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# WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA: A SUGGESTED APPROACH\*

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The market is a man-made institution. Specialization, trade, and exchange are human responses to comparative advantage. To be operative the market must exist within a particular cultural setting and must be protected by well defined laws and/or customs. It has come to symbolize many things to different people. To some it is simply a tool for accomplishing certain functions of an economic system. To others it has great normative significance either of positive or negative nature. To another group it represents a set of values and demands allegiance or enmity which exist independent of the performance of the market as such.

The literature in economics dealing with the market tends to focus on price as the signal for the allocation of resources as well as a means of distributing income. Yet universal satisfaction does not exist with the market either as a resource allocator or as a distributor of income. Galbraith<sup>1</sup> argues that the market is no longer viable for the really large allocation decisions in an industrial society. Nevertheless, much of the public tinkering with market prices and quantities has actually stemmed from dissatisfaction with the distribution of income resulting from market performance.

This dissatisfaction with market performance has resulted in a pragmatic action program in this country. As a group we have modified the market when its results have failed to satisfy. The arguments about its performance both by economists and non-economists are often highly doctrinaire. There is a failure to view the market in an objective fashion—as a means to an end. If this were to be done, one would need to establish criteria against which market results could be judged. Only in this way could objectivity be achieved. Obviously these criteria would need to be formulated independently of market results. A weakness of economics literature is that there is so little developed in the way of objective criteria

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1. J. Galbraith, *The New Industrial State* (1967).

against which the market and alternative institutions might be judged.

The position taken in this paper is that the market is a means to an end. As such, it should be judged in terms of its efficiency in achieving a particular end. We ascribe no particular normative significance to the market as such.

## I MARKET OPERATION

In the case of water resources the market has often been modified or eliminated as a means of performing the economic functions associated with the use of a scarce resource. Nevertheless, the traditional functions of the market can be discussed profitably in this connection.

In the case of resource allocation, it can be shown that the market will result in optimum allocation if certain conditions are present. However, this is not the case with income distribution<sup>2</sup> where there is no *a priori* assurance that optimum distribution will result. As mentioned above, it is probably dissatisfaction with the distribution of income rather than dissatisfaction with resource allocation that has led to much of the modification of market operation. It may seem surprising that in view of this, income distribution is not attacked directly through taxation and subsidies. However, there are at least two reasons which help explain this state of affairs:

1. Historically we may have been more interested in equality or provision of opportunity than in income equality in a static sense.<sup>3</sup> This may have particular relevance to such programs as that of the Bureau of Reclamation where one of the objectives was to provide opportunity in agriculture.
2. Income distribution and "effort" have been closely linked in our value system. Only recently have we been able to accept the idea that income may be a function of the social environment as well as individual effort. Poverty, therefore, becomes a social as well as an individual problem.

If the above is correct, then a possible rationale exists for attempting to affect the environment by modifying market operation with respect to resource allocation as opposed to leaving this allocation to the market and attacking income distribution directly. The latter approach is that advocated by Milton Friedman and others

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2. Bator, *The Simple Analytics of Welfare Maximization*, 47, *Am. Econ. Rev.*, 28, 29, 31-34 (1957).

3. For example, see Brewster, *The Impact of Technical Advance and Migration on Agricultural Society and Policy*, *SLI J. Farm Econ.* 1169-1184 (1959).

who generally favor considerable reliance on the market. Proposals such as a negative income tax are some evidence that this approach is gaining in favor.

## II

### MARKET EVALUATION CRITERIA

Water, in particular, raises additional points that must be considered. Are there unique characteristics of water as an input in production or consumption that will affect the capacity of the market to serve as a resource allocator?

Much has been made of water being essential to life, but many have pointed out that this is also true of other commodities.<sup>4</sup> The relatively minor role of water in the total production and consumption process is more relevant. The decision process in water resource development in this country can be more easily understood if we recognize that historically water has been abundant and cheap, rather than scarce and expensive. We have had considerable public participation in water resource development which can be viewed as an expression of the public's desire to continue a policy of abundance. Subsidizing the cost of water to its most important user, irrigated agriculture, by general public funds and revenues from hydroelectric power generation can be cited as an example.<sup>5</sup> Because water has been made relatively cheap and abundant, the consequences have been:

1. the substitution of water for other inputs in production; and
2. water developed with public funds has served as a substitute for the political action needed for reallocation or efficient water use.

There is evidence that water will become more expensive in the future. Yet there is almost no method of evaluation that automatically results in a comparison of the opportunity cost of failure to stimulate more efficient use of water or to reallocate it, with the cost of developing additional water resources. It is this state of affairs that has led any number of economists to advocate greater market reliance to correct many of the obvious misallocations existing in the water field.<sup>6</sup>

Why do we have this pessimistic attitude with respect to the role of the market in water allocation? Are there technical economic

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4. See Eckstein, *Water Resource Development* 192 (1961). For a more recent empirical study see R. Young and W. Martin, *The Economics of Arizona's Water Problem*, Arizona Review, (1967).

5. J. Hirschleifer, DeHaven and Milliman, *Water Supply: Economics, Technology and Policy* 1 (1960).

6. E. Renshaw, *Toward Responsible Government* (1957).

reasons why the market will not work as an allocator, or is the answer to be found in the political arena? Bator cites three reasons why the market may fail. These are:

- (1) The existence of technological interdependencies. This means that one person's consumption or production will automatically and inevitably affect another's production or consumption because they are physically linked. Water pollution is the classic example. The market may be unable to cope with such a problem because property rights cannot be appropriately defined.
- (2) The existence of indivisibilities. In this case decreasing costs prevail in production. It would be impossible to utilize marginal cost pricing (charging beneficiaries for the costs which they incur), a necessary condition for an efficient resource allocation, because such pricing in this case would make impossible the recovery of the full costs of production.
- (3) The existence of public goods. This is a special case of indivisibilities which exists when it is not possible to define private ownership rights without significantly reducing the public welfare. An example might be a spot of unique natural beauty when demand has not yet grown to the point where one person's use would result in the reduction of another's utility.<sup>7</sup>

Later in this article, the above technical economic conditions are examined in some detail, with particular reference to water problems. However, we need to mention here the relationship of economic and political power as they influence water development in this country. Quite apart from questions of economic efficiency as defined by the theory of markets is the incidence of economic benefits arising from water development. Associated inputs, ranging from the professional services of engineers and attorneys, to fertilizers and other chemicals, are examples. Water makes the West green both literally and figuratively. There are also economic benefits associated with the output resulting from water development projects. The result has been that water development and economic growth have been associated in many areas of the West.

Coupled with this has been a particular form of democratic government that results in our representatives being highly oriented to a particular geographic area. There is much less party discipline in the United States than in the parliamentary democracies such as Great Britain. The consequence is that the executive branch has lost

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7. Bator, *The Anatomy of Market Failure*, Q. J. Econ.

effective control over many water development agencies.<sup>8</sup> The agencies quite accurately recognize that Congress determines their fate. Not surprisingly, they become responsive to Congressional desires. Water development then often becomes primarily a method of transferring income, in the form of government expenditures from one region to another, and secondarily—quite often incidentally—a means of correcting a water shortage in any meaningful economic sense. By meaningful, we mean as a shortage would be defined in the context of market economics.

The reasons then for the development of alternatives to the market in the allocation of water resources stem from a number of interrelated sources. These include our value system, some technical water production relationships, and political institutions exogenous to the decision-making process in water resource development. Market alternatives cover a range almost as broad as the causes of their origins. We shall restrict our comments here to a discussion of public investment in water resources and certain kinds of water use regulations. We shall also attempt to focus upon those characteristics of these alternatives which are especially relevant to their evaluation.

Before proceeding with our assignment, a caveat is in order. Logically, we would be concerned with the evaluation of the market in comparison to other allocative mechanisms, noting their respective performances in "welfare maximization." While economists agree that this goal would be Utopian, there is disagreement about the extent to which the characteristics of our world differ from those of the imaginary ideal island. Krutilla has summarized the conditions which must exist to enable us to conclude that an action leads to an increase in welfare:

- (1) Gross benefits of the action must exceed all costs associated with it;
- (2) costs must be borne by beneficiaries in such a way that the initial income distribution is not disturbed;
- (3) the initial income distribution must in some sense be judged as "best"; and
- (4) the marginal conditions for an efficient resource allocation and exchange must be fulfilled in all cases except the one which is the subject of the action to be undertaken.<sup>9</sup>

If the economist were strictly doctrinaire, he would probably cease to be an economist. In any event, his knowledge that at least

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8. Marshall, *Rational Choice in Water Resources Planning*, Economics and Public Policy in Water Resource Development, (Smith and Castle ed. 1964).

9. Krutilla, *Welfare Aspects of Benefit-Cost Analysis*, 227 (1961).

conditions two through four would be violated, even if the first condition were met, would severely restrict his interest in policy oriented economic research. We take a more pragmatic approach.

First, we would insist on a careful evaluation of the benefits and costs associated with the action to be analyzed. While this may be difficult, opportunities for achieving greater accuracy and reliability exist. We shall return to this point later.

Second, except in some cases to be discussed below, it may be desirable to insist upon greater coincidence of benefits and costs. This would not only come closer to fulfilling the second condition with respect to leaving the income distribution undisturbed, but it would also have significant implications with respect to efficiency. We shall not treat these here in detail. Let it suffice to say that failure to hold beneficiaries responsible for the costs incurred on their behalf leads to an expression of demand for the services provided to them not only by those willing to pay the full opportunity cost of these services, but also by those willing to pay only the lower price at which they are actually supplied.<sup>10</sup> When changing the income distribution is among the objectives of the action under analysis, or when it is impossible for other reasons to insist upon reimbursement of costs, the income distributional effects should be spelled out so that they can be taken into account explicitly.

Third, we subscribe to the idea that in a democratic society the prevailing income distribution is not a totally inappropriate framework within which to analyze changes in resource allocation. If such a society were greatly dissatisfied with its distribution of income it has available numerous direct political means for changing it.

Returning to the subject of public investment in water resource development, we argue for the existence of at least one of the technical conditions enumerated above as a necessary condition for an intervention of this nature. It appears that indivisibilities, giving rise to decreasing costs of production, may be most widespread among these. For example, they are likely to exist in many developments for hydroelectric power, navigation, and irrigation. "Natural monopolies" might arise, if uncontrolled private development would take place in these areas. Controlled private development as it is exercised with public utilities generally is one of the alternatives against which the benefits and costs of public development ought to be evaluated. This is being done in some cases. Certain proposals for the development of the Hells Canyon provide an example.

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10. Krutilla, *Is Public Intervention in Water Resources Development Conducive to Economic Efficiency*, 6 *Natural Resources J.*, 60-75 (1966). Stoevener & Brown, *Analytical Issues in Demand Analysis for Outdoor Recreation*, J. *Agricultural Econ.*, (1967).

Public goods externalities, where products or services of a development are consumed collectively, may represent another case for abandoning the market. When public goods exist—as for example in the control of flood damages and water quality improvement—an individual's consumption of the service does not impose any costs upon others. From a social viewpoint, charging him for the service would result in a misallocation of resources. It appears that any project seeking to provide these services and avoid a misallocation in consumption would have to involve a substantial public subsidy. In this case, attempts to place greater emphasis upon market forces would have to alter the nature in which the services are provided. Therefore, such an alternative as compulsory insurance against floods, which is really an alternative to providing flood protection collectively, deserves careful analysis as an approach to the reduction of flood damages. It should be pointed out that compulsory insurance against flood damages and control of floods by structures are not mutually exclusive.

Finally, the existence of technical interdependencies must be considered as a condition for public investment. The nature of these interdependencies was probably the primary reason for the development of quite different kinds of property rights in water than those developed for land. We would argue that the existence of these externalities is probably the most important reason for public intervention in water use, but not necessarily for public investment. The case for public investment is a rather narrow one to which we alluded previously. It relates to the creation of social overhead capital for the development of a depressed area, for example. Here it is important to evaluate investment in water resources as one alternative approach among others using public capital for achieving the developmental objective. The case for the use of non-investment alternatives can be made much stronger.

### III

#### MARKET ALTERNATIVES AND THEIR EVALUATION

The range of alternatives to the market is quite wide. Even in those instances where the market may fail, the logic of resource allocation, which is a part of market price theory, may be of great value in creating and evaluating market alternatives. The reason for this is quite obvious. As water in quantity and quality becomes increasingly scarce, the social cost of providing it will increase. A rational society will evaluate returns relative to costs in deciding the optimum level of use and will consider and choose on the basis of cost from alternative ways of supplying that level of use. The theory



of resource allocation resulting from market price theory provides for such a system of logic. A laissez-faire market does not have to be in operation to make use of this powerful body of logic. We illustrate this by a discussion of three topics of considerable public interest: (1) water quality improvement, (2) water diversion, and (3) water-based recreational values.

#### *A. Water Pollution*

As will be recalled, the nature of this externality problem stems from the market's failure to reflect to the decision-maker certain costs stemming from waste disposal for which he is responsible. These costs are borne by the downstream water user. Kneese<sup>11</sup> has suggested a regulatory alternative, namely a system of charges or payments. Such a system represents an explicit attempt to correct the failure of the market system to provide appropriate incentives against waste disposal. In the case of a system of charges, polluters would be charged, for example, a fee per unit waste discharged equivalent to the downstream costs resulting from the discharge of this waste. This would force polluters to consider off-site costs in their production decisions.

The contributions which such a system could make toward the efficient allocation of water resources are considerable. In addition to giving polluters incentives to substitute changes in production processes, recovery of materials, and effluent treatment for waste disposal, the assimilative capacity of the receiving water and downstream water supply treatment costs can be reflected appropriately. Furthermore, locational differences in water pollution costs both within a river basin and among basins, can be taken into account. Thus these differences will serve as an incentive for a potential polluter to locate, say, at a downstream point or in a river basin where few other water uses are affected and pollution costs (charges) are relatively low, assuming that the downstream location does not add more to his production costs than the savings in water quality costs.

Given all these desirable attributes of the system of charges, it might be difficult to understand why this system has not been widely adopted. Only in the Ruhr Basin in Germany is a scheme with these general characteristics in operation on a significant scale. Difficulties from putting such a system into operation arise basically from two sources: the framing of appropriate institutional organizations, and the lack of engineering, biological, and economic information necessary for the determination of the level of charges. It can be readily

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11. A. Kneese, *The Economics of Regional Water Quality Management* (1965).

seen that in a complex river basin where externalities are many, and sometimes reciprocal, the estimation of damage functions is a formidable task. Nevertheless, from the point of view of the framework outlined above, a system of charges or payments holds the greatest promise of becoming a feasible, economically efficient solution to the water pollution problem.

Quality standards in the effluent or the receiving water have been the most widely used method of public intervention in water quality management. Conceptually, the enforcement of water quality standards is consistent with the requirements of the framework outlined above. It is necessary, however, that the quality standard be set in such a way that incremental changes in its level will equate marginal treatment costs with the marginal costs of damages avoided. That this condition is fulfilled in many practical situations is doubtful, because the informational requirements for doing this would be the same as those for the determination of effluent charges. As an ad hoc procedure water quality standards can be defended. However, a policy establishing uniform water quality standards for large areas, or even nationally, as the principal solution to the water pollution problem must be questioned on the grounds of economic efficiency. Such a solution would fail to account for widely different ratios between benefits and costs in different decision-making contexts. The system of charges would be preferable as it would provide for greater flexibility and would require less information than would be needed to design an economically efficient system of standards.

#### *B. Water Diversion; Operations Research and the Public Sector*

Robert McNamara has brought considerations of efficiency analysis in the public sector to the attention of the public to an extent unmatched by any other public official. The logic of production economics combined with modern computing equipment has been applied to a wide variety of problems which extend far beyond the Department of Defense. Those who argued for the modest expansion of these techniques in water resources development a decade and a half ago appear to be "pikers" in comparison. It is almost ludicrous that the debate was still raging among water economists as recently as 1960 when benefit-cost analysis was pioneered in the water resources field. The value of the techniques and the use of the computer is without question and it seems somewhat surprising in retrospect that they were questioned to the extent they were.

It is now possible to draw some generalizations from this experience. First, as noted above, the approach is here to stay. Second, these techniques are not a substitute for the decision process but an

aid to it. Anyone with visions of the bureaucracy withering away as a result of operations research techniques will be disappointed. Third, and this is a subtle point, this development represents a triumph of the market *in absentia* because the logic of these quantitative techniques is based squarely on firm theory. Furthermore, many of the data used stem rather directly from market operations. The market is being "simulated" by such studies to solve certain "sub-optimum" problems.

In the case of wide-scale water diversion, given the present state of technology, it is obvious that indivisibilities exist. If such transfers are to occur they would do so as a result of public intervention. Yet a rational society will consider alternatives to water transfer. Operations research techniques applied in the context of market price theory is a way of considering these alternatives in a systematic way. The estimation of the empirical relationships to make the following model operational is much needed.

$$M_{1,1} + M_{1,2} \begin{matrix} > \\ < \end{matrix} M_{2,1} + M_{2,2} + M_{3,1} \quad (1)$$

Where

$M_{1,1}$ —marginal value use of water in the area of "deficit" for primary purposes.

$M_{1,2}$ —marginal value use of water in the area of "deficit" for secondary purposes.

$M_{2,1}$ —marginal value use of water in the area of "surplus" for primary purposes.

$M_{2,2}$ —marginal value use of water in the area of "surplus" for secondary purposes.

$M_{3,1}$ —transfer cost of marginal water use.

When

$$M_{2,1} + M_{2,2} + M_{3,1} < M_{3,2}, M_{3,3} \dots M_{3,n} \quad (2)$$

Where

$M_{3,2} \dots M_{3,n}$  are the costs of all alternative means of supplying water to the marginal water uses in the "deficit" water area. Estimation of equations (1) and (2) would permit society to decide if the sufficient and necessary economic conditions for water transfer existed. To estimate these equations one would need to "simulate" market operations and make use of the data generated by the private sector of the economy. If only a fraction of the cost of debating, planning and fighting for and against this issue were spent estimating the relevant economic magnitudes, society would have some basis of judging its effect on resource allocation. The other side of the same coin would show the amount of regional income transfer that would be involved. It is apparent that it is dollar importation rather than water importation that is the real issue.

### *C. Market Performance and Intangibles with Special Attention to Recreation*

S. V. Ciriacy-Wantrup has treated the semantics of "intangibles" as related to benefit-cost analysis and water resource development in a logical and definitive way.<sup>12</sup> He makes a strong case for the use of the term "extra-market" rather than "intangible" to describe those benefits that are not routinely valued in the market place. He also argues that attempts to quantify such benefits should be encouraged. He suggests that such quantification need not be confined to estimating dollar benefits; there are numerous physical attributes that may be helpful in decision-making.

The fact that extra-market values exist is evidence of a real or imagined failure of the market. In this connection outdoor recreation is often mentioned as an example. The failure may be real in the sense that the market would bring about socially undesirable results. The failure may be imagined in that actual market performance might be superior to administrative management.

The market would undoubtedly fail to do a satisfactory job of managing some of the great natural wonders of the outdoors. The National Parks are an example. A site such as Crater Lake would become a monopoly and would be highly commercialized if left to the market. Yet the fear that some have of a commercial outdoor recreation industry seems, in some instances at least, to be unfounded. The market does provide these kinds of services in many circumstances. It is difficult to argue against an outdoor recreation market on income distribution grounds. It is easy to demonstrate that at the present much outdoor recreation is enjoyed by those with average or better incomes. Equipment expenditures are testimony to this fact. An additional site charge would not appear to be a major factor in discouraging consumption by those with lower than average incomes for those outdoor recreational experiences that involve large equipment expenditures or high travel costs.<sup>13</sup> Special provision might well be made, of course, for those of low income; the point is that much outdoor recreation that is provided by the public sector is not enjoyed by the low income segment of the population.

One of the more interesting developments pertaining to the eco-

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12. *Benefit-Cost Analysis and Public Resource Development*, Economics and Public Water Policy in Water Resource Development (Smith and Castle ed. 1964).

13. The above argument is couched in general terms. There is need for more precise formulations if one were to make a detailed statement on outdoor recreation policy. Joe B. Stevens has estimated income elasticities of demand for different kinds of outdoor recreation experiences on Yaquina Bay in Oregon. An outdoor recreational policy may wish to use studies of this kind to identify areas for possible interference and public subsidy. Stevens, *Recreation Benefits and Water Pollution Control*, 2 Water Resources Research, 167-182.

nomics of outdoor recreation is the development of a methodology which permits economic evaluation of this intangible. Such techniques have progressed to the point where outdoor recreation can be evaluated with as much confidence as flood control or navigation. Again, the market is operating *in absentia* through the use of economic theory based on market processes and data generated in the private sector of the economy.

A trend is underway to subject more and more outdoor recreation problems to the rule of the market. As the demand for outdoor recreation increases, more such recreation will be supplied by the private sector of the economy. The public sector will also be forced to use market processes either to allocate a scarce resource or to increase its supply. This trend is not particularly distressing to these writers. One frequently hears it said that dollars simply cannot measure the satisfaction that comes from viewing a beautiful sunset or an unspoiled mountain lake. But at the same time the food and clothing necessary to the maintenance of life itself have been subjected to the rule of the market. Does anyone contend that the consumer's surplus has been eliminated in the market for any commodity? The evidence is not available to substantiate the argument that outdoor recreation is "different." This does not mean that the market should be relied upon entirely; it does mean that greater reliance on the market might well bring about some desirable results.

### EVALUATION

It becomes obvious from the foregoing that the important social issues relative to the future of the market as an institution for the allocation of water cannot be simplified to the point where one argues for the complete acceptance or rejection of the market. The really relevant questions are of the following nature:

1. To what extent and what kind of regulation of the market will there be?
2. How will market performance be judged?
3. How is market performance affected by (a) taxation, (b) subsidy, (c) property loans, (d) zoning, (e) price supports, (f) other collective devices affecting economic decisions?

Arguments on purely doctrinaire ground about the market may be interesting but they are hardly worth the attention of the modern economist. To be relevant to the problems of the world he must consider government intervention in terms of specific problems.<sup>14</sup>

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14. For an eloquent statement of this point of view see George Stigler's 1964 presidential address to the American Economic Association, *The Economist and the State*, 55 Am. Econ. Rev. (1965). Stigler traces what economists have had to say about government inter-

There are many important tasks the market does exceedingly well; there are many important tasks the market does not do well at all; there are many important tasks where it is not clear whether the market is superior to another kind of organization. The first category is of interest to the economist as he studies the market for an understanding of its functioning. The second is a challenge in terms of designing market alternatives. The third represents the area of controversy which represents a real opportunity to the economist as he strives to provide information that will be of value in decision-making on social problems.

We return again to a point made earlier. Even though the market is rejected as a means of allocating certain goods and services, it may still provide data and criteria of value in dealing with extra-market problems. The role of the market in generating relevant information for decision-makers has not been given the explicit treatment it deserves. The generation and communication of information is an automatic function of the market. When the market is displaced, some substitute for the choice indicator—i.e., price—must be provided. The amount of information summarized by price-quantity-quality relationships is certainly rather considerable. Obviously, when non-market organizations are relied upon, a different hierarchy of values and subsequent incentives may be developed. As an example, the stated objective found in many statements on educational policy is to provide opportunity for the *complete* development of human potential. Such an objective would stand the test neither of market performance nor economic logic. We do not argue for complete dominance of the market; we do argue for the kind of rationality that market logic can bring to social decision-making.

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vention throughout the history of economic thought. He concludes that only recently have we acquired the measurement tools to answer the questions economists have been posing, but answering inadequately, for generations.