USING DATA ANALYSIS AND MODELING IN PLANNING*

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Using data analysis and modeling in planning

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This article will explain how data analysis and modeling can be used in planning in the volatile environment in which the energy industries currently operate. The discussion will be quantitative and systematic in terms of trying to integrate the various components of the energy picture, i.e., OPEC supply and demand in developed and developing countries.

In this discussion we will use oil price forecasting as an interesting lens from which to view this process of using data analysis to analyze important issues. There are many diverse opinions regarding the oil price trend over the next decade. The energy modeling theory presented here has as a basic premise that much can be learned from comparing different projections.

Ideas on how industry can utilize analysis by using a scenario approach will be presented. In addition, this article will illustrate how to incorporate and quantify uncertainty in the planning process.

Inherent uncertainty

Basically, data analysis and modeling are already useful to a certain extent in the energy industries. More, however, could be done. There should be more communication about the uncertainty inherent in individual forecasts and about the uncertainty that surrounds *all* forecasts.

Oftentimes, people in planning positions expect and demand more accuracy in forecasts than can be obtained. One has to understand that uncertainty is part of the world, and that it is an integral element of energy markets. Statisticians cannot be blamed for not always making accurate forecasts. There is a great deal of

Fig. 1—International price of crude oil

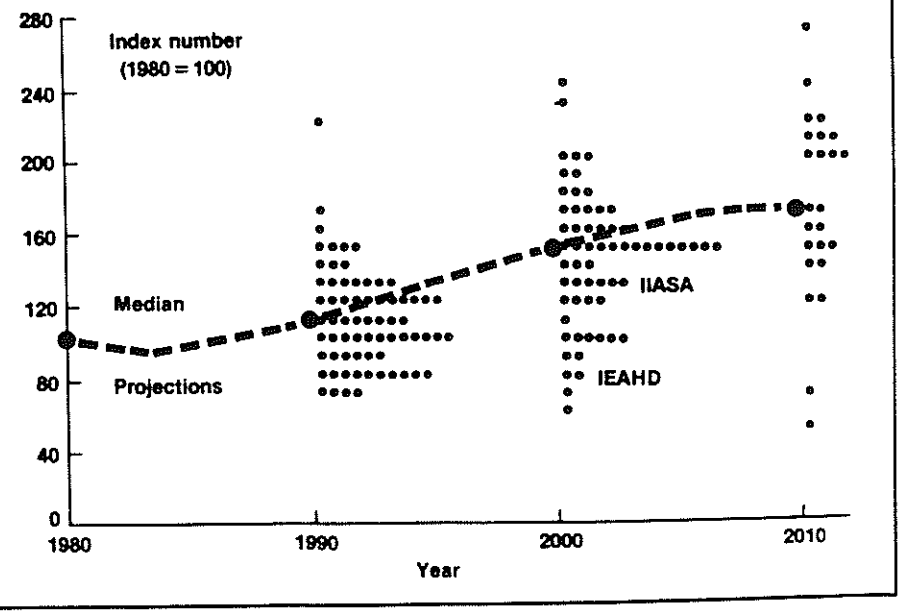
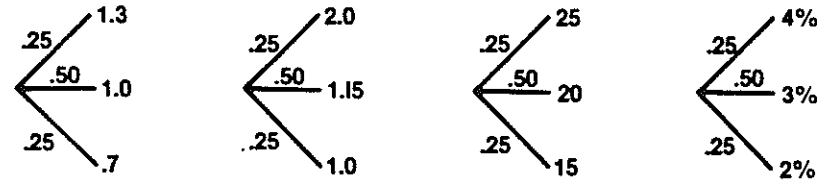


Fig. 3—Key uncertainties in oil price forecasting



uncertainty inherent in the world and data analysis and modeling cannot be blamed for that uncertainty.

Diversity of opinions

Since 1981 I have been involved in a project called "The International Energy Workshop." Anyone who has projections about the world energy scene can submit a forecast and revise it every six months. There are between 60 and 80 different groups participating.

In the Workshop projection of oil prices (Fig. 1), the real price of oil in 1980 has an index value of 100. Other prices in real terms are relative to that level. For calibration purposes, the 1980 price of oil in 1984 dollars is about $42. If the 1984 index is converted to 1984 dollars, the value goes to $28.

The median projections made in 1983 indicated that the price of oil in 1990 will be lower than it was in 1980. The 1990 projections have come down to the low $30s. The projections for the year 2000 are at about $60. The index number is 150 in 2000. The index number of 150 implies a $60 price in 1984 dollars. So, half the groups project a price in 2000 above $60 and half below. During the last couple of years the median projection has come down to about $50.

One forecast shown in Figure 1 is the International Energy Agency's High Demand forecast (IEAHD). This projection was not a systematic matching of supply and demand, but rather, was designed to show just high demand. Thus, the price was set at a level that reflected 20 million barrels of excess demand on the market in 2000. So, the I.E.A. projection was much lower than the median projections. However, if the surplus in the market is dissolved, the median is produced.

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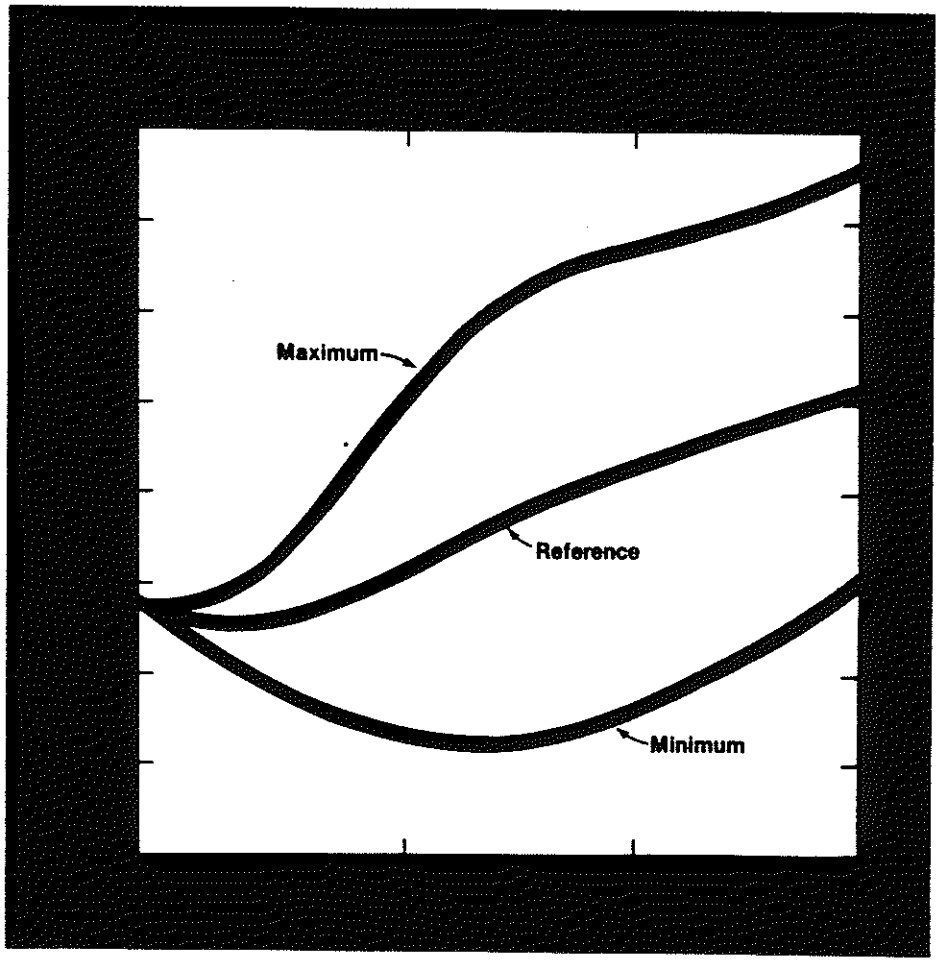


Another group, the International Institute for Applied Systems Analysis (IIASA), published a report that showed 1.2 times the 1980 price, which is about $40 or $50 a barrel, through 2000. This was based on the optimism that IIASA had that synthetic fuels would be widely available and would be less than $50 a barrel. Putting the U.S. and Canada together, the analysts projected a supply of 10 to 12 million b/d of synthetic fuels in North America by the year 2000.

So, one can see again the diversity of opinion in forecasts. My general conclusion about using analysis is that although it is impossible to make very accurate projections about the future of the world oil market, much more than nothing is known.

Table 1 shows a typical model of the world oil market that has OPEC supply, non-OPEC supply and demand in devel

oping and undeveloped nations. It is designed to balance supply and demand. The model is based on some reasonable assumptions such as 3% economic growth until the end of the century and a price elasticity of delivered energy in the aggregate of 1.0.

Outside the Persian Gulf and the centrally planned economies, it is assumed that there are 1.5 trillion bbls of oil-in-place awaiting discovery and that the target level of Persian Gulf production is 20 million bbls per day.

The findings are consistent with other poll projections. With the reference assumptions, projections are for $31/bbl in 1990 and $50/bbl by the year 2000.

Minimum/maximum scenario

Next, high and low values for different input assumptions were incorporated. The sensitivities from 1990 to the year 2000 reflect changes in assumptions about economic growth; the price responsiveness of demand to changes in prices; the level of resources outside of OPEC, centrally planned economies and the Persian Gulf; and the target level of Persian Gulf production. (The Persian Gulf is treated as a cartel.)

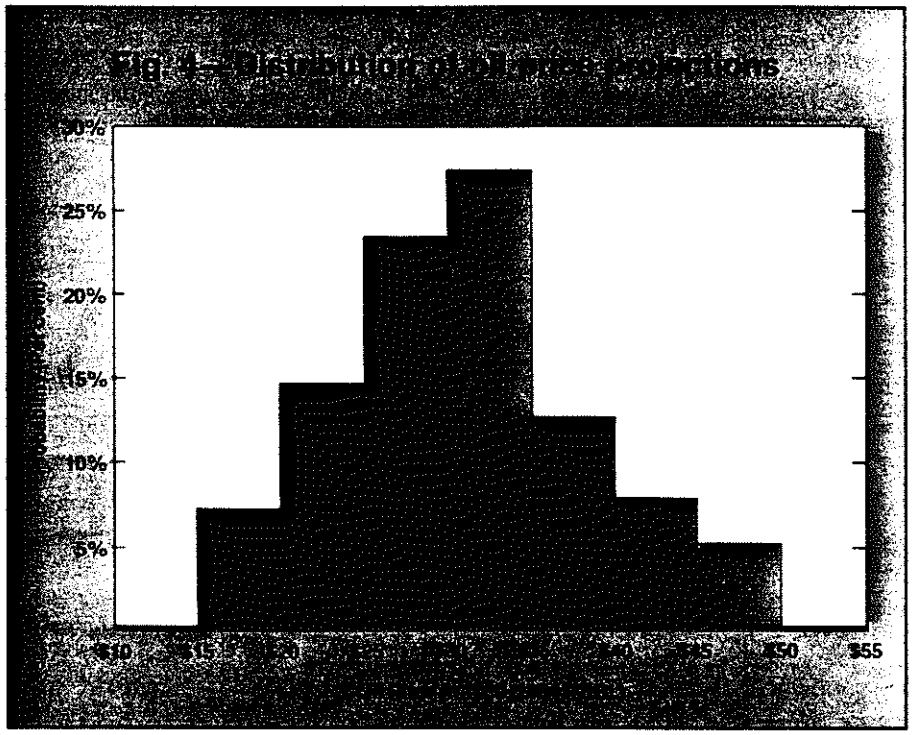
The model is sensitive to these inputs and outputs. Minimum/maximum scenarios give the best and worst possibilities (Fig. 2). A particular project can be evaluated using highs and lows. In fact, many large corporations use the high/low scenario analysis approach in deciding whether or not to invest in a given project.

Incorporating uncertainty

Taking into consideration the major uncertainties in oil price forecasting, it was possible to perform a sensitivity analysis (Fig. 3). This is done by putting in extremes in the various inputs. For example, an economic growth of 3% with a probability of 50% was used. This is part of projecting uncertainty into planning.

Results, after the probabilities were inputted, ranged from $15 to $50 a barrel for 1990 (Fig. 4). This was the range from the minimum to the maximum price projection. Thus, there is a 50% probability of the price being below $25 and a 25% probability of the price being above $35. If one wants to include 75% or 80% of the probability, you would have to go from $20 to $40 a barrel.

Highs and lows on the year 2000 chart (Fig. 5) do not grow much with respect to the 1990 chart. There is about a 10% chance that prices will be below $40 in the year 2000 and a 15 to 20% chance that prices will be above $60/bbl.



Conclusions

It would be wise never to rely solely on point forecasts. Another important factor in forecasting is to identify uncertainties. Analysts can take probability distributions on the key determinants of the world oil price and translate those probabilities into an understandable format. It is also important to quantify outcomes. Contingencies should be prepared on the upside and downside, and they should be compared.

Finally, any result from an analysis that does not coincide with intuition should be assumed to be wrong. Then, based on subsequent analysis, a mistake may be uncovered or intuition revised. □