The Nature and Origins of the U.S. Energy Crisis

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AGGREGATIVE economic policy is designed to stabilize the general price level and the growth in output and employment. Monetary policy, as a general tool of aggregate demand management, seeks to achieve these goals by affecting the volume of total spending in the economy. Whether ultimate goals of this policy are achieved depends to a large extent upon the external shocks to which the economy is subjected. Regardless of the sources of these shocks — weather, foreign actions, or changes in institutional conditions — they must be taken into consideration in the process of monetary policy planning and execution. One of the recent shocks has been the sudden and dramatic increase in the relative price of energy, which has significantly affected U.S. productive capacity.[1] This article traces and analyzes the underlying factors which were instrumental in rendering the U.S. economy vulnerable to the energy shock.

In the wake of the Arab oil embargo in 1973-74 and the weather-induced natural gas crisis in the winter just passed, concern about an energy crisis has spread across the U.S. The crisis often has been identified as an *energy gap* manifested as shortages of gasoline in 1974, and of heating oil and natural gas last winter. The emergence and the prospective persistence of such an energy gap often have been diagnosed as being the result of rising demand for energy and dwindling supplies of oil and natural gas. However, such a perception of the nature and the roots of the energy crisis is based on an uncritical acceptance of the "lump-of-energy" conception and on a denial of the laws of demand.

An alternate view of the energy crisis rejects the identification of the energy problem as a growing imbalance between the absolute quantity of energy demanded and supplied. Rather, the energy problem is diagnosed as the apparent "failure" of the energy market to accommodate the amount of energy demanded at policy-mandated prices, and the seemingly progressive deterioration in the capacity of the energy market to adjust to man-made and weather-induced shocks.

The history of U.S. energy markets reveals that the roots of the current crisis have been nurtured by past public policy measures. These policies were adopted in response to demands by segments of the energy industry for protection from the rigors of market competition. The crisis is rooted in the supplanting of the market mode of competition by the political mode. From this perspective, it is difficult to avoid the conclusion that past public policies (pursued to shelter some segments of the energy industry) have been, in large measure, responsible for the energy crisis.

THE NATURE AND ROOTS OF THE U.S. ENERGY CRISIS: TWO VIEWS

A Prevalent View

A widely accepted diagnosis of the nature of the U.S. energy crisis is one of growing imbalance in the nation's energy budget. Such a diagnosis is based on the premise that the amount of energy demanded will continue to increase, while the amount of oil and natural gas supplied will diminish.[2] The "crisis" the U.S. faces is often said to be a grave threat to the nation's economic security and the American way of life.

This conception of the energy crisis is, thus, that of an inexorable emergence and worsening of an *energy gap*, unless dependence on nonrenewable fossil fuel in general, and on oil and natural gas in particular, is not reduced. In estimating the length of the "grace period" during which plans for an oilless future must be made, the projections of energy "demands" are based upon alternative assumptions of the rate of growth in energy usage in the form of oil consumption. Such projections are typically made by extrapolating the historical

[1] Robert H. Rasche and John A. Tatom, "The Effects of the New Energy Regime on Economic Capacity, Production, and Prices," this *Review* (May 1977), pp. 2-12 and "Energy Resources and Potential GNP," this *Review* (June 1977), pp. 10-24.

[2] S. David Freeman, Director, A *Time to Choose*, Final Report by the Energy Policy Project of the Ford Foundation (Cambridge: Ballinger Publishing Co., 1974).

rates of growth in energy usage and by assuming different (lower) rates of growth under alternative conservation plans.[3] Then, given geological estimates of potentially recoverable oil reserves, the computation of the grace period becomes routine.

For example, some estimates of the grace period use as a benchmark the estimate of about 2 trillion barrels of total world recoverable oil. Even using a "conservative" projection of a 3 percent rate of growth in oil demand, as contrasted to the 8 percent rate of growth in the 1960s, the world's presently estimated recoverable oil resources would be exhausted before 2020. The arithmetic is unassailable and, hence, the spectre of freezing in the dark arises if the U.S. is not weaned away from its dependency on oil in time.[4]

The policy prescriptions that often follow from such a view of the energy problem are mandated conservation and the pursuit of technical energy efficiency during the transition into a new energy regime.[5] Such a transition is deemed to be facilitated by a mix of standby and regular excise and consumption taxes on energy, subsidies, tax credits, "reform" of the utility rate-making procedures, a system of incentive pricing for *new* oil and natural gas, and by a set of mandatory allocations and conversions to coal — the more plentiful "interim" fuel.

An Alternate Market-Based View

The essence of the energy problem from the alternate view is that the problem is one of apparent (or potential) "malfunction" in the market for energy. This view focuses squarely on the capacity of the energy market to respond to unforeseen shocks, such as the recent oil embargo and severe weather, and to accommodate foreseeable changes in the quantity of energy demanded. When the energy problem is framed in this manner,[6] the accumulated stock of knowledge regarding the functioning of markets can be used to diagnose the nature and the origins of the energy problem.

Despite its importance, energy must be viewed as a commodity not unlike any other commodity that competes for a share of limited budgets. Hence, the amounts of energy demanded and supplied are both determined by laws that govern consumer and producer behavior.

According to the *first law of demand*, the lower the price (that is, the lower the sacrifice incurred in terms of other goods that have to be given up to purchase energy), the higher is the quantity demanded, other things being equal.[7] And, according to the *second law of demand*, the longer the elapsed time after a price fall, the greater will be the extent of substitution toward the commodity which has become cheaper. As prices fall, increases in the quantity demanded occur, first, because more is demanded by the *present* users and, second, because *new* users enter the market.

Such an adaptive behavior on the part of consumers is mirrored in a similar behavior on the part of producers in an exchange system organized within a general private property framework. Thus, a greater quantity of energy will be supplied as prices rise because more energy will be supplied by the *present* producers and *new* (higher-cost) producers will be enticed to enter the market.

The nature of the energy problem from the market view is the "inadequate capacity" of the energy market to adjust to unexpected shocks, such as the man-made oil embargo and nature-induced severe weather conditions. Such a conception of the nature of the energy problem leads one to heed Santayana's dictum that, "those who do not learn from history are condemned to repeat it," and to study the history of energy markets in the U.S. for a clue to the roots of the current energy crisis.

Such a study of the history of energy markets, especially the markets for oil and natural gas, reveals some general characteristics of the energy market which have circumscribed its adjustment capacity, such as the exceptionally long (three-to five-year) lead

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[3]Ibid., pp. 19-25.

[4]For a graphic illustration of the apocalytic vision of the dismal energy future evoked by the recent discussions of the energy crisis, see Isaac Asimov, "Essay," *Time* (April 25, 1977), p. 33.

[5]Such a regime is characterized by renewable and essentially inexhaustible energy sources, such as solar and wind energy, and viable nuclear fusion technology.

[6]For a statement of this approach, see Armen A. Alchian, "An Introduction to Confusion," in *No Time to Confuse* (San Francisco: Institute for Contemporary Studies, 1975). Also see Edward J. Mitchell, *U.S. Energy Policy: A Primer* (Washington, D.C.: American Enterprise Institute (AEI), 1974); Hendrick S. Houthakker, *The World Price of Oil* (Washington, D.C.: AEI, 1976), Washington, D.C.; and Douglas R. Bohi, Milton Russel, and Nancy McCarthy Snyder, U.S. Congress, House of Representatives, Committee on Banking, Currency, and Housing, *The Economics of Energy and Natural Resource Pricing*, A Compilation of Reports and Hearings, 94th Congress, 1st Session, Parts 1 and 2, March 1975, pp. 1-230.

[7]Armen A. Alchian and William R. Allen, *University Economics*, 3rd. ed. (Belmont, California: Wadsworth Publishing Company, 1972), pp. 60-66.

times for end-use delivery and the common pool problem.[8] More importantly, a historical inquiry, which will be discussed in greater detail in later sections, also reveals that deep government involvement in the past has greatly attenuated the adjustment capacities of the energy market.

For example, the legacy of the demand prorationing system,[9] which arose in the 1920s, and the subsequent voluntary and mandatory import quotas on oil products (on national security grounds) in the 1950s, is evident in the current problem. Indeed, the formation of the oil producers' cartel (OPEC) in 1960 was proximately caused by the imposition of mandatory import quotas in the U.S. in 1959.[10] The Supreme Court's ruling on the Phillip's case in 1954 also was one of the roots of the current energy problem.[11] The more recent price controls on energy imposed in mid-1971 also have had adverse effects.

The unifying thread in the apparently disparate set of causes of the energy problem, is the replacement of the market mode of competition by the political mode of advocacy politics. The more successful were those who sought relief from the rigors of competition through political means, the less robust became the adjustment capacity of the energy markets to unforeseen shocks.

Comparison of the Two Views

The market-based view of the energy crisis denies the usefulness of the prevalent conception of the energy crisis as that of an ever accelerating shortfall in the amount of *BTUs (British Thermal Units)* embodied in finite and nonrenewable oil and natural gas. The fatal flaw in the prevalent view is the failure to perceive the fundamental distinction between (1) rising prices in response to changes in underlying schedules of demand and supply, and (2) the phenomenon of rising shortages in quantity supplied relative to quantity demanded, because prices *do not* or *are not allowed* to adjust fast enough to equate the quantity demanded to quantity supplied.

According to the market view, the adherents of the prevalent view, in advancing their various scenarios of impending disaster, ignore adaptive human behavior under perceived changes in scarcity and opportunities. They base their scenarios instead on the arbitrary projections of quantity demanded relative to estimates of fixed "recoverable" reserves of oil and gas.[12] Such a mechanistic conception of the problem neglects the roles which changes in price and technology play in inducing revisions in the estimates of recoverable reserves, as well as in altering the quantity demanded of oil and gas *and* the quantity supplied of alternate sources of energy. Such neglect reflects two underlying false premises.

The first premise is that energy is an "essential resource." According to this premise, the demand for energy is insensitive to changes in its price. The premise, in essence, denies the fundamental laws of demand. This premise is falsified by the available evidence which indicates that the quantity demanded of energy is sensitive to both its price and consumer income.[13] More importantly, the price sensitivity of demand for energy is greater in the long run than in the short run.

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[8]The common pool problem is similar to the fishery problem in that both arise due to the ill-defined property rights over the common resource at issue. Typically, the applicable law with regard to property rights is the rule of capture. That is, the exclusive property rights are created at the instant of capturing fish or drawing oil from the pool. There exist, therefore, incentives for co-owners of the pool to extract as much of the oil as they singly can. Such an unrestrained behavior on their part, however, tends to reduce the ultimate amount of oil recoverable by drilling, relative to the more paced rate of drilling known as the "maximum efficient rate of production (MER)." Hence, the logic of joint maximization would call for a rate of production not to exceed MER. The problem involved in striking an agreement to promote joint maximization is similar to the one in forming a cartel of producers to coordinate production decisions. See U.S. Congress, Senate, Committee on the Judiciary, *Governmental Intervention in the Market Mechanism: The Petroleum Industry*, Hearings before the Subcommittee on Antitrust and Monopoly, 91st Congress, 1st Session, Part 2, 1969, pp. 1070-71.

[9]Market demand prorationing refers to the system of allocating production quotas to individual oil producers. It arose in response to the common pool problem in the production of crude oil. Since the transaction costs (inclusive of negotiation and enforcement costs of agreed upon output shares) involved in determining the oil to be drawn from a common pool by co-owners are substantial, such determination was done through the mediation of various state regulatory commissions. Rationing of the quota was specified in terms of the allowable percentage of MER (maximum efficient rate of production), with a view to controlling total production such that the targeted market price of oil could be sustained. *Ibid.*, pp. 1069-73.

[10]See Kenneth W. Dam, "Implementation of Import Quotas: The Case of Oil," *The Journal of Law and Economics* (April 1971), pp. 1-60.

[11]The Supreme Court ruled that the Federal Power Commission *must* regulate the wellhead price of natural gas flowing in interstate commerce. Phillips Petroleum Company V. Wisconsin, 347 U.S. 622, 1954. See Edmund W. Kitch, "Regulation of the Field Market for Natural Gas by the Federal Power Commission," *The Journal of Law and Economics* (October 1968), pp. 243-80.

[12]For a discussion of various concepts of (mineral) reserves and the problems in estimating them, see U.S. Congress, House of Representatives and Senate, Joint Economic Committee, *Adequacy of U.S. Oil and Gas Reserves*, 94th Congress, 1st Session, 1975, pp. 14-27.

[13]Dale W. Jorgenson, ed., *Econometric Studies of U.S. Energy Policy* (Amsterdam: North-Holland, 1976); Also Houthakker, *The World Price of Oil*, p. 8.

The second premise is that the reserves of oil and gas in particular, and other nonrenewable energy resources in general, are a predetermined, fixed "lump" which is independent of both price and technology. This premise ignores the fact that reserves are essentially adjustable inventories which the energy producers hold in order to safeguard their market positions. The amount of reserves (inventories) producers want to hold, then, is dependent upon the perceived cost of holding them relative to the expected returns from such holdings.

The prevalent view of the nature and origins of the energy crisis is, thus, based on twin fallacies: the lump of energy fallacy and the denial of the fundamental laws of demand. Such a view tends to ignore the following facts: (1) that the demand for energy is a derived demand,[14] (2) that energy produces valued output in conjunction with other scarce factors of production (such as labor and capital), (3) that other factors are substitutable for energy in the production process (hence other factors are valuable, as is energy), and (4) that the substitution of one form of energy for another depends on the relative cost of alternative forms of energy.[15]

Underlying the prevalent view is a concept that could be characterized as the "BTU theory of value." A strict BTU theory of value would hold that energy is the *only* scarce resource and, as such, is as fallacious as the Marxian labor theory of value, which holds that labor is the sole source of value. If the issue is presented so starkly, one would be hard put to find an advocate of such a BTU theory of value. However, the theory, at least in its applied forms, appears to have substantial adherents.

A variant of the BTU theory of value imputes an inherent, independent value to a specific source of BTUs, such as oil or natural gas. This variant denies the proposition that a dollar's worth of energy (in whatever form) is equal in value to a dollar's worth of labor or capital. Therefore, a question regarding the cost of conserving energy in terms of non-energy factors of production is seldom raised explicitly in assessing the comparative merits of various energy programs.

For example, some proposals to conserve the BTUs embodied in natural gas would use taxation and other measures to induce conversion to coal of electric power and industrial plants, designed to operate on natural gas. The question of cost-effectiveness in terms of the *total* resource use, relative to the desired output forthcoming from the production process, is seldom fully addressed. Implicit in this view is either a belief in the inherent value of the BTUs embodied in natural gas and the denial of the scarcity value of other cooperating factors, *or* a lingering belief that the price of natural gas does not, or will not be permitted to, reflect its true scarcity value.[16]

The market-based interpretation of the energy problem implies that the urgent task of public policy is to make the energy market *more* responsive to *unexpected* shocks and *expected* changes in market demand and supply conditions. Such a goal is likely to be achieved only if tinkering in the energy market by self-serving domestic power groups, acting through the government, is effectively curtailed.[17] Public pol-

[14]Demand for energy is a derived demand in the sense that an energy resource is not wanted for its own sake but for the output of the objects of more immediate consumption, such as comfortable temperatures and transportation services, which energy helps to produce.

[15]For recent articles which document the "abundant" availability of energy at higher market prices (from such sources as untapped natural gas reservoirs, Devonian shale and geopressured methane), see *The Wall Street Journal* editorial pages, 27 April 1977 and 14 June 1977. For an account of a series of substitutions of alternate fuels used for illuminants as the price of whale oil (the dominant lighting fuel in the U.S. in the early 1800s) rose drastically, see Murray L. Weidenbaum and Reno Harnish, *Government Credit Subsidies for Energy Development* (Washington, D.C.: American Enterprise Institute, 1976), pp. 4-5.

[16]Should the price indeed reflect the true scarcity value of natural gas, and, even given that, should some industrial users decide to use natural gas in conjunction with the natural gas powered capital goods already put in place (presumably because the total resource cost is lower than the alternative of enforced capital replacement), the only basis for questioning such a decision appears to be a BTU theory of value.

[17]In case of a discrepancy between direct private costs and total social cost of using energy resources in the presence of pollution externalities, an intervention through excise taxes could be appropriate. It may also be appropriate to attempt to induce changes in the discount rate that market participants use to optimize the time distribution of extraction and consumption of energy resources, if a demonstrable basis exists for a bias in the market interest rate. For a classic discussion of the problem of social cost, see Ronald H. Coase, "The Problem of Social Cost," *The Journal of Law and Economics* (October 1960), pp. 1-44. For a voluminous literature inspired by the Coase work, see William J. Baumol, "On Taxation and the Control of Externalities," *The American Economic Review* 62 no. 3 (June 1972), pp. 307-322 and various comments on the article together with "Reply," *The American Economic Review* 64 no. 3 (June 1974), pp. 462-92. For a discussion of the "proper" social discount rate for capital deepening decisions, see Kenneth J. Arrow, "Discounting and Public Investment Criteria," in *Water Research*, A. V. Kneese and S. C. Smith, eds. (Baltimore: Johns Hopkins Press, 1966), pp. 28-30; Jack Hirshleifer, James C. DeHaven, and Jerome W. Milliman, *Water Supply* (Chicago, The University of Chicago Press, 1960), pp. 139-41; Stephen A. Marglin, "The Social Rate of Discount and the Optimal Rate of Investment," *The Quarterly Journal of Economics* 77 no. 1 (February 1963), pp. 95-111; Gordon Tullock, "The Social Rate of Discount and the Optimal Rate of Investment: Comment," *The Quarterly Journal of Economics*, 78 no. 2 (May 1964), pp. 336-45.

icy becomes questionable if it is based exclusively on conserving particular forms of energy, such as oil and natural gas, without an explicit regard to the total cost of that policy, including the capital cost, relative to the demonstrable total benefits.

PAST PUBLIC POLICIES AS THE ROOTS OF THE ENERGY CRISIS

The Natural Gas Market

The controls on the wellhead price of natural gas, which were imposed in the 1960s, were below the market clearing level in the 1960s. According to the first law of demand, mentioned above, the expected result was an increase in the quantity of natural gas demanded by existing users of natural gas. According to the second law of demand, as the lower price persisted, there entered a new class of users, such as electric utilities. At first glance, it would appear that there should have been a "shortage" of natural gas, as the quantity demanded outstripped the quantity supplied when prices are held down artificially. This was not the case, however.

It appears paradoxical that an "artificially" low price of natural gas led to an *actual* increase in consumption, rather than to a mere increase in *attempted* consumption. Why did producers supply enough gas to accommodate the increase in quantity demanded at the artificially low price? The resolution of this puzzle holds a key to unravelling the nature of the fallacy imbedded in the prevalent view of the energy problem.

The technological nature of the natural gas (and oil) industry is such that the industry maintains a relatively high inventory-to sales ratio.[18] The inventories are held in the form of *proved reserves*. The existence of inventories helps to dampen fluctuations in the current price and facilitates quantity adjustments to fluctuations in demand. The amount of reserves (inventories) sellers want to hold is systematically related (1) to the expected future market price relative to the current price, and (2) to the cost of holding inventories.

To understand what we observed in the 1960s — (1) the simultaneous lowering of the regulated price of natural gas below the market clearing level *and* increased consumption and production of natural gas, and (2) the conversion to natural gas by utilities and industrial users — it is necessary to review the history of regulatory control on the wellhead price of natural gas since the Phillips case of 1954.

The Federal Power Commission (FPC) approached its Supreme Court mandated task of regulating the wellhead price of natural gas on a case by case basis until the early 1960s. The case by case approach, however, put such a strain on the FPC's resources that the commission itself estimated that its 1960 case load would not be completed until the year 2043.[19] Faced with such a backlog of case load, the FPC introduced in 1961, the Permian Basin method of area-wide rate-making.[20]

Under the Permian Basin methodology, the FPC would establish a "just and reasonable" ceiling price for all natural gas produced within a broadly defined producing area such as the Permian Basin in Texas or Southern Louisiana. This method of price control resulted in the practice of basing the permitted price on the historical cost of a low cost producer in a given area. Therefore, the new method was instrumental in inducing a downward revision in the expected *future* price of natural gas.

Chart I indicates that the hypothesized downward revision in the expected price was in fact borne out by the actual price behavior. The relative price of natural gas declined on balance in the post-Permian 1960s, in sharp contrast to its rising trend between the late 1940s and the early 1960s. Chart I also shows that the actual thrust of regulation after the Phillips case of 1954 and prior to the Permian Basin proceedings, was such that the price of natural gas was permitted to continue its rise relative to both the price of oil and other prices in general.

In terms of the interpretation offered above of reserves as business inventories, one would expect that the downward revision in the expected future price of natural gas would have induced an accelerated

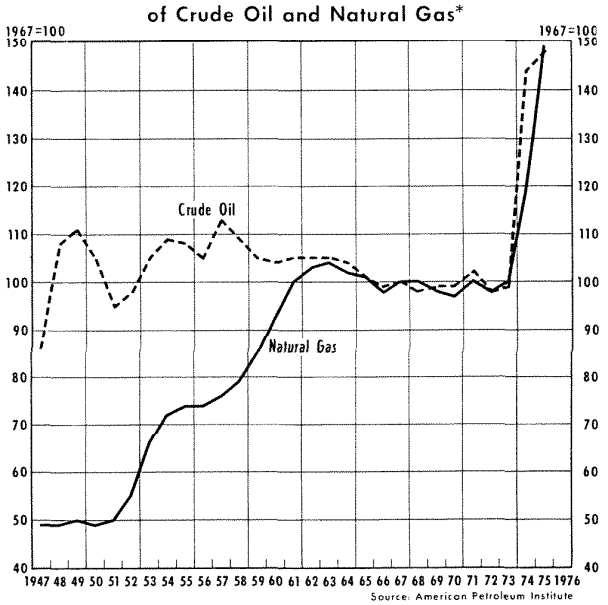
[18]This is because of the long lead time between exploration and production. See Paul W. MacAvoy and Robert S. Pindyck, *Price Controls and the Natural Gas Shortage* (Washington, D.C.: American Enterprise Institute, 1975), pp. 16-19.

[19]Ibid., p. 12.

[20]The area-wide rate making procedure, based on an adaptation of the public utility rate-making approach, tended to impart a downward bias to the regulated wellhead price. The FPC attempted to arrive at an area-wide composite average cost estimate based on a survey of cost data. Confronted with the logically impossible problem of joint cost allocation between oil and gas, the FPC systematically chose the figures at the lower end of the choice set. The Supreme Court once again ruled, in 1968, that it was within the discretion of the FPC to adopt the area-wide rate-making procedure, however arbitrary the rate may be. Permian Area Rate Cases, 390 U.S. 747 (1968).

Chart I

The Relative Wellhead Prices of Crude Oil and Natural Gas*

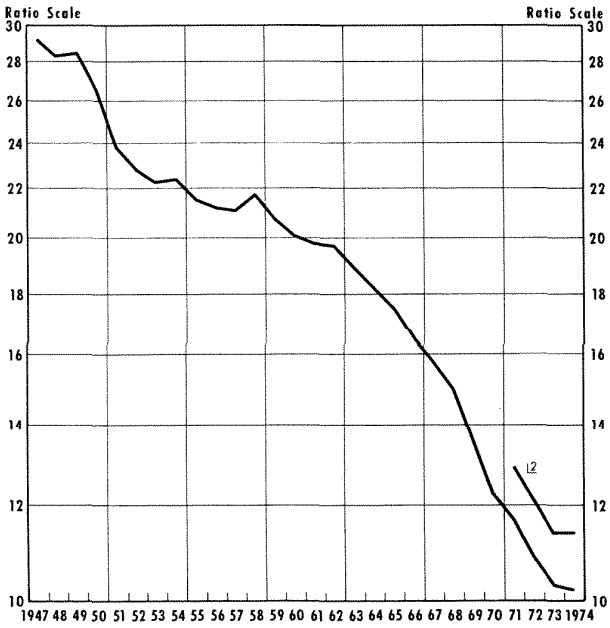


Source: American Petroleum Institute

*Data are indicies of constant (1967) prices.

Chart II

Ratio of Natural Gas Reserves to Production [1]



Source: American Gas Association

[1] Measured as the ratio of: the beginning and end of year figures for proven reserves of natural gas to the production of natural gas during that year.

[2] Includes 26 trillion cubic feet at 14.72 psia and 60°F in Prudhoe Bay, Alaska.

downward revision in the desired reserve-to-production ratios. Such an expectation is borne out by the behavior of the reserve-to-production ratios shown in Chart II. The chart shows that the reserve-to-production ratio was falling even before the Permian Basin proceedings in the early 1960s, indicating that the actual ratio was above the desired ratio. However, the downward adjustment proceeded at a slower rate of 1.8 percent per year after the Phillips case of 1954 but prior to the Permian proceedings in 1961, compared to the 3.7 percent per year rate in the earlier 1947-54 period. Such behavior is consistent with the earlier finding that regulation permitted a relative increase in the price of natural gas prior to the early 1960s.

The decline in the reserve-to-production ratio accelerated after the Permian proceedings began early in the 1960s. The ratio fell at the rate of 6 percent per year from 1963 to 1970. Such an acceleration in the decline of the ratio reflects the downward adjustment in the desired reserve-to-production ratio induced by the adoption of the Permian methodology.

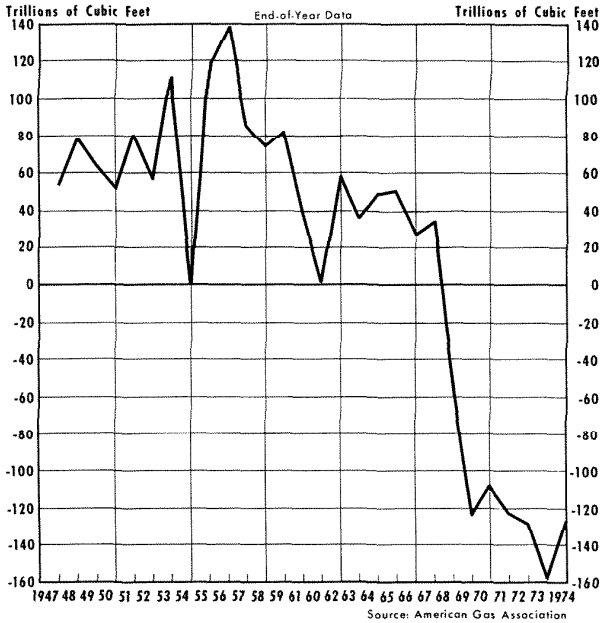
Chart III indicates that the accelerated downward adjustment in the reserve-to-production ratio in the 1960s took the form, first, of decelerating growth of reserves, and then of outright reduction in reserves since 1968. Chart IV indicates that this slowing in reserve accumulation and the eventual reduction in reserves, can be attributed squarely to the slowing in *the search for reserves as a direct consequence of* policy-induced souring in the prospective returns on exploration and development activities. The Chart shows that there has been a secular improvement in the success ratios in exploratory and development efforts, possibly due to technological progress.[21] Therefore, the marked reduction in the number of successful gas well drillings since 1962, as shown in Chart IV, is primarily due to the reduction in the search activities. Production of natural gas, however, did not start decreasing absolutely until 1973.

The drawing down of reserves (inventories) by producers reconciles the apparent puzzle of an "artificially" low, controlled price and the observed increases in the quantity supplied. It is ironic that the peculiarities of the market for natural gas masked the policy-induced disequilibrium in the market, so that many new industrial and electric utility users switched over to natural gas from coal. They were attracted to natural gas because of its apparent "bargain" price

[21] The conclusion regarding the success ratios also holds individually for new-field wildcats, total exploratory wells and development wells.

Chart III

Changes in Natural Gas Reserves*



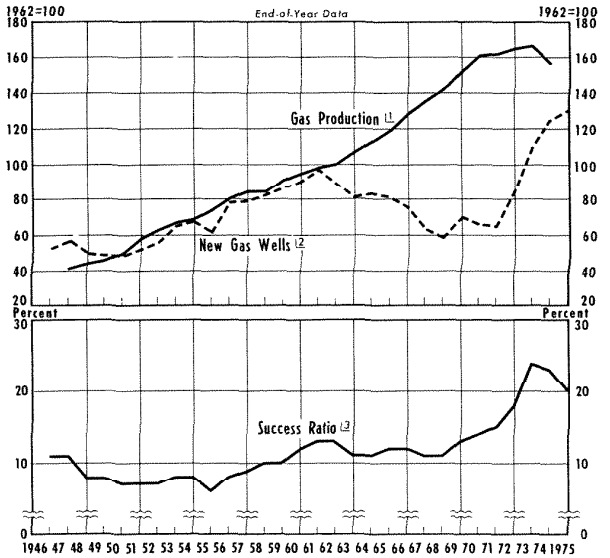
Source: American Gas Association

*This series is generated by subtracting estimated production of natural gas during the year from the reserve revisions, extentions, and discoveries during the same year.

and the higher cost of using coal occasioned by the passage of various environmental legislations.

Chart IV

Natural Gas Drilling and Production



Sources: American Association of Petroleum Geologists, American Petroleum Institute, and the American Gas Association.

[1] Based on 13.638 quadrillion cubic feet of gas produced in 1962.

[2] Based on 5,848 new gas wells in 1962. This figure includes exploratory and development wells.

[3] Measured as the ratio of new gas wells to total wells drilled.

In view of the eventual emergence *at the controlled price* of a shortage in the market for natural gas, which led to supply curtailments, the decisions of new users to convert to natural gas must be judged with hindsight to have been ill-advised. It is doubly ironic that these victims of the unintended side-effects of public policy could now become targets of elaborate tax and administrative measures.

The Oil Market

The preceding analysis of the nature and origins of the natural gas crisis is applicable to the market for oil, the other endangered specie of energy. The adjustment capacity of the market for oil also has been attenuated as a consequence of past public policy. In contrast to the unintended shortage policy followed in the market for natural gas, a *deliberate surplus* policy was followed in the market for oil. As noted earlier, various state regulatory agencies followed a demand pro-rationing policy to cope with the common pool problem in the industry, which arose from the rule of capture doctrine in existence. This, in turn, arose from incompletely defined property rights over oil in the ground.[22]

In the absence of a demand pro-rationing system and of consolidation of an oil field under one or joint control, violent fluctuations arose in the price of crude oil that producers received as developed fields were intensively mined and new discoveries made.[23] The demand pro-rationing system evolved to protect the joint interests of the producers.[24] Under the demand pro-rationing system the state regulatory agencies, such as the Texas Railroad Commission, sought to alleviate this condition by setting total production targets for the particular state, and by distributing the production quotas according to a formula which favored small and usually higher-cost producers. The ever-present stripper wells — producing less than 20 barrels per day — were usually exempted from quota regulation altogether. The economic consequence of this form of allocation was higher than necessary

[22]Since oil is mobile in underground reservoirs, it is difficult to define and enforce property rights when the field is owned jointly.

[23]Morris A. Adelman, "Efficiency of Resource Use in Crude Petroleum," *Southern Economic Journal* 31 (October 1964), pp. 101-22.

[24]This system is a classic case of "acquired regulation." In such a situation, regulation is supplied by the state in response to the demand by the incumbents (mainly to restrain entry). For the original statement of the hypothesis of acquired regulation, see George Stigler, "The Theory of Economic Regulation," *The Bell Journal of Economics and Management Science* (Spring 1971), pp. 3-21.

resource costs of domestic oil, as higher-cost producers were rewarded.

Prior to 1948, the U.S. was a net exporter of oil, holding 31 percent of the then proven world reserves. Thus, the U.S. occupied a position of dominance, even greater than the position of Saudi Arabia today. But an accelerated pace of discovery and development by the major international oil companies of low-cost reserves in the Persian Gulf states began to make inroads into the U.S. position. Threatened by the competition from low-cost foreign oil imported mainly by the U.S. based major integrated international oil companies, other domestic oil producers and refiners, who had not developed foreign sources of oil, succeeded in persuading the government to institute a voluntary oil import program in 1957.[25]

The voluntary program failed, mostly due to the attempts of non-major U.S. producers to import from their recently developed wells in the Persian Gulf area. Unlike the international majors, which had already developed extensive networks of markets outside the U.S., these late-comers from the U.S. seized the opening under the voluntary import program to increase their market share at home. As a consequence, total imports as a percent of domestic production jumped from 19.7 percent in 1957 to 22.4 percent by 1959. Yielding to the intense pressure by a coalition of domestic producers and refiners, who demanded protection from cheap foreign oil on "security of supply" and other grounds, the voluntary import program became a mandatory import quota system in 1959.[26] As a result, a segment of the domestic oil industry was insulated from the rigors of competition in the market place. The mandatory program was to last until April 1973.

Under the Mandatory Oil Import Program, the overall import quota was set so as to freeze the share of imports at the level achieved in 1959. The distribution of import licenses among refiners was skewed in favor of smaller refiners. Such refiners received a disproportionately larger share of import licenses (in effect, subsidies), which had a market value per barrel equal to the difference between the higher-priced, regulated domestic oil and the cheaper, market-priced foreign oil.

The conventional method of arriving at the cost of the mandatory quota system is to add the estimated additional consumer costs of oil products to the cost of domestic resources unnecessarily used up to produce oil that could have been imported more cheaply. The real cost of the Program, however, would far exceed the conventionally estimated sum. The Program had sown the seed of the current energy crisis by sharply reducing the capacity of the oil market to respond to external shocks such as the effective cartelization of the Organization of Petroleum Exporting Countries (OPEC), and the Oil Embargo of 1973.

The Program set in motion a chain of events that culminated in the birth of OPEC in September 1960. The imposition of the U.S. import quota, based on a fixed share of the U.S. oil market, meant that imports could grow only at the rate of growth of U.S. production. This meant that the increased production that was just coming on stream from foreign wells developed by non-major U.S. producers had to be diverted away from the U.S. market. Precipitous price declines ensued in the world oil market and price competition forced the major international oil companies (majors hereafter) to match the decline.

It so happened, however, that the profit-sharing arrangement which the majors had with the oil producing countries was on the basis of the *posted price* rather than on the *market price*.[27] Therefore, in order to lighten the squeeze on their profits, the majors unilaterally cut posted prices in 1959 and once again in August 1960, despite strenuous protests and explicit warnings from the exporting countries.[28] The quota-induced cut in posted prices by the majors provided the spark for the exporting countries to form an organization to safeguard their common interest.

It is a moot point whether such an organization would have formed in the absence of the Mandatory Oil Import Quota Program. The point is that the quota system adopted in 1959 had a direct causal effect on the formation of OPEC, and such an untoward effect should be considered as a significant component of the cost of import programs.

The surplus policy on domestic oil, pursued by both state and Federal authorities at the instigation of some segments of the industry, reduced the incentives of the oil industry to improve efficiency and to add to

[25]See Dam, *Implementation*, pp. 5-8. Also see Morris A. Adelman, *The World Petroleum Market* (Resources for the Future, Inc.; Baltimore: The Johns Hopkins University Press, 1972), pp. 150-55.

[26]Dam, *Implementation*, pp. 9-14 and pp. 58-60.

[27]Yoon S. Park, *Oil Money and the World Economy* (Boulder: Westview Press, 1976), pp. 27-35.

[28]Bohi, Russel, and Snyder, *Economics of Energy*, p. 47, (p. 57 of the *Compilation*).

its stock of oil reserves. Public policy then delivered another blow to the oil market in the form of a series of price freeze and control programs instituted in 1971 to fight inflation. The domestic oil price control program had the unintended effect of killing off the mandatory import quota system. While the domestic price was being held down, the foreign price of oil increased and surpassed the U.S. level, thus wiping out the value of import licenses.

The familiar scenario of one control begetting another, in order to deal with the unintended distortions produced by the previous control, was repeated many times.[29] For example, under Phase IV of the price control program, the Cost of Living Council (CLC) adopted the technique of "vintaging" to the pricing of crude oil. A two-tier price system, with a ceiling price on "old" crude and a market-determined price on "new" and "released" domestic crude oil, was designed to encourage new exploration and production.[30] The program, while encouraging domestic exploration and development, created predictable problems of its own, due to the fact that not every refiner had equal access to *old* and *new* domestic crude oil, nor to domestic and imported crude oil.

Complaints of discrimination and charges of evading the two-tier pricing system through tie-in-sales, were often raised.[31] As a consequence of the two-tier pricing, substantial price differentials appeared in refined products reflecting different access to lower and higher-priced crude oil. The crude oil program was instrumental in creating artificial, policy-induced competitive advantages and disadvantages where none existed. A coalition of refiners, who had not developed their own domestic sources of old crude oil, lobbied actively for a crude oil allocation program under which they would receive their "equitable share" of lower-priced old crude oil.[32]

When the OAPEC (Organization of Arab Petroleum Exporting Countries)[33] embargo unexpectedly hit the U.S. in October 1973, the energy markets, particularly those of oil and natural gas, were tied up in knots due to the effects of the past policies, such as demand pro-rationing, the mandatory import quotas, and price controls on oil and natural gas. The U.S. dependence on foreign oil was to become larger than that which would have resulted in a world of open markets for natural gas and oil.[34]

The public policy response to the embargo exacerbated the adjustment problem. The Federal Energy Office — instead of focusing on the level of stocks of crude oil and refined products (which was the technique used to allocate production quotas by the Texas Railroad Commission) — focused on an anticipated reduction in U.S. oil imports, which was repeatedly overestimated. The amount of oil allocated for consumption consistently fell below the sum of domestic production and imports. As a consequence, the U.S. ended the embargo period with a higher stock of petroleum products than it started.[35]

In the wake of the embargo and the quadrupling of the crude oil price, a coalition of refiners without access to cheaper domestic old oil finally succeeded in having the newly organized Federal Energy Administration adopt the crude oil cost equalization program in December 1974.[36] The program was designed to allocate lower-priced domestic crude oil subject to price controls proportionately among refiners, and was adopted in response to the pressures to allow *all* refiners to have the equal access to cheaper domestic oil.

The principal part of the program was designed to distribute low-cost "old" domestic crude oil proportionately to *all* U.S. refiners through the issuance of tickets or entitlements. The entitlements represented rights to purchase lower-priced "old" domestic crude just as the import licenses during the mandatory oil import quota period represented rights to purchase the then cheaper foreign oil. Although the situation is reversed, the principle of resorting to political com-

[29]For an authoritative and revealing account of the utter frustration experienced by a former Federal Energy Office (FEO) administrator, see William A. Johnson, "The Impact of Energy Controls on the Oil Industry: How to Worsen an Energy Crisis," in *Energy: The Policy Issues*, edited by Gary D. Eppen (Chicago: University of Chicago Press, 1975), pp. 99-121.

[30]Ibid., pp. 109-110.

[31]Ibid., pp. 110-111.

[32]U.S. Congress, House of Representatives and Senate Subcommittee on Consumer Economics of the Joint Economic Committee, *The F.E.A. and Competition in the Oil Industry*, 93rd Congress, 2nd. Session, 1974, p. 17 and pp. 52-53.

[33]OAPEC was founded in 1967 by the Arab members of the OPEC.

[34]The price control on natural gas was having a delayed impact on the quantities supplied relative to the quantities demanded by then. Hence, the excess demand for natural gas spilled over into the market for oil. Bohi, Russel, and Snyder, *Economics of Energy*, pp. 81-7.

[35]Richard B. Mancke, *Performance of the Federal Energy Office* (Washington, D.C.: American Enterprise Institute, 1975), pp. 4-7.

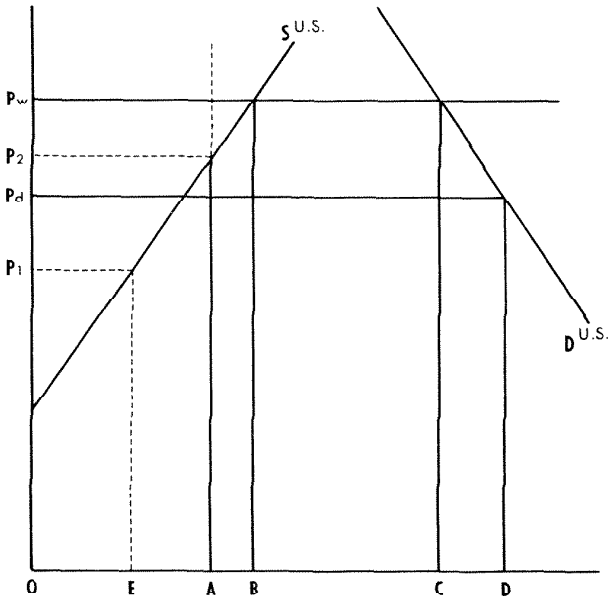
[36]See "Allocations: F.E.A. Adopts Regulations Designed to Equalize Crude, Fuel Oil Costs," *Energy Users Report* no. 69 (Washington, D.C.: The Bureau of National Affairs, Inc., 5 December 1974), p. A-7. Hereinafter, *Energy Users Report*.

petition to alter economic outcomes remained invariant. Once again, as in the import licensing and the demand pro-rationing systems, smaller refiners (with less than a 175,000 barrel per day capacity) were to receive proportionately more entitlements than larger refiners.[37]

The system of entitlements, in conjunction with the multi-tier pricing of crude oil that was introduced earlier, had the unintended effect of increasing U.S. dependency on foreign oil.[38] The increase in foreign dependency was due to the joint effects of the "uncontrolled" price of "new" domestic oil being set below the world (the OPEC cartel) price, and the entitlement program. The former reduced the domestic production below the level that would otherwise have been attained under free (open) market pricing, while the entitlement program had the perverse effect of encouraging imports by, in effect, taxing domestic production and subsidizing imports.[39]

Figure I illustrates how a public policy, designed to deal with one set of problems through intervention in the market place, created another problem. The rise in the world (cartel) price of oil and the domestic price control on crude oil led to a demand by some refiners for crude oil allocation and cost equalization programs. Such a demand was eventually answered by the Emergency Petroleum Allocation Act of 1973 and Crude Oil Equalization Program of 1974. In Figure I, one can contrast the amount of imports that would have prevailed under free market pricing and the entitlement programs as evolved. Pw denotes the "world" price set by OPEC.[40] OPEC is assumed ready to supply all the "residual" oil demanded by the U.S. at Pw. In the absence of any domestic price control, the domestic production would be OB and the imports BC. However, under the price controls on both the "old" and the "new" domestic oil at P1 and P2 respectively, the U.S. producers would supply OE of "old" oil and EA of "new" oil. The total domestic production would now be OA and the amount of imports would be AC, which are purchased at price Pw. The dependence on foreign oil increases by AB.

Figure I
The Effects of Price Controls and Entitlements



Pw: World Price (set by OPEC)
P1: U.S. "Old" Oil Prices
P2: U.S. "New" Oil Price
Pd: Weighted Average of Domestic and Foreign Oil *
*Assume Controls on End-Product Prices Using Pass-Through Provisions

The introduction of the entitlement system worsens the situation further, especially when one assumes the existence of controls on end-product prices through pass-through provisions, for example, on utility rates. If we assume that the pricing of oil products is based on the weighted average price, denoted by Pd, of domestic and foreign oil, imported oil now increases to AD whereas the domestic production is still at OA. In view of the avowed objective at that time to achieve energy self-sufficiency by 1985 (Project Independence), it is indeed ironic that the policies chosen militated against the professed goal.

Aside from the adverse effect on foreign dependency, the crude oil cost equalization program raises a fundamental question regarding the role of public policy in the market place. Those who first asked for allocation and, then, for cost equalization of crude oil were those refiners who had not integrated backward

[37] *Energy Users Report*, p. A-8.

[38] See Hans H. Helbling and James E. Turley, "Oil Price Controls," this *Review* (November 1975); Also Robert E. Hall & Robert S. Pindyck, "The Conflicting Goals of National Energy Policy," *The Public Interest* no. 47 (Spring 1977), p. 3.

[39] See Milton Friedman, "Subsidizing OPEC Oil," *Newsweek* June 23, 1975, p. 75, and Hall and Pindyck, "The Conflicting Goals," p. 3 and p. 5.

[40] The analysis abstracts from the question of how the Pw has been chosen. Presumably, if the objective is to maximize the joint profits (or wealth) of the OPEC members, a dominant-firm price leadership model would be relevant.

to production of crude oil.[41] Their argument was that it was unfair for them to be deprived of the supply of crude oil by the integrated producers in times of crude oil "shortage." They argued that the price to society of impending failures, due to their inability to secure crude oil in times of "tight" supply, would be a reduction of competition in the market. They sought, through political actions, access to crude on the same terms as the integrated producers.

However, the reasoning advanced above for political intercessions runs counter to the concept of competition in the market place. The cardinal rule of competition is that individual participants in the market place bear the full consequences of their own market decisions, inclusive of those decisions regarding the future supply of raw materials. One possible strategy for an oil refiner, regarding the future source of raw materials, is to depend on the spot market for a supply of crude oil. This tends to be a higher risk strategy than the alternative one of integrating backward to the production of crude oil. A higher risk strategy is associated in the long run with a higher expected return than the alternative lower risk strategy.

In terms of this "new view" of industrial organization, then, the demands of some refiners for equal access on competitive ground is difficult to defend.[42] Furthermore, expected accommodations of their pleas tend to have effects beyond the mere redistribution of wealth from the integrated companies to those who were not integrated. It would tend to reduce the integrated oil companies' incentives to explore and develop new reserves of crude oil.

[41]See Eppen, *Energy*, pp. 106-107.

[42]For a systematic statement of the "new view" of industrial organization, see Oliver E. Williamson, *Markets and Hierarchies* (New York: The Free Press, 1975). For an application of the new view to the U.S. oil industry, see David J. Teece, "Vertical Integration in the U.S. Oil Industry," in *Vertical Integration in the Oil Industry*, edited by Edward J. Mitchell (Washington, D.C.: American Enterprise Institute, 1976).

An exploration into the history of two major energy markets in the U.S. reveals that the overriding uncertainty regarding the thrust and direction of public policy on energy has shrouded the energy markets. Under these circumstances, decision-makers in the energy industry were distracted from the business of securing, processing and marketing energy products in response to the perceived "energy consumption policies" of individual consumers and "energy supply policies" of fellow competitors. Instead, they have had to play the socially unproductive game of trying to anticipate and influence shifts in public policy.

CONCLUSIONS

The growing concern about an energy crisis has resulted in a repeated call for a national energy policy. Unfortunately, there are widespread misconceptions about the nature and origins of the U.S. energy problem. Past attempts by various segments of the energy industry to avoid the rigors of competition have resulted in public policies which have emasculated the energy market's ability to adjust to man-made and nature-induced shocks. It is ironic that those who now call for deregulation of the energy market are the ones that had successfully sought most of the existing regulations.

We are now faced with a "crisis," which calls for policy-mandated conservation measures that may be costly in terms of economic utilization of existing capital resources. And we seem to forget that an unfettered energy market could, and still can, bring forth ever expanding supplies of energy from higher-cost conventional sources and more exotic, alternate sources. Also, an unencumbered energy market could, and still can, induce effective conservation on the part of consumers, through the working of the first and second laws of demand. The question that remains, however, is whether the various elements of the energy industry will accept competitive market outcomes in totality or demand protection from the rigors of competition when the sledding gets tough.