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In March 1975, Senators Cranston and Johnston introduced legislation (S. 1291, 94th Congress, First Session), that would create a National Commission on Economic Growth and Stability, comprised of nine professional economists. According to the bill, the purposes of the Commission will be "to identify major changes and long-term trends in the economy of the United States and to propose public policy responsive to such changes and trends."

In remarks accompanying the introduction of the bill, Senator Johnston referred specifically to current energy problems in the United States as one of the main sources of the motivation to establish the Commission. Said the Senator: "Perhaps if something like this had been undertaken in the 1960s we could have discovered many of the problems we are now facing in the 1970s and might have better prepared for them. If such a commission had made but one basic recommendation -- for example, the need for energy conservation -- we could have avoided many of the economic hardships that we are now experiencing."

Suppose that such a commission had been formed in 1965, and that it had possessed the foresight to look into the issue of American dependence on foreign sources of natural resources. Very probably the commission report would have discussed world petroleum resources,

and it might even have recognized that the perpetual instability of the Middle East created the possibility that the OPEC oil cartel would gain power and stability. By similar reasoning, it might also have reached the same type of prediction about the world copper market. The leading exporters of copper -- Chile, Zambia and Zaire -- could all have been identified as in volatile political situations. A Marxist takeover in Chile and a war between the black and white nations of southern Africa (Zambia and Zaire border then white-dominated countries, Rhodesia and Angola) were regarded as possible threats in the mid-1960s and as these nations undertook to nationalize copper production the possibility of the politically-catalyzed establishment of a cartel for marketing copper was certainly not remote. A policy proposal to stockpile oil would, retrospectively, have been brilliant; one to stockpile copper would by now undoubtedly have generated a series of nasty speeches from Senator Proxmire.

Information and Uncertainty

The information base available in 1965, and even today, is probably not adequate to determine with certainty whether copper or oil or numerous other commodities are likely to be effectively cartelized. Instead, policy makers must deal with a list of uncertainties and possibilities. On some issues, organizations such as the proposed national commission of economists might be able to produce sufficient information to justify the conclusion that a particular economic problem is certain to arise within the planning horizon of society. On others, it might identify inexpensive measures that would provide protection against a possible, but not certain event. But on most issues, uncertainties about the future and the effectiveness of policy responses to unanticipated events are likely to prove to be in some significant measure irreducible,

and conclusions are likely to be hedged and conjectural. A particular event will be identified as a possibility, and each alternative policy response will have uncertainties attached to its likely effectiveness.

To turn the current energy problem on its head, many informed, intelligent scholars of the energy sector believe that the current energy crisis is transitory. Some believe that nuclear power, as it is used more extensively, will prove to be sufficiently safe and cheap that, in a decade or two, we will have fully adjusted to current problems and returned to an economy based upon extensive consumption of inexpensive energy. Others believe that in response to current oil prices new reserves will be discovered and exploited, causing the OPEC cartel to disintegrate and the price of oil to fall dramatically. Still others place bets on new energy sources such as geothermal steam, solar energy, tar sands, gasification of coal, oil shale, etc. At the same time, the prevailing mood of the country, of many scholars, and of most politicians is that current conditions are the best precursors of the future, and that American society must make fundamental readjustments to accommodate a world in which energy will continue to become increasingly expensive, especially if environmental consequences of its production and use are taken into account.

The basic information problem underlying the current energy crisis is to determine future supply conditions with respect to energy resources. For more than a few years into the future, these conditions are in significant measure fundamentally uncertain, which is to say that, try as we may, we can never gather enough information to identify a clearly dominant public policy towards energy because we can never boil down the number of plausible future states of the world to a sufficiently small and homogeneous group that a single policy clearly dominates. (For an excellent discussion of the implications of this argument for nuclear power development, see Joskow, 1974.)

Unfortunately, social scientists know very little about what constitutes optimal behavior under conditions of uncertainty. Generally, the literature in decision theory emphasizes the following strategies: (a) gather more information to reduce uncertainty, (b) devise contingency plans for each plausible state of the world, (c) develop institutions that respond quickly and flexibly to unpredictable events and (d) concentrate on procedural values of decision-making processes when predicting the social value of their outcomes is not feasible.

To decide the extent to which each of these strategies should be employed is a normative question of great difficulty. The answer depends in part on the value (presumably negative) that affected members of society place upon living in an uncertain world. It also depends upon recognizing and quantifying interrelationships among the strategies. For example, information gathering is in some measure a substitute for contingency planning. If information is cheap compared to developing contingent strategies, it makes sense to gather more information to reduce the number of possible states of the world for which contingencies must be developed. But if contingency plans are cheap compared to information costs, as long as the possible states of the world have been reasonably identified it makes sense to sacrifice more information for more plans.

The four strategies also are sometimes inconsistent. Since it is all but impossible for major government policy actions to demand the same sacrifice and provide the same benefit to everyone, procedural equity can conflict with all three of the other strategies. A less obvious example is the potential conflict between plans and flexibility. A contingency plan that takes the form of directives to decision-makers contingent upon outside events may not only be useless if an unforeseen event transpires, it may be counterproductive. The organizational structure and allocation of responsibilities implicit in the plan may

reduce the adaptiveness of the organization to events for which no contingent plan was developed.

Given these and other very complicated aspects of the problem of making decisions in an uncertain world, one should not expect any decision-making process to be identifiably optimal. This is particularly true in terms of ex post evaluations, since after the fact some efforts to gather information, develop contingency plans and make organizations more adaptable will have been unnecessary hedges against states of the world that never developed, or were later shown to have been impossible. The only ground on which ex post evaluations of these efforts makes sense is with respect to their effect on the negative consequences of uncertainty as perceived by individuals, and such evaluations are, for all practical purposes, impossible either before or after the fact.

Nevertheless, it is possible to identify some aspects of specific decision-making procedures that yield systematic biases in the types of policies adopted under conditions of uncertainty. The remainder of this paper is devoted to identifying some of these.

The Effect of Uncertain Information on Government Decisions

The proposed commission of economists is typical of the approach normally taken by government in making policy on complicated matters dealing with sophisticated technical issues. Political leaders conventionally assume, implicitly, that a solution to a difficult policy issue can be found by applying expert analysis. The inability of government officials to identify a single, dominant policy option is attributed to their lack of technical expertise and their inability, owing to other commitments, to devote sufficient time to studying the matter. To solve the problem, then, requires delegation of investigative and analytical responsibility, and, in the case

of regulatory agencies, of the power to make decisions within broad policy guidelines, to a specialized group of experts.

Although the details differ enormously across expert decision-making institutions, the basic model is the same. Neutral, objective experts are commissioned to collect relevant information on a particular policy issue, determine the "true" consequences of alternative policy actions, and either recommend or implement the "best" policy, given objectives laid down by the political leaders. Only one such decision-making institution is normally constructed for each policy issue, and only one policy option is pursued. The institutional mechanisms for making energy policy, in both the regulatory and research and development aspects, follow this pattern.

One consequence of this type of policy-making is that it leads to systematic errors in estimating the extent of uncertainty, and, as a result, to a misallocation of effort among uncertainty-reducing activities.

Information flows into government decision-making processes from three types of sources. First, certain types of information are purchased by government through its various activities that support research and development. Second, the agencies themselves generate and process a substantial amount of information. Third, formal channels have been developed for individuals and organizations to provide information at their own expense, such as by appearing at Congressional hearings, proceedings before executive regulatory authorities, and trials in the court system, and by lobbying decision-makers.

Each supplier of information has a stake in the perceptions of the extent of uncertainty on behalf of the government decision-maker. All other things being equal, most individuals prefer less to more uncertainty with respect to their own future.

The relationship between the uncertainty faced by society and that faced by a particular individual or organization can be very complicated. For example, an organization established to engage in planning for a particular contingent event will have a stake in generating information that keeps that event within the set of perceived plausible states of the world. By contributing to the uncertainty of society it can reduce the uncertainty associated with its continued prosperity: It will find organizational value only in information that supports the perception that the contingent event is more likely to occur, as advertising executives with deodorant accounts have long-since learned.

Individuals and organizations that do not profit from societal uncertainty may, nevertheless, reduce their uncertainty by transferring it to others. For example, policies that reduce uncertainty with respect to price usually tend to increase it with respect to employment, indirect acquisition costs and availability of supply, as was evident in 1974 during the gasoline shortage.

Strategic use of information to generate greater uncertainty for others as a vehicle for reducing one's own uncertainty would not be particularly troublesome if everyone had equal access to the channels of information. Then, each attempt to burden a particular individual, group or organization with additional uncertainty would be identified by the recipient, and countering information would be fed into the decision-making process. But such an idealized model is unrealistic.

One source of difficulty is that information is expensive. Resources are required to keep informed about the information entering the system and to generate responses to information that implies a societal reduction in uncertainty but, in reality, merely transfers it and even increases it. Whether an individual, group or organization will find it worthwhile to incur these costs depends upon its stake in the issue at hand. It will also depend upon the costs the organization faces in organizing itself to participate in the policy-making process.

Generally, the larger, more heterogeneous a group is, the more expensive will it be for the group to become effectively organized. Furthermore, the larger the group the smaller the incentive of any individual to join it, since the success of the group in obtaining his desired ends is less dependent upon his own participation in and support of group activities. As a result, a few people with an intense per capita interest in a particular policy problem are more likely to participate in the information-gathering and evaluation process than a larger number with a smaller per capita interest, even though the aggregate interest of the latter may be in excess of that of the former. For these reasons, a policy issue subject to considerable uncertainties opens the door for small, well-represented groups to use information strategically to transfer risks to large, poorly represented groups.

Another source of difficulty is the uncertainty attached to the quality of information about an issue that itself is subject to uncertainty. Aware of strategic possibilities in the use of information, decision-makers attempt to institute procedures for testing the quality of information. Information generation is a highly technical activity involving the use of sophisticated methods from numerous disciplines. No decision-maker is likely to be skilled in all the relevant methods for generating and evaluating information. Consequently, rules of evidence and mechanisms for subjecting information to scrutiny by other participants in the process are developed to create procedural tests of the quality of information that, in theory at least, require a narrower range of professional skills on the part of the decision-maker.

These procedures do very little to protect unrepresented interests except insofar as their interests overlap those of a group that has decided to participate in the process. In addition, they bias the process in favor of established institutions and ways of doing things since information about existing policies and operating institutions will

be more certain, and hence accorded greater weight, than conjectural information about a state of the world and a set of institutions and policies that do not yet exist. Implicitly this accords most of the burden of proof on those who argue the likelihood of a change in the state of the world and support a change in policy to accommodate that eventuality.

To some degree, the third source of information -- disinterested parties whose participation is financed by government through agencies themselves disinterested in the outcome -- can offset some of the informational biases in the decision-making process. They can examine the extent to which proposals transfer uncertainty, and they can expose uncertainties in the quality of information supplied by others. And their own systematic bias -- to create a continuing demand for their services by emphasizing the presence of substantial but reducible uncertainty -- is presumably counteracted to some extent by the opposing interests of the represented groups. In these arguments rests the case for public interest law firms, consumer protection organizations, and even the proposed commission of economists mentioned at the outset.

Unfortunately, many problems are not effectively attacked through this mechanism. For one thing, the absence of a direct connection between those providing purchased information and the unrepresented groups prevents them from correctly representing the extent of the distaste for uncertainty and the desirability of policy actions to cope with it among those not represented in the process. Attempts by those providing such information will inevitably be branded excessively paternalistic or insensitive, depending upon the tastes of the critic in relation to those implicit in the purchased information. And, in any event, because of the tenuous connection between the provider of the purchased information and the unrepresented group, the purchased information will be accorded less weight in the decision-making process.

Another continuing problem is a bias in the process toward preserving the status quo. In fact, adding more participants to the decision-making process probably increases resistivity to change. First, it makes decisions more protracted by increasing the amount of information decision-makers must process and by expanding the number of issues to be considered. This reduces the expected net gains accruing from a proposal (it pushes the benefits further into the future and increases the costs of participating in the process by extending its duration and the amount of information it requires), and thereby the incentive to propose a change in policy. Second, it increases the chance that the rationale for and consequences of a change will be identified as uncertain, by adding to the number of perspectives from which the information supporting the change will be viewed.

Implications for Energy Policy

The conclusions with respect to energy policy to be drawn from these observations are rather straightforward. First, it makes a great deal of sense for the government to buy information about future energy supply and demand, especially through agencies with no particularized stake in the issue. It would be a mistake, for example, to allocate total responsibility for studying energy supply and demand to an agency whose mission is the development of new energy resources, such as the Energy Research and Development Agency, but it is surely correct to have ERDA provide information about future energy technology to balance that from private industry.

Efforts should be made to break information monopolies. In some sense, participation in the information-gathering process by those possessing key data should not be voluntary, and government organizations should be created to serve as independent sources of

estimates of the same information to place checks on the primary source. The most egregious example of monopolized information is the protection of so-called proprietary information held by corporations. The alleged reason for retaining secrecy about such data is that it can in some way damage competition among firms; however in a competitive market individual firm advantages are, ex hypothesis, not present.

The real purpose of corporate secrecy is to retain anti-competitive features of a market and to control the flow of information to the government as a mechanism to influence decisions. An unfortunately common scenario in hearings before courts, commissions or Congress is for some piece of objective analysis illustrating the presence of monopolistic or other socially undesirable activities to be attacked by the perpetrating corporation as misleading because it is based upon incomplete, fragmentary information, and then in the next breath for the corporation to express shock at a request to supply more information because of its proprietary nature. Detailed information on activities and resources of companies when relevant to a policy debate should be collected and made public as with census data, with periodic checks for authenticity, backed by penalties for noncompliance.

Regardless of the success of programs to generate more information, it is futile to expect that information gathering alone will be adequate for dealing with long-run energy policy. Conditions of long-run supply and demand, especially the former, are likely to have important aspects that are irreducibly uncertain within the policy-planning time horizon. In part, this suggests the development of contingency plans and built-in flexibility. For example, energy resources should be stockpiled, and some excess capacity should be maintained in industries that convert resources to usable energy, such as in oil refineries and electric power facilities. In case of an

unanticipated shortage in one type of energy, some immediate substitution of other energy is possible when excess capacity is present.

With respect to investments in research, development and operating facilities, mixed strategies are called for. Automobiles with greater fuel flexibility, for example, can cushion the impact of cut-backs in the availability of any particular fuel. Investments in several methods of generating electricity can smooth the transition that would follow new information regarding undesirable environmental effects of any particular technology. And the tendency to focus all support on the top-ranking of several R & D proposals should be avoided when others on the list have a significant chance of success and when the apparently most promising alternative is still subject to considerable uncertainty.

Finally, far more attention needs to be paid to improving our understanding of the relationship between the procedures used to make policy decisions and the general character of the decision outcomes. In designing policy-making and policy-implementing institutions, attention has tended to focus on procedural values solely as ends in themselves, with little or no attention given to the effect that procedures can have on income distribution, political power and economic efficiency in a world where information is expensive and of uncertain quality. Unfortunately, the state of knowledge about the relationship between procedures and outcomes is too skimpy to permit much in the way of specific policy proposals. Perhaps here is where the academic community can contribute the most to the development of public policy not only with respect to energy, but with respect to numerous other technically sophisticated areas of public concern as well.

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