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Distribution Effects of Land Use Policy: An Empirical Example of Forest and Range Policies in Arizona*

Harry W. Ayer**

Introduction

Little empirical research pertaining to the distribution impacts of land use policy exists and a substantial research effort is warranted. This paper is a modest effort to increase interest in funding and conducting such research. The paper is divided into two major sections. The first section focuses on a case study of forest and range policy and the resulting changes in regional income distribution. The importance of this type of research is developed and the possibility of using very common empirical tools of the economist to conduct the research illustrated. The final portion of this first major section illustrates the results and types of policy implications which can be drawn from them. The second major section gives research needs in a broader sense. Three different kinds of distribution information which need to be exposed by research, and the

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**Harry W. Ayer is Agricultural Economist, Natural Resource Economics Division, USDA, and Adjunct Associate Professor, Department of Agricultural Economics, University of Arizona.

usefulness of this information, are discussed.

Distribution Effects of Forest and Range Policy: A Case Study

Importance of the Distribution Effect and Research Setting

The distribution effects of forest and range land use policies, such as timber cut and grazing restrictions, or policies to encourage or discourage recreation, are of potential great importance. First, the welfare of large numbers of both consumers and producers will likely be affected. On the consumer side the price and quantity consumed of many products, including lumber, beef and recreation are dependent on forest and range policy. The distribution of these products will be based in part upon policy affected price and quantity changes, and upon the initial distribution of income which affects demand for the products. On the production side, owners of particular factors of production will be affected as the quantity and price of the forest and range inputs are changed or as demand for their product (in the case of recreation related business) is altered. Neither consumers or producers may count on a neutral distribution of the costs and benefits of forest and range policy--some people will likely benefit more than others. Thus, a second and corollary reason that distribution effects may be important is that in a democracy the People are free to make and act upon value judgments of what is a good and what is a bad distribution welfare. These judgments are usually reflected through the statements and actions of our government representatives and institutions.

The relevance of the distribution issue to forest and range policy is heightened by the fact that much of our forest and rangeland is owned and managed by the government, and the two agencies primarily responsible

for its management, the Forest Service and Bureau of Land Management (BLM) have recently been assigned greater management powers and guidelines. National forests include eight percent of the total land area of the U.S., and are particularily important in the West where seventy percent of the national forest area is located. The increased management powers and guidelines, or mission, are contained in the Multiple Use-Sustained Yield Act of 1960, the Forest and Rangeland Renewable Resources Planning Act of 1974, and other laws and expressions of Congress and the Executive Branch, and court interpretations. Much of the mission of the Forest Service is expressed in Framework for the Future, a Forest Service "statement of policy." Two of the policy objectives are (1) to generate forestry opportunities that will accelerate rural community growth and (2) to improve the welfare of underprivileged members of society. Although these two objectives relate directly to the distribution issue, other objectives, including those pertaining to economic efficiency, will also have distribution effects. The fact that efficiency and distribution goals are often conflicting only increases the importance of knowing the magnitude of each effect.

Finally, the distribution effects are important because they affect the demand (and supply) of local, publically provided goods and services. Knowledge of this changing demand is useful for local planning.

The empirical research reported here focuses on the distribution impacts of likely forest and range policy in the Salt-Verde Basin area of Arizona (Figure 1). The particular distribution impacts estimated are those occurring to different income classes of wage earners. The Salt-Verde area presents an interesting and relevant example of the

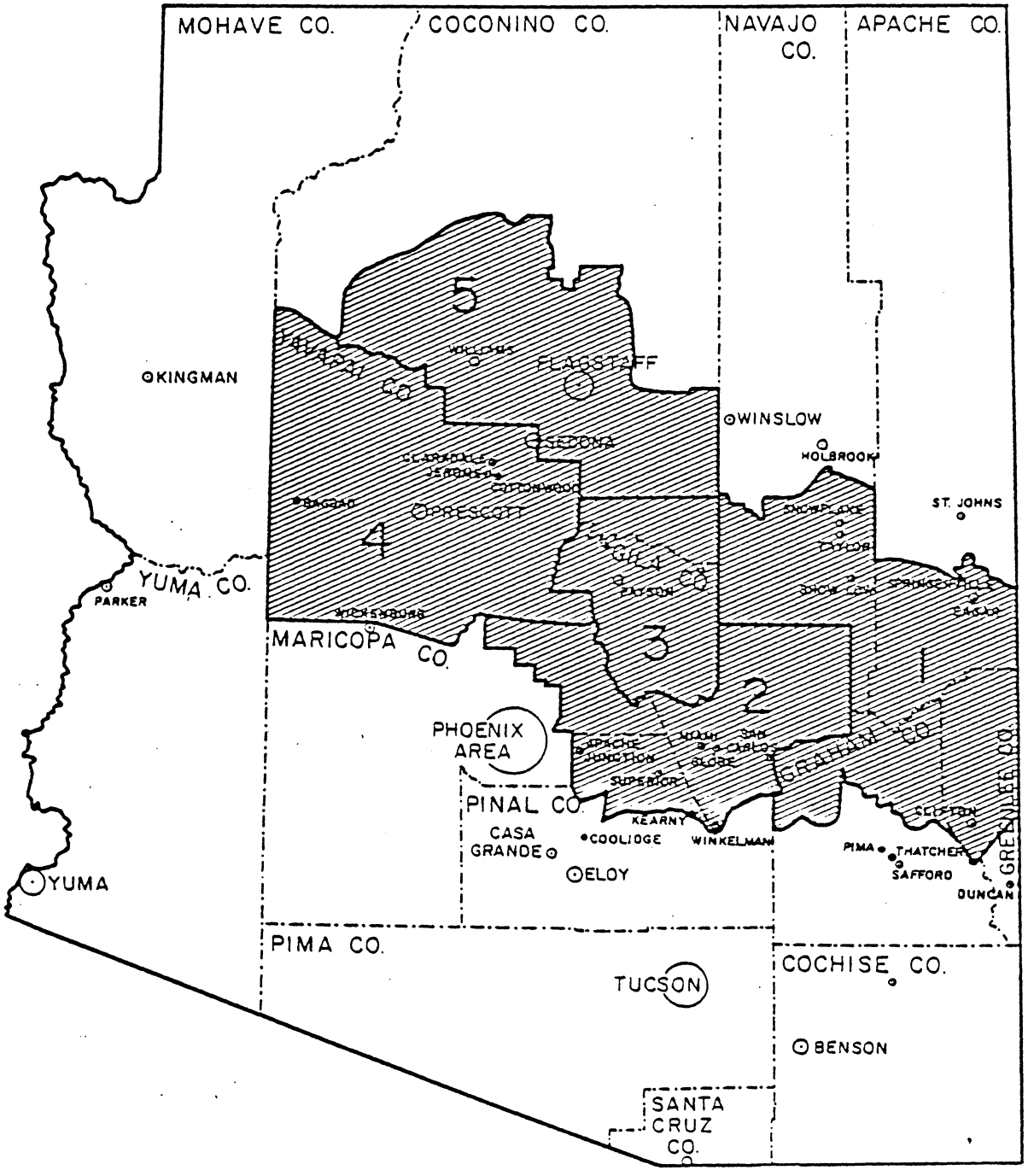

Figure 1. Local Areas of the Salt-Verde Basin, Arizona.

need and potential usefulness of distribution information. First, incomes in the area are, in general, below state and national averages, and there is a relatively high rate of unemployment as well as a high proportion of people with incomes below or near the poverty threshold. Second, communities in the area are attempting to more effectively provide public utilities and other services, and these needs will be influenced by how income is distributed. Third, the Salt-Verde Basin may be divided into subregions, some of which are primarily forest areas and particularly affected by the timber cut and recreation policies, and other areas are primarily grazing areas affected by range and recreation policy. Finally, this area, along with other forest and range areas managed by the Forest Service or Bureau of Land Management will shortly be affected by decisions carried out in accord with the Forest and Rangeland Renewable Resources Planning Act of 1974.[1/]

The Salt-Verde Basin encompasses approximately 22 million acres, nearly one-third the land area of Arizona, and most is under Forest Service control. The region is rural in nature with some 26 scattered communities whose populations range from 100 or less to roughly 30,000. Boundaries of each of the five subregions are determined by jurisdictional boundaries and economic similarities. Lumbering, grazing, tourism, mining, retirement settlement and government directly or indirectly account for most jobs in the region.

Particular range and forest policies which will affect cow-calf production, lumber production, and tourism have not been specified by the Forest Service. However, as indicated earlier, several recent expressions

of general policy and the policy impact on these forest and range products have been published. Perhaps the two most important documents are the 1976 and 1977 Forest Service publications on RPA, A Recommended Renewable Resource Program and RPA Program, A Plan for Implementation of the Forest and Rangeland Renewable Resources Planning Act of 1974 in the Southwest Region. These documents plus publications by Clawson and recent conversations with Forest Service officials in the area suggest approximate direct policy impacts on the quantity of tourism, lumber production and cow-calf production. As a rough, first-cut, it is estimated that in the medium to long run, these policies will result in a 10 percent increase in tourism, 10 to 20 percent decrease in lumber production (depending on the native forest productivity of the region), and a 20 percent decrease in cow-calf production.

A Methodology

The impacts of land use policy on the distribution of income among income classes of wage earners may be estimated by a simple extension of interindustry analysis.[2/] Interindustry analysis, either input-output or the very similar from-to analysis[3/], is a common and powerful methodology used to estimate direct plus indirect changes in regional income or employment resulting from policy induced changes in final demand sales of a particular sector or sectors.

One easy way to get at the wage distribution effect of government policies is to determine employment by skill level (unskilled, semi-skilled, skilled and professional for example) for each industry. To obtain this information, questionnaires administered to the businesses of the region to collect the usual income, expenditure, and/or employment data for inter-

industry studies, need to be expanded only slightly. Each business is asked how many people it employs in each skill level. With appropriately worded definitions of each skill level, most businesspersons in our study found this information easy to compute and unobjectionable to disclose. Thus, response rate is not adversely affected by the addition of this question.

Individual business responses are aggregated to the industry level and the number of workers of each skill level associated with industry output. For example, for each 10,000 dollars worth of output produced by industry B, perhaps it employs .05, .02, .01, .03 unskilled, semi-skilled, skilled and professional workers respectively. These coefficients are then easily multiplied by the policy induced change in output of each industry (the (I-A) inverse matrix times change in final demand). Regional change in employment by skill level is then found by summing these products over industries. Secondary data on wage rates by skill levels is then used to determine change in income distribution.

There are two prime advantages of specifying the model extension in terms of employment by skill level. First, as implied earlier, businesses are much better able and inclined to divulge information on skill level than they are on wage payments. Second, most regions have readily available secondary data on wage rates by skill level which can be used in conjunction with employment data to determine incomes. In our study, for example, wage rate information was found in the 1970 U.S. Census And a report from the U.S. Department of Labor and Bureau of Labor Statistics on weekly and hourly earnings.

Results and Policy Implications

The estimated impacts on income distribution of hypothesized forest and range policies are presented in Tables 1 and 2. For brevity, estimates of only two of the five subregions of the Salt-Verde Basin are given. Both areas have large lumber, cow-calf, and tourism industries. Based upon information mentioned earlier, a 20 percent reduction in the cow-calf sector and 10 percent increase in the tourism sectors is hypothesized. Lumbering in Area 1 is expected to decrease by 10%, while in Area 5 it is expected to decrease by 20% because of the lower productive capacity of the land.

Some of the results and their policy implications are briefly discussed. First, the net effect of expected policy in Area 1 is significantly regressive. Substantially more low income people lose their jobs than those with higher incomes. Thus, at least for this small region, stated goals of the Resource Planning Act are not being fulfulled. If similar problems were found in many regions, there would be some grounds for altering policy. Or, perhaps policy could be tailored for this particular region if the distribution impacts are not general. Or yet other choices are open. The Forest Service may believe that even with the regressive effect on income distribution, the stated policies should be carried out for other, perhaps efficiency, reasons. In this case, other government agencies should be informed of expected hardships caused by unemployment and encouraged to make preparations and carry out policy to mitigate hardships. Low income groups are especially vulnerable because of lower savings to meet livelihood and job relocation needs, and possess fewer skills which limits reemployment chances.

Table 1. Changes in Income Distribution from Forest and Range Policies Likely to Affect Area 1, Salt-Verde Basin, Arizona.

Average 1976 Income and Skill Level	Initial Man Years Employment	Total Direct plus Indirect Change in Man Years Employment to do: 10% Decrease in Lumber-Wood Products	20% Decrease in Cow Calf Production	10% Increase in Tourism	Net Change
$13,100 Professional	1274	-13	-15	+22	-6
$12,000 Skilled	1559	-26	-12	+19	-19
$8,700 Semi-skilled	2426	-33	-18	+31	-20
$6,700 Unskilled	2241	-87	-15	+26	-76
Total	7500	-159	-60	+98	-121

Computations of employment change based "short run" and "Tourism" refers to seasonal-tourists consumption expenditures as defined in Baskett and Ayer.

Table 2. Changes in Income Distribution from Forest and Range Policies Likely to Affect Area 5, Salt-Verde Basin, Arizona

Average 1976 Income and Skill Level	Initial Man Years Employment	Total Direct plus Indirect Change in Man Years Employment to do: 10% Decrease in Lumber-Wood Products	20% Decrease in Cow-Calf Production	10% Increase in Tourism	Net Change
$13,100 Professional	1846	-26	-5	+65	+34
$12,000 Skilled	1861	-39	-8	+47	0
$8,700 Semi-skilled	2945	-56	-16	+100	+28
$6,700 Unskilled	2885	-95	-7	+117	+15
Total	9537	-216	-36	+329	+77

Computations of employment change based on "short run" and "Tourism" refers to seasonal-tourists consumption expenditures as defined in Baskett and Ayer.

The estimates indicate that the most severe distribution problems will occur as a result of decreased sales of lumber and associated sectors. Thus, in getting information to those that will need it most, extension efforts can focus on these sectors.

The impact of both range and tourism policy are quite neutral with respect to income distribution. Furthermore, the employment impact resulting from a relatively large decrease in cow-calf production is more than offset, in each income category, by the expected increase in tourism. In many areas of the West where ranching and recreation interests are in conflict, this finding has important policy implications.

Local planners in Area 1 will be faced with a declining economy if the only sources of change are the forest and range policies indicated. Should this be the case, fewer public services and employees will be needed, with needs cut most (if the unemployed move from the area) in areas of low income housing. For example, neighborhood schools (if they exist) in low income housing areas will experience the greatest change in teacher requirements. Garbage collection assignments may be changed. Even the private sector can directly benefit from the estimates of distribution impacts. Builders can shift housing construction away from low income units.

Table 2, which contains similar information for another area, will not be discussed. The reader may use it to note similarities and differences between results and the implications in the two regions.

Needed Research

Empirical research on the distribution impacts of natural resource policy, including land use policy, has long been avoided. This omission is in spite of recognized distribution problems, the proper role of the federal government to carry out a distribution function, the likelihood that many land management policies will significantly affect the distribution of real income, the fact that the Principles and Standards Act "requires" a distribution accounting, and the fact that economists already have at hand theory and empirical methodology to analyze many of the distribution impacts.

Thus, there are strong grounds for more applied distribution research in association with nearly all policies which affect land use. Here we describe three kinds of information which distribution research should expose, and discuss its usefulness.

Research on the effect of land use policy on the distribution of factor payments.

Nearly all land use policies affect the incomes earned by laborers, managers, and the owners of capital. Estimates of these distribution impacts, before the policy is enacted, can guide policy in at least three ways. First, since some public land use policy, especially federal policy, may overtly attempt to improve or at least not deteriorate real income distribution, research is required to verify that distribution will improve or not be imperiled, and the magnitude of the distribution change. A recent example of a federal policy with a distribution objective is given in the "Plan for Implementation of the Forage and Rangeland Renewable Resources Planning Act of 1974 in the Southwest Region." Part of the stated mission is to "provide for the sustained, moderate production of timber and forage with emphasis on

rural community stability, job opportunity, and preservation of a life-style with local cultural heritage." Will such a public policy accomplish this objective?

Second, some land use policy, federal state or local, does not have a distribution objective, but is opposed by local-regional owners of factors of production on distribution grounds. The thrust of the argument by private entrepreneurs is frequently that their regional industry is responsible, indirectly if not directly, for significant employment (income) in the region. A common example in the West of this type of opposition is that of ranchers in opposition to proposed changes, generally suggested on efficiency grounds, in federal grazing regulations. The validity of the distribution argument, in opposition to that for efficiency, needs to be established.

Third, the changing distribution of factor income in local communities, resulting from a change in land use policy, is needed in subsequent public (and private) planning processes. Perhaps the need for this information is most acute in boom towns, where new land uses, such as energy development, are causing sharp changes in both the total and the distribution of income. Many local public service demands are affected not only by total population and income, but also income distribution. For example, higher family incomes are associated with single family dwellings, often on large or dispersed lots, whereas, lower family incomes are associated with apartments and high density housing. Thus, zoning, sewer, water, police, fire and other community services are greatly affected by the income distribution which results from some land use policies.

Research on the effect of land use policy on the distribution of consumption goods and services, particularly public goods.

Many land use policies are designed to increase the supply of public or semipublic goods. Examples of these goods are the "environment," "recreation," and "prime" agricultrual, range and forest lands. Most of these goods yield psychic benefits and are public goods in the sense that one person's consumption does not preclude another's consumption. In addition, in many cases it is impossible or impractical to exclude consumption even if the consumer does not pay for benefits received. Because of these characteristics, these public goods are often not sold or valued by a market mechanism, nor are they often produced in a socially optimum quantity without government regulation, production or subsidy. Hence the push to create national parks and wilderness areas; preserve prime lands; and regulate tillage practices and the application of fertilizer and pesticides. In justifying these activities, it is important to know not only the total benefits and costs of the goods produced vs. those from alternative land uses, but also the distribution of costs and benefits.

As implied, because public or semi public goods seldom are valued in the market, it is difficult to assess even their total value. Determining the distribution of public goods benefits is thus doubly troublesome. However, both theory and empirical techniques are improving. One of the very few and promising pieces of theory and empiricism on the distribution of public goods benefits among income classes has recently been done by Aaron and McGuire, and Maital.

Research on the economics of collective choice mechanisms (institutions per se.

Income distribution policy, and policy which affects real income even if not by design, occurs through collective choice mechanisms. The most pronounced parts of the mechanisms are government institutions of one kind or another. These mechanisms and institutions are a very key determinant of the efficiency with which real income distribution goals (or allocation or growth or stability goals for that matter) are accomplished. Even if distribution is perceived as a problem by The People, and even if the costs of obtaining a better social distribution are in fact less than increased social welfare (including the value placed on a better distribution), the collective choice mechanisms and institutions may prevent an efficient solution to the problem. Thus, there needs to be research done on both the normative and positive economics of collective choice mechanisms.

An example of this type of research may provide insights into its usefulness. The USDA, through the Soil Conservation Service, conducts the Resource Conservation and Development (RC&D) Program and one of its goals has been to improve the distribution of real income. The literature of collective choice can help answer questions about the efficiency with which the RC&D Program can meet a distribution objective: (1) Is redistribution a legitimate goal for this federal agency? (2) Is the specified chain of initiating RC&D measures, from The People up, an efficient means of redistribution? (3) Are the spending powers of the RC&D Program, vs. the tax and regulatory powers which it does not contain, a relatively efficient means of redistribution? (4) May a key part of the RC&D Program,

that of the local RC&D coordinator stimulating non RC&D government support of RC&D objectives, be expected to effectively improve the distribution of real income? All of these very basic questions, and more, can be answered at least in part through the literature of collective choice.

Economists often wonder why their rational policy suggestions fail to become policy. An example of this dilema is illustrated by the recent uproar over the huge water projects which the President wishes to veto and others wish to complete. Quite possibly the answer relates to our lack of understanding of why institutions do what they do, or our failure to apply what understanding is available and suggest policy to change the ground rules under which institutions operate.

In spite of the apparent benefits of research into the economics of collective choice, almost no applied research exists. One place to start with such research would be to select an institution and review the collective choice literature, especially that since the mid 1950's, to draw out the implications of why the institution does what it does, and how it can be changed to better perform its mission. If production functions for research exist, in which public welfare is the output and research effort the input, surely this type of research is in Stage I: payoffs will likely be high, though possibly risky.

Footnotes

1/In fact, in the Southwest Region, which encompases the Salt-Verde Basin, "A Plan for Implementation of the Forest and Rangeland Renewable Resources Planning Act of 1974 in the Southwest Region" has just been released (May 1977).

2/Interindustry methodology is commonly used to estimate the growth or allocative effects of a policy. Growth effects are defined in terms of total regional income or employment, and allocative effects are defined in terms of which products are produced. The improvement of growth and allocation are two of the three principle goals of government policy, and here inter-industry methods are used to aid in planning for the third basic goal, improvement of distribution.

3/See Tiebout, Kaltor, or Baskett and Ayer for a description of from-to analysis and the similarities and differences between it and input-output analysis. From-to analysis was used in the study reported here (Baskett and Ayer).

REFERENCES

Baumol, William J., Welfare Economics, Second Edition, Cambridge, Harvard University Press, 1965.

Bish, Robert L., and Patrick D. O'Donoghue, "A Neglected Issue in Public-Goods Theory: The Monopsony Problem," Journal of Political Economy, November/December 1970, 1367-71.

Buchanan, James, "Federalism and Fiscal Equity," American Economic Review, September 1950, 583-90.

Buchanan, James M., The Demand and Supply of Public Goods, Chicago, Rand McNally, 1968.

Buchanan, James M., and Craig W. Stubblebine, "Externality," Economica, November 1962, 371-84 .

Burkhead, Jesse and Jerry Miner, Public Expenditure, Chicago, Aldire-Atherton, 1971.

Clawson, Marion "Economic Trade-Offs in Multiple-Use Management of Forest Lands," American Journal of Agricultural Economics, December 1974, 919-926.

Clawson, Marion, Forests for Whom and For What?, Baltimore, Johns Hopkins University Press for RFF, 1975.

Coase, Ronald K., "The Problem of Social Costs," Journal of Law and Economics, October 1960, 1-44.

Coleman, James S., "The Possibility of a Social Welfare Function," American Economic Review, December 1966, 169-78.

Davis, Otto A., and Andrew Whinston, "Externalities, Welfare and The Theory of Games," Journal of Political Economy, June 1962, 241-62.

Demsetz, Harold "The Private Production of Public Goods," Journal of Law and Economics, October 1970, 293-306.

Downs, Anthony, An Economic Theory of Democracy, New York, Harper and Row, 1957.

Gardner, B. Delworth, "The Effects of Resource Policies on Income Distribution," Journal of Farm Economics, December 1966, 1242-1251.

Hansen, David E. and S.I. Schwartz, "Income Distribution Effects of the California Land Conservation Act," American Journal of Agricultural Economics, May 1977, 294-301.

REFERENCES (cont.)

Head, J.G., "The Theory of Public Goods," paper presented at Conference on Economic Policy, University of Queensland, August 1967.

Head, J.G., Public Goods and Public Welfare, Durham, Duke University Press, 1974.

Head, J.G., and Carl Shoup, "Public Goods, Private Goods, and Ambiguous Goods," Economic Journal, September 1969, 567-72.

Herber, Bernard, Modern Public Finance, Homewood, Irwin, 1971.

Kalter, Robert J. and T. Stevens, "Resource Investments, Impact Distribution and Evaluation Concepts," American Journal of Agricultural Economics, May 1971, 206-215.

Kalter, Robert J. and L.A. Shabman, "Effects of Public Programs for Outdoor Recreation on Personal Income Distribution" American Journal of Agricultural Economics, December 1969, 1516-1519.

Maass, Arthur, "Benefit-Cost Analysis: Its Relevance to Public Investment Decisions," The Quarterly Journal of Economics, May 1966, 208-266.

Mueller, Dennis, "Public Choice: A Survey," Journal of Economic Literature, June 1976, 395-433.

Musgrave, Richard A., Fiscal Systems, New Haven, Yale University Press, 1969.

Musgrave, Richard, The Theory of Public Finance, New York, McGraw-Hill, 1959.

Ng, Y.K., "Recent Developments in the Theory of Externality and the Pigovian Solution," Economic Record, June 1971, 169-85.

Oates, Wallace E., "The Theory of Public Finance in a Federal System," Canadian Journal of Economics, February 1968, 37-54.

Oates, Wallace E., Fiscal Federalism, New York, Harcourt Brace Jovanovich, Inc., 1972.

Samuelson, Paul A., "The Pure Theory of Public Expenditure," Review of Economics and Statistics, November 1954, 387-89.

Samuelson, Paul A., "Diagrammatic Exposition of a Theory of Public Expenditure," Review of Economics and Statistics, November 1955, 350-56.

REFERENCES (cont.)

Samuelson, Paul A., "Aspects of Public Expenditure Theories," Review of Economics and Statistics, November 1958, 332-37.

Samuelson, Paul A., "Contrast Between Welfare Conditions for Joint Supply and for Public Goods," Review of Economics and Statistics, February 1969, 26-30.

Shoup, Carl, Public Finance, Chicago, Aldine, 1969.

Sorenson, Donald and Herbert Stoevener (eds.), Economic Issues in Land Use Planning, Oregon State University, Agricultural Experiment Station, Special Report 469, April 1977.

Stigler, George, "Tenable Range of Functions of Local Government," in Joint Economic Committee, Subcommittee on Fiscal Policy, Federal Expenditure Policy for Economic Growth and Stability, Washington, D.C., 1957, 213-19.

Tiebout, Charles M., "A Pure Theory of Local Expenditure," Journal of Political Economy, October 1956, 416-424.

Tullock, Gordon, "Public Decisions as Public Goods," Journal of Political Economy, July/August 1971, 913-18.

Turvey, Ralph, "On Divergencies Between Social Costs and Private Costs," Economica, August 1963, 309-13.

USDA, Forest Service, RPA, "A Recommended Renewable Resource Program," Washington, D.C., 1976.

USDA, Forest Service, "Framework for the Future," 1970.