STUDYING THE ECONOMICS OF A WATERWAY -- A CRITIQUE OF STUDIES OF THE McCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM

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This paper briefly reviews the scope of the Arkansas River development system and some dozen studies of the impact of that system. Based on this background, attention is given to the choice of what should be studied next. Three types of studies are examined.

First, locational response to the shifts in transportation cost structure could be estimated, both to develop and test methodology for improved benefit estimates on future projects and as a basis for associated planning, both on the Arkansas System and other projects. Fairly low explanatory power can be expected in explaining location decisions; but with information in hand, this approach should not consume a very large share of available research resources. Emphasis would be on those industrial sectors most likely to be influenced by waterway transport.

Second, with the prospect of a working inter-industry transactions model, it would be possible to estimate the effects on sector activity and income due to expansion of national demand for the waterway-sensitive products of the region and the expansion of final demand in the region. Again, emphasis would be on those sectors affected by shifts in transport costs, but some attention should be given to other project outputs such as recreation. Simple income redistribution effects by region and income class can be estimated, but verification empirically will be difficult because of the problem of separating the with and without effects from the before and after effects.

Third, further identification of the impact of waterway development on private and public entrepreneurial capacity in the region would be a most challenging line of research. Existing regional development theory offers some conceptual models to integrate institutional elements with other theoretical bases for growth. Empirical research is needed. Social impact studies in hand provide an excellent basis on which to proceed.

1/ Extension of remarks at the Seminar on Ex-Post Study of the McClellan-Kerr Arkansas River Navigation System held by Institute for Water Resources, Corps of Engineers, at Fort Smith, Arkansas; Nov. 10-12, 1976.

2/ Professor of Resource Economics and Graduate Research Assistant, respectively, Dept. of Agricultural Economics, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, New York.

The first two lines of research would be less risky, more likely to contribute, at least marginally, to improving existing evaluation techniques for national and regional economic development effects. Adding to our understanding of the effect of public programs on entrepreneurship and possibly identifying techniques for use in project formulation and evaluation would be less sure of success, but if successful, could be much more rewarding. Part of the promise is in the possibility of showing a basis for more effective and different program components on the part of the federal government.

Should the Corps of Engineers, and/or some other agency such as the Economic Development Administration, go beyond construction and operation of the physical works into assisting local people in their response to the opportunity? A part of the answer to that question lies in understanding the factors that affect local response to opportunity. Available theory and data suggests that communities vary greatly in response capacity and a comparable response to the same physical investment may require different forms of assistance. In other words, expanding local response capacity may have to be planned as a jointly provided feature along with the bricks and mortar. Without such an ex-ante analysis of response capacity, future investments run the risk of beneficial effects falling far short of those projected in other parts of the evaluation and planning analysis for those investments. The Arkansas offers an ex-post opportunity to develop such techniques.

Lakes and Barges from Tulsa to the Mississippi

To provide Tulsa, Oklahoma and the four other intervening communities with major public port facilities to service barge navigation required a major engineering feat. Flood control, water-based recreation, hydropower and more reliable water supply provided what may have been equally important opportunities for development.

Barge transport began in 1970 and was fully available in 1974, when 34.2 million tons valued at $500 million were shipped. Between 1970 and 1975, 497 new industrial plants or additions were built in the 21 counties adjacent to the navigation channel. Many other factors explain this growth, not the least of which is the expansion of the inter-state highway system which parallels the channel. Energy and labor resources are also significant to the region's competitive advantages. Recreationists along the waterway spent, during 1974, some $155 million (excluding major equipment), and $192 million in 1975. Many were attracted to the reservoirs that provide control for the river, as well as to the new channel.

Rebuilding the Arkansas cost over $1.2 billion -- perhaps $2 billion at current prices. Operation and maintenance costs are some $20 million per year. Antle, in a summary and extension of the ex-post economic studies elsewhere in this seminar, estimates that return on invested capital is easily in excess of four percent and could be as high as 13.5 percent. The rule laid down by the Congress in the 1936 Flood Control Act, that the benefits, to whomsoever they may accrue, should exceed the costs, appears to have been satisfied. Recreation benefits in particular have been substantial. The full development of the navigation capacity

may not have had time to work itself out. Inter-model shifts, particularly for iron and steel products, have accounted for much of the navigation benefit. Inter-model shifts, while popular arguments for navigation projects, have inherently low levels of national benefit. New traffic with larger inherent benefits are reasonably anticipated from grain, agricultural chemicals and energy commodities.

Much of the political support for public works projects comes from those who look no further than the impacts on business activity from the construction itself. Kim, elsewhere in these proceedings, has estimated these effects for $1.1 billion of expenditures (in 1963 prices). Half those expenditures were for labor. Over 70 percent of the inputs were estimated to have been purchased in the region. The project generated $2.0 billion in income with half of it realized in the region. The model was also used to estimate the differential effects of different project components such as power houses, levees, revetments, and dredging. Similar evaluations on project outputs such as transportation, recreation and flood control remain to be worked out.

Ex-Post Studies -- A Unique Opportunity

The Institute of Water Resources of the Corps of Engineers deserves commendation by all of us in the professional disciplines who turn our attention to water resources. We are the clientele for ex-post studies. The opportunity is to verify and validate analytical technique and the conceptual understanding which we usually only get to use in ex-ante studies. Ex-post studies are rare and usually supported only by those disposed to be critics, albeit constructive critics. An example of this rare literature by Haveman[1/] makes the point. Most research and analysis in water resources is supported by the public agencies whose orientation is necessarily to the future -- in particular responding to those difficult problems calling for attention today. Investment in studies of the past with all their potential to expose the raw nerves of past controversies is a rare luxury.

Consider, for example, the meager efforts put forward to monitor past performance. White,[2/] in his monumental series of studies to examine the need for research in dealing with natural hazards, repeatedly cites the lack of data to chart progress in reducing flood losses. Only the crudest estimates can be put forward for what has happened to the values the nation has at risk in its flood plains. While spending many billions to protect them, and clearly avoiding many, many more billions of damage, we still argue whether or not the protective works have significantly encouraged flood plain occupancy. The data base upon which to move ahead to new programs such as flood plain land use controls is poor in part because we haven't studied what we've done with much care.

1/ Robert H. Haveman. The Economic Performance of Public Investments: An Ex Post Evaluation of Water Resources Investments (Baltimore: The Johns Hopkins Press, 1972).

2/ Most recently see White, Gilbert F., et. al. Flood Hazard in the United States: A Research Assessment, #006 Monograph Series, Institute of Behavioral Science, University of Colorado, Boulder, Col., 1975.

Alternatively consider water quality. More billions spent to upgrade sewage treatment, yet the data to evaluate progress achieved in terms of water quality parameters of our lakes and streams is most imperfect. Recent studies cast considerable doubt on whether we know how often to measure, where or when or even what should be measured.[1/] For some time phosphorous has been suspected of being the limiting nutrient in the algal build-up in our lakes. The great bulk of our data is in terms of total phosphorous. Yet it is now suspected that much phosphorous measured is not available to aquatic plants, being tightly tied to silt particles and made unavailable in other ways. Available phosphorous is imperfectly correlated with total phosphorous varying greatly with the timing of storms, algal activity and the like. The data base to move ahead to non-point pollution control is poor in part because we haven't evaluated what we've done with much care.

Lack of ex-post study of the rebuilding of rivers to provide navigation systems is, then, not an exception but the rule in water resources. This opportunity is to be treasured, and made the most of. Economic studies are probably strategic. Surely sound economic justification should be in hand before the more difficult and more poorly understood environmental analysis is worth mounting.[2/] The logic of an overall framework for the navigation component is critical and highly specialized. Roberts, elsewhere in this seminar, has identified the major components of this framework. Likewise, the conceptual framework for a multiple objective analysis is now being developed in the literature in response to the pioneering efforts of the Water Resources Council.[3/] Neither needs further elaboration here. Such frameworks and their legitimation and ratification in the professional literature provide a basis for faith in the rational analysis that undergirds professional planning. Appeals to standards of good practice among the professionals involved is, of course, an important element in achieving consensus and consent for the authorization and construction of future controversial projects.

The opportunity here is twofold. First, is to build a data base and identify techniques that will improve future guesses and estimates by planners about effects of future projects. Tozzi makes a similar point that ex-post evaluations should provide constructive insight and

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1/ See, for example, Porter, Keith S., Editor, Nitrogen and Phosphorus -- Food Production, Waste and the Environment (Ann Arbor, Mich.: Ann Arbor Science Publishers, 1975).

2/ John Krutilla and Anthony Fisher, The Economics of Natural Environments (Baltimore, Md.: Resources For the Future and the Johns Hopkins Press, 1975).

3/ Multiple Objectives: Planning Water Resources, Vol. 1 & 2 (Moscow, Idaho: Idaho Research Foundation, Inc.).

comment to improve pre-construction evaluations.[1/] Second, is to identify more closely what interested groups need to know to influence better decisions. It may be a little difficult to imagine at this time a repeat of a project of this scope. The Tennessee-Tombigbee system was approved not long ago, is under construction and under some attack. The Cross-Florida Barge Canal is partly built, but rather dormant. Will we ever consider linking Baltimore with the Finger Lakes through the Susquehanna River to stimulate the sagging economy of the Northeast? Not likely, but stranger ideas have grown to reality. Tulsa as a port seemed as strange to some not many years ago. Perhaps more to the point is the opportunity to develop insights to be applied to overhauling our older navigation systems on the Ohio, Great Lakes, Mississippi, Tennessee and the like. How should the Corps of Engineers act differently in planning and implementation, and why?

The Regional Development Process

The McClellan-Kerr Project will reduce the cost of transporting goods and production inputs to and from the Oklahoma-Arkansas region. The area might not benefit in terms of a net improvement in employment opportunities through industrial development within. It will benefit if the navigation channel gives industry an absolute economic advantage if it locates (or produces more) within the region. Alternatively, it may lose some jobs if the navigation channel gives industries outside better access to markets within. Whatever the net effect on regional employment, the project may still be worthwhile overall. A conceptual and empirical approach to industrial location follows.

The Location of an Economic Activity

In order to present a simple model of the industrial location process as developed by Alfred Weber and extended by Walter Isard and others we will begin with a focus on the location of one economic activity in a simplified world where transportation costs are the only determinant of location.[2/] Economic activity will locate at that point where transport costs (i.e., the costs of moving inputs to the place of production and outputs to the market) are minimized. All other things being equal, an economic activity that resuires inputs that are relatively costly to transfer to the place of production will be attracted to the input site (e.g., ore smelting); and, conversely, activities that produce products

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1/ Jim J. Tozzi, "The Expost Evaluation of Federal Water Resource Projects in the United States," a paper prepared for the Organization for Economic Cooperation and Development Seminar on Expost Evaluation, The Hague, Netherlands, Oct. 1970, p. 3.

2/ This is the procedure followed by Weber and Isard. See Alfred Weber, Theory of the Location of Industry, translated by C. Friedrich (Chicago: University of Chicago Press, 1929) and Walter Isard, Location and Space-Economy (Cambridge: The M.I.T. Press, 1956).

that are relatively expensive to distribute to the market will be attracted to the market location (e.g., soda-bottling).[1]

Transportation costs are not, of course, the only determinant of economic location and regional development. However, transportation has been quite important to the regional development structure of the United States.[2] There are many other variables that come into play that affect the location of economic activities and determine the structure of regional growth. For example, labor costs may vary over space in addition to the variations in transport costs. Economic activity may move (or not locate to begin with) if the savings in the costs of labor were greater than the increased costs of transportation.[3]

This logic can be carried out for additional inputs (e.g., cheap power or tax locations) to the production process to find the location where production costs are minimized. In the real world, however, one will not always find economic activities at their minimum transport cost or cheap power or labor locations. This is due to a powerful economic force -- called agglomeration economies. Agglomeration economies are defined as:

(a) Large-scale economies within a firm, consequent upon the enlargement of the firm's scale of production at one point.

(b) Localization economies for all firms in a single industry at a single location, consequent upon the enlargement of the total output of that industry at that location.

(c) Urbanization economies for all firms in all industries at a single location consequent upon the enlargement of the total economic size. [4]

For example, steel producers will establish large-scale plants so they can achieve economies-of-scale in production. Localization economies are important to activities such as the garment industry in New York City. Firms in the garment district in the City locate near one another so that buyers can easily compare the products of each firm.

1/ This logic is developed more rigorously in Isard, op. cit., pp. 77-125.

2/ For a discussion of the importance of waterways and railroads to regional growth in the United States, see Harvey S. Perloff, et. al., Regions, Resources, and Economic Growth (Baltimore: The Johns Hopkins Press, 1960).

3/ For a more complete exposition, see Isard, op. cit., pp. 126-142. Also see Jansma, J. Dean and Frank M. Goode, "Rural Development Research: Conceptualizing and Measuring Key Concepts," American Journal of Agricultural Economics, Vol. 58, No. 5 (December 1976), pp. 922-927.

4/ Isard, op. cit., p. 172.

Location outside the district would be economic "suicide." Urbanization economies are achieved when the location of economic activities in a region generate inputs or a market for other activities. For example, agricultural production stimulates food processing activities. Or, the location of a new industry in a region generates increased production in the retail trade sector and so on.

So far we have assessed some of the factors involved in the location of one producer supplying a fixed market demand at one market center. In the real world there are many producers and consumers who interact in the production and consumption of a large number of goods and services over space.1/

Producers and suppliers compete to serve multiple regional markets. Their location depends upon the production and marketing advantages (disadvantages) of alternative regional locations. Transportation networks affect the marketing advantages (disadvantages) of alternative regional locations and the location choices of industries. Improved transportation networks will stimulate regional industrial development if it gives industry an absolute economic advantage to expand or locate within the region. New transportation networks may cause some regional industrial dislocation if it gives industry an economic advantage to move or expand outside of the region to exploit the regional market. This logic is developed more rigorously in Appendix A.

These interactions implicitly provide a logic to the regional growth process. An overview of this process will be presented below. The unit of analysis will be the region or the economic sectors of a region as opposed to the focus on one economic activity.

The analysis of regional growth will be presented in two parts. The first will analyze regional development in the short run where prices, wages, income distribution, technology, and economic structure and capacity are fixed. The second will analyze long-run development where all these factors may vary.

Regional Growth2/

Short-run regional growth is caused by either an internal or external increase in the demand for a region's product. Increases in demand for the region's output will generate an increase in regional economic activity

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1/ This concept is further developed in Isard, op. cit., pp. 143-171; Walter Isard, et. al., General Theory: Social, Political, Economic, and Regional (Cambridge: The M.I.T. Press, 1969), pp. 519-562; and Leon N. Mores, "The General Equilibrium Approach," in Robert D. Dean, William Leahy, and David L. McKee (eds.), Spatial Economic Theory (New York: The Free Press, 1970).

2/ The discussion of regional growth heavily relies on Hugh O. Nourse, Regional Economics (New York: McGraw-Hill, 1968), pp. 155-207.

that is greater than the initial increase in expenditures. The logic of this multiplier effect is that an increase in expenditures on our region's product will generate an increase in expenditures on the inputs that go into producing this product. If some of these inputs are located within our region, then it follows that regional transactions have increased by a multiple of the initial expenditure increment. Just as expenditures increase on the inputs that go into producing the region's product, so will expenditures increase on the inputs that go into producing the inputs that go into producing the region's product, and so on.

In order to present a simple exposition of long-run regional growth where capacity and economic structure may vary, let us assume that a region produces two goods -- one for export and one for local consumption. If the region uses all its resources to produce exports, it could produce OA of them, as shown in Figure 1, following. Likewise, if the region uses all its resources to produce local consumption goods, it could produce OB of them. Points on AB are all the technically feasible combinations of exports and local consumption goods that could be produced within the region.

If resources were fully employed in the region, it would want to produce on AB. That is, the region wants to maximize its product. If resources were not fully employed, the region would be producing below the curve AB.

The relative prices of exports and local consumption goods will determine at what point on AB the region will produce. If relative prices are represented by the line XY then the region will produce OC exports and OD local consumption goods. If the price of local consumption goods increased with respect to the price of exports, then more goods for local consumption and less for export would be produced within the region.

Within this framework, long-run regional growth can be depicted as an outward shift of the production possibilities curve AB. That is, the total capacity for production within the region increases. Long-run regional growth could be generated in a number of ways (e.g., technological change and larger capital investment, an increase in the productivity of labor and growth in labor supply, an improvement in economic organization and institutional capacity, an increase in the supply of natural resource inputs, either due to discovery, new technology, or capital investment).

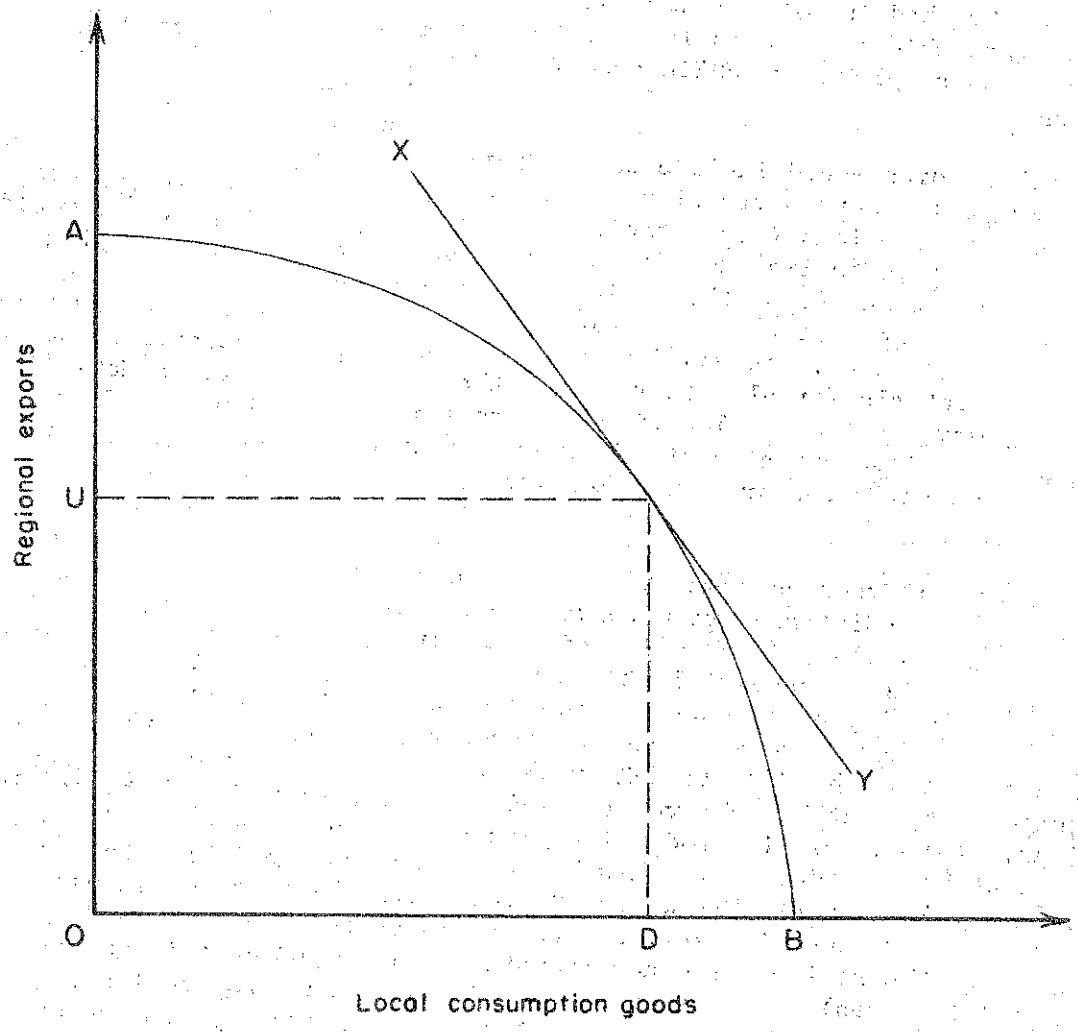
Empirical Analysis -- Inter-Regional Competition

This conceptual model of the industrial location and regional development provides some insights into the potential of the McClellan-Kerr Project to generate regional growth in the Arkansas-Oklahoma region. The model provides the basis for an empirically-oriented approach that could be used to assess the project's potential for influencing industrial location and development in the impact region.[1/]

1/ These concepts are more completely developed in Walter Isard, Methods of Regional Analysis. Also plant location factors are being studied for other purposes in a research project on the Ozarks States by the Regional Analysis Program of the Economic Research Service, USDA. Also see application of transportation models used to evaluate inter-regional competition in agricultural products by many state agr. expt. stations.

FIGURE 1.

REGIONAL GROWTH MODEL



The most fundamental question that must be examined with respect to the regional economic impact of the McClellan-Kerr Project is to what extent does it give an industrial sector an absolute economic advantage to locate or expand in the region. All other questions about regional economic impacts are secondary. This question could be addressed through comparative cost studies of industrial sectors that might be sensitive to a waterway location. Much of the data needed is in hand, and to develop the methods only a few key sectors need be analyzed. The comparative cost studies would delineate the advantages (or disadvantages) that industry had in establishing plants in the region. Such information would be valuable as a basis for estimating benefits and would also be useful to those planning public and private adjustments to the new investment.

Such studies would include the differential costs of producing goods on the McClellan-Kerr navigation channel as opposed to producing these goods in other regions (e.g., the Northeast, Northwest, etc.). It would be necessary to establish the differential transport cost of shipping inputs to locations along the McClellan-Kerr waterway as well as the differential transport cost of marketing goods produced along the waterway to other regions. It would also be necessary to calculate production cost differentials for all other inputs that might vary from a McClellan-Kerr waterway location to locations in other regions. Some key factors might be the differential cost of labor, power, and taxes. Unless such non-transportation factors are taken into account, projections will be suspect.

A more vigorous assessment of comparative cost advantage (or disadvantage) of McClellan-Kerr waterway locations over locations in other regions would include (1) studies of transport savings from new input sites that might be accessible to industries that locate along the waterway. For example, an industry in the Northeast that utilizes inputs from the Southeast may be able to get the same inputs from the Southwest if it located along the McClellan-Kerr channel. (2) Estimation of economies-of-scale that might be achieved (or lost) at McClellan-Kerr waterway locations. (3) Changes in production processes ("substitution effects") that might be engendered by a new location near the McClellan-Kerr waterway. And (4) production linkages ("externalities") that new industry may provide for other industries. For example, the channel may draw new industry to the region. The new industry will demand certain inputs (backward linkages) that may draw other industry into the region to service the new industry. In addition, the new industry may provide outputs (forward linkages) that may be used as inputs into the production processes of other industry. This may also attract new industry to the region. And, as employment and income in the region increases with the location of new industry, other industry may be attracted to the area to service increments in the local demand for consumption goods (consumption linkage). The input-output tables already developed for the ex-post project evaluation provide the means of evaluating production linkages.

It is one thing to evaluate how an industrial sector known to be influenced by the availability of waterway transportation will respond in a region. Likewise, the indirect effects can be discussed sector by

sector on a regional basis without becoming site-specific. But would it be worthwhile to have a better understanding of the "why this town" question? It would seem to be important from two points of view and given the relatively low costs involved, the methodology is worth exploring and verifying.

First, the creditability of the planning process would be enhanced if the changes by industry could be linked to specific communities. Support for the project should be more effective and negative effects more easily identified and accommodated. Second, the adjustments and associated investments along the waterway would be easier to identify and bring about. Agglomeration factors may or may not be strong in the sectors affected. If they are, steps to anticipate response in a small number of locations should be easier to achieve. If agglomeration is not important to the effectiveness of the response to the waterway, that, too, would be worth knowing. Steps to concentrate development around a few ports may be necessary for that aspect of effective response to the waterway investment.

Existing studies of port development, reported elsewhere here, provide a partial answer to the question of response. But the agglomeration requirements of the sectors which have and are likely to respond to the waterway have not been fully explored.

It is widely believed that a few key characteristics of individual communities are related to their success in attracting new industries or the expansion of existing employers. Local officials have been known to express frustration with economic models that seem to explain change largely in terms of national level variables and not in terms of factors subject to local control. To date, research to identify those few locally manageable factors, has not borne much fruit. Regression equations on simple census data produce little that is statistically significant. Work on towns in the Ozarks employing community profiles that go beyond census data is proceeding.[1/] Groups of variables include community services, commercial services, labor attributes, industrial sites and buildings and transportation facilities, including barge services and competing modes of transport. Such a study should provide a useful complement to the study of industry by industry effects. It is also relevant to the consideration of institutional and entrepreneurial capacity which will be discussed below.

1/ John Kuehn, "Location of Manufacturing Plants and Community Characteristics in the Ozarks States." Mimeograph prepared for Regional Analysis Program Area Review, Economic Research Service, USDA, 3 November, 1976.

Some Additional Comments on the McClellan-Kerr Impact Study -- Alternatives

Although water resources investments such as the McClellan-Kerr Arkansas River Navigation System are justified, in part, on the basis of an economic efficiency calculus, non-efficiency objectives are often primary in the political decision-making calculus. Senator Kerr was surely more interested in the regional impact of this project than its national impact.

The point has been made that a navigation project does not necessarily promote regional development. Could alternative investment packages be considered that are more closely linked to a regional development objective? Could alternative investment packages include water as well as non-water related activities? That is, is there much scope for intergovernmental cooperation to achieve regional development objectives?

Meyerson and Banfield note that such an approach (i.e., array alternative means to achieve competing ends) is the basis for "rational" planning. They write that a rational decision is one in which the decision maker considers

> ... all of the relevant alternatives ... identifies and evaluates all of the consequences which would follow from the adoption of each alternative ... and selects that alternative the probable consequences of which would be preferable in terms of his most valued ends. 1/

Although Meyerson and Banfield's comprehensive rational planning is more of an ideal and Braybrooke and Lindblom's disjointed incrementalism approach 2/ where planners strive for small changes in narrowly defined problem areas in which there is a convergence of interests among a limited set of policy makers is closer to reality and practicality, there may be some scope to approach development objectives more broadly.

Intersector Analysis

Kim estimated through input-output analysis the indirect impacts of constructing the McClellan-Kerr Project. 3/ This type of analysis

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1/ Martin Meyerson and Edward C. Banfield, Politics, Planning, and the Public Interest (New York: The Free Press, 1965), p. 314.

2/ David Braybrooke and Charles E. Lindblom, A Strategy of Decision (New York: The Free Press, 1970).

3/ Ungsoo Kim, "Evaluation of Interregional Input-Output Models for Potential Use in the McClellan-Kerr Arkansas River Multiple Purpose Project Impact Study," Institute for Water Resources Contract Report 74-6 (Aug. 1974) and "An Application of the Interregional I/O Model for the Study of the Impact of the McClellan-Kerr Arkansas River Multiple Purpose Project," Catholic University (March 1975).

could be extended to estimate the indirect impacts of the various project components (e.g., navigation, recreation, flood control). Indirect impact evaluations could be used as both a justification and basis for cost sharing or cost allocation for the project's components.[1/] Boisvert additionally used indirect impact evaluation as a basis for distributing flood recovery assistance.[2/] Indirect impact evaluation could also be used in ex-ante project evaluation studies to assess a project's expected sectoral and regional impacts.

Social Equity Considerations

To date, the economic impact studies of the McClellan-Kerr Arkansas River Project have been concerned with economic efficiency or direct benefit considerations, inter-sector and inter-regional impacts from constructing the project. Little attention has been given to social equity considerations as they relate to the distribution of benefits and allocation of costs among income groups. Social equity or income distribution has been recognized as an important consideration in project planning by economists and other social scientists and it is included in the U. S. Water Resources Council's guidelines for project evaluation.[3/] However, the agencies and the Congress have been reluctant to call for estimation of effects by income class -- in part perhaps because of the lack of a widely-tested methodology. Obviously, other factors, such as controversy over the effectiveness of public works investments to achieve income redistribution as well as controversy over whether such an objective should be addressed at all, are also involved. However, research should help clarify all of these questions.

1/ See Helen M. Ingram and David J. Allee, "Equity and Cost Sharing -- A Neglected Opportunity for Improving Water Policy," Cornell Agricultural Economics Staff Paper No. 76-1, Jan. 1976; S. V. Ciriacy-Wantrup, "Benefit-Cost Analysis and Public Resource Development," The Journal of Farm Economics, Vol. 37, No. 4 (Nov. 1955), pp. 676-686; and David J. Allee and Frank Davenport, "Development of Procedures for Cost-Sharing and Repayment Analysis," Office of Water Research and Technology Report, 1976.

2/ Richard N. Boisvert, "Impact of Floods and Flood Management Policy on Area Economic Development and Recovery," Department of Agricultural Economics, Cornell University, Dec. 1975.

3/ For example, see: Peter O. Steiner, "The Public Sector and the Public Interest," in The Analysis and Evaluation of Public Expenditures: The PPB System (Washington: U. S. Government Printing Office, 1969); Arthur Maass, "System Design and the Political Process: A General Statement," in Arthur Maass, et. al., Design of Water Resource Systems (Cambridge: Harvard University Press, 1962); and Robert J. Kalter and Thomas H. Stevens, "Resource Investments, Impact Distribution, and Evaluation Concepts," American Journal of Agricultural Economics, Vol. 53, No. 2 (May 1971).

It may not be enough to invest in poor regions with the expectation that the investment will engender broadly-based growth (i.e., growth that is shared by all of the socio-economic classes, economic sectors, and sub-regions or towns and cities within the region). Such a strategy might only make, as Mishan notes, the rich-richer and the poor-poorer.1/ Or, the differential impact of the project within the region may not reach the groups for which the original investment was targeted. For example, the McClellan-Kerr Project might not stem outmigration as it might if better waterway related employment opportunities for the unemployed and underemployed in the region are not stimulated specifically for that purpose.

A more explicit assessment of the differential impact of the project within the region would seem to be warranted. In addition, a distributional assessment of the project might help to array alternative or complementary investment strategies that might improve the efficiency of the investment package in terms of achieving explicit distributional objectives. For example, the economic linkages from the navigation channel might not reach remote towns in the region. Alternative investment packages may be more appropriate for these towns.

It is important to recognize that it is very difficult to rigorously assess the distributional impacts of a project. The data is not readily available and it is difficult to delineate cause and effect. However, a relatively simple format which provides a broad assessment and that can be followed with a manageable level of effort is to let:2/

NB^A_{at} = the value of the net benefits to income class a in subregion A of the study area at time t;

B^A_{at} = the value of the gross benefits to income class a in subregion A of the study area at time t;

T^A_{at} = the tax payment by income class a in subregion A for capital investments in the project at time t;

$(O\&M)^A_{at}$ = the operations and maintenance cost that income class a in subregion A bears for the project at time t.

Thus,

$$\sum_{t=1}^{T} NB^A_{at} = \sum_{t=1}^{T} B^A_{at} - \left[\sum_{t=1}^{T} T^A_{at} + \sum_{t=1}^{T} (O\&M)^A_{a} \right].$$

1/ Mishan, Elements of Cost-Benefit Analysis, pp. 22-23. Lewis, William C. and James R. Prescott, "Urban-Regional Development and Growth Centers: An Econometric Study," J. Reg. Sci. 12 (1972):57-70. Milkman, Raymond H., Christopher Bladen, Beverly Lyford, and Howard L. Walton, Alleviating Economic Distress: Evaluating a Federal Effort (Lexington, Mass.: Lexington Books, 1972). Stewart, Charles T. and Virginia Benson, "Job Migration Linkages Between Smalles SMSAs and Their Hinterlands," Land Econ. 49(1973):432-39.

2/ This is an extension of the approach developed by Kalter-Stevens, op. cit.

That is, the net benefits to income class a in subregion A are equal to the gross benefits to income class a in subregion A minus the tax payments and the operations and maintenance costs by income class a in subregion A at time t.

Working almost entirely with secondary data Kalter and Stevens develop net benefit estimates by income class for a variety of different types of projects. To demonstrate the method for a navigation project, it would not be necessary to produce a complete application of the Kalter-Stevens approach. The problem would be to identify those elements unique to the navigation element and seek empirical verification of the method. Several community case studies of income and employment shifts which elaborate on existing social impact studies should be sufficient.

It was noted at the seminar that recreation accounted for a sizeable share of the project's benefits. This should increasingly be the case for water resource projects since a disproportionate share of increments in personal, regional, and national income will be spent on recreation. Or in economics jargon, more affluent groups and areas have a relatively high income elasticity of demand for recreation.[1/] This implies that water resources development agencies must be increasingly concerned with recreation development.

More affluent groups are the primary or direct beneficiaries of recreation development, as noted above. Lower-income groups may benefit indirectly. However, if social equity is the objective, recreation may not be the best strategy. Alternative strategies where the poor are the direct beneficiaries should be developed.

Institutional and Entrepreneurial Capacity

Note that the four state Ozarks region that surrounds the Arkansas River Navigation System (Arkansas, Kansas, Missouri, Oklahoma) has experienced substantial growth. In particular, a surprising amount of this growth has taken place in nonmetropolitan portions of the region. This is part of a recent reversal in national trends. Population increases now occur in the less dense areas. Urban areas of under 750,000 population are expanding net in-migration; those above are not. Increases in nonmetropolitan areas are even more extreme.[2/]

From 1967 to 1974, in the Ozarks, 2,617 new plants or old plant expansions were reported. Of these, only 55 percent were located in counties classified as either metropolitan or adjacent to metropolitan counties. To be a metropolitan county, 20 percent or more of the population

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1/ See William J. Baumol and Wallace E. Oates, The Theory of Environmental Policy (Englewood Cliffs, N. J.: Prentice-Hall, 1975), pp. 191-212.

2/ See Calvin L. Teale, "A Further Look at Non Metropolitan Population Growth Since 1970," AJAE Vol. 58, No. 5 (Dec. 76), pp. 953-962.

had to live in a census-defined urban place. Looking at the town level, only 11 percent of those towns under 2500 in size got new plants of 10 employees or more. But they were 45 percent of all towns with new or expanded plants, or 206 towns in the region. Whether from the classification of location by the county or by the town, a suspicion is generated about institutional and entrepreneurial capacity to manage growth.[1/] Some questions come to mind.

Is this capacity in the project area sufficient to exploit the waterway investment at a level which justifies (optimizes?) that waterway investment? Even if capacity were judged to be sufficient to justify the waterway investment, was it adequate to deal with negative and positive side effects of the development opportunity? What steps were taken to expand this capacity by the Corps, the states, or other federal agencies? How is such capacity to be measured and changes evaluated? How could the expansion of entrepreneurial and institutional capacity be evaluated and planned as a part of the original basin plan? It would seem that these questions should be addressed before raising the issue of who should have the responsibility for actually stimulating changes in such capacity. Partial answers are available in the ex-post social impact studies already carried out. However, further work would be fruitful and should be linked closely to models of the development process and the requirements of the water resources planning process.

Just as we have done in the above discussions, economists have long attempted to explain regional development as a function of investment, technology, markets, adjustments to spatial distribution of inputs and markets. Policy prescriptions follow depending upon the emphasis of the analyst. More resources, eg. waterway investments, will help a region develop. Or technology transfer is the answer. Expand export sectors and substitute for imports. Envigorate the growth centers and income effects will trickle down to the surrounding hinterlands. But all of these bromides and the many others in the field depend upon institutional capacity for implementation. Sufficient institutional growth should not be taken for granted, particularly in a region that "needs" development.[2/] Where development has had a history of success, institutions are more likely to have the capacity to facilitate it. Private entrepreneurs are then accustomed to public services being there when needed. Opportunities such as a navigation improvement are quickly recognized and seized. Indeed, the possibilities for such improvement are apt to be more widely anticipated while still in the planning stages.

1/ Kuehn, op. cit.

2/ For a recent review of some of the literature related to each of these "bases for growth" and the need for a synthesis, see Clark Edwards, "The Political Economy of Rural Development: Theoretical Perspectives," AJAE, Vol. 58, No. 5 (Dec. 76), pp. 914-921. For an older treatment of the same concepts applied to water resources development, see David J. Allee, "Place of Water Resources Planning in Economic Regional Development."

Entrepreneurship can be addressed at two levels, either with emphasis on the individual change agent and/or with emphasis on institutional capacity. Following either approach may result in similar insights and prescriptions since the change agent is forced to operate within the constraints of the institutional environment in which he finds himself. Prescriptions tend to focus on a combination of enhancing the skills and resources available to the change agent and adjusting the institutional environment so that more change agents are available and their efforts are more successful.

The entrepreneur is characterized as the risk taker, the person who brings together technology -- broadly defined -- plus labor and capital to do things that were not done before. Organizational skills to match new technology, recognizing an unsuspected opportunity, achieving consent from those who hold vetoes to needed resources and approvals, inspiring others to adopt new values and modes of behavior -- the list of attributes is long.[1/] Schools of business administration provide testimony to the fact that these skills can be taught. Various economic development programs such as those of the Economic Development Administration, the Small Business Administration or the rural development activities of the land grant college system and the U. S. Department of Agriculture, have sought to enhance these skills by less formal approaches.

One study of entrepreneureal activity in New England[2/] identifies constructive and non-constructive entrepreneurship with respect to regional development as well as some general roles. General roles included buying out businesses or taking over activities that were in decline, reorganizing them and preventing their loss to the region. Important was exploiting new opportunities produced by outside changes and less frequently applying technological innovations. Neutral impact on the region was observed in many activities. A new owner, a new location, a new activity simply substituted for another in the region. Many inducements provided by the communities to attract development were dissipated on such neutral changes. Negative long-term impacts were observed where an entrepreneur locates to exploit advantages in the region such as low wages, but then is successful in keeping others out to prevent competition from bidding away those advantages. Absentee-owned activities were cited in particular. It was concluded that incentives and policies must be highly selective to have maximum beneficial effect. Also noted were a number of factors opposing entrepreneurship that were largely in the realm of local institutional capacity. Local leaders may not see a need for change or may actively oppose growth. Local institutions may not have the capacity to invest the energy and capital required to risk change.

1/ See, for example, McClelland, D., The Achieving Society (Princeton: VanNostrand Co., 1961) and Motivating Economic Achievement (New York: The Free Press, 1969) and Schrage, H., "The R & D Entrepreneurs: Profile of Success," Harvard Business Review (Nov.-Dec., 1965).

2/ Quinn, J. B., R. C. Dean and T. W. Walker, Entrepreneurship and Economic Growth, working paper of the Amos Tuck School, Dartmouth College, no date.

Institutional economics has a long tradition of attempting to explain economic performance by the way the economy is organized and by the rules that are employed to regulate behavior.[1/] The public choice approach to applying normative economic thinking to the design of collective action uses concepts such as market failure, rational self-interest and hold-out strategies, plus simplified notions of public agency pathologies.[2/] These can be applied to the design and analysis of institutions that deliver public services and in particular to those that are related to the "bases for growth" such as those that provide capital, manpower training, market information, or transportation services. But how do we know in which communities to apply such designs? And which ones to implement? Indeed, what is a theory of how they will be implemented? Theoretical constructs from sociology are available to begin answering these questions.

Much like central place theory pioneered by Christaller[3/] we begin by envisioning a hierarchical arrangement of communities which differ from each other in their capacities and are linked to each other in many ways. Larger is interpreted to mean more specialized functions and greater complexity, ie., greater differentiation. The emphasis is on the concept of differentiation -- essentially the ability within the community to process information that is generated within and particularly that obtained from linkages from outside the community. Much like the concept of homeostasis[4/] in organisms and their adaptation to a changing environment, this theory visualizes both the capacity to sense and interpret changes in the environment through linkages and differentiation and to bring about internal changes to respond to those changes. Fluidity is this ability of the community to adapt in order to take advantage of opportunities such as a federal investment. Differentiation -- many different kinds of specialists and organizations, specifically those that provide services that enhance the bases for growth -- needs to be complemented by fluidity. Finally, a community may be poorly placed with

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1/ Schmid, A. Allan, "Analytical Institutional Economics: Challenging Problems in the Economics of Resources for a New Environment," AJAE 54 (1972), pp. 893-901.

2/ For an example of the public choice approach applied to water resources see Ostrom, Vincent, Institutional Arrangement for Water Resource Development -- the Choices, prepared for the National Water Commission, National Technical Information Service PB 207314, Springfield, Virginia, 1971.

3/ Christaller, Walter, Central Places in Southern Germany: A Pioneer Work in Theoretical Economic Geography (1st edition, 1935). Translated by C. W. Buskin, Englewood-Cliffs, N. J. (Prentice Hall, 1966).

4/ See Boulding, Kenneth, The Skills of the Economist (Cleveland: Howard Allen, Inc., 1958) for an application of homeostasis to the survival of firms.

respect to the flow of messages in the larger system -- its linkages.[1/]

Empirical measurement of differentiation, fluidity and linkages have been attempted with varying success.[2/] It appears to us that the most success has been enjoyed in measuring the differentiation variable which should be the most important for the purposes at hand. A scaling technique displays the hierarchy between communities for various institutional sectors such as transportation or planning services. For any given community the scaling identifies missing skills and organization for a given level of differentiation, and those needed to move up the hierarchy of information processing capacity.

Changes in differentiation come about from two processes. First, functions (organizations) and specialists are added. Second, these functions and specialties are manned by people whose value orientation, experience and skill levels are as much like those in the larger region as possible. The emphasis is on communication and information exchange, the ability to influence specialists and organizations outside of the community and to be influenced by them. Community change processes emphasizing leadership training, development grants and the like, then become a possible means to achieve the ends of increased differentiation. They increase fluidity or the ability to adapt.

A lack of fluidity may prevent linkages and differentiation from occurring which in turn may prevent the success of a project investment brought to a community by the state or federal government. Small organizations set up for particular functions can't add the specialized functions of information gathering and analysis. Large organizations, particularly private firms, have an incentive to manipulate information to their own benefit. Thus if homeostasis is to work, information and fluidity must be facilitated. Often this requires, for efficiency and effectiveness, the recruitment to, and organization of groups for the study and evaluation of new opportunities. Thus, critical are public organizations that encourage the flow of information and resources from one population segment or organization to another. These are usually public organizations and have been successfully stimulated by resources brought into the community in development programs.

1/ See Frank W. Young and Ruth C. Young, "Toward a Theory of Community Development," in Richard J. Ward (ed.), The Challenge of Development (Chicago: Aldine Publishing Co., 1967); Frank W. and Ruth C. Young, "The Sequence and Direction of Community Growth," Rural Sociology, 27 (Dec. 1962), pp. 374-386; and Frank W. Young and Ruth C. Young, Comparative Studies of Community Growth, Rural Sociological Society Monograph No. 2, 1973 (Morgantown, West Virginia University, 1973).

2/ For example, see Ibid. and Paul Eberts and Frank W. Young, "Sociological Variables of Development: Their Range and Characteristics," in George M. Beal, Ronald C. Powers, and E. Walter Coward, Jr., Sociological Perspectives of Domestic Development (Ames: Iowa State University Press, 1971).

The point here is not so much to identify the program measures that might be adopted but to see if the concepts of differentiation, linkage and fluidity appear to hold promise in explaining differences in community response to the waterway opportunity. Once this is established, the role of different kinds of program strategies to influence fluidity and differentiation could be studied. Some community development specialists argue that sewer and water projects are particularly good vehicles for developing local leadership and community decision-making capacity. Once these sorts of vehicles for change are explored, the question of how they would be built into the basin and project planning process would need to be addressed. Finally, deciding upon the agency to carry out or stimulate such community development as a part of the overall development activity would then be relevant.

Appendix A

Impact of Improved Transportation Modes on Industrial Location -- A Diagrammatic Analysis

In the text above it was stated that improved transportation modes do not necessarily stimulate industrial location and could, in fact, cause some industrial dislocation in a region. An economic logic for assessing the net industrial development impact is presented below.[1/]

On the other side of the coin the demand for goods and services produced within a region will also be affected by distance (transport costs). The logic for this is also developed diagrammatically below.

Let us assume that there are two producers of a good who are located at points X and Y on line AB in Figure 2 following. These producers supply a market at point M with the same good. Each producer's variable supply curve is represented by Y'Y" and X'X". The curves are upward sloping since each producer will supply more of the good as its price increases. Producer X will not enter the market unless he receives a price of P_1 at point X and producer Y will not enter the market unless he receives a price of P_2 at point Y. Each producer, however, must pay the cost of transporting his product to the market at M. This transport cost is represented by the upward sloping lines from X' and Y' to the market at M.

At the market M producer X's variable supply curve is shifted upward by the transportation gradient to SS. And, producer Y's variable supply curve is shifted upward by the transportation gradient to S'S'. Producer X and Y's variable supply curves are added together at M to form the market supply curve SS'S".

Therefore, at the market it is shown that producer X must receive a price of P_3 before he will supply his good and producer Y must receive a price of P_4. If, for example, the price of the good was less than P_3 at M, X and Y would supply nothing. If the price at M was P_3' producer X would supply MM' of the good and producer Y would still supply nothing to M. If the price at M was P_4' producer X would supply MM" of the good and producer Y would supply M"M".

From this simple diagram one can see that as transport rates decline (i.e., the transport gradient from X' and Y' to M becomes less steep)

1/ This logic is based upon and developed more completely in Walter Isard, Location and Space -- Economy, pp. 143-171.

Figure 2.
MARKET AREA ANALYSIS: SUPPLY

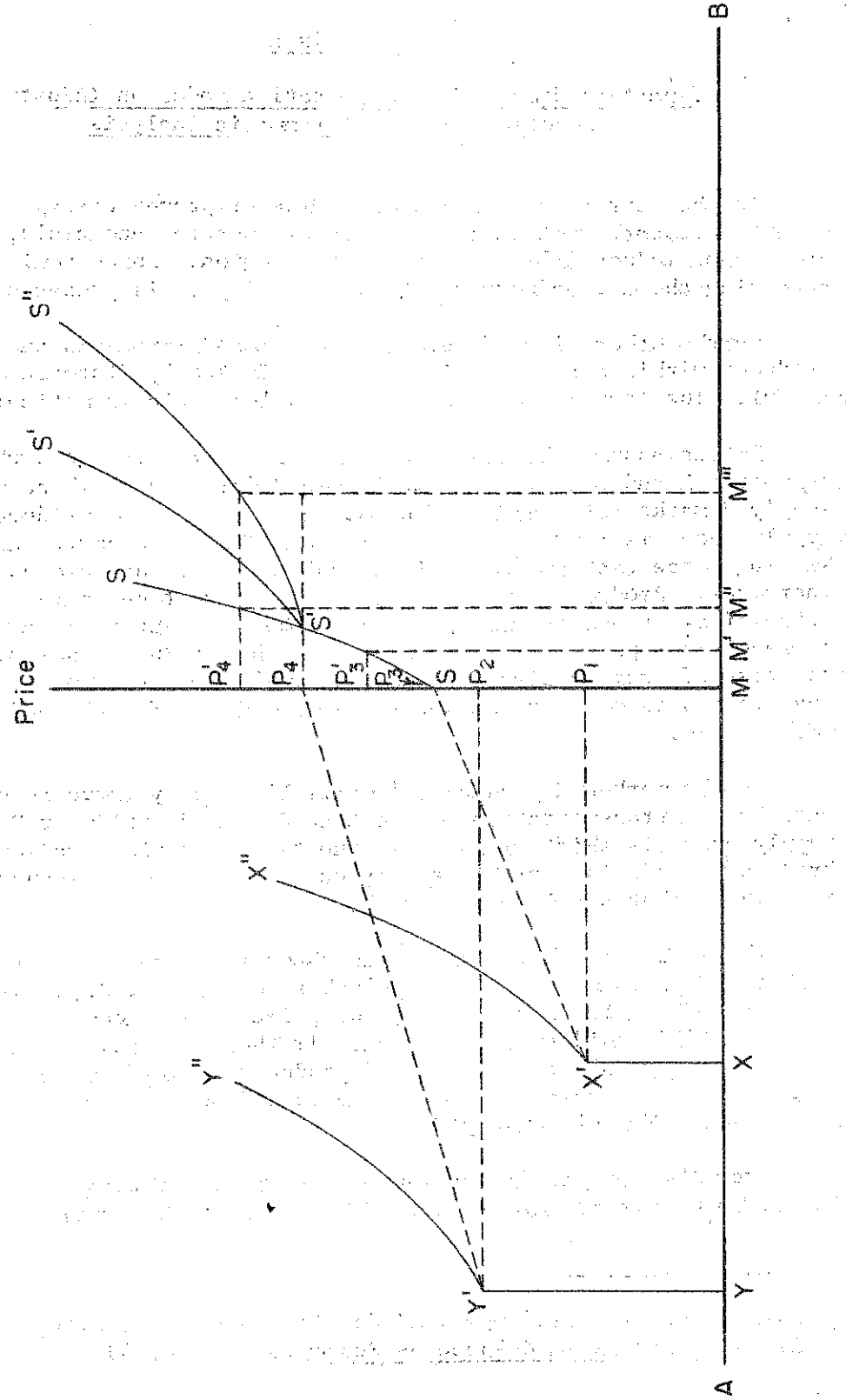
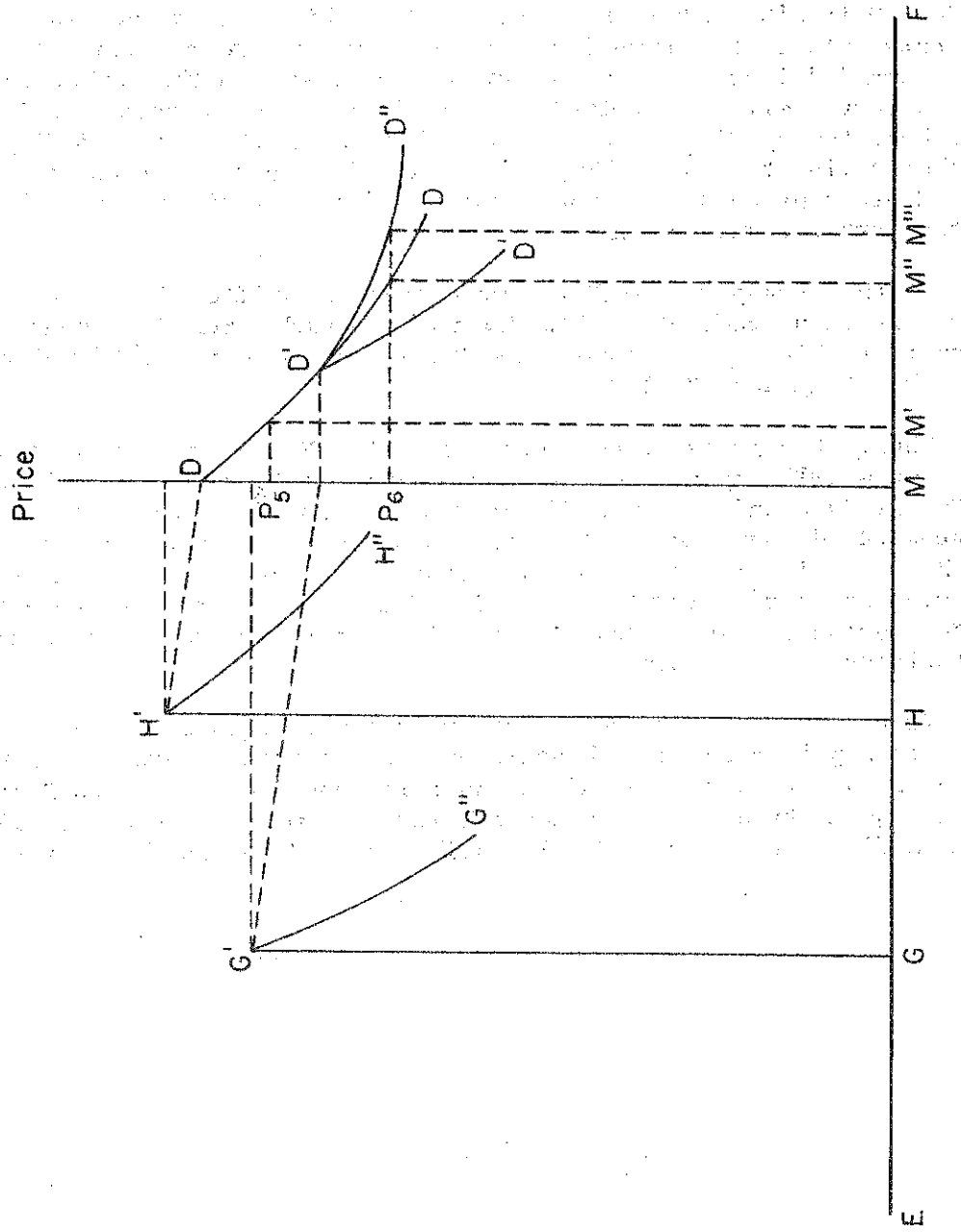


Figure 3.

MARKET AREA ANALYSIS: DEMAND



the aggregate supply curve at M becomes flatter and producers farther away from M become more competitive. Thus, improved transportation modes could give producers outside of a region better access to a region's market so that regional producers who previously had an economic advantage in their location and level of production were put at an economic disadvantage.

Let us assume two towns at G and H and a market center at M along line EF in Figure 3 below. At town G the demand for a product that is sold at M is G'G" and at H the demand for this same product is shown by the curve H'H". The demand curves are downward sloping since the quantity demanded increases as the price decreases. At the market the two demand curves will be shifted downward because the consumer at G or H will have to pay the transport cost of going to the market to buy the good or having the good shipped to him. The transport costs from G and H to M are represented by the downward sloping gradients from G' and H' to the market center at M.

At the market M town H's demand curve is shifted downward by the transportation gradient to DD. Town G's demand curve is also shifted downward to D'D' at M. Town G and H's demand at M is DD'D" (DD and D'D' are added together at M).

Thus, at a price of P_5 town H will buy MM' of the product at M and town G will buy none of it. At a price of P_6 town H will buy MM" of the product and town G will buy M"M"' of it. As transport costs are reduced the demand curves of towns G and H will shift upward at the market M. This implies that improved transportation modes within a region may give industries within the region better access to markets outside of the region so that industrial development and regional employment opportunities are stimulated.

If the two diagrams above are superimposed upon each other, the demand and supply curve would intersect at a point that would define the price of the product at M and the quantity supplied by plants X and Y and the quantity demanded by towns H and G at market center M. This would define the net industrial development and regional employment impact.

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