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Toward constructing an effective method to predict oil prices

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Abstract. As human civilizations advance, the dependence on oil grows rapidly. Predicting oil prices is a big challenge due to the importance of oil in effecting human life style. Unlike any other commodity, oil prices can't be left to supply and demand factor only. The most popular approach to predict future oil prices is the statistical approach. The purpose of this study is to investigate the validity of taking a non statistical approach to predict oil prices.

Keywords: data fitting; gross domestic product GDP; prediction algorithm

Introduction

Oil is considered to be the major source of energy for industry and machine around the globe. It is capable of providing massive amount of energy after properly processed by refineries, and manufacturing products such as plastic cloths, etc. for domestic needs. on the other hand, oil is not a mere commodity; in fact oil prices are not governed by the same rules that affect other commodities or products (supply and demand) Hamilton (2009) and IMF (2011).

Andreou, et, al. (2011), Baumeister, and Kilian (2012), Clark and McCracken (2009), Croushore (2011) and Pesaran, and Timmermann (2009) and many other attempts to predict oil prices used a statistical approach by fitting or manipulating the previous data. However, this paper takes an optimization origin approach by driving a heuristic to predict future oil prices. In order to have a good prediction, it's essential to determine the factors that affect oil prices. One of the important factors that affect oil prices is the cycle of economic depression.

The cycle of economic depression

In the past decade, oil prices had a value of $94.08 in the year 2008 before drastically dropping down to $ 60.86 in the year 2009 during the last financial crisis. This recession in the world economy has greatly affected the oil industry in total. Ekmekcioglu (2012) proposed that those kinds of recessions are inevitable at a certain degree as if the rise in oil prices pushed the economy over the hill. The oil prices sudden increasing or decreasing due to political reasons is hard to predict. However, the economical depression cycle is known to be repeated every 10 to 15 years (http://www.econedlink.org/lessons/index.php?lid=816&type=educator, accessed 11 January 2013). Figure 1 shows the economical depression cycle for the gross domestic product GDP.

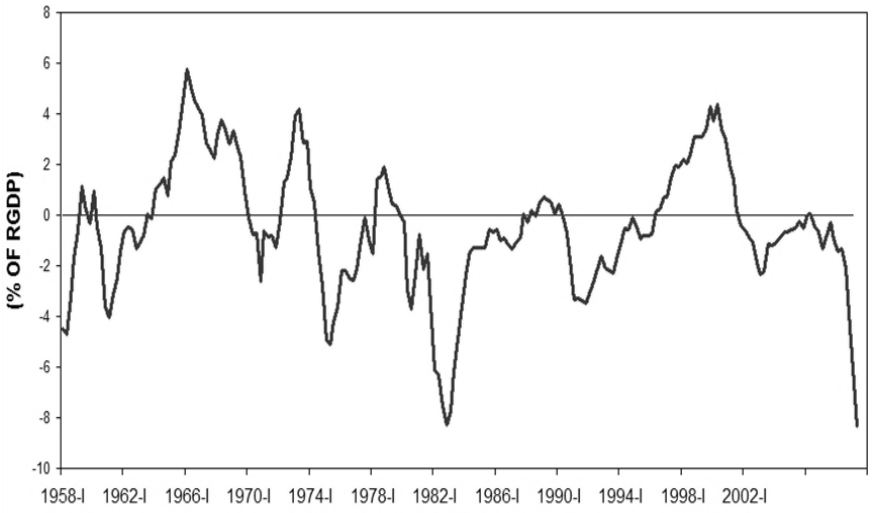

Fig. 1. GDP Depression Cycle

Using data fitting for oil predictions

For a preliminary analysis of choosing the influential factors related to oil pricing, the study of the total supply and demand of the world was considered as a major contributor in determining an approximate interval on which oil prices may fall upon if properly fitted within a curve by means of regression on a quarterly basis. Also, the global GDP was considered and assigned as a factor to be compared with the trend of the oil prices from the year 2000 to the year 2010 to test the oil price per barrel of the years 2011 and 2012. The data for the GDP are from (http://www.econedlink.org/lessons/index.php?lid=816&type=educator, accessed 11 January 2013) and the oil prices data are from (http://www.opec.org/opec_web/en/publications/337.htm , accessed 14 December 2012).

This proved somewhat promising at first since all the statistical data were provided along with a regression tool of three dimensional statistical analysis factors that would create a fitting in the shape of a surface. The regression considered is a **polynomial surface** fitting tool (Fang et, al. (2005)) that can estimate the anticipated waviness of oil prices while providing a model that can be used to optimize the oil prices predicted to fit the data in a three standard deviation bounds. Table 1 results below are obtained using the surface fitting approach.

Table 1. 2011 Prediction Using Surface Fitting.

Parameters	*Quarters/ Annual*	*Actual 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

Oil prices vs. economy

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 product (GDP) can be a valid approach.

As a further economic indication, the GDP should be remained as a factor to be influential to the oil prices. 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. For further illustration of global influence of economy, China is also included to this group to be included in the group in terms of the gross domestic production GDP.

An approach to oil price prediction and analysis

For a simplified explanation of the approach to prediction, the following steps should be followed:

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.)

1. *Get P_o, let $P_u = 2P_o$ and $P_L = 0.5P_o$,, $i=1$*
2. *For P_i, compare if the prices increased at the same ratio previously in a period of 1 or 2 years. If not, go to step 6.*
3. *Get GDP_i that associate with P_i from the previous GDP 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_i. if $i=2$ go to 8.*
5. *If the change in ratio occurred previously within 1 or 2 years, then assign $x=P_i$ as the upper limit of the oil price and go to 7. Otherwise, go to step 6.*
6. *Update the value of P_1 to be $P_1= 2P_1 -5$ and repeat from step 2.*
7. *$i=2$, Repeat the steps from 2 to 5 for P_i.*
8. *If the change in ratio occurred previously within 1 or 2 years, then assign $y=P_i$ as the lower limit of the oil price. Otherwise, head to step 9.*
9. *Update the value of P_2 to be $P_2=0.5P_2+5$ and go to step 2.*
10. *Calculate $z = \frac{x+y}{2}$.*
11. *Print P_1, P_2 and z*

Computational results

The analysis is conducted by using the programming software (MatLab). The data for the GDP are from (http://www.econedlink.org/lessons/index.php?lid=816& type =educator, accessed 11 January 2013) and the oil prices data are from (http:// www.opec.org/opec_web/ en/publications/337.htm , accessed 14 December 2012). The following Table provides the results obtained by the prediction algorithm.

Table 2. Yearly Prediction Intervals of Oil Prices.

Year	*Limits*	*Oil Price ($/barrel)*	*Average*	*Actual price ($/barrel)*	*Accuracy percentage*
2007	Lower	58	60.5	69.7	12%
	Upper	63			
2008	Lower	67	69.5	94.8	26%
	Upper	72			
2009	Lower	90	99	60.86	38%
	Upper	108			
2010	Lower	85	70.5	77.38	7%
	Upper	108			
2011	Lower	71	93	107.44	13.5%
	Upper	83			

From Table 2 it can be seen that the predictions for the years 2007, 2010 and 2011 were reasonable. However the prediction for 2008 and 2009 weren't good in terms of accuracy. The rapid decreasing in oil prices occurred in 2009 was a direct result to the rapid increasing in oil prices that occurred in 2008. The depression cycle could affect the outcomes of applying the prediction algorithm badly. This should be a challenge for any future work to predict oil prices.

Conclusion

This paper is the first step in the path of driving an effective approach to predict oil prices. The data, logical argument and the obtained results in this paper provided better understanding on how to encounter the prediction problem. The depression cycle mentioned in 1.1 showed that any prediction algorithm for oil prices should take the cycle as an important factor. Also, section 1.2 illustrates how fitting could fail in predicting oil prices. The prediction algorithm that mentioned in section 2 showed encouraging results to predict future prices based on GDP only. The accuracy of the prediction algorithm could be increased by taking other factors as boundaries to the future prices. Some other important factors will be considered in our future work to improve the prediction algorithm. Factors like current supply in terms of output, oil reserves, including what is available in U.S. refineries and what is stored at the Strategic Petroleum Reserves, oil demand, particularly from the U.S and the bidding on oil futures contracts.

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