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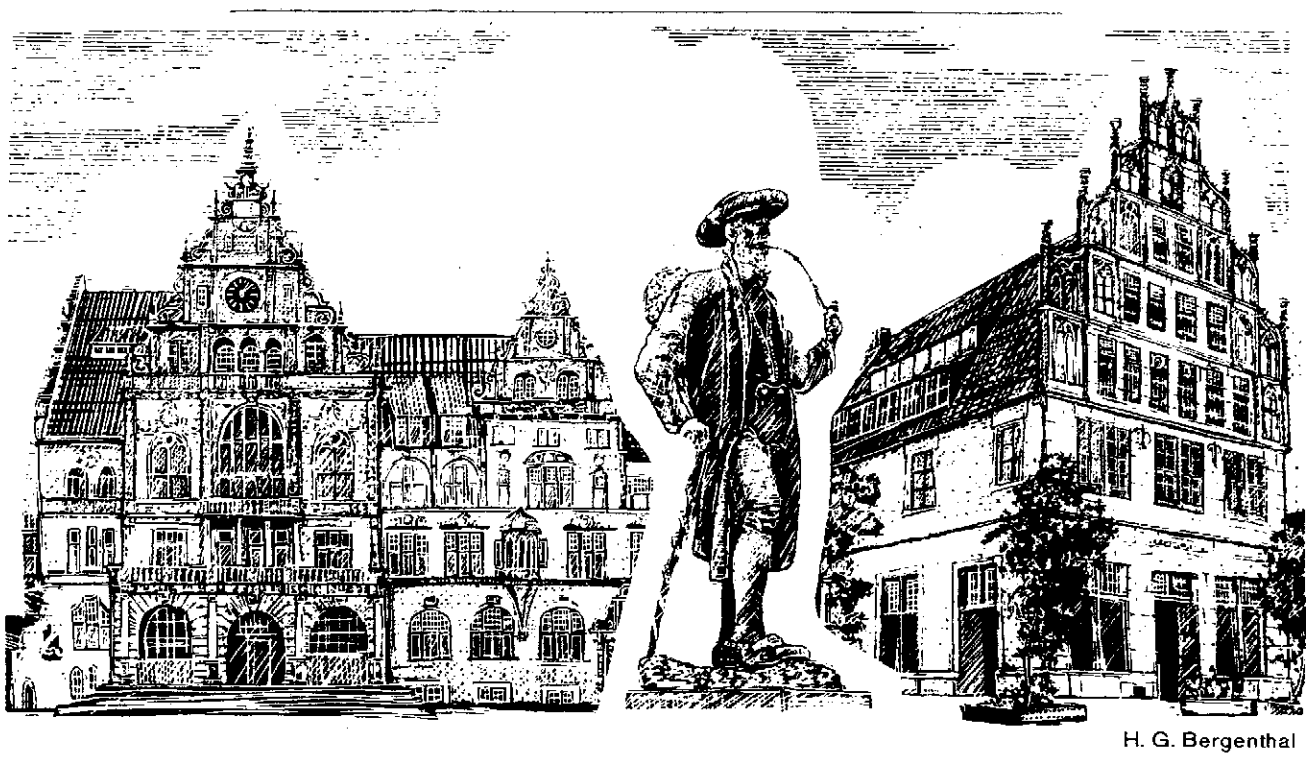

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ENDOGENOUS CHANGES OF PREFERENCES IN THE ENERGY MARKET

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ABSTRACT

Suppose that a resource has the property that consuming it induces changes in the preferences of those who do the consuming. Suppose further that these changes are of the "habit forming" variety. Then, it makes sense for those who own the resource to sell it at very low prices for a certain number of periods, and then switch abruptly to very high prices, after the consumer becomes sufficiently dependent on the resource. By doing so, the seller at first helps his customers build up a habit and then he proceeds to reap the fruits of this habit. This simple observation shows that the changes-in-tastes hypothesis could potentially be a very powerful tool in explaining the observed behaviour of oil prices.

The significance of this and related results can be summarized as follows.
First, the investigation would provide a foundation for modeling the demand structure in econometric studies of exhaustible resource markets, giving rise to inelastic demand.
Second, the investigation could be hoped to provide a better understanding of the economic forces underlying the resource markets, thus making predictions more accessible.
(For example, questions regarding the stability of a resource-selling cartel could be formulated in a precise manner and, hopefully, answered.)

Third, on the normative side, the investigation might be expected to answer questions such as what the rate of extraction of exhaustible resources should be and what schedules of taxes or subsidies should be imposed on resource industries.

Fourth, based on this analysis, there will be an attempt to venture a comprehensive assessment of public policy decisions in the area of national resources and energy.

1. INTRODUCTION

If a cake is appetite-arousing (the more of it you have eaten, the more eager your are to continue eating and the less willing you are to wait), then the cake will be eaten up too quickly. Certainly this will be the case if the consumer is unaware of the effect that consumption has upon his preference. You can intuitively think of examples such as: Addiction problems, drug consumption, but also enjoying classical music, being in love with a beautiful stimulating girl, or getting addicted to consumption of a single resource, building up a production and consumption technology depending on this resource and not being liable to shortrun reversibility of consumption levels.

It is clear that an agent whose preferenes are changing over time is bound to run into an intertemporal conflict: Consuming now makes him better off for a while but makes him considerably worse off in the foreseeable future. Hence he is caught in a dynamic "tragedy-of-the-commons" or "prisoner's dilemma" situation with himself, which not necessarily can be resolved by an internal competitive adjustment process since upper price shifts may not induce the consumer to consume less or more slowly. If markets fail, coercion from outside, if it forces the economic unit to consume more slowly, could make it better off.

Actually, the "addiction rule" of an optimal consumption policy can be transformed to a game of strategy, where one regards the resource-user at two different points of time as two different persons, as two players in the game. Each player selects a strategy that maximizes his own payoff, given the strategies of the player whose moves take place after his move.

A set of strategies (one for each player) having this property is an equilibrium for the game in the sense of Nash. It

is , in fact, a special kind of Nash equilibrium, where each player's strategy is best against any moves by those players who precede him - be they computed from the equilibrium strategies or not - and it is best against the equilibrium strategies of those players that succeed him. This version of Nash equilibrium which is clearly stronger than regular Nash equilibrium, is known as perfect Nash equilibrium. We shall say that the resource user's exhaustion and consumption policies are in equilibrium if, when viewed in the game-theoretic framework, they constitute a perfect Nash equilibrium.

Let's point to a brief historical note. The principle of "habit formation" is not altogether new. It appears that Alfred Marshall [1920] has taken up the theme in a different context, and hinted at its significance in demand analysis.* The following quotation clearly shows what he has in mind:

"Whether a commodity conforms to the law of diminishing or increasing return, the increase in consumption arising from a fall in price is gradual: and, further, habits which have once grown up around the use of a commodity while its price is low, are not quickly abandoned when its price rises again. If therefore the supply has gradually increased, some of the sources from which it is derived should be closed, or any other cause should occur to make the commodity scarce, many consumers will be reluctant to depart from their wonted ways."

*We are indebted to Dr. W. Gaertner, University of Bielefeld, for this reference.

2. EXPLANATIONS OF PRICE HIKES IN THE OPEC-CARTEL

It is crucial to try and understand the mechanism which governs the behavior over time of the prices of crude oil and other raw materials. Surely, the positions taken by the various delegates to any given OPEC meeting are, to a large extent, reflections of strong economic forces, operating in the background. The importance of trying to gain an understanding of these economic forces can hardly be exaggerated. First, such an understanding would lead to more reliable predictions concerning the behavior of prices of raw materials and other relevant variables in the future.
Second, any attempt to assess the effectiveness of various regulatory measures which might be proposed with regard to oil and other resources would not be likely to succeed without an understanding of the underlying mechanisms.

There is, in fact, a very broad concensus on these points, both among economists and among political scientists. As a result, many efforts have been invested in recent years in trying to discern and analyze the forces governing the behavior of the prices of raw materials (particularly crude oil) in the world makets. It is not feasible (nor is it desirable) to try and summarize these efforts within this presentation. Nevertheless, it is perhaps worthwhile to mention three prominent lines of thought on this problem.

(a) The behavior of oil prices is determined largely by political considerations, with economic forces playing only a minor role. (H. Kissinger: "What has gone up by political decision could come down by political decision".)

(b) The behavior of oil prices is explainable in terms of equating the cost of producing a unit of energy from oil with the cost of producing the same unit from other types of inputs.

(c) The behavior of oil prices is explainable in terms of the monopoly positions held by oil producers, and a market environment that sustains the monopoly position.

All three hypotheses contain some truth but they also have serious drawbacks. Hypothesis (a) is not totally consistent with the fact that oil prices began to shoot upwards many months before the Yom Kippur War. Nor can this hypothesis explain the difference between the positions of the various oil producers regarding further increases in oil prices. Hypothesis (b) implies that oil producers have not behaved optimally until the early 1970's, which is doubtful. Hypothesis (c) has the same drawback as hypothesis (b), plus the fact that, upon examination, it turns out that the scope for using monopoly power in the oil industry is rather limited. (See Stiglitz [1976].)

3. HABIT FORMATION AND RESOURCE USE

In most of the theoretical work what has been done to date on the economics of exhaustible resources, the demand function for the services of these resources is either taken to be fixed or, more often, it is assumed to shift upwards, exponentially, with the rate of growth of the economy. This is true, for example, in Hotelling's classical paper [1931], in Solow's survey lecture [1974] and in all ten papers comprising the Symposium on the Economics of Exhaustible Resources, published in the Review of Economic Studies (Heal and Hendry, eds. [1974]). Now, viewing the demand side of the markets for exhaustible resources in this fashion immediately rules out the possibility that prices would behave as they have indeed behaved where, in crude oil, we have observed a discontinuous price rise of 500% and even more so on the Rotterdam spot market. Therefore, the central theme of our research is motivated by the notion that the dynamics of the demand for exhaustible resources must be formulated so as to permit discontinuous jumps in prices. Specifically, the idea is to view the demand for certain exhaustible resources as being generated by consumers whose preferences are subject to change over time. Indeed, the idea is that some raw materials, most notably oil, are to some extent habit-forming. The more of them we consume, the

more we are willing to give up other goods, in order to gain one unit of these resources for further consumption. The framework here is one that has come to be called "endogenous changes in tastes." There can be no doubt about the changes-in-tastes aspect of the consumption of petroleum products. Sociologists as well as economists trace some of the most profound changes in consumption patterns, that have occurred since World War 2, to the spread of the automobile as a popular good. Now, the consumption characteristics of the automobile rest upon the internal combustion engine which, in turn, rests upon fuel derived from petroleum. Given existing technology, no other fuel could have taken the place of petroleum in permitting the automobile to gain such a position of prominence. A similar observation holds true for other petroleum derivatives, such as plastics.

Now, if demand for an exhaustible resource is generated by consumers whose preferences are subject to change over time, then it becomes quite reasonable for the owner of the resource to adopt a price policy involving a sudden jump upwards. The story is quite straightforward: Initially, it is optimal for the owner of the resource to pick a very low sales price, so as to sell in large quantity, thereby inducing a rapid change in consumers' tastes (getting them hooked, so to speak). Then, after this initial period, the time comes to harvest the fruits of the induced changes in consumers' preferences, by raising the price of the resource sky high - going through the roofs.

Apart from their economic significance, the issues discussed in the preceding paragraphs also have a philosophical significance. For example, the concept of consumers' sovereignty becomes philosophically untenable as soon as one admits the possibility that the act of consumption may in itself bring about a change in the consumers' preferences. These philosophical questions have been discussed in Yaari [1978a]. The principle of endogenous changes of preferences giving rise to

irreversible demand structures (at least in the short run) is incompatible with the principle of diminishing eagerness to trade which states that if a trade is accepted, it will also be accepted if you get fractionally less and pay fractionally more (up to a certain degree). In fact, the latter principle introduces some kind of convexity of preferences into your utility function that appears to be responsible for smooth, continuous demand functions derived from utility. Clearly, endogenous changes of preferences destroy the convexity property that explains the jumps in the demand functions (see Yaari [1978b])

4. ECONOMIC ANALYSIS - HYPOTHESES AND PROBLEMS

When the consumer's preferences are subject to change over time, it is no longer clear how to describe rational behavior. The best consumption bundle according to today's preferences (and this bundle includes savings for tomorrow) may not be best according to tomorrow's preferences. However, the economic literature offers a resolution of this difficulty. (See, for example, Pollak (1968) and Peleg-Yaari [1973].) Using the methodology of the Theory of Games, it is possible to describe the optimal behavior of the consumer unit, even though its tastes keep changing over time. With this definition of optimality, one can proceed to investigate a whole host of problems, having to do with the extraction and consumption of exhaustible resources which have the property of inducing changes in consumers' preferences. In our present project, an attempt is being made to tackle the following problems.

PROBLEM (i): SPEED OF RESOURCE EXTRACTION. Assume that the resource in question is owned and extracted by the consumer unit itself. (This unit may be an entire economy.) Under what conditions does the optimal consumption plan -- optimal in the sense discussed above -- lead to a rate of extraction which is too fast? (By "too fast" we mean that there exists

a slower rate of extraction that would render a greater utility in every period.)

PROBLEM (ii): EXPLOITATION OF THE CONSUMER BY A RESOURCE SELLER. Now assume that the consumer unit, rather than owning the resource, must buy it from a price-setting agent. Assume that this other agent attempts to maximize profits. Under what conditions will the prices set by the seller be at a very low level in the initial phase of the process, then jumping to a very high level at some point? Also, under what conditions will the prices set by the seller force the consumer to pick an inefficient consumption path? (By "inefficient" we mean that, with the same prices, there exists another consumption path rendering a greater utility in every period.) Examples where these two phenomena occur can easily be constructed, but the general conditions which permit them to occur are not known. Nor is it known whether the conditions leading to one of these phenomena are in any way related to the conditions leading to the other.

PROBLEM (iii): CORRECTIVE TAXATION: Assume that the framework is as in Problem (ii). Is there a tax-subsidy scheme (on both buyer and seller) that would guarantee that the buyer will always be able to pick an efficient consumption path? If not, is there a tax-subsidy scheme that always makes the buyer better off, in every period? (Note that the seller cannot be forced to sell.) There is some reason to believe that a progressive income tax, levied on the seller, will have the property of making the buyer better off in every period.

PROBLEM (iv): CARTEL STABILITY. Now assume that the ownership of the exhaustible resources is distributed among several agents who form a cartel. In what phases of the process will the cartel be stable, and in what phases will it be unstable? Specifically, will it ever be profitable for one member of the cartel (e.g., the one with the largest

reserves of the resources) to break the collusion, in order to be able to set a price policy independently? Here, it will be assumed that sellers have control not only over prices, but also, to some extent, over quantities.

PROBLEM (v): HOW TO DISCERN A PATTERN OF CHANGING TASTES OF OBSERVED DATA? The hypothesis, that the markets for certain raw materials are affected by changes in consumer tastes, is based upon sociological and meta-economic considerations, and not upon an econometric study of the data. The reason for this is that the question of whether any given set of market data can be used to infer a pattern of changing tastes has not been studied, let alone resolved. At issue here is, essentially, the possibility of proposing a revealed preference theory for a consumer with changing tastes.
Each of the foregoing five problems is, potentially, a topic for a separate paper.

It is envisaged that the research could be carried out on four different methodological levels. First, an attempt to obtain analytical results, using dynamic programming methods. Second, solving out specific examples on the computer, and making use of the algorithm developed by Scarf [1973] to locate the consumer's equilibrium consumption paths. Third, computer simulation (i.e., synthetic data generation), using a very large number of examples, but restricting the agents' actions down to a choice among a small number of alternatives in each period. The results of these computations can then be studied statistically. Fourth, if an answer could be found for Problem (v) above, then a rough econometric study of data from the market for crude oil could be attempted, in an attempt to obtain endogenous confirmation for the changes-in-tastes hypothesis. Fifth, a Markovian decision model will be developed, in which the price development - based on the changes of tastes hypothesis - is likely to be going upward, in which provisions of substitution technologies remain uncertain as well as the availability of the resource.

Based on this model a forecasting method will be developed, that specifies under various scenarios, the price quantity equilibrium position of substitutable resources.

5. PRELIMINARY EMPIRICAL RESULTS*

Work on this project has proceeded along the following lines. An econometric study of household demand for energy has been carried out, in which the main feature has been the allowance for change in consumers' preferences. The hypothesis was that, as households use more and more energy in various forms, they get accustomed to certain largely irreversible consumption patterns (such as the use of private automobiles) which tend to affect the households' preferences vis-a-vis future consumption. The household's demand for energy was broken down into five components, according to the types of fuel involved (coal, natural gas, fuel oil, automotive gasoline, and household heating fuel) and a simple utility-maximizing model was used to fix the general forms of the demand function. To keep the problem manageable, it has been assumed that households are "naive" in the sense that they optimize in each period separately without taking into account the effect of present consumption on future preferences. Under this assumption, household demand functions for various fuels have been estimated, using time series data for all OECD countries. Several specifications have been tried out, some involving estimating the demand for each country separately, and others using various methods for grouping the countries and estimating a smaller number of demand functions. The results so far have been quite encouraging in several ways:

(1) In all the specifications, the change-of-preference term came out quite significant, and always of the predicted sign.

(2) The introduction of the change-of-preference term in income elasticities in a way puts them in line with predicted values. (Previous studies of the demand for energy had given rise to unreasonably high elas-

* This work is being carried out in collaboration with Dr. Alexander Lebanon, Hebrew University.

ticities.)

(3) The relationships among the individual fuels turned out as anticipated, with coal having almost no effect on future preferences (and coming out as an inferior good) and automotive fuel having the largest effect on future preferences.

(4) A preliminary test of the hypothesis that fuel sellers attempt to take advantage of their customers' changes in preferences turned out to show a significant effect.

Throughout the study, a recurring difficulty kept coming up, in the form of unduly high serial correlation in the residual terms. Attempts are now under way to eliminate this flaw by changing the econometric techniques in an appropriate fashion.

What remains forthcoming is a study of the supply side of the energy markets, not so much as regards production costs but rather as regards the suppliers' view of their own effect on their customers' future demand. (As mentioned above, a preliminary test of this effect proved significant.) It is reasonable to suppose that sellers of fuels behave in the market in a more sophisticated way than buyers. Sellers are more likely than buyers to make plans which take into account the long-run effects of changes in consumers' preferences on the behavior of the market in the future. If sellers are price-setting monopolists (as is reasonable to suppose) then one might try to test the extent to which they use these prices to manipulate consumer demand so as to increase their profits in the long run. A model of the long-run behavior of sellers is now being developed, to be used later on in a systematic attempt to test this "price-preference manipulation" hypothesis. Of course,it would be very nice if this hypothesis could be shown to account, even partially, for the behavior of fuel prices in recent years.

6. ECONOMETRIC RESULTS

(a) The consumer's demand function

(1) Utility: $U(x_1, \ldots x_K, y) = -\left[\sum_{i=1}^{K} \frac{\alpha_i}{\gamma_i} e^{-\gamma x_i} + \frac{1}{\sigma} e^{-\delta \gamma}\right]$

(2) Budget constraint: $\sum p_i x_i + y = M$

(3) First order conditions: $\alpha_i e^{-\gamma_i x_i} = p_i e^{-\delta y} \quad i=1,\ldots,K$

Taking logarithms, one gets:

$$x_i = \frac{1}{\gamma_i} \log \alpha_i - \frac{1}{\gamma_i} \log p_i + \frac{\delta}{\gamma_i} y$$

(4) Constraints on parameters:
The first order conditions imply that: $\alpha_i > 0$, all i
The second order conditions imply that $\gamma_i > 0$ $\delta > 0$, all i
The other Slutsky's conditions do not imply additional constraints on the parameters.

(5) Elasticities:
The income elasticities are: $\varepsilon_{iM} = \frac{M}{\Delta} \frac{1}{\gamma x_i}$

where: $\Delta = \sum_i \frac{p_i}{\gamma_i} = \frac{1}{\delta}$

The own price elasiticities are: $\varepsilon_{ii} = -\frac{1}{\gamma_i x_i} -$

$$- \frac{1}{\Delta \gamma_i x_i}(p_i x_i - p_i/\gamma_i)$$

(6) The marginal rates of substitutions between fuel i and y is:

$$\frac{dy}{dx_i} = \frac{U_i}{U_y} = \alpha_i \frac{e^{-\gamma_i x_i}}{e^{-\delta y}}$$

(7) Regression equations:

From the first order conditions:

$$x_i = a_{oi} - a_{1i} \log p_i + a_{2i} y \qquad i=1, \ldots, K$$

with the constraint: $\frac{a_{2i}}{a_{1i}} = \frac{a_{2j}}{a_{1j}}$ for all i and j

(8) Habit formation:

Formulate: $a_{oi} = b_{1i} \log(S_i - b_{oi})$

where S_i denotes cummulated past consumption.
If habit formation occurs at a decreasing rate, then we expect:

$$0 < b_{1i} < 1$$

(9) Short run revenue maximization:

A monopolist picks $p_1, p_2, \ldots, p_K$. Equivalently, separate monopolists, each picking p_i on the assumption that p_j, for $j \neq i$, is given and fixed. Define $z_i = p_i x_i$, and maximize either $\sum_i z_i$ or each z_i separately.

$$\frac{\partial z_i}{\partial p_i} = 0 \Longrightarrow a_{oi} - a_{1i} \log p_i + a_{2i} y = a_{1i}$$

or: $x_i = a_{1i}$

If the monopolist is aware of consumer's habit formation, then he will pick p_i such that $x_i > a_{1i}$

(10) Long run revenue maximization:

The monopolist now picks a series of prices p_i such as to maximize his discounted flow of revenue over the whole time horizon as defined by his resources. The optimal price at time t is given by:

$$p_{i,t} = - C_i e^{rt} \varepsilon_{ii,t}$$

where: C_i is a constant, r is the monopolist's discount rate, and $\varepsilon_{ii,t}$ is the consumer's own price elasticity at time t.

The monopolist's supply function can be approximated by:

$$p_i x_i = c_i e^{rt}$$

where c_i is another constant.

(b) Energy market model with monopolistic supply and household demand with habit formation

Supply function:[1] $p\,x = c\,e^{rt}$

Demand function: $x = -a_1\,\ell n(p) + a_2\,y + b_1\,\ell n(S - b_o)$

Three Stage Least Squares Estimation Method. OECD data.

Fuels	Coal	Oil	Gas	Electricity	Trans. fuel	Other commodities
Supply						
$\ell n(c)$*	2.56	2.95	2.38	3.52	3.98	
	(26.1)	(43.9)	(31.8)	(59.1)	(64.5)	
r**	.032	.032	.032	.032	.032	
	(8.8)	(8.8)	(8.8)	(8.8)	(8.8)	
$\bar{R}^2$***	- .27	.27	.23	.30	.20	
Demand						
a_1	-.024	.003	.051	.006	.116	
	(-6.2)	(0.7)	(22.7)	(7.8)	(32.7)	
1000 a_2	-.130	-.042	.042	.005	.060	
	(-16.3)	(-3.8)	(6.1)	(1.8)	(5.0)	
b_1	.187	.354	.248	.195	.411	
	(25.7)	(27.9)	(22.8)	(40.1)	(32.4)	
$\bar{R}^2$	.71	.85	.87	.92	.90	
Average data values						
$\bar{x}$	.225	.396	.176	.121	.450	2385.0
$\bar{p}$	148.8	109.7	250.6	667.5	306.8	1.0

* Figures in parantheses are t statistics.

** The estimates refer to the constrained model with common discount rates for all fuels.

*** $\bar{R}^2$ was computed as if each equation was estimated separately.

Energy market model

3SLS method with constrained common δ for all fuels

Fuels	Coal	Oil	Gas	Electricity	Transportation fuel
Supply					
log(c)	2.58	2.91	2.32	3.45	3.92
	(27.2)	(44.1)	(31.0)	(58.3)	(63.4)
r	.037	.037	.037	.037	.037
	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
$\bar{R}^2$	-.39	.34	.17	.38	.23
Demand					
a_1	-.035	.009	.051	.007	.106
	(-8.5)	(2.2)	(21.0)	(10.0)	(23.8)
1000* a_2	-.062	.016	.090	.012	.187
b_i	.090	.279	.162	.176	.254
	(23.8)	(55.6)	(38.9)	(78.7)	(55.9)
$\bar{R}^2$	.43	.85	.82	.92	.87

Estimates of demand elasticities
for all eight OECD countries and for three subgroups of countries

Fuels	Coal	Oil	Gas	Elect.	Transp. fuel	Other Commodities
All eight OECD countries						
Income elasticity	-.217	.016	.588	.101	.523	1.062
Own price elasticity	.109	-.008	-.292	-.052	-.270	-.982
United States and Canada						
Income elasticity	-2.830	.400	.418	.300	.538	1.084
Own price elasticity	1.444	-.204	-.209	-.163	-.288	-.985
Britain, Germany and Belgium						
Income elasticity	-1.562	.031	.914	.162	.584	1.104
Own price elasticity	.556	-.010	-.305	-.056	-.205	-1.001
France, Japan and Italy						
Income elasticities	-.797	.641	3.742	.372	1.161	1.005
Own price elasticities	.099	-.082	-.441	-.049	-.165	-.937

7. PUBLIC POLICY PROBLEMS AND PROBLEM SOLVING

Along with the envisaged results of Section 4, supported by the findings in Section 5 and 6 it is hoped to treat some more policy-related problems and some technical problems that are of immediate interest for public decision analysis and decision making.

PROBLEM (i): What kind of substitution processes could be taking place to mitigate the sole dependency or reliance on the usage of this exhaustible resource? Furthermore, what technological switching processes are feasible and forseeable to provide for a sufficient energy basket of an economy in view of an enforced sharp decline of fossil fuel usage?

PROBLEM (ii): How to develop various game-type configurations relating to policies (strategies) of resource holders as compared to resource users, in particular situations where the future availability of the scarce resource is uncertain or where substitution for this resource becomes feasible?

PROBLEM (iii): The essential property of the energy resource, from the final consumer's point of view is that it is not directly consumable but enters the consumption process indirectly via the consumption of other goods and services. This will raise the question whether and to which extent technological irreversibilities, dominantly based on one energy resource, e.g. fossil fuel, will create consumption patterns that are habit persistent over time, or whether it is possible via energy saving designs (for instance, in the automobile industry) to drastically decrease the energy consumption, but still for the consumer to maintain the same standard of living or level of comfort.

PROBLEM (iv): To capture the notion that catastrophe entails large losses, we suppose that whenever the resource stock

falls below a critical value, and unless resource substitutions are feasible, society receives the same level of utility as it would receive if consumption were zero. Hence a catastrophe is defined here as an uncertain event which reduces society's consumption (utility) to zero.
In optimal depletion problems it is wellknown that a resource user demanding a given share of some resource, with a positive discount rate, and a strictly concave utility function, will decrease his consumption of the resource over time. However, when the available stock of the resource is uncertain, and, additionally, preferences are of the habit-forming variety then it may be optimal that society increases the consumption of the resource over time. It will be investigated to which extent, in society's perception, there is an intrinsic relationship between the increasing probability of substitutable resources and the increasing uncertainty on the availability of the resource to be substituted.

PROBLEM (v): What pricing strategies of a nonrenewable energy resource are feasible and optimal to avoid a catastrophic outcome that is nonreversible in terms of depleting existing resource levels, but which, on the other hand, are able to provide effective incentives to generate substitution processes?

PROBLEM (vi): It should be explored what are the consequences to admit other constraints on the decision process of the resource user (or the resource holder), such as limits on his information-carrying capacity, that require improvement-related strategies compatible with the habit-forming consumption pattern of the resource user (or with the exploitative attitude of the resource holder), rather than optimizing strategies (see Gottinger 1978 a,b).

PROBLEM (vii): Finally, an investigation will be made about what conclusions can be drawn, using the endogenous change-of-tastes-hypothesis regarding national resource and energy policies, regulation vs. economic incentive schemes in the European Economic Community as compared to the U.S. The ques-

tion of a Pareto-efficient resource-use policy of a common property resource as well as those of various policy responses toward resource-holding cartels such as OPEC and others will come up in this context. [2)]

In a previous paper, Yaari [1978] stated that in the case of purely endogenous changes of tastes, serious doubts can be raised as to the merit of a market mechanism, based on free exchange. However, this viewpoint appears too much demand oriented, and neglects the fact that even "addicted" consumers may be rational enough to switch to other goods, offered to them by induced changes on the supply side, if these goods serve the same purpose as regards their addiction.

Since technological factors may impede a switch to the production of other goods, at least in short-run, this argument, still being valid, may bear sole responsibility for market failure on markets with "addicted" demand.

In these cases justification for intervention (by policy makers) can be given on the grounds that future generations have to be protected from morally wicked, addicted present day consumers if and only if

(i) technology remains stationary (i.e. does not generate alternatives serving the purpose of addiction),

(ii) addiction causes the aggregate time preference of consuming to be substantially higher than the socially optimal time preference of society,

(iii) supply is not monopolized.

In particular, if the rationality of the market or the price mechanism fails, in the sense that the market yields a lower time preference than is justified by the scarcity of the resource, or equivalently, if the depletion rate of the resource advances more rapidly now as against future use, then under the assumption of habit formation of the resource-user, it can be shown that paternalism, as a way of coercion,

appears to be a rational policy to pursue. Under these circumstances it could be argued that outside intervention is justified in the sense that the resource user is willing to accept the principle of coercion as reasonable, due to his desire to achieve a Pareto-optimum, a device to be justified on the grounds that the person being forced will be better off.

However, unless at least one of the listed conditions (i)-(iii) hold in particular situations, if it turns out that through the hypothesis of habit formation, demand for a single exhaustible resource becomes price-inelastic, and given that there are strong indications of the supply side being inelastic too (see W. Häfele and W. Sassin 1978), then only markets with an effective price mechanism signal profit incentives to engage in substitution processes for replacing this resource, allowing a strengthening of the supply side of the market.

Footnotes

1) Data description
The data consists of 176 observation points. There are 22 yearly observations for each of eight major OECD countries over the period 1955-1976. The data sources used were mainly OECD statistical publications.
Variables used were defined as follows:

x_k represents the average per capita quantity of fuel k consumed by the households and commercial sector (expressed in TOE - tons of oil equivalent - units per year);

p_k represents the average retail price of fuel k (expressed in 1976 US Dollars/TOE, the consumer price indexes were used as deflators and the official currency rates used as conversion factor);

t represents the time (t=1 at 1955);

M represents the average per capita private consumption expenditure (expressed in 1976 US Dollars);

y represents the average household expenditure on commodities other than fuels ($y = M - \sum p_k x_k$);

S_k represents the cummulative per capita household consumption of fuel k)expressed in TOE since 1921 and up to year t).

c, r, a_1, a_2, b_1 and b_o represent fixed parameters.

2) Since this will require a dynamic analysis of resource policy we consider it useful to explore the situation along three main phases: First, an initial phase, during which the jump of oil prices raises the general price level and simultaneously transfers income from consumers to producers of energy.
Second, a transition phase in which energy producers gradually increase their spending out of the higher receipts, oil-exporting countries increase their purchases from oil-importing countries.

Third, a final phase in which consumers of energy are fully paying for the higher prices through a transfer of real resources - as reflected in higher imports to foreign producers of energy and higher resource costs for domestic production of primary sources of energy.
The economic consequences of higher oil prices for the industrial countries are quite different during the various stages of this process and hence require different economic policy reponses.

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