# ENERGY, GOVERNMENT POLICIES AND THE STRUCTURE OF THE FOOD AND FIBER SYSTEM

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It has become almost trite to suggest that the U.S. and the World are presently in a fundamentally changed economic situation requiring new diagnoses, prescriptions, and treatments. However, that is the unsettling conclusion that many have reached after some assessment of a number of recent economic events. A partial list would include the following: (1) two devaluations of the U.S. dollar, (2) formation of price-raising raw material producing country cartels and threats of others, (3) wage & price controls and their lingering distortions, (4) stagflation, (5) U.S. balance of payments-inflow of petrodollars, (6) expanded U.S. trade in agricultural commodities-detente with new trading partners, (7) growing obsolesence of U.S. manufacturing plant & equipment relative to major trading nations of Europe and Japan, (8) decline in the rate of U.S. technological innovation relative to the rest of the world, (9) slowed growth rate of the U.S. labor force, (10) environmental impact regulations and (11) more energy conscious consumers and producers.

Taken individually, the economic system would likely respond to these shocks in traditional ways. Interacting together, however, they strain our ability to sort out past impacts and predict future changes. Many of these occurrences are new - never dealt with before - and hence data are not organized for analyzing them - contributing to greater uncertainty. The economic units of the system are having difficulty in formulating expectations upon which to base decisions.

Our purposes in this paper are: (1) to evaluate the energy-environ-

ment component of this confluence of forces, giving special attention to government policies as both a source of and solution to problems of uncertainty and (2) to discuss important potential impacts of uncertainty forces in general on the organizational structure of the food and fiber system.

## A Framework of Concerns

The concerns initially focus on directly affected economic units. But the ultimate concern is with the likely effects on the growth rate of our domestic economy, on the economic organization of production, on our ability to compete in world trade, and on our role in reducing world hunger.

Economic growth in excess of the rate of population growth has been the formula by which the U.S. has developed the highest standard of living in the world. Labor-saving technology has permitted the economic pie to yield an ever larger slice to each person. Growth has been viewed as subject only to the constraints of the rate of technological advance, the rate of saving and capital formation available to finance new technology, and the rate of growth of the labor force.

Two new kinds of apparent constraints have now entered the growth equation -- environmental and natural resource considerations, interacting peculiarly in the context of energy. Unfortunately, their emergence has coincided with an apparent downtrend in the relative rate of U.S. technological advance (Boretsky), with a rising concern about the world population-food supply balance, and with the predominant U.S. contribution to maintaining the balance.

The additional constraints are of special concern in the food and fiber system. We depend on energy in our processes and are stewards of

large amounts of land and water resources which are subject to environmental hazards. The growth potential of our markets is directly related to both U.S. and world economic growth. Food exports have both balance of payments and human survival dimensions. Thus, the concern about quality of life manifest in many environmental regulations has become transformed into concern about the more basic elements of world food supply and productive capacity. Finally, the magnitude of recent economic change creates concern that the organization of our economic system may prove unable to cope with the combined impacts and may undergo a major structural adjustment in response.

## The Energy Situation

The current energy situation developed over a long period and is a result of many converging forces. Domestically, energy consumption has more than doubled since 1940, while production has increased one and one-half times. In 1940, production exceeded consumption by eight percent, but at the time of the 1973 Arab oil embargo, we were importing seventeen percent of all energy, and fully one-third of our petroleum (International Economic Report).

The U.S. economy made several significant initial responses in 1974 to the higher oil prices. Oil consumption decreased at a 3.9 percent annual rate, while during the past two decades, it had been increasing at an increasing rate, reaching 7.2 percent annually in 1971-73. Oil imports made an astounding turnaround, going from a 22 percent annual rate of increase in 1970-1973 to a 1.7 percent decrease in 1974. However, the percentage of oil from foreign producers actually increased in 1974 as domestic production continued to decline. All prices (GNP deflator basis) rose ten

percent in 1974, energy prices rose 29 percent, and aggregate consumer spending on autos and parts and energy dropped seven percent. Thus some flexibility was indeed demonstrated.

Cost impacts are still not fully understood, due partly to confounding with a great variety of economic shocks which occurred concurrently, and due partly to the extent to which energy costs are embodied throughout the U.S. economy. We still face the uncertainty over how much substitution and induced new technology will affect supply, and how much consumption patterns of all goods will adjust.

The way OPEC countries spent their additional oil revenues was of great interest, but first year developments turned out to be considerably less severe than had been feared. OPEC countries received some $100 billion of export income, 95 percent from oil, and over 60 percent was available for investment. Initially, most was put in short term deposits, and the U.S. received only about one-fifth of those, far less than expected.

Concern was expressed that the deposits were temporary, awaiting substantial investments in real assets. Specific fears were of possible takeover of strategic industries in developed countries, including U.S. rural real estate and food production. Congressional hearings demonstrated that little factual information was available on inbound investment, and resulted in the Foreign Investment Study Act of 1974. It mandates a benchmark survey to determine the current amount of foreign investment by major types. Various other legislative proposals have been introduced to provide monitoring of rate of change in such investment, and attempts have been made to collate the information currently collected by Federal agencies but for other purposes. Morrison and Krause recently completed a review of Federal

and State statutory limits on such investment and found them to be nonexistent, minor, possibly unconstitutional, or avoidable in most cases.

1974 also saw major efforts to fill other data gaps on energy. A report prepared by ERS concluded that the food side of the food and fiber system uses about thirteen percent of total U.S. energy requirements, and that utilization was increasing at about four percent per year, the same as the rest of the economy. Within the system, farm production accounts for about 22 percent, farm family living twelve percent, food processing 28 percent, marketing and distribution eighteen percent, and selected input industries twenty percent. Total 1980 requirements are estimated to be up 11.3 percent, with a decrease in family living due to declining numbers of farm households, a four percent increase in farm production requirements, and a 20 to 30 percent increase in inputs, processing and distribution industries.

Cartel pricing of export oil also has important impacts on the terms of trade between nations. The ramifications are complex, depending on whether additional U.S. expenditures for oil are used by OPEC countries for consumption or investment, the sources of the consumption or investment goods, the location and type of financial investments, and the related policies of the U.S. Since agricultural products are a major export item, terms-of-trade considerations obviously give us a great stake in the outcome of international oil money movements.

## Contributions of Energy-Environment to Uncertainty

Two levels of uncertainty arise from the energy situation. First, what are the final impacts of the major 1974 shift in the price level for petroleum? Even if the oil price increase were a one-time shock, U.S. and World economies may go through many rounds of adjustment in response. There is a

great deal of uncertainty about the eventual impacts on these economic systems. Second, what are the prospects of future irregular variability in energy prices and supplies? For the domestic economy, these questions interrelate closely with efforts to reduce dependence on foreign energy supplies, further implementation of environmental regulations, and with formulation of new government energy-environment policies which sometimes must treat inherently conflicting objectives.

In future considerations of this problem, a crucial relationship is close past correlations among technological advancement, GNP growth, and BTU consumption. Boretsky (p. 71) asserts that per capita BTU consumption in civilian production "is probably the single most comprehensive indicator of overall relative technical advancement." Does the recent shortage of BTU energy signal a change from a growth tradition to one of no-growth? While there is no definite answer yet, recent studies have explored this central question from varying length of run perspectives.

Short term impacts

Our own recent work involved use of a static, short run, constrained input-output model to examine sectoral impacts of fuel shortages (Penn and Irwin, Penn, et. al., and McCarl, et. al.) due to reduced oil imports or natural gas restrictions, both with and without allocation programs. This methodology provides insightful results from examining direct and secondary impacts of short-term quantity restrictions.

The results strongly illustrate interdependence of the food and fiber system with the rest of the economy. Indirect energy requirements of most sectors dominate their direct requirements. Allocations based on direct requirements at any predetermined output level were not effective in alter-

ing output combinations. They might, of course, be useful in overcoming real world bottlenecks and lags which are not treated explicitly by the model. The short-term availability of natural gas is a special and serious problem, since it accounts for some 30 percent of total food system BTU use -- especially for nitrogen fertilizer production and crop drying.

Generally, the agricultural sectors adjusting to fuel restrictions, demonstrated their "basic commodity" nature following the path of the economy closely. Aggregate output is always reduced significantly less than the percentage cutback in the single energy source, even though the I/O model does not permit substitution in utilization among energy sources.

Long-term impacts

Substantial reductions in energy use appear to be possible without major economic costs in aggregates such as growth, employment, and GNP. The economy has considerable flexibility in adapting to changing resource availabilities and their relative prices. In addition, only a slight percentage change in consumer purchase habits can offset the growth drag of higher investment costs of pollution control or more expensive energy sources. However, some significant distributional impacts would occur between sectors.

Hudson and Jorgenson, using a very flexible model combining input-output and econometric techniques, estimated that an eight percent saving in aggregate energy use was possible at a cost of only one percent increase in average prices and a 0.4 percent decrease in real income. The composition of production was expected to change, with relatively slower growth in raw material industries, including agriculture, due to changed terms of trade and higher fuel prices.

Anne Carter has provided additional evidence using a dynamic input-output model. She examines the question of whether the higher investment domestic energy producing technologies of nuclear electric generation and coal gasification retard growth of the economy. As is typical of first generation technologies, growth rates tended to be decreased, but only slightly. Carter demonstrated that only a minor decrease in propensity to consume could generate necessary capital formation to more than offset the increased technological cost. Thus adjustments in consumer behavior patterns are extremely important to the whole economy. We hypothesize that the rising relative price of energy could cause other consumer adjustments which could offset much of growth drag.

Energy-Environment Relationships

During the decade of the sixties, the non-GNP portion of the implicit U.S. social welfare function was accorded higher priority. Environmental concerns came to the fore and were recognized as externalities to individual firm decisions. Various taxation or regulatory devices were created to eliminate the discrepancy between private and social costs. In the process, our growth equation gained an environmental constraint.

A subsequent major concern is that these environmental policies may not be cost-free with respect to energy. Some initial reactions were for any environment-energy tradeoff to be decided in favor of energy. With the 1973 expenditure for complying with environmental regulations some $6.3 billion, and a 1982 projection of $28 billion (Hamrin), the question is important. Results do differ significantly when energy considerations are added to environmental analyses.

Impacts of current environmental regulations, taken alone, will not

retard the aggregate growth rate, nor will jobs or prices be affected significantly, according to a recent review of studies (Hamrin). Expanded activity in air pollution control industries is a major offset. Carter's dynamic input-output formulation suggests a similar conclusion. However, distributional impacts on industries are significant to us in two ways. One, some eight industries made 80 percent of private pollution control investments in 1974, and their share will probably grow. A significant member is the food and kindred products processing industry. Second, all eight industries are in the basic group, so there is a potential ripple effect throughout the economy. Estimates indicate that 85 to 100 percent of these cost outlays will be passed through to consumers, depending on industry structure, availability of substitutes, elasticity of demand, size of the expenditure, etc., and that some of the remainder will be offset by raw material saving or other gains from salvaging wastes.

Various studies of a sector nature have examined questions of individual environmental restrictions on farming. Forster has shown that water pollution control rules would not have a severe impact on feed lot production, but that the impact is regressive due to economies of size in compliance. Similarly, Gilliam and Martin showed that banning antibiotics in animal feeds tended to increase production costs, ultimately borne by producers or consumers, depending on one's assumptions about the industry's ability to pass through price increases.

Impacts, when energy constraints join environmental constraints, are indeed more significant. As demonstrated rather strikingly in Carter's work, neither higher cost in electric power generating technology alone nor pollution control alone had much negative impact. But when the two constraints

interacted, growth potential was cut almost one percentage point (from 3.5 to 2.6). When one adds the impact of the dramatic supply induced price rise for all energy sources, the potential drag on economic growth indeed seems serious. However, we should remember that the same sort of fear was felt for environmental regulations alone, as they were being instituted in the 1960's, and these proved exaggerated. Carter (p. 591), speaking only of the costs imposed by new energy technology and environmental regulation, concluded "We can meet environmental standards and resource constraints over the next decade and still maintain or even increase present growth rates for conventional goods."

Energy Policy

Further adjustments are imposed by even higher price levels achieved through cartel pricing or through U.S. counter policies to achieve greater energy independence. Their likely extent and nature is an increasingly important source of uncertainty, as more of the energy constraint is controlled by political processes in the U.S. and the rest of the world.

We do not know whether the OPEC cartel will be successful in maintaining or increasing petroleum prices. Even if it is not, we do not know whether they will periodically attain such success, thereby introducing additional variability.

The slow process of developing a U.S. energy policy is a major source of uncertainty. The long run need appears to be for energy programs stressing development and conservation, but these may be inflationary in the short run (at a time when inflation is already a major economic concern), thus complicating development of short run economic policy (Economic Report of the President, pp. 20-21). In addition, concensus has not developed on the

nature of a long run energy policy. The Administration proposed a series of programs designed to reduce dependence on imports by conserving energy, developing domestic sources, and developing a strategic reserve to blunt any repeated embargo by OPEC. The programs would rely on market forces across the board. The argument made for market rather than rationing or allocation mechanisms was that the latter might have more undesirable structural consequences by making the economy less responsive and by tending to favor large and established firms.

An alternative viewpoint on U.S. energy policy would focus the impact of shortages directly to target on specific subsectors, via selective rather than general energy price rises. Specific gasoline taxes have been voted upon, vetoed, and the veto sustained. Policy making is tortuous because of the complex regional interests among producers and consumers of each of the fuel types, environmentalists, and the wide variety of other special interests.

Intensive development of domestic energy sources could have a number of impacts. Coal and oil development could interfere with farm production in certain areas, either as competitors for land or for irrigation water. The level of prices established also may affect the spatial location of food production. Finally, adjustment in consumer purchases to the "tax" of higher oil prices, as well as direct taxes to control consumption, could alter overall consumption patterns. Farm commodities, to the extent they are demand inelastic, are less likely to be cut back than are levels of food processing.

Nordhaus (1974) identifies important questions yet to be resolved from the viewpoint of the domestic economy as: (1) Should the rate or direction of the economy be changed as a result of global shortgages of natural resources? (2) Are markets a reliable allocative mechanism for energy, or is some sort

of intervention necessary? (3) What are the best ways for insuring security of supply?

## Structure of the Food and Fiber System

Our discussion indicates that the energy-environment complex has indeed raised some uncertainties which have tended to compound larger uncertainties from other sources. It appears that the first major adjustment set will be in response to changing relative prices rendering differential impacts on sectors, not to changing aggregate growth in the economy, just as Carter and Youde (p. 886) hypothesized in these meetings a year ago. The next set of adjustments which must be examined involves consequences on organizational structure. A first part of the remaining discussion will be applicable to various uncertainty sources, then we focus more specifically on application to energy issues.

### Comments on Theory

Frank Knight's 1920 Risk, Uncertainty and Profit emphasized that entire economic systems evolve in response to the dominating impact of risk and uncertainty. But most attention has been focused on the dual question of how individual decision makers can or should respond to risk situations: consolidate, specialize, control the future, increase predictive power, diffuse, or avoid. Even in 1970, Coase (p. 60) was able to note: "What is curious about the treatment of problems of industrial organization in economics is that it does not now exist." While modern economic theory continues to develop in this area, it still does not provide a clear guide for empirical analysis.

Two alternatives have some rudimentary development, one in economic-industrial organization and one in the legal-economic boundary. Coase (1970,

p. 64) suggests that "The way an industry is organized is dependent on the relation between the costs of carrying out transactions on the market and the costs of organizing the same operation within the firm which can perform the task at lowest cost." T. W. Schultz has expanded the argument to say that new institutions are created, or activities are shifted among old ones, for four types of reasons: to reduce transactions costs, to allocate risk, to link personal and functional income streams, or to handle public goods and services. Thus, both the relative costs of carrying risk internally and the willingness to bear it are crucial to future adjustments in economic organization.

The conventional economic viewpoint is developed along these same lines by theorists on the subject of market failure, and by Arrow (1974), who argues that modification of the neoclassical analysis to include information provides the most reasonable approach to uncertainty. Arrow (1975) has also concluded from a theoretical argument that vertical integration may be encouraged solely due to uncertainty in the supply of upstream goods. The need for downstream firms will cause a situation thought of as competitive to tend toward imperfect competition. This improves the spot price forecast of inputs and enables the firm to choose its level of capital more confidently. It is well known that such structural characteristics alter the possibilities for behavior, introducing both possibilities and incentives for collusion. Energy price uncertainties might thus be expected to provide further incentive for these large firms to develop integrative devices for their input streams. On the other hand, energy cost increases for processing would tend to restrain a certain amount of product experimentation, which is characteristic behavior of large processors who might be

the more active integrators (Padberg). However, we have seen no definitive work on impact of uncertainty on firm size which takes as a variable the scope of activities undertaken by the firm. A further uncertainty restraining integration could be change in U.S. eating habits (Winski), such as a back-to-the basics movement brought on by consumer budget crunches during the recent recessionary-inflationary period. If we are experiencing a threshhold change in eating habits rather than just a cyclical response, ability of food manufacturers to follow behavior patterns of the past may be lessened. On the other hand, users and exporters of farm products in raw or near-raw form may see incentives to tie ahead.

The second alternative, the legal-economic approach, has its roots in the concept of property rights (Chueng). Adjustments involving such rights are treated as the basic entities for economic analysis. When property rights are not clearly defined, or when they are created, destroyed, or altered by some exogenous event or governmental restriction, resource allocation and economic organization may undergo adjustments. Looking at adjustment in terms of property rights seems to improve explanation and predictive power. The theory is not well developed and is yet to be integrated into our theoretic base.

Comments on Government Programs

Government programs may affect organizational structure directly by encouraging or discouraging growth of individual firms at a rate faster than growth in the aggregate market for their products, by either creating or providing assistance in overcoming barriers to entry, by encouraging or discouraging exit, or by altering the climate for merger and integration. They may affect organizational structure indirectly by institutional pro-

visions, rationing, price controls, import quotas, allotments or similar regulatory programs if these programs deliberately (or through oversight) alter the ownership of property rights within traditional exchange systems (Chueng). Resource allocation is affected, and organizational structure adjusts by the same sort of processes followed whenever a deliberate, direct policy is implemented.

Dahl (1975) had contended that most public policies either have no structural impact on the food and fiber system, or else are concentration-increasing. How about proposed Administration energy policies? Their impacts on the food and fiber system are likely to be through price level as well as availability. We must expect problems of bottlenecks, both with allocation schemes for short term quantity emergencies and long term situations of technological introduction and phase-over. These may disadvantage certain industries, locations, or types of firms. Food has a heavy embodiment of energy price in it, but is also a basic commodity with inelastic demand. Impacts of rising energy price are not likely to stifle volume of output. Instead, they are more likely to affect type, amount, form, and location of production and processing. They will raise the variable cost component of production, both directly and indirectly through other purchased inputs. This, in turn, further reduces the relative cushion of fixed costs, long the mainstay of farmers and small businessmen in weathering adverse years.

## Summary

We have dealt with three general uncertainty related issues in this paper: (1) uncertainty about the overall nature of the energy situation, (2) the question of whether the energy-environmental complex portends greater future uncertainty for the food and fiber sector, and (3) the likely impacts

on organizational structure.

Our substantive evaluations are that: (1) Uncertainty is likely to be greater in the future. Primary contributors are resource scarcities, domestic and world food demand, exchange rates and investment, inflation, greater political as well as economic interdependence, and environmental impacts. (2) Energy and environmental problems thus have merely added to these concerns. (3) The food and fiber system is completely interdependent in the larger picture. (4) Policies and anticipations of policies yet to be developed have a great impact on the level of uncertainty, as well as on who will bear it. (5) Current models for understanding change in organizational structure are not adequate but are slowly stimulating conceptual developments which will help focus analyses.

The energy-environment situation appears to have minor overall impact on GNP, employment, overall economic growth, and the like. But effects for certain sectors, including the food and fiber system, are quite significant, and impacts on individual firms may be even greater. The organizational structure impacts are likely to involve further evolution of existing institutions and techniques designed to deal with uncertainty. Organizational forms can be expected to continue to adjust control toward those units most willing to assume risk, and those most innovative in coping with it. Devices to reduce uncertainty will proliferate, including massive efforts already underway in the area of information gathering. Economists once again have a bonanza of work, as they always do in an environment of scarcity and uncertainty.

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Footnotes

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