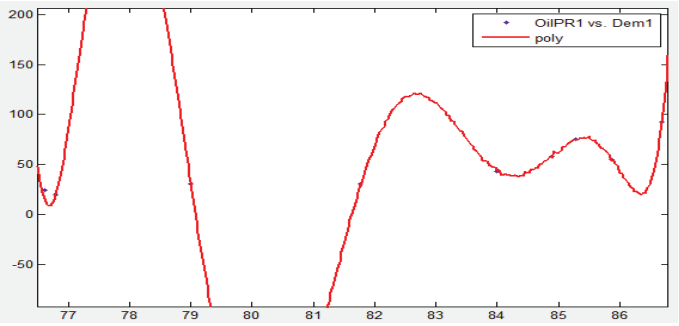

Figure 2: The demand and oil prices surface fitting of each year's first quarter.

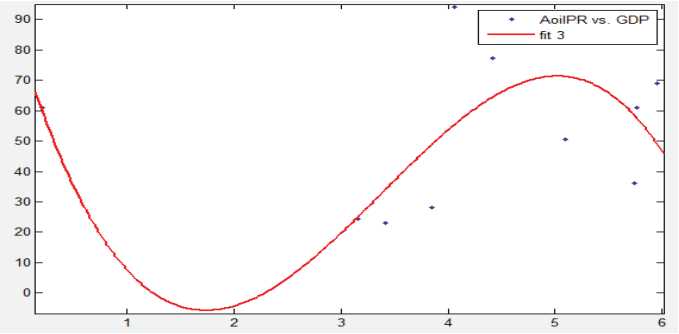

Figure 3: The annual GDP and oil prices polynomial curve fitting of the years' first quarter.

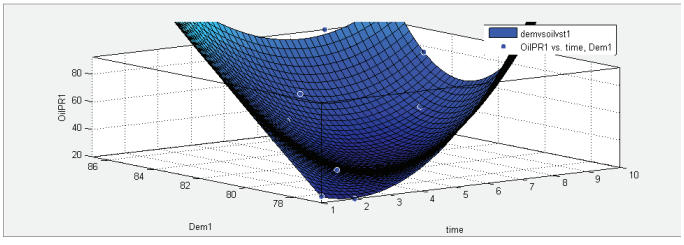

Figure 4: The demand and oil prices surface fitting of each year.

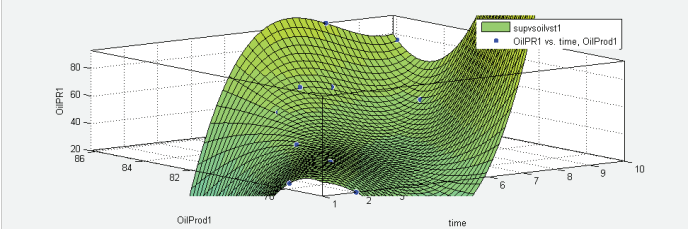

Figure 5: The supply and oil prices surface fitting of each year.

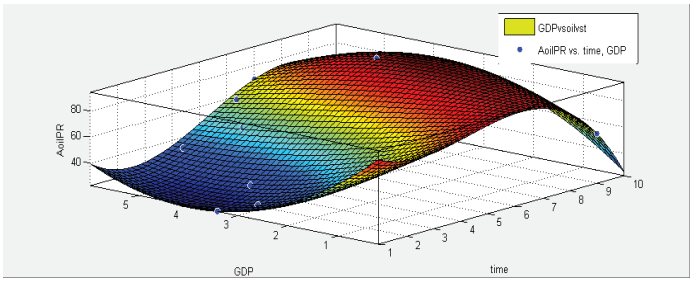

Figure 6: The annual GDP and oil prices surface fitting of each year.

1.2 The Economy and Oil Prediction

The previous section showed that data fitting can be far from accurate when predicting oil prices for the midterm range. Investigating other approaches, the GDP could be an important factor that affects the prices of oil.

Considering the oil as any other commodity in the world could be a huge mistake. In fact, oil is more than a normal commodity that can be predicted by merely fitting its previous prices. One may conclude that the importance of oil prices in human life forced oil producing countries as well as the industrial countries to maintain a steady increasing or decreasing in the prices. Hence, the approach of predicting oil prices using the gross domestic production (GDP) can be a valid approach.

This paper consider the GDP for the group of eight includes most of the world's advanced countries, which are Canada, France, Germany, Italy, Japan, Russia, United Kingdom and United States of America also China GDP is considered due to the rapid growth in the Chinese economy.

The next factor to be considered is of the currency nature. However, to include numerous currencies in oil prediction analysis seemed to be impractical and time wasting. A factor must be sought that combine some of the most influential currencies known around the world, hence the U.S. Dollar Index (USDX) was chosen for such presentation. This factor is a measurement of the value of the U.S. dollar relative to the basket of foreign currencies, which included the Euro, the Japanese yen, Pound sterling, Canadian dollar, Swedish krona and the Swiss

GJEIS | Print ISSN: 0975-153X | Online ISSN: 0975-1432

franc. This index included such currencies in a different weight for each currency. The U.S. Dollar Index holds a 57.6% weight of the Euro currency, a 13.6% weight of the yen, a 11.9% weight of the Pound sterling, a 9.1% weight of the Canadian dollar, a 4.2% weight of the Swedish krona and a 3.6% weight of the Swiss franc. This factor is a good indication of economy of some of the world's most developed countries. This will help in determining how this will relate with future data relation with the oil price.

1.3 An Approach to Oil Price Prediction and Analysis

The purpose of this research is to find a non-statistical approach to confine the oil price within a reasonable range in future years to better understand and anticipate global economy… The analysis is done by backtracking a yearly average of the data to produce a range of oil for the years 2006–2012 as means of testing the accuracy.

The prediction approach can be summarized as follows:

2. Prediction Algorithm

(Note that P_o is the oil price of the previous year, P_u is the upper limit of the oil price interval, P_L is the lower limit of the oil price interval, GDP_o is the GDP of the previous year, GDP_u is the GDP of the upper limit of the oil price interval, GDP_L is the GDP of the lower limit of the oil price interval and USD_o is the US dollar value of the previous year, USD_u is the US dollar value of the upper limit of the oil price interval, USD_L is the US dollar value of the lower limit of the oil price interval.)

1. With the value of P_o, evaluate $P_u = 2P_o$ and $P_L = 0.5P_o$.
2. For P_u and P_L, compare if the prices dropped at the same ratio previously in a period of 1 or 2 years. If not, go to step 6.
3. Compare the changes in ratios between P_o and P_u in order to get GDP_u and USD_u from the years the ratio is consisted of from the data.
4. With the value of GDP_o, compare the change in the ratios of GDP to generate the ratio between GDP_o and GDP_u. With the value of GDP_o, compare the change in the ratios of USD to generate the ratio between USD_o and USD_u.
5. If the change in ratio occurred previously within 1 or 2 years, then assign $x=P_u$ as the upper limit of the oil price and head to step 7. Otherwise, go to step 6.
6. Update the value of P_u to be $P_u = 2P_o - 5$ and repeat from step 2.
7. Conduct the steps from 2 to 5 for P_L.
8. If the change in ratio occurred previously within 1 or 2 years, then assign $y = P_L$ as the lower limit of the oil price. Otherwise, head to step 9.
9. Update the value of P_L to be $P_L = 0.5P_o + 5$ and go to step 3.
10. $z = \frac{x+y}{2}$.

2.1 Computational Results

The analysis is conducted by using the programming software (MatLab). The data for the GDP are from reference (Pesaran, & Timmermann, 2009) and the oil prices data are from reference (econdlink). Table 2 provides the results obtained by the prediction algorithm.

3. Conclusion

The results obtained by the prediction algorithm are better than the regression results. However, the prediction algorithm still not very accurate as it can be seen clearly in table 2. The prediction algorithm fails to predict the rapid increase in oil prices that occur in 2008 or the rapid decrease that occur in 2009. This suggests that other factors should be taken in consideration. The effect of other natural resources, other economical factors and the size of the oil future contracts should be considered in any future work.

Table 2: Yearly prediction intervals of oil prices

Year	Limits	Oil Price ($/barrel)	Average	Actual price ($/barrel)	Accuracy percentage
2003	Upper	27	25	28	10.7%
	Lower	23			
2004	Upper	36	31.5	36	12.5 %
	Lower	27			
2005	Upper	42	38.5	50	23%
	Lower	35			
2006	Upper	58	53	58	8.6%
	Lower	48			
2007	Upper	66	60.5	69	12.3 %
	Lower	58			
2008	Upper	73	69.5	94	26%
	Lower	66			
2009	Upper	94	92	61	33.6%
	Lower	89			
2010	Upper	103	94	77	18%
	Lower	85			
2011	Upper	85	81	107	24.2%
	Lower	77			
2012	Upper	132	116.5	109	6.4%
	Lower	101			
2013	Upper	110	100.5	NA	NA
	Lower	91			

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