

The International Energy Workshop

The International Energy Workshop (IEW) is a network of analysts concerned with international energy issues. It was founded in 1981 and is jointly organized by Stanford University and IIASA. The aims of the IEW are to compare energy projections and to understand the reasons for diverging views of future developments. The energy projections are collected in a poll of crude oil prices, economic growth, primary energy consumption and production, and energy trade. The results are published and analyzed semi-annually. The participants in the IEW poll and other interested persons come together in annual meetings to discuss these results and related matters in the wider field of energy.

Since 1983, the IEW poll responses have been stored in computer files, thus facilitating the analysis of differences between projections made at different points in time and their comparison with actual developments. A deviation between a projection and the related future outcome does not necessarily mean a forecasting error. (It might be the result of a stochastic process that did not lead to the expected value.) Accordingly, we base our observations of forecasting performance primarily on variations of projections over time (i.e., of projections of the same event made by different forecasters at the same time.) Variability over time can be illustrated with time series of forecasts for the same event (e.g., the medians¹ of the 1990 oil price projected at different times during the 1980's) and discussing its smoothness, in particular its convergence to the actual value. Variability in space will be described by formally defined ranges² which cover some two-thirds of all answers for one item. On the basis of these

1 The median of a set of projections (in general: of a collection of numbers) is the middle value, i.e., the number of projections higher than the median is equal to the number of projections below it. In the case of an even number of projections (where no middle exists), the median is defined as the arithmetic mean of the two middle responses.

2 The ranges in this article are used in a narrow sense. Their definition assumes that the collection of projections for a given item and for a given point in time are distributed log-normally, i.e., that their logarithms are distributed normally. With this assumption, the sample average and the sample variance of these projections can be calculated. The range is then found by forming the interval which is two sample variances wide and centered around the sample average. If the log-normal distribution is a correct model of the poll responses then some 68% of the total probability are covered by this range.

Conclusions from the Forecasts Collected by the International Energy Workshop (IEW)

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two measures, some observations of past IEW poll results will be presented, and tentative conclusions will be offered for discussion.

Prices and Quantities

Taking higher variability as a proxy for greater difficulty of forecasting a specific variable, our first conclusion is that *prices are more difficult to forecast than quantities*. To illustrate this point, Figure 1 shows the IEW poll medians of projections made at different points in time and the actual oil price at the time when the projection was made. There is some kind of convergence between the two variables, but the movements of both are rather erratic. In contrast, Figure 2 shows the same kind of comparison for the projection of total primary energy consumption for the OECD region. Here, the convergence is much closer to the theoretical idea of a smooth trajectory of a variable towards its (constant) projection value in the future.

The larger variability of oil price projections in space is illustrated by Figure 3, showing typical ranges for the projections of the world oil price and by Figure 4, showing the much narrower range for the projections of total primary energy consumption in the IEW region Eastern Europe and Soviet Union.

Trends

Our next observation has to do with the difficulty of forecasting the development of the world oil price. The inspection of past IEW results (as shown in Figure 5) suggests that *the role of trend has been overestimated*. Beginning with the very first IEW oil price projections made in 1981, the IEW medians show an almost uniform pattern, i.e., a trend line - typically representing a real annual growth in the neighborhood of 3% - between the actual oil price at the time of forecasting and the future. At no point in time did the curve connecting the actual oil price and the medians point downwards. This pattern may be a consequence of *Hotelling's Rule* saying that the price of an exhaustible resource rises at a rate

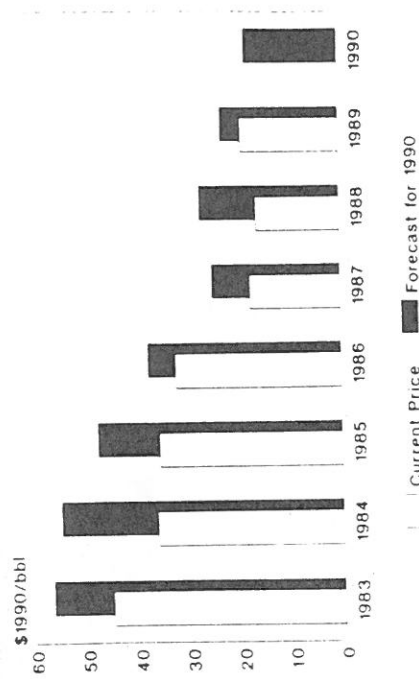


Figure 1. Actual oil prices and IEW poll medians for 1990

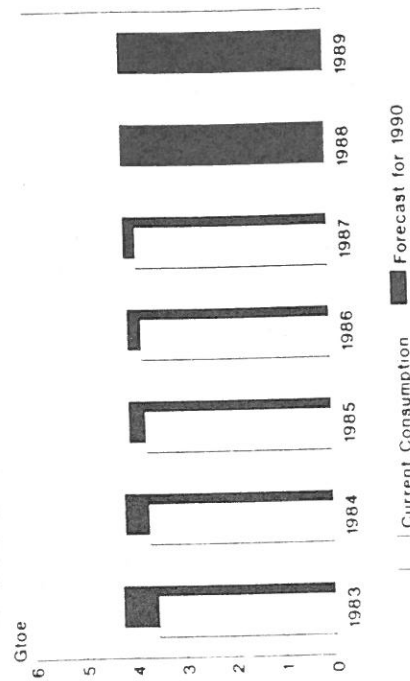


Figure 2. OECD Primary Energy Consumption: IEW poll medians and actual

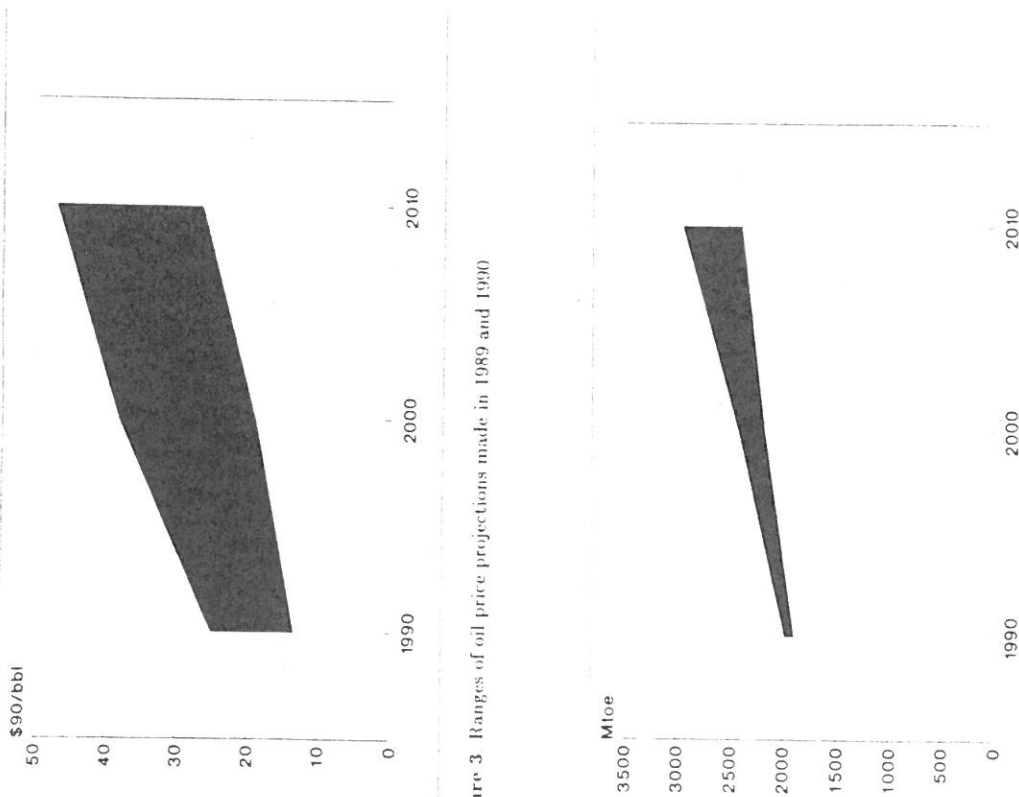


Figure 3. Ranges of oil price projections made in 1989 and 1990

Figure 4. Ranges of primary energy consumption projections for the region EE/SU (Eastern Europe and Soviet Union)

equal to the real interest rate. Since the conditions under which Hotelling's rule is supposed to apply are hardly fulfilled in the contemporary world oil market, we still cannot decide whether his rule applies to oil or not. Oil resources are being depleted in the OECD countries, but OPEC's undiscovered resources are vast.

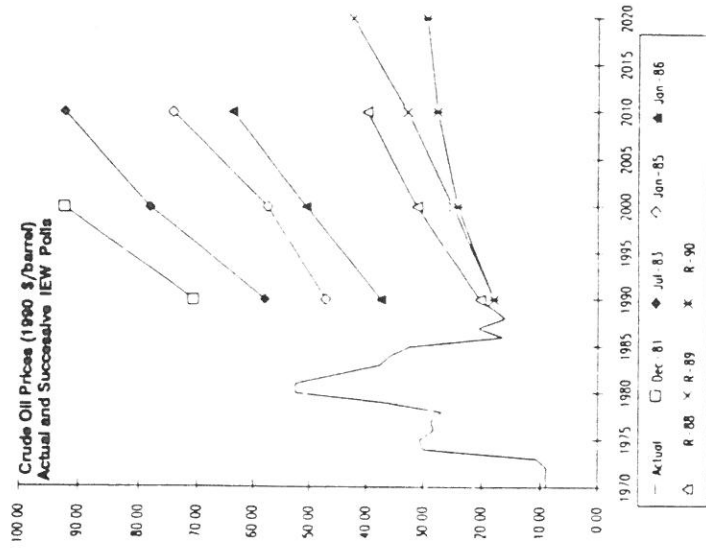


Figure 5. Crude oil price development: actual and successive IEW polls (medians)

Forecasting Methods

Finally, we look at the question whether there is evidence for systematic errors having been made during the past decade of oil price forecasting, i.e., whether we can identify classes of projections with significantly different results. This exercise would be of questionable value if one were to categorize the forecasts *a posteriori*. Fortunately, this is not a problem because we can go back to a table taken from [3], dated October 1985 - which summarizes studies that contain oil price projections which were made in the years 1982 and 1983. In that table, these studies are grouped, and the full range of projections (from the lowest to the highest) of the oil price in the year 2000 is attributed to each group. Figure 6 translates that table into a graph. The numbers in parentheses next to each group give the numbers of reports in each group. Since one report can include many different projections, the table actually summarizes significantly more than 13 (the sum of reports) estimates of the oil price in the year 2000. Here is a short characterization of the individual groups:

Analytical. In this group we find models (often econometric-type) that have the oil price as an output.

Assumption. Estimates in this group were not explicitly derived in a model-like manner. They should be regarded as educated best guesses.

Direct. In this group those price estimating procedures were included that used reserves and resources figures, extraction costs, and demand estimates to derive prices.

Expert opinion. There is not much of a difference between this group and the *assumption* category - neither in the definition nor in the outcome.

Trend extrapolation. Today, such projections are often described as "business as usual".

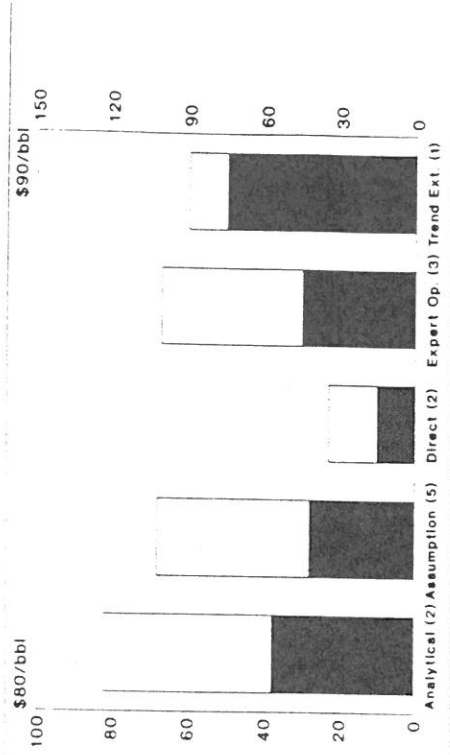


Figure 6. Oil price projections for the year 2000, made in 1982/83

Of course, no final judgement about the performance of the individual groups is possible for the time being. However, a comparison with today's prices and price expectations for the year 2000 and a closer inspection of the paths leading to the ranges of Figure 6 suggest that the projections summarized in the *direct* group have turned out best. In theory, this match between projection and outcome could be a coincidence like winning a prize in a lottery. However, looking at the arguments put forward in the 1983 reports in the *direct* group indicate that their arguments were valid and missed by the other groups. But even if one took the view that the high price paths could have become reality just as well, the fact remains that the exclusion of low prices from the consideration by the other groups was an unwarranted omission. The only alternative explanation would be that a series of unlikely events determined the oil price path between 1983 and today.

Conclusions

The tentative conclusions presented here suggest that quantities (of primary energy and of economic product) have been more accurately projected by IIFW poll respondents than oil price developments. From the analyst's point of view this makes the field of price forecasting the more interesting. This is why the rest of the conclusions and the discussions dealt with this area. The possible guidelines that can be derived from this are positive and negative. The positive are that established methods for projecting GDP and primary energy consumption can be relied upon with some confidence, and that direct methods of determining the future oil price should at least be considered in parallel to other methods. The negative insight is that oil prices are much more volatile than GDP and primary energy consumption, and that an accordingly wide range of possibilities should be considered right from the beginning. Often enough, this range will be too wide to decide the question about the profitability of a specific long-term investment. But then, this is what planning under uncertainty is all about.

References

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