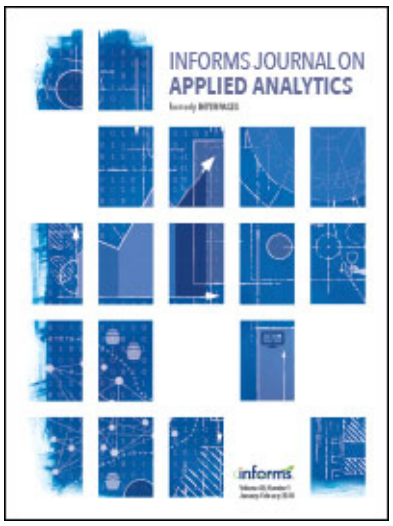

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Editorial: Why I Have Never Published in *Interfaces* but Hope to in the Future

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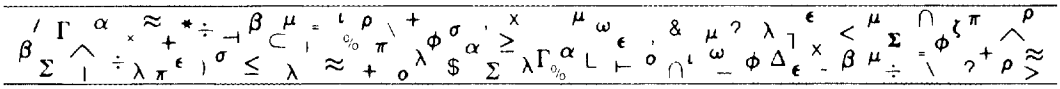

It's true, I am the editor of *Interfaces*, and I have never published a refereed article in this journal. I have written articles about applications I worked on, but I published them elsewhere.

Here's the reason. For seven years I worked as a full-time practitioner in the Energy Information Administration (EIA) of the Department of Energy. I studied the impact of different energy policy options. The world of policy analysis is a world of ambiguities. It is impossible to demonstrate a direct link between analyses and decisions or to measure the benefits precisely. And the essential constraint to publishing in *Interfaces* has been demonstrable savings or increased profits. I could never show any savings or profits, so I never tried to publish here.

I want to define an alternative constraint for acceptance of papers on policy-oriented practice. Former editor Gary Lilien accepted papers that met this criterion. I want to make the criterion formal so that there can be no doubt that I am seeking policy-oriented papers as well as papers on private sector applications. This constraint comes from my perception of the differences between management science as applied to operating problems and management science as applied to policy analysis.

Models of operations represent a well-defined aspect of a problem; the people running the operation know a great deal about the details of the problem to be solved. Policy modelers often have to rely on people who are experts in only some aspects of the subject to be modeled, and they must fill in the gaps themselves to provide a complete view of the subject. In the Energy Information Administration,

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we had experts in oil drilling, refining, electric power generation, and so forth but no experts in representing the decision processes that lead to changes in capacities in these industries, nor did we have experts in how specific industries would alter their behaviors in response to changing economic and legal environments.

Policy models have greater breadth than operating models but lack their depth. This breadth leads to many more approximations that leave out realistic detail. This lack of detail leaves the model open to easy criticism and undercuts people's confidence in the results.

The data used to determine the parameters of a policy model are weaker than the data used in operating models. If data does not exist for an operations model, one can collect it without years of bureaucratic review, or one can ask the people who do the work and get a very good guess. Here are some examples of the kinds of data problems one can encounter in policy modeling: What do you do when two series on gasoline consumption collected in two different ways track very well for a few decades and then start to diverge dramatically and no one knows why? What do you do when the oil reserve additions data show a shift of 25 percent because a different organization starts to collect the data? We know that all data are inaccurate, we just hope that they are consistent in the inaccuracy. But this is not always the case.

Operations models are not based on assumptions about human actions. They deal with situations where the desired goal is to optimize specific actions, for example, to optimize production plans, or to simulate selected rules that will define the action, such as job-shop-scheduling rules. Policy models have a far greater economics content than operations models. In this context, economics is the mathematical psychology of self-interest projected into aggregate behaviors. In energy modeling, this takes the form of estimating drilling rates for oil and gas for the entire industry, or estimating consumer responses to appliance efficiency standards, or estimating electric utility purchases of high and low sulphur coal.

The essential distinction between policy models and operating models is in one's ability to verify their conclusions. Say one builds a model of a refinery. One can run the model, recording the model results as one operates the refinery with existing procedures, and then verify the model's conclusions against actual experience. In the early days of linear programming, an oil company did exactly this with their very first model of one of their refineries. After correcting some obvious flaws in the model, such as using up the best crudes first and leaving the worst for the next period, they ran the model in parallel with the blend master, who directed all the flows in the refinery. Within a short period, the model results showed a whole extra tank of inventory beyond what was actually there. After much head scratching, the analysts discovered that the model was doing a better job of blending in crude oil components than the blend master, who was flaring some of the components as waste. In this case and with all operations models that produce an anomalous result, one can

pursue a series of checks to find out whether the anomaly is due to an error in the data or the model structure or instead is an insight into improved operations.

Sometimes our energy model produced a result that could equally well have indicated a data problem or an insight. Often when we ran scenarios with assumptions of high world oil prices, we saw natural gas prices that were lower than those produced by runs using lower world oil prices. Since natural gas can substitute for oil, we intuitively expect gas demand to increase as oil prices go up, leading to higher gas prices as well. There are two problems with this straightforward view. First, many energy-intensive industries use all forms of energy. In the steel industry, for example, coal provides most of the Btu's, but natural gas provides the heat for clean finishing operations. Oil refining is another major consumer of natural gas. A decrease in oil consumption due to high oil prices can decrease the consumption of natural gas in refineries. A decrease in the size of automobiles decreases steel consumption, which can lead to decreased gas consumption as well. As these examples show, one may not get as great a substitution effect as one might initially assume.

The question is not just a theoretical nicety.

When one considers the geology of natural gas, the arguments become more convoluted. Natural gas is often found with oil, and sometimes accidentally when searching for oil. Thus, when drilling rates increase in response to higher oil prices, the increased supply of natural gas may exceed the increased demand. If this happens, the apparently anomalous drop in natural gas prices that can accompany increases in oil prices is not so anomalous. In this situation, the results are a function of admittedly weak data. We have no obvious qualitative result from economic theory that can be used to predict the direction of the price move and judge the correctness of a model formulation.

This question of the direction of gas price movements is not just a theoretical nicety. The Carter policy staff and Congress were continually looking for ways to insulate natural gas prices from movements in oil prices, especially to protect homeowners who heated with natural gas. That search may have been unnecessary, but we could not draw a definitive conclusion. The data are insufficient to verify this particular model result. We did not have enough time series data, and we could not tell Congress to hold on all legislation until we collected data over a few decades, nor could we organize experiments, changing the world to test the model.

Given all of these problems with policy models, they are still valuable and papers on them should appear in *Interfaces*. Such models ensure consistency (for example, we showed the Carter staff that they could not replace oil with coal, as they envisioned and meet their desired clean air standards). The models also make explicit the fine points on which policy decisions turn.

Clearly the requirement established

when Gene Woolsey was editor, that papers describe work with directly measurable benefits, is inapplicable to policy models. We cannot rely entirely on results from the use of the model. We have to look at the process by which policy is made and the role of the model in helping policy makers to formulate options and to select among the alternatives.

Let me illustrate from my own experience the kind of application that would be a sure fire acceptance. During the 1970s when energy policy was an important national issue, Senator Jackson chaired the Senate Committee on Energy and Natural Resources. He had spent many months working through a compromise with the House of Representatives on changing the laws that regulated the price of natural gas. To satisfy a request from Senator Metzenbaum for a study of the legislative alternatives, Senator Jackson asked us to forecast what the effects of the different bills would be in 1985, the target year for gas deregulation. After working up preliminary results (how this was done is described in Murphy et al. 1981), we made presentations to the Office of Policy within the Department of Energy and to staffers from both the House and the Senate energy committees. We also delivered a written report with our final estimates to Senators Metzenbaum and Jackson as well as to John Dingell, chairman of the House Subcommittee on Energy and Power.

The report was delivered with the understanding that no party would make public any of the results for 48 hours. Everyone would then have time to read it thoroughly before having to make public comment. We planned to hold a press conference several days later, explaining our results, which described the pluses and minuses of the compromise and the original bills.

Senator Metzenbaum, an enemy of the compromise, violated that agreement and had a press release out within a few hours, presenting only the negative features of the compromise, the chief negative being that residential gas prices

We have to look at the process by which policy is made.

would be higher under the compromise than under either the original House or Senate bills. The press picked this up immediately, and phones started to ring. Senator Jackson called his chief staffer on energy and said "Who the ——— asked them to do this study." Her response was "You did, sir." President Carter called James Schlesinger, the Secretary of Energy at this time, and asked what was going on in his agency. Schlesinger called his assistant secretary for policy and posed the same question. The assistant secretary, who did not treat our presentation to him seriously and did not warn anyone of our conclusions, said that we had changed the results after the presentation (we had revised the numbers, but the revision was more favorable to the compromise than the preliminary results).

As part of our plans to hold the press conference, we tried to schedule a time

and location. However, we were told that no rooms were available in all of Washington for the next few weeks.

The strongest response came from John Dingell, who sent a six-page letter to Schlesinger criticizing the report and our approach. The letter contained the following sentences. "The report causes me great concern not because of the conclusions it reaches, but because of the way those conclusions were reached. The EIA has relied heavily upon the Project Independence Evaluation System (PIES) model in their analysis. For reasons discussed more fully below, that model could not possibly serve as a useful basis for near- and mid-term analysis of natural gas policy alternatives."

We know that a lot of management science goes on in government.

Needless to say, if this were the only correspondence documenting the use of this model in a policy analysis, I, as editor of *Interfaces*, would have to reject a paper describing this application. However, this was not the only correspondence from Congressman Dingell. In fact, it is his second letter that makes my copy of the first a prized possession.

Four days later Dingell sent us another letter. "This letter requests that the EIA examine an alternative interpretation of incremental pricing in the Senate deregulation bill that more closely reflects my own understanding and that of most of my colleagues ... ." (We had used the Senate staffers' interpretation of the Senate bill.) Thus, our models and results were used by both sides, making our work an essential part of the debate; the combatants were using the same source for their ammunition.

So what is the criterion for acceptance of policy articles in *Interfaces*? The answer is very simple: document how the model was used in the process of formulating and evaluating policy, either internally or as part of public testimony. Since policies are determined by more than the results of analyses, the key measure is being part of the process rather than an evaluation of the resulting product.

From the record-busting attendance at the Washington meeting of TIMS and ORSA in April 1988, we know that a lot of management science goes on in government. Let's start publishing it — there are no more excuses. (Also, keep the private sector work coming, there are never enough good practice articles.)

Reference

Murphy, F. H.; Sanders, R.; Shaw, S.; and Thrasher, R. 1981, "Modeling natural gas regulatory proposals using the project independence evaluation system," *Operations Research*, Vol. 29, No. 5, pp. 876–902.