

AN ABSTRACT OF THE THESIS OF

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Title: THE ESTIMATION OF REGIONAL SECONDARY BENEFITS  
RESULTING FROM AN IMPROVEMENT IN WATER QUALITY  
OF UPPER KLAMATH LAKE, OREGON: AN INTERINDUSTRY  
APPROACH

Abstract approved: \_\_\_\_\_  
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The primary objective of this study was to estimate the impact that an increase in recreational expenditures, resulting from water quality improvements of Klamath Lake, would have upon the Klamath County economy. As the sales of the economy expand to serve the needs of the recreationists, real benefits will be forthcoming to the businesses and households of the county in the forms of more business and higher incomes.

To estimate the total impact of the increased volume of recreational expenditures that may be made in the economy, the economic relationships of the local economy had to be determined. Primary data were collected from business firms in the county to construct an input-output model of the county's economy.

The level of recreational expenditures that would be made in the county as the water quality of the lake improved were estimated. This was done for two different stages of water quality improvement. The estimated levels of recreational expenditures were then analyzed within the input-output framework to estimate the total increase in the sales of the economy and to estimate the increase in income of households in the county.

The Estimation of Regional Secondary  
Benefits Resulting from an Improvement  
in Water Quality of Upper Klamath Lake,  
Oregon: An Interindustry Approach

by

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THE ESTIMATION OF REGIONAL SECONDARY BENEFITS  
RESULTING FROM AN IMPROVEMENT IN WATER QUALITY  
OF UPPER KLAMATH LAKE, OREGON:  
AN INTERINDUSTRY APPROACH

I. INTRODUCTION

Oregon's largest body of fresh water is Upper Klamath Lake, located in Klamath County. The lake is over 30 miles long and comprises a total area of more than 130 square miles. Several streams flow into the lake to provide a year-round water supply. These streams comprise a watershed of more than 23,000 square miles. Klamath River begins at the southern end of the lake near the City of Klamath Falls.

U.S. highway 97 follows the eastern shore of the lake north of Klamath Falls for about 20 miles. The highway is used by tourists during the summer since it is the principal southern route to Crater Lake National Park. Usually one would expect such an accessible body of water to be a popular site for water-based recreation. However, this is not the case at Upper Klamath Lake. Although the lake now supports a limited amount of water-based recreation, the presence of large concentrations of algae tends to render the lake undesirable for large-scale recreational use and development.

The over-production of algae is attributed to the large quantities of nutrients in the lake. Just as land is more productive when the necessary nutrients are available in the soil, a lake is more

biologically productive when the quantities of nutrients are available in the water. A body of water that contains an over-abundance of nutrients is termed eutrophic.

Several activities can contribute to the eutrophication problem in a body of water. Many of these activities occur naturally in the environment. For example, streams may carry large quantities of nutrients to the body of water where they accumulate. Even rain water, which once was thought to be pure, contains nutrients and can contribute to the problem. Most of the eutrophication of Klamath Lake has been attributed to natural causes (Bartsch, 1968).

However, man is often a contributor to the problem. Disposal of wastes into lakes can seriously affect the quality of the water. Lakes Michigan and Erie are notable examples of this phenomenon. Lake Washington near Seattle was also being polluted with municipal wastes. This soon led to expanded algae production and poor water quality. However, water quality improvements have been noticeable now that sewage is no longer being deposited in the lake (Bartsch, 1968).

Examination of some of Klamath Lake's physical characteristics that contribute to the water quality problem is helpful in understanding the situation. First, on the bottom of the lake are mud deposits that range in depth from a few inches to more than 150 feet (Bartsch, 1968). These deposits contain large concentrations of the primary

nutrients necessary for plant growth, particularly nitrogen and phosphorus.

The shallow depth of the lake also contributes to the problem. Because the average depth of the lake is less than ten feet, wind velocities as low as two to five miles per hour cause sufficient water movement to keep the needed nutrients suspended in the water where they can be utilized by the algae. The mixing motion of the water in the shallow lake also precludes the formation of temperature stratifications. The difference between water temperatures on the surface and at the bottom of the lake is only 2-3° (Bond et al., 1968). This difference is usually much larger in lakes of greater depth.

During late July and August, high water temperatures further decrease the water quality of Klamath Lake. Temperatures between 70° and 75° are common during that time period (Bond et al., 1968). Temperatures of this magnitude restrict the size of the ecological niche of the rainbow trout in the lake. Since high water temperatures are lethal to the cold water fish, they must restrict their movement to the deeper portions of the lake and around the mouths of streams flowing into the lake as water temperatures are lower in these regions.

These conditions have substantially restricted the use of Klamath Lake as a recreation area. High water temperatures restrict the size of the sports fishery of the lake while the large quantities of algal

growth render the lake undesirable for boating, swimming, water-skiing, and sight-seeing. Thus, the potential uses for this vast body of water have not been fully realized. In an attempt to correct this situation, the Pacific Northwest Laboratory of the Federal Water Pollution Control Administration is studying the water quality problem of the lake. It is hoped that the research will lead to solutions that can be applied to Klamath Lake and other bodies of water throughout the nation that have similar water quality problems.

### The Problem

Once a solution to the biological and physical problems has been determined, it will have to pass the test of economic feasibility before it can be implemented. Given the scarcity of available resources for water quality improvement purposes, it is imperative that they be devoted to those projects where the returns are the greatest. It is here that economic considerations become important.

Decisions concerning water quality improvement projects, like other projects financed by public funds, are made within the framework of the public decision-making process. Although this process is primarily politically-oriented, economics, like other disciplines, should contribute to the process. For example, economic issues should be identified and brought to the attention of decision makers. Economics should also contribute in the evaluation of alternative

proposals and in defining criteria for analyzing the various aspects of the problem.

By fulfilling these positive roles, economics can provide valuable assistance to the public decision-making unit. Elucidation of the economic issues surrounding any decision eliminates much of the uncertainty faced by the decision maker and provides the means for making rational decisions.

### Objectives and Procedures

The above paragraph provides the justification for this study. Decision makers will require information concerning the economic benefits resulting from an improvement in water quality of Klamath Lake before any decisions concerning the implementation of the solution can be made. The primary objective of the study is to determine the economic impact that increased recreational use of Upper Klamath Lake, due to an improvement of water quality, would have upon the local economy.

An increase in recreational expenditures will increase the income of the community. This additional income will then circulate within the economy and generate still more income. Therefore, the total impact upon the economy will be greater than the original increase in expenditures.

The quantity of additional income that is generated within the local

economy is directly dependent upon the trade structure of the economy. If the businesses in the county buy a large portion of their goods and services from other local firms, the additional income generated will be greater than if they buy a smaller portion of their purchases locally. Therefore, the structural relationships of the economy must be determined before the total impact of additional recreational spending can be estimated. An input-output model of the economy is to be constructed to determine the structural relationships. Knowledge of these relationships also provides the means to determine how the benefits of additional recreational spending are distributed in the economy. The latter result may be particularly important in the event that institutional arrangements for cost sharing between various public and private groups are to be made.

The impact of increased recreational spending, due to water quality improvements at Klamath Lake, is also of interest to the local community. For example, the economic base of the community may be significantly modified if Klamath Lake develops into a prime recreational facility. This could alter local economic institutions and may lead to a substantial expansion of several sectors of the economy. In order for the economy to make this transition as smoothly as possible, it is necessary to know the type and the magnitude of the change in the institutions. This information is provided by the input-output model. Thus, the model serves two purposes in the study. First, it



makes it possible to quantify the total impact of a change in recreational spending. Finally, the model provides the information needed to modify the local economic sectors should they be drastically altered by the increased recreational spending.

### Organization of the Thesis

In order to accomplish the objectives, the thesis is divided into two parts. The first, which consists of Chapter II, is concerned with the conceptual framework of the study. The theory of secondary benefits is considered briefly along with a more thorough treatment of input-output theory. The remaining portion of the thesis, including Chapters III, IV, and V, describes the empirical techniques used and the results that were attained in the study. Chapter III contains a discussion of the data collecting process, including the determination of the sample size and its allocation among the sectors of the model. The study area is also defined. Chapter IV contains the analysis of the Klamath County economy. The input-output model is presented along with the multipliers determined for each sector.

Chapter V consists of a brief discussion of methodology used to estimate the demand for recreation at Upper Klamath Lake with varying degrees of water quality improvement. The net increase in recreational spending in each sector of the economy is determined and multiplied through the model of the economy in order to determine

total regional secondary benefits stemming from an improvement in water quality of the lake.

In Chapter VI, the study is summarized and conclusions are drawn. Limitations of the study and suggestions for further research are also discussed.

## II. THEORETICAL FRAMEWORK OF THE STUDY

Before considering the model to be used in this study, the nature of the economic benefits to be estimated should be discussed. Two types of economic benefits may result from water quality improvements at Klamath Lake. The first is the estimation of the net economic value of improved water quality. This is equivalent to the "consumer surplus" received by recreationists that would use Klamath Lake. This is usually referred to as the "primary" benefits resulting from water quality improvements at Klamath Lake.

Another type of benefit may also be forthcoming from an improvement in water quality of Klamath Lake. Recreationists incur costs as they recreate. For example, the recreationist must pay the cost of traveling to the recreation site and the cost associated with staying at the site. The expenditures made by recreationists increase the economic activity of the surrounding community. The incomes of households in the area will also increase in some proportion to the increase in economic activity. Thus, the people of the community where recreational expenditures increase are recipients of real benefits that can be attributed to the project. These benefits are called "secondary" benefits and are the concern of this study.

Economists have devoted a great deal of effort to the study of secondary benefits. Many articles in economic journals have discussed the pros and cons of secondary benefits. For example, Kimball and

Castle (1963) argue that conditions in the local and national economy may determine whether or not secondary benefits exist from a national standpoint.

The purpose of this study is not to add to the literature pertaining to secondary benefits.<sup>1</sup> To avoid many of the problems surrounding this subject, it is stressed that the benefits will be estimated from the standpoint of Klamath County. Whether or not the same benefits exist at the national level will not be considered.

Because of its unique ability to quantify secondary benefits, an interindustry or input-output model was selected for this study. An input-output model portrays the flow of goods and services throughout an economy. It provides a means to measure the impact of changes in activity within the economy which may give rise to secondary benefits. Stoevener and Castle (1965) cite two reasons why the interdependencies portrayed by an input-output model are important. They are: (1) The determination of the aggregate level of regional secondary benefits, and (2) the distribution of the same benefits. Both of these points are important when evaluating the affect of a public resource development project, such as the Klamath Lake project, upon the Klamath County economy.

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<sup>1</sup> The reader interested in pursuing this subject is referred to Beattie (1970), in the bibliography.

### History and Development of Interindustry Analysis

The basic concepts of interindustry analysis originated with Quesnay's Tableau Economique published in 1758. As founder and leader of the Physiocratic School, Quesnay was one of the first persons to look at the economy as a whole instead of considering its components separately. As a result, the Economic Table was an early forerunner of the national income accounts (Oser, 1963). Quesnay graphically depicted the circular flow of goods and money in a freely competitive economy. He clearly recognized the interrelationships between the sectors of the economy. Phillips (1955) illustrated how the Economic Table could be incorporated into an input-output framework.

The next significant contribution to interindustry analysis was made by Walras in 1874. In Elements d'Economie Politique Pure, Walras designed a model in which all prices in the economy could be determined simultaneously. By solving a system of equations, one for each price to be determined, a general equilibrium model was developed. In developing this theory, Walras relied upon coefficients of production. These coefficients were a function of the technology existing in the producing sectors at that time. They measured the quantities of factors required to produce one unit of finished goods. The Walras model, like Quesnay's model, showed the interdependence among the various producing sectors. By changing any one of the

variables in the system of simultaneous equations, a new general equilibrium would be attained.

Walras considered his model to be purely theoretical because the data requirements were too great to empirically apply it. It was not until the 1930's and Wassily Leontieff that the basic concepts were modified and used as an empirical tool. With the publication of his first work in 1936, Leontief added another dimension to economic analysis. His contribution to the theory and empirical application of input-output analysis was so great as to earn him the title of "father of input-output analysis". Since Leontief's first publication, several extensions and alternative uses of the model have been developed.<sup>2</sup> The input-output method has spread rapidly and is a widely used economic tool in the world today. Over 54 advanced and developing nations have constructed input-output tables of their respective national economies (Carter, 1966). The volume of literature relating to input-output analyses is so large that several bibliographies have been compiled<sup>3</sup> and international conferences relating to input-output have been held.

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<sup>2</sup>For a discussion of the extensions of input-output analysis, see Chapter 3 of Chenery and Clark (1959).

<sup>3</sup>See Riley and Allen (1955), Taskier (1961), and Input-output bibliography 1960-63 (1964).

## Input-Output Theory

Several sources are available to anyone seeking an explanation of the theory of interindustry economics.<sup>4</sup> The basic theoretical concepts will be illustrated here and then the assumptions upon which the theory is based will be discussed.

An input-output model is usually illustrated by the use of a "transaction matrix." It describes the flow of goods and services between the sectors of the economy in a given time period. A simplified transactions matrix is presented in Table 1. The hypothetical economy is divided into three sectors. Each of the sectors is listed twice in the matrix--once as a "producing sector" as a row heading and again as a "purchasing sector" as a column heading. The rows of the matrix describe how the total output of sector  $i$  ( $i = 1, 2, \text{ or } 3$ ) is distributed among the various sectors of the economy. Likewise, each column describes sector  $j$ 's ( $j = 1, 2, \text{ or } 3$ ) purchases of inputs from the various sectors of the economy. Therefore, the  $x_{ij}$ 's, which represent the intersectoral flows, may be interpreted in either of two ways. The  $x_{ij}$  represents the flow of goods and services from sector  $i$  to sector  $j$  or, alternatively, the  $x_{ij}$  depicts the flow of money from sector  $j$  to sector  $i$ . By summing over  $j$ , the sum of the  $x_{ij}$ 's indicate the amount of  $i^{\text{th}}$  sector's output that is used as an input

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<sup>4</sup>Two widely used texts are Miernyk (1965) and Chenery and Clark (1959).

Table 1. A hypothetical transactions matrix.

Producing Sectors	Purchasing Sectors				
		1	2	3	
					FD
					TO=X <sub>i</sub>
	1	x <sub>11</sub>	x <sub>12</sub>	x <sub>13</sub>	Y <sub>1</sub>
	2	x <sub>21</sub>	x <sub>22</sub>	x <sub>23</sub>	Y <sub>2</sub>
	3	x <sub>31</sub>	x <sub>32</sub>	x <sub>33</sub>	Y <sub>3</sub>
	VA	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>f</sub>
	TP=X <sub>j</sub>	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	

or "intermediate good" by the other sectors in the economy (Chenery and Clark, 1959):

$$\sum_{j=1}^3 x_{ij} = W_i \quad (i = 1, 2, \text{ or } 3) \quad (1)$$

where  $W_i$  = total intermediate use of the output of sector  $i$ .

By summing down a column, the total amount of "produced inputs" purchased by sector  $j$  may be obtained:

$$\sum_{i=1}^3 x_{ij} = U_j \quad (j = 1, 2, \text{ or } 3) \quad (2)$$

where  $U_j$  = total amount of produced inputs purchased by sector  $j$  from all sectors of the economy.

The  $x_{ij}$ 's may represent the number of physical units of output of sector  $i$  flowing to sector  $j$  or they may express the monetary value of



the  $i^{\text{th}}$  sector's output purchased by sector  $j$ . The second method will be used in this study. Although it will not be shown here, expressing the  $x_{ij}$ 's and all other entries in the table in dollar values allows a comparison of the input-output accounting system and the national income accounting system.

The Final Demand column (FD) of the transactions matrix, represented by the  $Y_i$ 's ( $i = 1, 2, 3$ ), shows how much of the producing sector's output was consumed as a "final good". Output allocated to final demand are not re-used as intermediate inputs in producing other goods and services within the economy under study. Final demand is referred to as the "exogenous" or autonomous portion of the input-output system because the level of demand is not dependent upon the level of economic activity within the economy being studied.

The components usually assigned to the final demand sector in an open input-output model are consumption, investment and inventory accumulation, purchases of the various levels of government and exports (Miernyk, 1965). However, the model may be "closed" with respect to the household or government components of final demand by including it as an additional sector in the processing portion of the economy. For example, the model can be "closed" with respect to households by removing consumption from final demand and payments to households from value added and forming a "households" sector in the endogenous portion of the model. Formation of a households

sector gives a more complete picture of the economy because it shows the relationship that exists between household income and expenditures. However, the cost of obtaining the additional information needed to construct a household sector is often prohibitive.

The last column of the transaction matrix (TO) represents Total Output. Total output of sector  $i$  ( $X_i$ ) is the sum of all of its intersectoral sales and sales to final demand (Chenery and Clark, 1959):

$$X_i = \sum_{j=1}^3 x_{ij} + Y_i \quad (i = 1, 2, \text{ or } 3) \quad (3)$$

or by using equation (1):

$$X_i = W_i + Y_i \quad (i = 1, 2, \text{ or } 3) \quad (3a)$$

The value-added row (VA) of the transactions matrix is composed of the payments made by the various sectors for "primary inputs" used in their productive process. The components of the value-added row are payments made to all levels of government for services rendered, payments to households for labor services, imports, and depreciation on capital equipment used in the production process (Miernyk, 1965). This is called the value-added row because the values represent the increase in value of the inputs due to the production process of that sector. The sector takes produced inputs from the various sectors and produces a new product of greater value. The increase in value is reflected in the payments made for the primary factors of production.

At first it may appear that imports should not be included in the value-added row since they may consist of intermediate goods produced by other economies. However, imports represent primary inputs into the economy being studied and they are being used in a production process within that economy. Therefore, their value is reflected in the producing sector's product and must be included in the value-added row.

It should be noted that some of the components of final demand may also purchase primary inputs. For example, when the government hires a person, it is purchasing a primary input. Therefore, wages paid by the government represent purchases of primary inputs. The symbol  $V_f$  in the transactions matrix represents the value of all purchases of primary inputs made by the components of the final demand sector.

The final row of the transactions matrix represents Total Purchases (TP). Total purchases of sector  $j$  ( $X_j$ ) is the sum of all inputs used in the production process of that sector:

$$X_j = \sum_{i=1}^3 x_{ij} + V_j \quad (j = 1, 2, \text{ or } 3), \quad (4)$$

or by substituting in equation (2):

$$X_j = U_j + V_j \quad (j = 1, 2, \text{ or } 3). \quad (4a)$$

A final characteristic of the transaction matrix should be noted. It is that the total output of each sector is equal to its total purchases:

$$X_i = X_j \text{ where } (i = j).$$

This characteristic is a manifestation of Euler's Theorem which states that, under conditions of constant returns to scale (linear, homogenous production functions) "total product is equal to the sum of the marginal products of the various inputs, each multiplied by the quantity of its input" (Stigler, 1966, p. 152).

### Technical Coefficients Matrix

Now that the transactions matrix has been presented, it may be used to derive the technical coefficients matrix. This step relies upon one of the basic assumptions of input-output analysis. It is that the level of inputs purchased by a sector is dependent upon the level of total output of that sector. Using this assumption, we can derive the technical coefficient,  $a_{ij}$ . We recall from the transactions matrix that the  $x_{ij}$  represents sector j's purchases from sector i and that the total output of sector j was recorded in the total output column. It follows directly from the assumption that:

$$a_{ij} = \frac{x_{ij}}{X_j} \tag{5}$$

where  $a_{ij}$  = the technical coefficient,

and  $X_j$  = total output of sector j.

By solving equation (5) for  $x_{ij}$  and substituting it into equation (3) we obtain a new equation for total output:

$$X_i = \sum_{j=1}^3 a_{ij} X_j + Y_i \quad (i = 1, 2, \text{ or } 3) \quad (6)$$

Technical coefficients indicate the value of inputs sector  $j$  must purchase from sector  $i$  to produce one dollar of output. They illustrate the direct interdependencies that exist between the sectors of the economy. For example, an increase in the output of sector one will lead to increased output in sectors two and three (providing  $a_{ij} > 0$ ) because the first sector will require more inputs from sectors two and three to produce its increased output.

### The Direct and Indirect Coefficients Matrix

The direct coefficients do not, however, explain the total addition to total output caused by an increase in the demand of the first sector's product. As sectors two and three increase output to satisfy the additional requirements of sector one, they must also purchase more inputs from the various sectors to produce their increased output. This causes another increase in the level of demand within the economy. Therefore a change in the output of one sector will cause direct increases in the output of other sectors which will in turn cause a series of indirect changes in the output of all the sectors. The matrix of direct and indirect coefficients is used to describe the total effect an exogenous change in the demand of one sector will have upon the entire economy.

The matrix of direct and indirect coefficients, or the "R" matrix, is obtained from equation (6) and simple matrix algebra. Restating equation (6):

$$X_i = \sum_{j=1}^3 a_{ij} X_j + Y_i,$$

and rearranging gives

$$X_i - \sum_{j=1}^3 a_{ij} X_j = Y_i. \quad (7)$$

Rewriting equation (7) in matrix notation yields:

$$X - AX = Y, \quad (8)$$

where X is the column vector of total output,

A is an nxn (where n = 3 in our example) technical coefficients matrix, and

Y is the final demand column vector.

Equation (8) is illustrated below using the example of this chapter.

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} - \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

Factoring X out of the left side of the equation yields:

$$X(I-A) = Y \quad (9)$$

where I is an identity matrix of the same dimensions as the A matrix.

The identity matrix has the characteristic that, when multiplied by another matrix of the same dimensions, it does not change the

original matrix. It serves the same purpose in matrix algebra that multiplying by unity serves in arithmetic algebra. The main-diagonal cells of the identity matrix contain unity while all other other cells in the matrix are zero.

Solving equation (9) for X yields:

$$X = (I - A)^{-1} Y. \quad (10)$$

The  $(I - A)^{-1}$  or "R" matrix is also called the matrix of direct and indirect coefficients. Each interdependence coefficient shows the output of sector i needed by sector j to deliver one dollar of its output to final demand. It takes into account the direct and indirect effects caused by a change in final demand of one of the processing sectors.

The availability of digital computers has made the method of matrix inversion the most popular means of obtaining the interdependence coefficients. However, it offers very little economic interpretation to those who want a more thorough understanding of what the interdependence coefficients represent and why their magnitude is always greater than the corresponding direct coefficients. The "iterative" or step-by-step method of solution offers a more intuitive understanding of what is taking place within the economy. Although the iterative process becomes very complex and impractical as a method of solution to large models, application of the method to a simple example would be valuable to the person wanting an economic

understanding of what the interdependence coefficients represent.<sup>5</sup>

### Input-Output Assumptions

Chenery and Clark (1959) list three general assumptions used in input-output analysis:

- (1) Each commodity is supplied by a single sector.
- (2) The inputs purchased by each sector is dependent upon the level output of that sector.
- (3) The total effect of carrying on several types of production is equal to the sum of the separate effects.

The first assumption implies that each sector uses only one method of production and that only one primary output is produced by each sector. This assumption requires satisfactory criteria by which to aggregate the numerous economic activities in the economy. Ideally, two criteria should be used in aggregation. They are to aggregate industries with similar input structures and/or industries that produce strictly complementary outputs (Chenery and Clark, 1959). It is seldom possible to strictly follow these criteria when constructing a model but they should be adhered to as closely as possible to insure more stable input coefficients.

One further point should be considered in the aggregation process.

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<sup>5</sup> For two slightly different approaches to the iterative method of solution, see Evans (1954) and Carter (1966).



It should be clear to the researcher how the model is to be used after its completion. More aggregation in some industries may be possible if they are not expected to be important in the model's final use.

Likewise, increased specialization may be beneficial in the industries that are of major interest in the analysis. For example, in this study it was felt that the major portion of recreational spending would be spent on gasoline, groceries, prepared food and lodging. Therefore, a sector was designed for each of these categories to obtain a more detailed analysis.

The second assumption, that the amount of inputs purchased by any sector is a function of the level of the output of that sector, was mentioned earlier. This assumption allows us to represent the production function of sector  $i$  as a linear equation:

$$x_{ij} = a_{ij} X_j \quad (i = 1, 2, \dots, n).$$

Under this condition the proportion of inputs used to produce the output of each sector is fixed and remains constant. This assumption has drawn criticism from many sources who feel it does not apply in the real world. These criticisms will be mentioned in the next section.

The third assumption of additivity disallows external economies and diseconomies. It simply states that all the production processes carried on within the economy are independent of each other. One production process has no effect--beneficial or detrimental--upon any

other process.

Brems (1959) points out another assumption which was mentioned earlier that is implied in an open model. He indicates that in an "open" model with respect to households, the Keynesian consumption function is irrelevant because household demand is "assumed to be independent of employment and output" (Brems, 1959, p. 137). The reason for this is that all elements of final demand, including household expenditures, are considered exogenous and determined by forces outside the model.

### Predictive Use of Input-Output Models

Input-output predictions are based on equation (10). The first step is to project a new level of final demand that is expected to occur due to an exogenous force acting upon the economy. The new "projected" final demand is then post multiplied with the R matrix to obtain the new projected total output of each sector:

$$\hat{X} = (R) (\hat{Y}) \quad (11)$$

where  $\hat{Y}$  = projected final demand vector,

$\hat{X}$  = projected total output vector,

$R = (I-A)^{-1}$  matrix.

The accuracy of this prediction depends upon the accuracy of the R matrix, which is directly dependent upon the accuracy of the transactions matrix, and the accuracy of projected final demand ( $\hat{Y}$ ). Both are

subject to error and must be minimized if meaningful predictions are to be obtained.

Some doubt has been expressed concerning the ability of input-output models to predict accurately. Many feel that the assumptions upon which the model are based are too restrictive and unrealistic to give meaningful predictions. Most of the criticisms have centered around the assumed fixed input coefficient. It ignores three changes that can occur in an economy (Chenery and Clark, 1959). They are: 1) changes in the composition of demand, 2) changes in the relative prices of inputs, and 3) changes in production technology. Of these three, a change in technology is usually considered to have the greatest effect upon the input coefficients. However, since changing technology usually alters the relative prices of factors of production, it is often difficult to separate the two effects.

Although the changes listed above will certainly affect the input coefficients in the long run, their effects may be minimal over shorter periods of time. Even though new production processes become available, the existing technological process is usually used until it has been depreciated out and new plants are built. In the same vein, changes in the composition of demand and input substitutions usually occur gradually. Therefore, it would seem that the assumption of fixed input coefficients would be justifiable in the short run.

Cameron (1953), in a time series analysis of selected input

coefficients from the Australian model, concluded that his results generally supported the assumption of fixed input coefficients in the short run. The major materials input coefficient appeared to remain relatively constant for a period as long as a decade. The substitution that did occur between inputs appeared to be caused by a change in the product-mix of the industry and not changing technology or price ratios.

However, in reporting other tests conducted by various people, Chenery and Clark (1959) are more cautious. They point out that even though input-output projections appear to be somewhat better than other methods of projection, it is still only a first approximation to reality. One must be aware of the limitations of the model and restrictions of the assumptions to prevent misusing the model. Improvements in the projections can and should be made by using less restrictive methods such as dynamic input-output models whenever possible.

### Regional Input-Output Models

As mentioned previously, input-output analysis has become a popular analytical tool at the regional level. A wide variety of types of regions have been analyzed. In most cases, regions have been defined by using political boundaries, i. e., counties, states, multi-state, etc. However, geographical characteristics such as river basins have also been used to define the regions being studied.

A regional model is constructed in the same manner as a

national model. The only difference is in the area covered. However, the regional model is usually much more "open" than a national model (Miernyk, 1965). This is because a region usually has a much more specialized economy. Each region usually has a comparative advantage in producing certain products. It exports these goods to the nation and imports goods that cannot be produced within the region. Therefore, exports and imports play a much more important role in a regional economy than they do in a national economy.

Since the regional input-output model is identical to a national model with the exception of the area covered, it is open to the same theoretical criticisms discussed earlier. However, obtaining the data necessary to construct a regional transactions matrix has been the dominant problem faced by the regional researcher. Very often the cost of obtaining the primary data through extensive surveys is prohibitive. Therefore, indirect methods to constructing a regional transactions matrix have been used.

The most widely used method of constructing a regional model has been through the use of the input coefficients derived in the national models. The first step in this process is to obtain estimates of the total output of each sector in the regional economy. Then the national input coefficients for that sector are multiplied by the output of the sector to fill in the entries in that sector's column. Each column of the transactions matrix is completed in the same manner. Once this

has been done, any additional information that is available is used to modify the distribution of output to more accurately reflect the region's flow of goods and services. This method was first used by Moore and Petersen (1955) in their input-output study of Utah. This method provides a means of constructing a regional model without collecting primary data.

A number of studies have been conducted using primary data. In Oregon, Stoevener's (1964) work at Yaquina Bay and Bromley's (1967) study of Grant County, are two examples. Stoevener was concerned with evaluating various water pollution control alternatives and their effect upon the local community. Primary data was essential in the study because the study area was only a part of one county and secondary data were not available.

The Grant County study evaluated the effect a change in federal land use programs would have upon the county's economy. Even though an entire county was used as the study area, there were not sufficient secondary data available to construct a transactions matrix. In both studies approximately 30% of the business establishments in the respective study areas were interviewed to obtain the necessary information.

Although it is expensive, extensive interviewing is often the only available means to obtain the data necessary to construct a regional input-output model. Many regional economies, especially a region

smaller than a state, are too specialized to make effective use of national coefficients. Because of this, regional models have not been used as extensively as they would if the data could be obtained more economically. However, because the model provides a complete and flexible analysis of the economy under study, the cost of constructing the model may very often be justified.

### The Klamath County Model

The model that was constructed in this study differs slightly from the basic input-output model that was just presented. The previous model was concerned with the technical input structure of the various sectors. This gives the model a technical orientation in that the input structure of each sector is determined by the state of technology used by the sector. In the Klamath County model the basic trade flows of the sectors of the economy will be studied instead of the more technical input structures. Therefore, the  $a_{ij}$ 's may more accurately be termed "trade" coefficients rather than technical coefficients. A model of this type has been called a "from-to"<sup>6</sup> model. It focuses upon the trade structure of the economy instead of the more technical input structure.

There is one other conceptual difference between the Klamath

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<sup>6</sup> This technique was first suggested by Leven (1961) and has been used by Hansen and Tiebent (1963) and Kalter and Lord (1968).

County model and the basic input-output model. In the input-output model, all transactions involving capital items are removed from the endogenous flows. They are then included in the Investment component of final demand. This is necessary since investment purchases may not be a function of the level of current output. Therefore, the equation  $a_{ij} = \frac{x_{ij}}{X_j}$  would not pertain to investment purchases.

However, in a from-to model, where the  $a_{ij}$ 's are interpreted as trade coefficients rather than input coefficients, it is not necessary to remove capital item purchases from the interindustry flows. Only the gross flows of goods and services between the various sectors are relevant in the from-to model.

The inclusion of investment purchases in the endogenous flows of the model does, however, raise an important question: What effect does their inclusion have upon the stability of the trade coefficients? At first it may appear that including investment purchases in the interindustry flows would decrease the stability of the coefficients. This would be due to the fact that investment decisions are not determined entirely by current output trends. That is, investment purchases are cyclical and reflect conditions other than those portrayed in the model. Therefore, the interindustry flows would vary as investment purchases varied.

To understand this problem, two types of investment cycles must



be considered. The first is the cyclical investment decisions of the individual firm. A firm usually does not have a constant rate of investment over a given period of time. Instead, a large investment is usually made during some years while smaller investments are made during the remaining years. This investment cycle may not significantly affect the stability of the trade coefficients. One firm may purchase capital items during one year and another firm may invest the following year. Therefore, if the firms are sampled in a random fashion, the level of investment observed may reflect a relatively stable yearly estimate for all of the firms in a sector.

The other investment cycle of importance is that observed for the entire economy. Aggregate investment varies from year to year. This variation is due to several factors such as the expectations of businessmen and the availability of funds. If data were gathered in a year when investment spending was above or below its usual level, inclusion of investment purchases in the interindustry flows would cause errors. To determine if this had occurred, national aggregate investment figures were studied (Bd. Fed. Res. Sys., 1968). The data indicated that investment spending at the national level increased sharply in the second half of 1968. Whether the Klamath County economy experienced the same general increase cannot be determined.

### III. CONSTRUCTION OF THE MODEL

#### The Study Area

Before the from-to model could be constructed, the most appropriate study area had to be defined. The primary objective was to include all communities in the study area that may be affected by expanded use of Klamath Lake. Other factors considered included the natural economic and trade boundaries in the region and the economic constraints imposed upon the study. If the study area was too large, it would not be economically possible to gather sufficient data for constructing the model.

Three specific regions were considered. They were: (1) the Klamath Basin; (2) Klamath County, and (3) the City of Klamath Falls.

The Klamath Basin consists of Klamath County and the northern portions of Modoc and Siskiyou Counties in California. Since there is no large city in the extreme northern part of California, Klamath Falls serves as the center of trade and economic activity for the entire basin. However, since Upper Klamath Lake is approximately 20 road miles north of the California border, it was felt that the California counties would not benefit significantly from increased recreational spending resulting from water quality improvement at Klamath Lake. Because of this, the Klamath Basin was not used as the study area.

The City of Klamath Falls was also eliminated. Even though the city is the trade center for the surrounding area and it is located at the southern end of the lake, other communities as much as 30 miles away from Klamath Falls are still located near the lake and may also benefit from its expanded use. Therefore, it was decided that Klamath County would be the most appropriate study area for the project.

Defining the county as the study area offers some additional benefits. First, secondary data that would aid in the study were available on a county basis. Also, having the study area coincide with political boundaries is advantageous since it provides information which may be helpful to county planning and development groups.

Klamath County is located in south-central Oregon (see Figure 1). The county contains 6,151 square miles (Oregon, 1968), ranking it as Oregon's fourth largest county. The topography of the county consists mainly of high mountains, numerous lakes and a high plateau. The rugged Cascade Mountains cover the western portion of the county. Mt. Scott, which is located in Crater Lake National Park, rises to an elevation of almost 9,000 feet and is the highest peak in the county. Most of the eastern portion of the county is part of the central Oregon high plateau with elevations ranging from 4,000 to 6,000 feet. The elevation of Klamath Falls, the county seat, is 4,105 (Oregon, 1968).

Precipitation and temperatures in the county vary with the

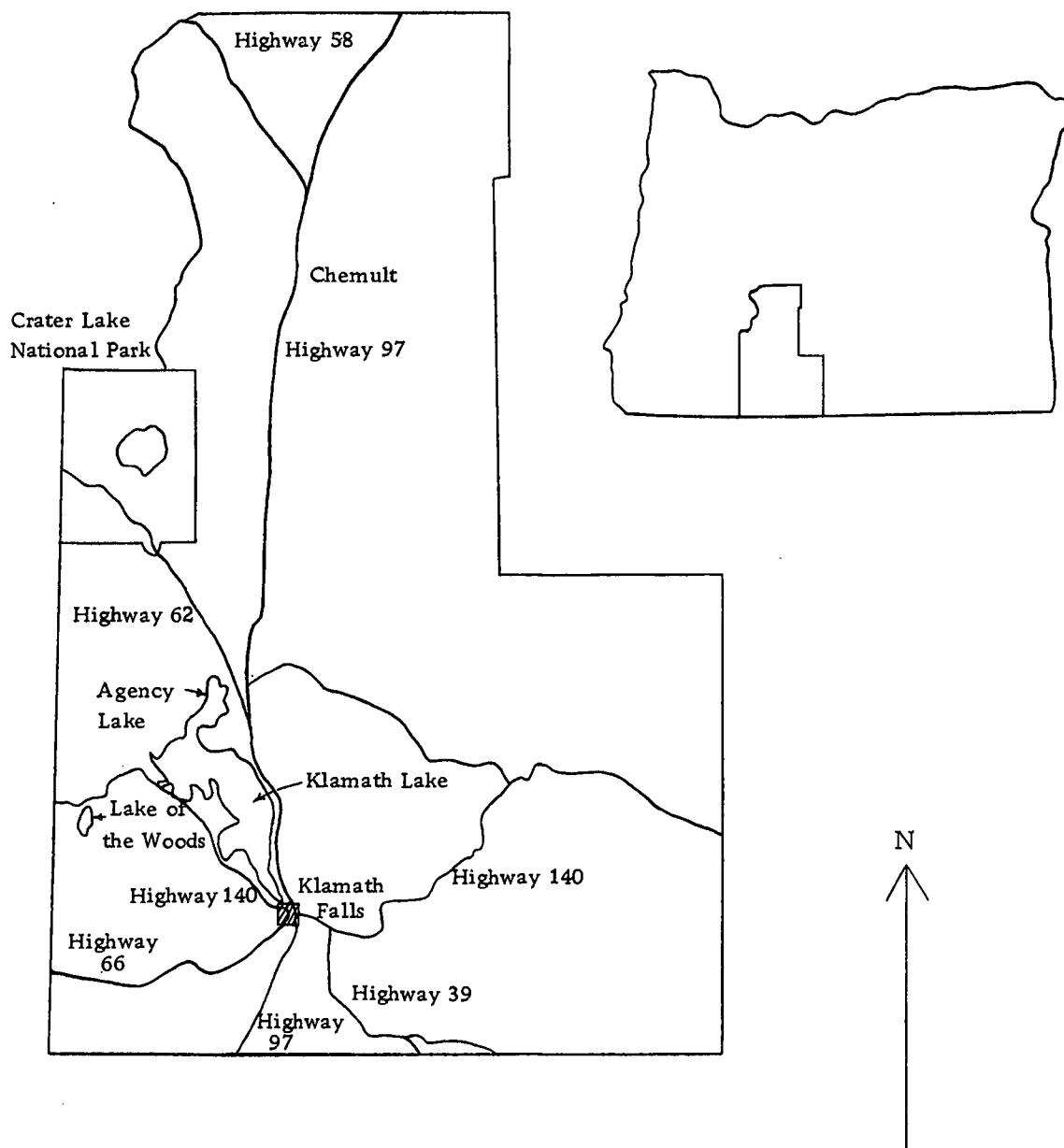


Figure 1. Map of Klamath County.

topography. Precipitation ranges from 35 inches on the western slope of the Cascade Mountains to less than nine inches on the drier portions of the semi-arid plateau. Most of the precipitation occurs in the form of snow between the months of October and March. Average snowfall at Crater Lake is 578 inches compared to only 48 inches at Klamath Falls. Average precipitation at Klamath Falls is 13.7 inches (Klamath Planning Conf., 1968).

Klamath Falls has an average January low of about 21<sup>o</sup> and an average July maximum of almost 85<sup>o</sup>. The average growing season is 119 days. Relative humidity is usually low throughout the year.

The population of the county in 1967 was 48,300 (Oregon, 1968), placing it ninth among Oregon counties. Klamath Falls, the largest city in the county, has a population of 17,600. However, the population of the metropolitan area of Klamath Falls is 38,000 people (Klamath Planning Conf., 1968), or about three-fourths of the county's population.

The economy of Klamath County, like that of Oregon, is based primarily upon lumber, agriculture and tourism. The county's forest products industry employs about 3,400 workers and has an annual payroll of over \$23 million (Klamath Planning Conf., 1968). About 70 percent of the county's area is in forest. A large portion of the forest land (about 70 percent) is owned by the Federal Government and is administered by the U. S. Forest Service and Bureau of Land

Management (O. S. U. Extension Service, 1964).

The growth of agriculture in the county was made possible by a Bureau of Reclamation irrigation project. The project was started in 1906 and is the second oldest such project in the nation (U.S. Reclamation Bureau, 1957). Currently, more than 300,000 acres are irrigated in the county, most of this under the Bureau of Reclamation project. Upper Klamath Lake is one of the primary sources of irrigation water for the project. Irrigation has made it possible to grow such crops as barley, oats, wheat, potatoes and alfalfa hay. Klamath County is the leading producer of potatoes in Oregon. The value of potatoes raised in the county in 1968 was almost \$4.75 million. Total agricultural and livestock production was valued at more than \$28 million in 1968 (U.S. D. A. , C. E. S. , 1969).

The abundance of lakes and streams in the county has greatly enhanced the recreation and tourism industry. The county is well known for its trout fishing and big game hunting. Also, since the county is located on the Pacific Flyway, it serves as a feeding ground for more than seven million migratory waterfowl each year. Waterfowl hunting accounts for a large part of the recreation industry from mid-October to early January.

Crater Lake, one of the most famous scenic attractions in the Pacific Northwest, it also located within the county. The National Park is located about 65 miles northwest of Klamath Falls. It is the

largest scenic attraction in the county. More than 578,000 people visited the park in 1968.

Klamath County also has an abundance of transportation facilities. The Southern Pacific and Great Northern Railways are located in the county and contribute to its economy. The county is also served by several motor freight companies. Klamath Falls is at the intersection of highways U.S. 97, Oregon 140, Oregon 66 and Oregon 39. Because of its geographical location and transportation facilities, the city is the distribution point for a large part of southern Oregon and northern California.

Oregon Technical Institute and Kingsley Air Force Base, which are located at Klamath Falls, also contribute to the economy of the area.

### Sampling Procedures

Since sampling was used to obtain the data required to construct the model, it was necessary to obtain a listing of all the business firms in Klamath County. Because of its size and the large number of businesses in the county, it was not feasible to attempt to canvass the entire county to obtain the population of firms. Therefore, three secondary sources were relied upon in compiling the population. They were: (1) the 1968 Telephone Directory of Klamath Falls and surrounding communities, (2) a listing of business firms in Klamath

County received from the Klamath County United Good Neighbors, and (3) the 1967 Klamath Falls City Directory published by R. L. Polk and Company of Monterey Park, California. A population of 1,840 business firms was obtained from the above sources.

Each firm in the population was placed in the appropriate sector of the model. Table 2 lists the sectors of the model and gives examples of the types of firms contained in each sector. The household sector is also defined in the table even though it is not included as a sector in the processing portion of the matrix. A firm with multiple economic activities, such as selling and servicing, was placed in the sector that described its largest income-producing activity.

In most cases, persons familiar with the businesses in the county were able to provide a description of a particular firm so that it could be included in the appropriate sector. In a few instances, it was necessary to visit the business to determine the sector in which it should be included.

After each firm had been assigned to the appropriate sector of the model, most sectors of the model were stratified. The sectors were stratified so that the firms in each sector could be grouped into more homogeneous categories than a sectoral grouping alone could provide. By increasing the homogeneity of a group of businesses, a smaller sample could be used to obtain information about the businesses



Table 2. Description of the sectors in the Klamath County model.

Sector No.	Sector Title	Sector Description
1	Agriculture	Farms, ranches and feedlots.
2	Agricultural Services	Farm implement dealers, farm cooperatives, feed, seed and fertilizer stores, livestock auction yards and irrigation pump dealers.
3	Lumber	Logging, log hauling, lumber and plywood mills.
4	Manufacturing & Processing	Potato processors, creameries, bottling companies, meat and poultry processors, machine manufacturing, trailer manufacturers, and stone, clay and glass manufacturers.
5	Lodging	Hotels, motels, trailer parks, and apartments.
6	Cafes & Taverns	Businesses that sell beverages and prepared food that may be consumed on the premises.
7	Service Stations	Gasoline bulk plant distributors, service stations and heating fuel distributors.
8	Construction	General building contractors, electrical and plumbing contractors, sand and gravel operations, asphalt paving contractors, carpenters, concrete manufacturers, excavators, land levelers, road and highway contractors, roofing and painting contractors, masonries and well drillers.
9	Professional Services	Doctors, dentists, lawyers, accountants, architects, surveyors, engineers, hospitals, veterinarians, ambulance services and nursing homes.
10	Product-Oriented (wholesale and retail)	All firms that receive the largest part of their income from the sale of products at the wholesale or retail level that are not included in other sectors. Examples: electric companies, department stores, drug stores, specialty stores, and bottled beverage distributors.
11	Service-Oriented	Firms that receive the largest part of their income from the sale of services. Examples: barber and beauty shops, insurance, and real estate agencies, repair stores, laundries, churches, social organizations, and labor unions.
12	Communications & Transportation	Trucking firms, railroad, airlines, buses, radio, television, telephone, telegraph, newspapers and television cable.

(Continued on next page)

Table 2. (Continued)

Sector No.	Sector Title	Sector Description
13	Financial Institutions	Banks, savings and loan associations, loan companies and securities investment businesses.
14	Grocery	Firms which sell food for off-premise consumption. Examples: grocery stores, seafood stands, meat stores and fruit stands.
15	Resorts & Marinas	Stores at recreational sites, marinas and boat dealers.
16	Automotive	Auto and trailer sales, tire, parts and accessory stores, and auto repair shops.
17	Local Government	County and city governments, school districts and special taxing districts.
	Households	All private individuals.

in the group.

Two types of stratification were used in the study. All sectors except Agriculture, Professional Services, Service-Oriented, Resorts and Marinas, and Local Government were stratified according to size. That is, each firm in the sector was placed into a size group, usually large, medium, or small within the sector. If the gross sales of a firm were thought to be large, relative to the other firms in the sector, the firm was placed in the large-firm stratum. Likewise, if the gross sales of a business were small compared to other firms in the sector, it was placed in the small-firm stratum. Several Klamath County businessmen were relied upon to rank the firms in each sector.

The Professional Services, Service-Oriented, and Resorts and Marinas sectors were stratified on the basis of the economic activities within the sector. For example, in the Professional Services sector, physicians were put in one stratum, dentists in another stratum, accountants in a third, etc. It was felt that this method would provide a greater degree of homogeneity since information was not available to rank the firms in these sectors according to their sales.

The Agriculture and Local Government sectors were not sampled. They will be discussed later in the chapter.

### Determination of the Sample Size

In order to use conventional sampling theory, two pieces of information are needed to estimate the sample size. They are (1) the limits of error which can be accepted in the sample estimates, and (2) an estimation of the variance of the variable(s) under consideration so that a probability statement can be made relating the limits of error and the sample size.

Standard statistical procedures could not be used in this study because the information needed to satisfy the second requirement was not available. Two problems were encountered. First, information was not available that would give any indication of the magnitude of the variances of the parameters. Secondly, since there are many important parameters in the from-to model, it would be necessary to know the variance of each of these variables in order to determine the optimum sample size. That is, total gross output ( $X_i$ ) is not the only important variable in the model. The trade coefficients ( $x_{ij}$ 's) are also of prime importance in a study such as this. Therefore, the variances of each of the  $x_{ij}$ 's would also need to be known. This means that each sector would have many variances associated with it. It would then become a problem as to which variance should be used in estimating the necessary sample size.

Because of these problems, other means had to be used to estimate the sample size for the study. Two factors were considered

to arrive at the estimate. The first was the amount of funds available for collecting the data. If funds are limited it may be necessary to accept larger errors in the parameters being estimated. The other factor was the sampling rate used in previous input-output studies in the state. In the studies by Bromley (1967) and Stoevener (1964), the sampling rates were between 25 percent and 30 percent of the total population.

After considering these factors, a sample size of 500 was selected. A 10 percent oversample was drawn because a 100 percent completion rate could not be expected. Therefore, the total sample consisted of 550 firms.

#### Allocation of the Sample

Three criteria were used to allocate the total sample among the various sectors. They were (1) the number of firms in each sector, (2) an estimate of the gross sales of each sector, and (3) the amount of variability in each sector. In the case of the first criteria, an allocation of the sample was made, based entirely upon the number of firms in each sector. If a sector contained 10 percent of the businesses in the county, 10 percent of the sample was allocated to that sector.

The second criteria was used in order to give a weighting factor to each sector based upon its total output, relative to the total output of the entire economy. In order to do this it was necessary to obtain an

estimate of the total output of each sector. Secondary sources were used to obtain these estimates. Even though complete sales data were not available for all the sectors, it was possible to get a general indication of the volume of sales.<sup>7</sup> These estimates were then used to allocate the sample on the basis of the total output of each sector.

As mentioned previously, data were not available to estimate the variances of the parameters to be estimated. However, a subjective measure of variability was considered in the allocation of the sample. Two types of variability were studied in each sector. The first was the variation in size of the firms in each sector. The other dealt with the amount of diversification as to the type of economic activity included in each sector. If either or both types of variability were great, a larger sample size was allocated to that sector. Table 3 lists the sectors and the allocation of the sample that was determined using the three criteria.

Once the sample size had been determined for each sector, it was necessary to allocate the sector sample size among the various strata in each sector. The same three criteria were used to accomplish this. A random sample was then drawn from each stratum

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<sup>7</sup> The only useful secondary data available was 1963 Census figures. However, they did provide an estimate of total sales of most of the sectors since the sector definitions of this study are similar to the Standard Industrial Code used in the Census data. See the bibliography for the list of Census data used.

Table 3. Distribution of the sample among the sectors of the model.

Sector	Number of Firms	
	Population	Sample
1. Total economy	1,840	551
2. Agriculture	*	*
3. Agricultural Services	25	17
4. Lumber	39	17
5. Manufacturing and Processing	36	20
6. Lodging	165	36
7. Cafes and Taverns	119	26
8. Service Stations	135	34
9. Construction	156	40
10. Professional Services	160	33
11. Product-Oriented	259	100
12. Service-Oriented	442	123
13. Communications and Transportation	60	23
14. Financial	30	15
15. Grocery	95	29
16. Resorts and Marinas	15	4
17. Automotive	104	34
18. Local Government	*	*

\* Not included in the sampling procedure.

of the 15 sectors that were sampled. Because the large firms in each sector accounted for a large portion of the total sales of their respective sector, all of the large firms in each sector were sampled. The sample drawn included 551 firms.

#### Design of the Questionnaire

A questionnaire was designed to obtain the information needed to construct the model. The questionnaire is similar to those used by Bromley (1967) and Stoevener (1964). Each business was asked to give the distribution of its sales so that the interindustry flows could be

estimated. That is, each firm in the sample was asked "To whom do you sell?" instead of "From whom do you buy?" The reason for this is that firms usually know the destination of their output much better than the origin of their purchases (Hansen and Tiebout, 1963).

Purchases are often so varied and complex that their origin is difficult to determine. However, most firms are more interested in who is purchasing their output. Therefore they can provide a reasonably accurate distribution of their sales.

If input and output data were both collected, it would be possible to check the estimates obtained for the interindustry flows. The estimate of the amount sold to sector 2 by sector 1 could be compared with the estimate of the amount purchased by sector 2 from sector 1. Such comparisons help minimize any errors that may exist in the model. However, because of the problems associated with obtaining input data and the added cost of collecting information about purchases as well as sales, only sales data were collected.

Additional questions were included to obtain the data needed to complete the model. The questionnaire used in the study is contained in Appendix 1.

### Sampling Results

Personal interviews were conducted with each firm in the sample. However, it became obvious in the early stages of data collection that



500 responses would not be obtained from the 551 firms in the sample. The information was unobtainable from a much larger percentage of the firms than was expected when the sample was drawn. Therefore, it was necessary to draw a second sample. The second sample contained 175 firms, thus increasing the total sample size to 726 firms. The allocation of the second sample was determined by the number of firms in each stratum that did not respond in the first sample. That is, if four firms did not respond in a particular stratum, four additional firms were drawn from that stratum to replace the original firms.

Of the 726 firms sampled, responses were obtained from 438 of them. The nonresponding firms can be broken down into three broad categories: 82 (11.27 percent) were out of business, 100 (13.77 percent) refused to take part in the study, and 94 (12.95 percent) were not heard from for reason that will be explained later. There were 12 additional firms that did not respond for various other reasons.

Several factors contribute to the low completion rate. First, relying upon secondary sources to compile the population of businesses probably increased the percentage of firms in the population that were no longer in business. Lists of businesses become obsolete very rapidly due to the usual rate of business turnovers. However, such a large portion of firms no longer in business was not expected when the same was drawn.

A second factor contributing to the poor results was the type of

data being collected. In order to construct the model, detailed financial data were required from each firm interviewed. Most of the refusals resulted from firms that considered the data to be confidential and, therefore, would not release it.

The type of businesses in the study area also contributed to the poor response. Many of the businesses were division offices of larger companies or corporations. In many cases they did not have the detailed information available at their Klamath County office. The head offices of these companies were contacted by mail and telephone. However, the interviewing procedures used in the study were not well designed for these nonpersonal contacts and many firms did not reply to the requests for information. Other firms indicated they did not maintain the type of data requested for individual branch offices of the company, and therefore, could not respond. In addition, it was not possible to determine the owners of some businesses such as self-service laundromats and car washes. Therefore, some firms of this type could not be contacted.

There is one additional factor that contributed (just how significantly is not known) to the poor response. During the time that data was being collected, a proposed solution to the water quality problem of Klamath Lake was released to the public. This solution proved to be unpopular with many of the people in Klamath County. When people realized that this study was concerned with the same water quality problem, many assumed that it was associated with the proposed

solution that had been released. Several businesses gave this reason for refusing to take part in the study. It is not known how many additional firms refused for the same reason.

The firms that did not respond were studied in an effort to see if their nonresponse may have introduced bias in the sample estimates. Attempts were made to discover any trend that may have indicated a nonrandom response. Sampling results were compiled for each size stratum in an effort to determine if firm size had any effect upon the response. However, the results did not indicate any such trends. Therefore, no corrections were made in the sample estimates.

Even though the sampling results left much to be desired, enough information was received to describe the population. The 438 responses accounted for nearly 24 percent of the firms in the county.

### Local Government

Since local government data were readily available, it was not necessary to sample the various units of government in the county. The expenditures of all governmental units were obtained for the 1967-1968 fiscal year. These expenditures were then allocated to the various sectors in the model with the assistance of the bookkeeper or purchasing department of each unit of government. These data were used to fill in the local government column in the transactions matrix.

### Agriculture

Even though it is the second largest industry in Klamath County, primary data were not collected for the Agriculture sector for two reasons. First, the 1964 Census of Agriculture estimated that there were more than 1,000 farms in Klamath County. Financial limitations prohibited the collection of the volume of data necessary to estimate the various parameters through a sample survey. Also, the abundance of secondary data pertaining to agriculture seemed to make the collection of primary data unnecessary. Of all the sectors in the model, more secondary data was available for agriculture than any other sector. It was felt that the necessary estimates could be determined from the available data.

#### IV. THE KLAMATH COUNTY ECONOMY

This chapter will present the from-to model developed for the Klamath County economy. The data obtained from the sample is used to construct the transactions matrix. The transactions matrix will be mathematically manipulated to derive the direct coefficients matrix and the direct and indirect coefficients matrix. The procedure used to obtain this matrices was described in Chapter II. The three matrices will also be used to describe the structure of the Klamath County economy.

##### Transactions Matrix

The transactions matrix, presented in Table 4, illustrates the flow of goods and services in the Klamath County economy. Each sector of the economy is listed at the left and again at the top of the matrix. Those listed at the left represent the selling sectors while those across the top indicate the purchasing sectors. The figures in the cells of the matrix indicate the value of goods and services sold by the sector at the left to the sector at the top. For example, reading across the Agriculture row shows it sold \$6,189,800 of goods and services to Agriculture (intraindustry sales); \$602,200 to Agricultural Services, zero to Lumber; \$9,484,110 to Manufacturing and Processing, and so on across the row. The distribution of sales by each of the 17 sectors to other sectors of the economy can be

Table 4. Transactions Matrix Showing Interindustry Flows in Dollars, Klamath County, 1968.

	SALES					PURCHASES																22.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	
	Agriculture	Agricultural Service	Lumber	Manufacturing & Processing	Lodging	Cafes & Taverns	Service Stations	Construction	Professional Services	Product-Oriented	Service-Oriented	Communications & Transportation	Financial	Grocery	Resorts & Marinas	Automotive	Local Government	Households	Government	Exports	Positive Inventory Changes	Total Output
1. Agriculture	6189800	602200	0	9484110	0	35400	0	0	11800	0	0	0	0	160480	0	0	725	87650	58310	12223240	0	28853715
2. Agricultural Services	4445044	203628	36868	203320	3048	3048	0	12482	3048	0	46098	12193	0	0	6098	3048	81886	1574456	70346	4108146	315871	11128628
3. Lumber	75660	0	9078878	143220	0	0	3000	425100	0	574900	3000	0	0	8000	0	0	0	164205	1588875	66842408	912000	79819246
4. Manufacturing & Processing	168712	203	148601	133	81500	719724	0	294001	26488	375333	21000	1440	0	3887324	26353	0	313600	1885729	3363182	11620564	221561	23155448
5. Lodging	0	0	144	0	0	0	0	6480	432	0	165	0	6562	0	0	144	480	4144642	50039	116657	0	4325745
6. Cafes & Taverns	0	552	18602	367	0	0	0	18051	0	0	0	0	367	0	0	0	865	6389220	7342	7255	20941	6463562
7. Service Stations	931082	83175	659601	148682	47095	56162	1685422	437078	51863	213294	94805	362098	1486	34718	92206	40909	161270	10504539	107649	643662	36892	16393688
8. Construction	174523	0	260241	227716	32778	103870	43568	2213796	28035	927365	231342	7380	44080	21723	1500	23494	564748	6231934	6817851	629222	28184	18613350
9. Professional Services	132377	15225	38777	24640	12371	7066	15225	37151	8398	17772	76962	19440	10510	11167	1766	19510	115366	12554059	1158196	411370	52650	14739998
10. Product-Oriented	917869	370834	1959997	626274	773262	1870911	346169	970800	260792	992712	814776	241687	173416	1743400	43760	224003	781627	25393634	2104422	5894513	1036741	47563599
11. Service-Oriented	430182	56802	169249	46438	142033	202597	99743	291772	133820	256562	849198	15097	304702	110210	22993	253931	313563	11767752	252848	668493	72417	16480402
12. Communications & Transportation	243587	759690	12880011	2584137	331352	54361	146217	321713	230384	1887177	424014	99805	108723	429084	0	182176	102636	4833473	1844492	2576587	12933	30052552
13. Financial	664893	128491	619804	146285	96450	16720	48612	147522	59144	81589	48300	16568	64868	16718	16718	432697	0	3324947	0	148185	0	6078511
14. Grocery	26000	0	48429	0	0	173949	0	0	0	8169	0	18789	0	1009154	0	0	42765	21821738	176428	650788	64148	24060357
15. Resorts & Marinas	4500	0	0	0	0	0	0	0	0	0	0	0	0	0	1500	0	530	683801	700	3300	8522	702853
16. Automotive	217599	77477	999703	67633	0	0	326021	192629	58235	444565	128148	92154	4547	6920	12197	1083667	343497	14699688	457936	379241	343814	19935671
17. Local Government	1363355	40196	1203539	95747	66077	41018	50545	70301	78670	985543	297236	809988	42274	56766	29356	60337	74982	1892030	5941882	0	0	13229842
18. Summation	15085183	2338473	28122444	13798702	1635966	3284826	2764522	5438876	951109	6764981	3035044	1696639	761535	7495664	274447	2323916	2898540	127953497	24002498	106923631	3146674	361597167
19. Households	9628840	1167182	22774364	3582073	1599988	2212820	2493078	4760157	8147045	8496250	6103324	8660497	1525558	2394523	109000	3338043	8465971	0	0	0	0	95448713
20. Imports	60527	7203070	15634118	4538836	501652	344202	10282673	7383363	4107854	27114422	5936861	13514040	3353634	13418780	280610	13266816	907291	0	0	0	0	127848749
21. Government	572608	130436	8165529	645296	126715	327305	569385	503998	758080	4325297	917204	3706821	290768	482164	21996	377625	958040	0	0	0	0	22889267
22. Depreciation and Negative Inventory Changes	2606557	289467	5122791	590541	461424	294409	284030	526956	775910	862649	487969	2474555	147016	269226	16800	629271	0	0	0	0	0	15839571
23. Total Inputs	28853715	11128628	79819246	23155448	4325745	6463562	16393688	18613350	14739998	47563599	16480402	30052552	6078511	24060357	762853	19935671	13229842	127953497	24002498	106923631	3146674	623623467

determined in the same manner.

The purchases of each sector of the economy can also be determined from the transactions matrix. This is done by reading down the column of the sector listed at the top of the matrix. For example, reading down the first column shows that Agriculture purchased \$6,189,600 of goods and services from itself; \$4,445,044 from Agricultural Services; \$75,660 from Lumber; \$168,712 from Manufacturing and Processing, and so on down the column.

The first 17 rows and the first 17 columns represent the endogenous portion of the transactions matrix. It illustrates the trade relationships among the sectors of the Klamath County economy. However, the remaining rows and columns of the transactions matrix also provide useful information about the economy.

Row 18 is the sum of the first 17 rows in each column. The figure represents the total value of goods and services the sector at the top of the column purchased within the local economy. The figures provide a general indication of how much that sector depends upon the other sectors of the economy. The larger the figure, relative to the total purchases of the sector (row 23), the greater the magnitude of dependence of that sector upon the other sectors of the local economy.

Rows 19-23 comprise the value-added portion of the matrix. As stated in Chapter II, this portion reflects the payments to the various primary factors of production. The Household row (19)

indicates the value of services purchased from private individuals. It includes such payments as wages, returns to entrepreneurial services, interest, dividends, and rent. This figure indicates another characteristic of the various sectors--the larger the payments to Households, relative to the total purchases of the sector, the more labor-intensive is the industry.

The Import row (20) depicts the purchases of goods and services from outside the Klamath County economy. This provides a measure of the degree of self-sufficiency of the economy. The large volume of imports purchased by the industries in the model indicates that the economy of the county is not self-supporting.

The Government row (21) represents the value of goods and services the various sectors purchased from the state and federal governments. Taxes paid to these governments are included in the Government row. It is implied that the governments provide services to the industries in return for the taxes they receive. Other goods and services purchased from the state and federal governments include Lumber's purchases of timber located on state and federal lands.

Row 22 is the sum of two elements: negative inventory changes and depreciation. The former represents the reduction in accumulated goods and services (both intermediate and finished) that are held by the businesses in each sector. Depreciation is the value of capital consumed by the production of goods during 1968. Row 23, labeled



Total Purchases, represents the value of all goods and services purchased by each sector in the model. It is the sum of intermediate and primary purchases.

Columns 18 through 21 comprise the final demand or final use of goods and services sold by the sectors listed at the left of the matrix. The four components of final demand indicate the major uses of the goods and services sold for final use. The Household column (18) represents the value of goods and services sold to individuals while the Government column (19) shows the value of sales to state and federal governments. It should be noted the units of local government have been aggregated and included as an endogenous sector in the model. This makes it possible to determine local government's relationships with the economy. Column 17 shows the value of purchases made by Local Government while row 17 indicates the distribution of its receipts from the sectors of the economy. These receipts include local taxes (primarily property tax) and license fees paid by the businesses in the county.

The column labeled Exports (20) represents the value of goods and services that were shipped out of the county in 1968. The Positive Changes in Inventories column (21) represents the increase in stocks of goods and services held by the sectors of the economy. It includes intermediate and finished goods and services. The final column of the matrix (22) represents Total Output. It is the sum of all the figures in

the cells of each row. It should be noted that, as stated in Chapter II, the total output of each sector is equal to its total purchases.

### Direct Coefficients Matrix

The information presented in the transactions matrix is presented in a different form in the direct coefficients or "A" matrix (Table 5). The cells of the "A" matrix represent the  $a_{ij}$  ( $i = 1, 2, \dots, 22$  and  $j = 1, \dots, 17$ ) coefficients described in Chapter II. It is recalled that  $a_{ij}$  was computed by:

$$a_{ij} = \frac{x_{ij}}{X_j}$$

where  $x_{ij}$  = the value of goods and services sold by sector  $i$  to sector  $j$ ,

$X_j$  = the value of total output of the  $j$ th sector.

Therefore, the  $a_{ij}$ 's indicate the value of goods and services sector  $j$  must purchase from sector  $i$  if sector  $j$  is to increase its sales one dollar. In most cases the  $a_{ij}$ 's, which represent purchases per unit of output, reveal more about the structure of a sector than the absolute magnitude of interindustry sales recorded in the transactions matrix. The direct coefficients matrix is utilized by reading down the column in order to determine the input structure of the industries. Therefore, the final demand portion of the transactions matrix would be the same as in the preceding table and is not repeated here.

Table 5. Matrix of Direct Coefficients, Klamath County, 1968.

	1.	2.	3.	4.	5.	6.	7.	8.	PURCHASES			13.	14.	15.	16.	17.
	Agriculture	Agricultural Services	Lumber	Manufacturing & Processing	Lodging	Cafes & Taverns	Service Stations	Construction	Professional Services	Product-Oriented	Service-Oriented	Financial	Grocery	Resorts & Marinas	Automotive	Local Government
1. Agriculture	.2745235024	.0541126903	0	.4095843881	0	.0054768563	0	0	.0000005428	0	0	0	0	.0066698927	0	.0000548004
2. Agricultural Services	.1540544779	.0182976734	.0004618936	.00087806550	.0007026185	.0004715666	0	.0006705940	.0002067843	0	.0027971	0	0	.0086760674	.0001528918	.0061894919
3. Lumber	.0026221927	0	.1137429687	.0061851535	0	0	.0001829973	.0228384466	0	.0120869743	.0001820	0	0	.0003324971	0	0
4. Manufacturing & Processing	.0058471500	.0000182412	.0018417189	.0000057438	.0188406852	.1113509857	0	.0157951685	.0017970152	.0078911817	.0012742	0	.1615655163	.0374923267	0	.0237039868
5. Lodging	0	0	.0000018041	0	0	0	0	.0003481372	.0000293080	0	.0000100	0	.0010795407	0	.0000072232	.0000362816
6. Cafes & Taverns	0	.0000496018	.0002330516	.0000158494	0	0	0	.0009697878	0	0	0	0	.0000603766	0	0	.0000653825
7. Service Stations	.0322690510	.0074739671	.0082636837	.0064210375	.0108871420	.0086890170	.1028092032	.0234819632	.0035185215	.0044843957	.0057525	.0002444678	.0014429545	.1311821716	.0020520503	.0121898659
8. Construction	.0060485452	0	.0032603791	.0098342299	.0075774231	.0160700864	.0026576082	.1189359250	.0019019677	.0194973681	.0140374	.0072517760	.0009028544	.0021341589	.0011784906	.0426874335
9. Professional Services	.0045878668	.0013680932	.0004858102	.0010641124	.0028508542	.0010932053	.0009287111	.0019959330	.0005697423	.0003736471	.0046699	.0017290419	.0004641245	.0025126164	.0009786478	.0087201344
10. Product-Oriented	.0318111203	.0333225264	.0245554437	.0270465076	.1787541099	.2894551023	.0211159929	.0521561138	.0176928111	.0208712549	.0494390	.0285293553	.0724594402	.0907159819	.0112362910	.0590805998
11. Service-Oriented	.0149090680	.0051041332	.0021204034	.0020054892	.0374578252	.0313444816	.0060842319	.0156754158	.0090786987	.0053940830	.0515277	.0501277369	.0045805638	.0327138107	.0127375196	.0237011901
12. Communications & Transportation	.0084421365	.0682644797	.1613647290	.1115995251	.0765909845	.0084103781	.0089191035	.0172839924	.0156298529	.0396769176	.0257283	.0178864528	.0178336506	0	.0091381925	.0077579158
13. Financial	.0230435838	.0115459875	.0077650946	.0063175197	.0222967373	.0025868089	.0029652876	.0079256018	.0040124836	.0017153664	.0029307	.0106716925	.0006948359	.0237859126	.0217046620	0
14. Grocery	.0009010971	0	.0006067334	0	0	.0269122506	0	0	0	.0001717490	0	0	.0419426029	0	0	.0032324649
15. Resorts & Marinas	.0001559591	0	0	0	0	0	0	0	0	0	0	0	0	.0021341589	0	.0000400609
16. Automotive	.0075414552	.0069619543	.0125245859	.0029208245	0	0	.0198869833	.0103489700	.0039508146	.0093467486	.0077757	.0007480450	.0002876100	.0173535576	.0543581904	.0259638021
17. Local Government	.0472505880	.0036119457	.0150783058	.0041349664	.0222115094	.0063460364	.0030831989	.0037769128	.0053371785	.0207205304	.0180357	.0069546637	.0023593166	.0417669129	.0030265849	.0056676414
18. Summation	.5540077941	.2101312938	.3523266055	.5959160021	.3781928893	.5082067751	.1686333179	.2922029619	.0445257211	.1422302169	.1841601	.1252831491	.3115358596	.3904756756	.1165707440	.2190910519
19. Households	.3337123140	.1048810330	.2853242187	.1546967694	.3675619687	.3423530245	.1520754817	.2557388648	.5527168321	.1786292497	.3703382	.2509756090	.0995215075	.1550822149	.1674407147	.6399147473
20. Imports	.0020977195	.6472558882	.1958690264	.1960159009	.1159649256	.0532526802	.6272336646	.3966702931	.2786875548	.5700666596	.3402370	.5517196563	.5577132542	.3992442232	.6654812873	.0685791259
21. Government	.0198452088	.0117207620	.1023002522	.0278679989	.0316049605	.0506384870	.0347319651	.0270772322	.0514301291	.0909371261	.0556541	.0478353992	.0200397692	.0312953064	.0189421766	.0724150749
22. Depreciations and Negative Inventory Changes	.0903369635	.0260110231	.0641798972	.0255033286	.1066692558	.0455490332	.0173255707	.0283106480	.0526397629	.0181367478	.0296090	.0241861864	.0111896095	.0239025799	.0315650775	0

Column 1 of the "A" matrix shows that Agriculture must purchase 22 cents of goods and services from itself if it is to increase its output by one dollar. Continuing down the column shows that Agriculture must also purchase 15 cents of goods and services from Agriculture Services; less than one cent from Manufacturing and Processing and Lumber; zero from Lodging and Cafes and Taverns; etc., down the column. The summation row (18) shows that Agriculture purchases over 55 cents worth of goods and services from the local economy for every dollar of output. Row 19 shows that Household incomes increase 33 cents per dollar increase in sales of the Agriculture sector.

### Characteristics of the Economy

Now that the transactions and direct coefficients matrices have been presented and their use explained, some of the characteristics of the economy can be studied. Table 6 shows a breakdown of the sales of each of the 17 sectors. It shows the dollar value and percentages of sales to the local economy and to final demand. It is interesting to note that only Agriculture and Communications and Transportation sell more than one-half of their total output to the businesses in the local economy (57 percent and 69 percent, respectively). Most of Agriculture's interindustry sales (95 percent) are purchased by itself or Manufacturing and Processing while Lumber purchases almost 62 percent of Communications and Transportation interindustry sales.

Table 6. Distribution of sales of the 17 sectors in the Klamath County economy.

Sector	Interindustry sales	Sales to final demand	Percent of sales sold to local economy	Percent of sales sold to final demand
1. Agriculture	\$16,484,515	\$12,369,200	57.13	42.87
2. Agricultural Services	5,059,809	6,068,819	45.47	54.53
3. Lumber	10,311,758	69,507,488	12.92	87.08
4. Manufacturing & Processing	6,064,412	17,091,036	26.19	73.81
5. Lodging	14,407	4,311,338	0.33	99.67
6. Cafes & Taverns	38,804	6,424,758	0.60	99.40
7. Service Stations	5,100,946	11,292,742	31.12	68.88
8. Construction	4,906,159	13,707,191	26.36	73.64
9. Professional Services	563,723	14,176,275	3.83	96.17
10. Product-Oriented	13,132,289	34,431,310	27.61	72.39
11. Service-Oriented	3,718,892	12,761,510	22.57	77.43
12. Communications & Transportation	20,785,067	9,267,485	69.16	30.86
13. Financial	2,605,379	3,473,132	42.86	57.14
14. Grocery	1,327,255	22,733,102	5.52	94.48
15. Resorts & Marinas	6,530	696,323	0.93	99.07
16. Automotive	8,054,992	15,880,679	40.40	59.60
17. Local Government	5,395,930	7,833,912	40.79	59.21

This is primarily due to the use of transportation facilities for shipping lumber and wood products out of the county.

Table 6 also shows that five sectors sell less than ten percent of their total output to the sectors of the local economy. They are Lodging (0.33 percent); Cafes and Taverns (0.60 percent); Professional Services (3.83 percent); Grocery (5.52 percent) and Resorts and Marinas (0.93 percent). The reason for the low percentages is that each of these sectors primarily serve the needs of the Household sector, which, in this model, is a component of final demand. If Households were included in the endogenous portion of the model, the percentage of interindustry sales to total sales for the five sectors would vary from about 89 percent for Professional Services to 99.45 percent for Cafes and Taverns.

As mentioned earlier, row 18 of the direct coefficient matrix (Table 5) indicates the value of each sector's purchases per dollar of sales that are obtained from the local economy. From this it can be seen that the same characteristic exists with respect to purchases as exists with sales. Only three sectors purchase more than one-half of their goods and services from the local economy. They are Agriculture (55.4 percent); Manufacturing and Processing (59.6 percent); and Cafes and Taverns (50.8 percent). The Communications and Transportation sector is least dependent upon the local economy. It buys only 5.6 cents of goods and services per dollar of output from

local businesses.

In absolute terms (Table 4), Lumber purchases more goods and services (\$28,122,440) from the Klamath County economy than any of the other sectors. Agriculture ranks second in dollar value of goods and services purchased locally (\$15,985,183), followed by Manufacturing and Processing (\$13,798,702). This gives some indication of the importance of these sectors in the economy.

The importance of the household coefficients ( $a_{hj}$ 's) in row 19 of the direct coefficients matrix becomes obvious when one realizes that they indicate the amount household incomes will rise if the output of sector  $j$  increases one dollar. They represent the direct effect a one-dollar change in output will have upon household incomes. It is interesting to note that Local Government has the largest  $a_{hj}$  (.64) in the economy. This indicates that payrolls and other payments to households account for a large portion of the budgets of the various units of local government. The Professional Services and Service-Oriented sectors rank second and third with  $a_{hj}$ 's of .55 and .37, respectively. One would expect the service sectors to have larger household coefficients since they are labor-intensive industries. Grocery and Agricultural Services have the smallest household coefficients of .0095 and .1049, respectively.

As noticed earlier, the large quantity of imports (represented in row 20 of Tables 4 and 5) purchased by the various sectors in the

model indicates that the economy is highly dependent upon the "rest of the world" as a source of goods and services. The large importers are those sectors that deal in products that are produced outside the economy. They include Agricultural Services (64 percent of purchases are imports), Product-Oriented (57 percent); Service Stations (62 percent), Grocery (56 percent), and Automotive (67 percent). The goods and services of these sectors must be imported since they are not produced in the local economy. Agriculture imports less, in absolute and relative terms, than any other sector.

A final characteristic of the Klamath County economy can be seen by studying the Export column (20) in Table 4. The fact that all of the sectors (except Local Government) export some goods and services illustrates that the economy serves as a trading center for other communities outside the county. This is especially true at the wholesale trade level. The largest exporters are the basic industries of the economy. Agriculture exports more than \$12 million, Lumber \$66.8 million, and Manufacturing and Processing about \$11.6 million. A large portion of the exports of the latter sector are agricultural commodities that have been processed by local firms.

The foregoing discussion illustrates that, like most small regional economies, the Klamath County economy is highly specialized. Lumber and Agriculture provide the base upon which the remainder of the economy rests. Many of the goods and services used



in the economy must be imported. The primary industries export a large quantity of products while wholesale traders in the other sectors of the economy also export some goods and services.

### The Direct and Indirect Coefficients Matrix

The  $(I-A)^{-1}$  or "direct and indirect coefficients matrix" is presented in Table 7. As with the transaction matrix, it contains 17 rows and 17 columns; one of each for the 17 sectors of the economy. The sectors listed at the left again represent the selling sectors and those listed at the top the purchasing sectors. The  $(I-A)^{-1}$  matrix will be used in the final solution of the model in the next chapter. Because of the direct and indirect effects explained in Chapter II, the figures in the cells of the  $(I-A)^{-1}$  matrix are larger than the figures in the same cells in the direct coefficients matrix. That is, a change in the output of sector one will cause an increase in demand for the products of the sectors that supply goods and services to the first sector. These sectors will increase output and cause another rise in demand throughout the economy. This again leads to more output and increased demand, and so on. The figures in the  $(I-A)^{-1}$  matrix indicate the total increase in output caused by the original change in demand for the output of a sector. For example, assume that there is a one dollar increase in final demand for the products of Agriculture. This will set into motion a series of changes in the output of all the

Table 7. Matrix of Direct and Indirect Coefficients, Klamath County, 1968.

	PURCHASES																
	1. Agriculture	2. Agricultural Services	3. Lumber	4. Manufacturing & Processing	5. Lodging	6. Cafes & Taverns	7. Service Stations	8. Construction	9. Professional Services	10. Product-Oriented	11. Service-Oriented	12. Communications & Transportation	13. Financial	14. Grocery	15. Resorts & Marinas	16. Automotive	17. Local Government
1. Agriculture	1.2224189074	.0715281007	.0017655294	.5303588931	.0114250295	.0705472584	.0002174472	.0100951196	.0022118550	.0048521335	.0016275802	.0005500256	.0004275199	.0988687371	.0217108404	.0001673971	.0142783076
2. Agricultural Services	.2034218584	1.0299959897	.0010798205	.0925498608	.0030606684	.0128890796	.0001018108	.0026726004	.0004590358	.0010560441	.0034529972	.0006905325	.0003060300	.0171586673	.0130502058	.0002722382	.0089655872
3. Lumber	.0050732356	.0008269099	1.1289852269	.0098114232	.0031941345	.0060240189	.0006957477	.0303902336	.0003767315	.0146981330	.0015116449	.0002067595	.0007492934	.0032410532	.0020454498	.0002620872	.0024847756
4. Manufacturing & Processing	.0101022195	.0010846867	.0032193853	1.0048380600	.0214898309	.1197485995	.0004001180	.0189836630	.0021971525	.0091555995	.0026499521	.0009457834	.0007721274	.1703329168	.0398946955	.0002816563	.0259867980
5. Lodging	.0000440465	.0000165859	.0000156253	.0000303031	1.0000327067	.0000179680	.0000062900	.0004080580	.0000355212	.0000122951	.0000223704	.0000025872	.0010962413	.0000078653	.0000340491	.0000340178	.0000574249
6. Cafes & Taverns	.0000316396	.0000549766	.0002714714	.0000441449	.0000107986	1.0000332970	.0000049433	.0011121064	.0000039420	.0000287982	.0000208756	.0000038375	.0000071992	.0000115082	.0000151779	.0000040984	.0001173768
7. Service Stations	.0505539854	.0126468200	.0137083626	.0302421569	.0160474281	.0166330693	1.1151829700	.0316320082	.0044136858	.0071525002	.0084349800	.0140276357	.0015409755	.0080539077	.1496507313	.0028893519	.0167171420
8. Construction	.0143484621	.0022168701	.0063512423	.0183535605	.0155904931	.0286042796	.0043592131	1.1378045479	.0031860021	.0242192753	.0192584670	.0019486055	.0104379591	.0063724811	.0089977455	.0024012383	.0513798349
9. Professional Services	.0071093127	.0019811396	.0009764527	.0042238129	.0036304509	.0021509306	.0011722538	.0026343430	1.0007313599	.0007632493	.0052421243	.0009295271	.0021428972	.0013759183	.0035552477	.0012092257	.0092311544
10. Product-Oriented	.0581251289	.0400508524	.0329185897	.0547836790	.1904908816	.3094691722	.0255199907	.0657222723	.0197731357	1.0259884395	.0567059496	.0106189579	.0338895043	.0880268238	.1049800406	.0142184155	.0679512703
11. Service-Oriented	.0260501526	.0082093822	.0043799922	.0140248817	.0433449357	.0378958345	.0080438781	.0207096849	.0102898561	.0073289373	1.0560206451	.0015323601	.0541727557	.0083281849	.0397204352	.0157132451	.0275268938
12. Communications & Transportation	.0319156949	.0738215499	.1854345897	.1288915634	.0899605240	.0391008481	.0117920796	.0309499860	.0173915564	.0453898170	.0311354642	1.0044428211	.0215341646	.0444174418	.0137008574	.0113082017	.0168817059
13. Financial	.0330278341	.0141071976	.0095785429	.0206359327	.0237808511	.0063267248	.0039979042	.0103770479	.0043564179	.0026005455	.0037809544	.0007712866	1.0112099738	.0047083851	.0264103329	.0233338385	.0019919117
14. Grocery	.0014714760	.0001595486	.0009294823	.0007187285	.0002002041	.0283061972	.0000285822	.0001195648	.0000397155	.0003072200	.0001060673	.0007512159	.0000549739	1.0439570090	.0002009353	.0000249121	.0034470004
15. Resorts & Marinas	.0002046199	.0000115940	.0000012077	.0000843014	.0000030114	.0000117835	.0000002188	.0000019063	.0000006121	.0000016983	.0000011172	.0000011935	.0000004470	.0000159055	1.0021440207	.0000001992	.0000427533
16. Automotive	.0158704850	.0094639969	.0169545136	.0110563624	.0041341138	.0058080830	.0240041558	.0148427019	.0048692663	.0116814160	.0104146013	.0044683275	.0020837156	.0034426547	.0248004671	1.0580258729	.0299144105
17. Local Government	.0653671833	.0103294070	.0232080540	.0351263349	.0305306526	.0188688901	.0046023154	.0081817959	.0064366182	.0234121169	.0214906430	.0275880321	.0094686086	.0112854032	.0474208603	.0043110028	1.0093432117
18. Summation	1.8155362219	1.2765056077	1.4297780882	1.9557739994	1.4569958050	1.7024360344	1.2001299187	1.3866376401	1.0773724640	1.1786482189	1.2218764336	1.0694794887	1.1499591846	1.5096048631	1.4983720924	1.1344569989	1.2863175590

sectors of the economy. When the change has worked itself out, Agriculture's output will have increased \$1.29; Agricultural Services, 20 cents; Lumber, one-half cent; and Manufacturing and Processing, one cent; etc., down the Agriculture column.

### Output Multiplier

The eighteenth row of the  $(I-A)^{-1}$  matrix is the sum of the first 17 rows of each column. Therefore, the figures in the row represent the change in total output of the economy caused by one-dollar change in final demand of the sector at the top of the column. For example, a one dollar increase in final demand of Agriculture will cause the output of the entire economy to increase \$1.82. This is called the output multiplier of the sector (Doeksen and Little, 1967). The magnitude of the output multiplier of each sector depends upon the quantity of goods and services the sector purchases from the local economy. Earlier it was pointed out that Communications and Transportation purchased only 5.6 percent of its purchases from the local economy. The output multiplier of that sector is small (1.07) as would be expected. Conversely, Manufacturing and Processing purchased more of its goods and services (almost 60 percent) from the local economy than other sectors and the output multiplier of the sector is the largest (1.96) in the economy. The output multipliers are listed in column 2 of Table 8.

### Income-Output Coefficients

Another useful tool that can be derived is the "income-output" coefficients listed in the last column of Table 8. They are computed as follows:

$$H_k = \sum_{j=1}^{17} a_{19j} r_{jk} \quad (11)$$

where  $a_{19j}$  = the value of purchased labor services from the Household sector by the  $j$ th sector per dollar of total output in the  $j$ th sector, i. e., it is the  $a_{hj}$  row ( $j = 1, 2, \dots, 17$ ) in the direct coefficients matrix.

$r_{jk}$  = the elements of the  $k$ th column of the  $(I-A)^{-1}$  matrix.

For example, the income-output coefficient for the Agriculture sector ( $H_1$ ) is calculated as follows:

$$\begin{aligned} H_1 &= a_{191} (r_{11}) + a_{192} (r_{21}) + a_{193} (r_{31}) + \dots + a_{1917} (r_{171}) \\ &= .3337 (1.2924) + .1049 (.2034) + .2853 (.0051) + \dots \\ &\quad + .6399 (.0654) = .55 \end{aligned}$$

The income-output coefficient of a sector measures the change in total county household income (that amount paid to the Household sector by all 17 sectors) resulting from a one-dollar change in the output of that sector. Again using Agriculture as an example, a one-dollar increase in the sales of Agriculture will cause a 55-cent increase in household income in the economy.

### Income Multiplier

Another multiplier that is often computed is the income or "Type I" multiplier (Miernyk, 1965). It is calculated by dividing the income-output coefficient derived above by the  $a_{hj}$  for that sector (Bromley et al., 1968):

$$M_k = \frac{\sum_{i=j=1}^{17} a_{19j} r_{ik}}{a_{19k}}$$

Thus, the income multiplier is the ratio of the direct and indirect changes in income to the direct change in income.<sup>8</sup> It measures the change in county household income resulting from a one dollar change in the income of households in that sector. The income multipliers for the 17 sectors are listed in column 3 of Table 8.

The income multipliers can be misleading. For example, if a government agency were interested in increasing the incomes of the households in the county, examination of the estimated income multipliers would indicate that stimulation of the Manufacturing and Processing sector would be the best policy since it has the largest income multiplier. However, this would not be the case since the output of that sector would have to increase almost \$6.50 before

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<sup>8</sup> If households were endogenous, the multiplier (Type II) would be larger because it represents the ratio of direct, indirect and induced changes in income to the direct change in income.

Table 8. Output and income multipliers and income-output coefficients for the 17 sectors of the Klamath County economy.

(1)	(2)	(3)	(4)
Sector	Output Multiplier	Income Multiplier	Income- Output Coefficients
Agriculture	1.82	1.66	.55
Agricultural Services	1.28	1.71	.18
Lumber	1.43	1.43	.41
Manufacturing & Processing	1.96	2.83	.43
Lodging	1.47	1.32	.49
Cafes & Taverns	1.70	1.45	.50
Service Stations	1.20	1.25	.19
Construction	1.39	1.38	.35
Professional Services	1.08	1.04	.57
Product-Oriented	1.18	1.30	.23
Service-Oriented	1.22	1.18	.44
Communications & Transportation	1.07	1.09	.31
Financial	1.15	1.19	.30
Grocery	1.51	2.11	.21
Resorts & Marinas	1.50	1.78	.28
Automotive	1.13	1.19	.20
Local Government	1.29	1.11	.71

household incomes of that sector would rise one dollar. That is, the  $a_{hj}(a_{194})$  for the Manufacturing and Processing sector is .1547. A \$6.46 increase in output would be necessary to increase household incomes of the sector by one dollar (.1547 x \$6.46  $\approx$  \$1.00). Thus, the government agency would have to increase the output of the sector almost \$6.50 to increase the income of household in the economy \$2.83.

In comparison, the same calculations can be performed for the Local Government sector which has one of the smaller income multipliers in the economy. The  $a_{hj}(a_{1917})$  for the sector is .6399. A \$1.56 increase in output of the sector would cause a one dollar increase in income for the households in the Local Government sector (.6399 x \$1.56  $\approx$  \$1.00). Therefore, a \$1.56 increase in output of the sector will increase household income in the economy \$1.11. A \$6.46 increase in output would increase county household income \$4.59, as compared to \$2.83 for the sector with the largest income multiplier.

The reason the income multiplier can be misleading is the large weighting factor given to the  $a_{hj}$  of the sector. Since the  $a_{hj}$  is the denominator in the calculations, it has a large influence upon the magnitude of the multiplier. For example, a small  $a_{hj}$  will lead to a larger multiplier than will a large  $a_{hj}$ , given that the numerator is held constant. Thus, caution must be exercised when interpreting the income multipliers.

The income-output coefficients are easier to interpret because the total change in income is related to a change in final demand and not to a change in income as in the income multiplier. It is now obvious how much income will rise as output increases. One does not have to be concerned with how much the output of a sector must increase to obtain the desired one-dollar change in income for that sector. For example, the results obtained above for the Local Government sector can be obtained directly from the income-output coefficient. Multiplying the \$6.46 by the income-output coefficient (.71) yields \$4.59, which is the same figure that was obtained using the income multiplier. This illustrates that, in many cases, the input-output coefficient is easier to work with and less confusing than the income multiplier that is normally calculated.

#### Some General Comments About the Data

Before proceeding to an analysis of the impact of recreational spending upon the economy, perhaps some general remarks should be addressed to the following question: How accurate are the data presented in the transaction matrix? This is a critical question since errors in the matrix could have a significant effect upon the final analysis. However, an unqualified answer to the question cannot be given. The reason for this is that there are very few opportunities for making comparisons. Indeed, if other sources of data had been



available, it would not have been necessary to collect the data.

Some secondary sources were available to check a few of the cells in the transactions matrix. For example, estimates of the total sales of some of the sectors could be ascertained from Census of Business data. The total output of Agricultural Services, Lodging, Cafes and Taverns, Service stations, Grocery and Automotive sectors were compared with this source.

Another source used to check the data was previous input-output studies. Three such studies were available for different regions of Oregon.<sup>9</sup> These studies were only used to determine if large, unexplained differences existed between the Klamath County model and the other models. No such differences were observed. The variations that exist between the data in this study and that of the three other studies could be assumed to reflect characteristic differences in the economies that were studied.

A final source used to check the model was the 1968 Oregon covered employment and payrolls data for Klamath County. These data were obtained from the Oregon State Department of Employment. The data are based on tax reports submitted quarterly by the employers subject to the Oregon Department of Employment Law. It provided the means to check the payments to households in the model. The

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<sup>9</sup>See Stoevener (1964); Bromley (1967); and Collin (1970).

payments to households in the model were always higher than those reported in the payroll data. However, two factors explain this phenomenon. First, not all firms are under the jurisdiction of Oregon Department of Employment Law. Therefore, they need not report their payrolls. Also, certain types of payments to households are not required to be reported. For example, payments to corporation officers, wages of the owner and rent and interest payments are excluded from the payroll data. Therefore, one would expect the total payments to households to be greater than shown by the payroll data. Nevertheless, it provides a lower limit for the value of services purchased by the various sectors from households in the community.

These checks of the data in the model provide some degree of reassurance. However, they did not answer all of the questions concerning the accuracy of the data. For example, it was not possible to verify the total output of the Construction, Professional Services and Communication and Transportation sectors. The only checks that could be made was to ascertain whether the data seemed "reasonable". The other input-output studies were useful in this respect since they provided an indication of the size of these sectors relative to the size of other sectors in the previous studies.

Perhaps less can be said about the Communications and Transportation sectors than any other sector in the economy. The volume of its total sales (over \$30 million) may, at first, seem rather large.

However, the sector employed more than 1,000 workers in 1967.

The three railroads in the county provided jobs for more than 900 of these workers (Oregon. Dept. of Employment, 1966). This would seem to indicate that the estimate of the sector's payments to household (\$8.66 million) may be reasonable. The other estimates for the sector may or may not be as accurate. However, without additional information, they represent the best estimates obtainable.

In conclusion, the checks that were performed seem to indicate that the data represent satisfactory estimates for the analysis of the next chapter. This is not to say that errors are not present in the transactions matrix. However, lack of information precludes improving upon the estimates. The checks just indicate that gross errors could not be detected. Therefore, we will proceed to measure the local benefits resulting from an improvement in water quality of Klamath Lake.

## V. THE IMPACT OF AN INCREASE IN RECREATIONAL EXPENDITURES

In order to estimate the economic impact of improved water quality of Klamath Lake, the quantity of recreational expenditures that may be made in the county must be estimated. In this chapter, a methodology is explained and used to estimate the increase in local recreational expenditures. The estimated increase in recreational expenditures is then analyzed within the input-output framework developed in the previous chapter to estimate the total impact upon the local economy.

This thesis is the second of two studies dealing with the benefits of improved water quality of Klamath Lake. A study recently completed at Oregon State University estimated the demand for recreation at Klamath Lake with varying degrees of water quality.<sup>10</sup> Interviews were conducted with recreationists at Klamath Lake and at three other lakes in southern Oregon to obtain the data for Gibbs' study. Forty-three of Gibbs' questionnaires completed by recreationists at Klamath Lake are used in this chapter to obtain inferences about the type and the magnitude of recreational expenditures made

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<sup>10</sup> See Gibbs (1969). Future reference herein will be to Gibbs when discussing that study.

made in Klamath County.

The costs associated with recreation at Klamath Lake that are incurred in Klamath County are separated into three categories: 1) the cost of traveling to and from the lake; 2) on-site costs, or normal daily expenditures while at the lake; and 3) the cost of investment items that are used for recreation. Each of these will be considered separately and then they will be aggregated to obtain the total value of recreational purchases made in Klamath County.

#### Travel Cost

The relevant travel cost for this study is composed of all purchases made in Klamath County by recreationists while traveling to and from Klamath Lake. Travel cost is composed of six categories: automobile, cafes and taverns, groceries, lodging, camping and any other costs not included in the first five categories.

To estimate the amount of money spent on travel costs in Klamath County, the 43 questionnaires were put into one of two groups. The first contained those recreationists that were residents of the county while the second included the non-Klamath County residents. The first group contained 29 of the 43 observations. It was assumed that all travel costs incurred by the first group were spent locally since their origin and destination were both within the county. Automobile expenses for this group were computed by multiplying the

number of miles traveled to and from the site by an average cost per mile of five cents. This, and all other components of travel cost for the resident group, was divided by the number of people in the party to obtain the desired estimate of average travel cost per person.<sup>11</sup>

A different procedure had to be developed for the non-resident group. It could not be assumed that all expenditures associated with traveling to and from the site would be made in Klamath County. However, since the questionnaire indicated where the recreationists came from, it was possible to estimate the total miles traveled in the county by assuming they took the most direct route to the lake. The number of miles traveled inside the county was then multiplied by \$.05 to estimate automobile travel expenses incurred within the county.

An additional step was required to estimate the other five components of travel cost for the non-resident group. The number of miles traveled in Klamath County was divided by the total miles traveled during the trip to obtain the percent of the total distance that was traveled within the county. These percentages were then multiplied by the other components of travel cost to estimate the amount that was spent in the local economy. That is, if the distance traveled inside Klamath County accounted for ten percent of the total miles traveled,

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<sup>11</sup> Travel costs were calculated on a per-person basis because an estimate of the number of people that visited Klamath Lake in 1968 was available from the U. S. Forest Service.

it was assumed that ten percent of the total expenditures for food, lodging, etc., was made inside Klamath County. It was again necessary to divide these estimates by the number of people in the party to obtain the average travel cost per person. Table 9 shows the average amount per person spent inside the county for each of the components of travel cost.<sup>12</sup>

Table 9. Mean and total cost incurred in Klamath County for each component of travel cost in 1968.

(1)	(2)	(3)
Component	Mean	Total Cost by Component (mean) (number of visits)
Automobile	\$ .6371	\$ 93,329
Cafes	.1088	15,938
Grocery	.6360	93,168
Lodging	.2477	36,286
Camping	.0458	6,709
Other	.1242	18,194
Total	\$1.7996	\$263,624

It should be emphasized that the average travel cost computed in this study is not the same as that computed by Gibbs. His estimate (\$6.84) is larger than the one computed for this study (\$1.80). The primary reason for this is that the estimate in this study represents

<sup>12</sup>The standard deviations of the means in Table 9 are quite large. Differences in travel cost incurred by local and non-local recreationists produced a bimodal distribution.

only those travel costs incurred in Klamath County while Gibbs' figure represents total travel cost without reference to where it was spent.

Now that an average travel cost incurred in Klamath County has been estimated, it can be multiplied by the number of people visiting the site in 1968 to obtain the total amount of travel expenditures made in the county during the year. U.S. Forest Service data collected by Gibbs estimated that 146,491 people visited Klamath Lake in 1968. Therefore, recreationists spent an estimated \$263,624 ( $146,491 \times \$1.7996$ ) in Klamath County while traveling to and from Klamath Lake. A breakdown of this cost into its components is presented in column 3 of Table 9.

#### On-Site Costs

On-site costs consist of all normal daily expenditures made in the county that are associated with staying at the site. It includes food expenses, lodging, camping fees, automobile and boat expenses, and any other purchases made while staying at Klamath Lake. An average on-site cost per person was computed in a manner similar to the one discussed in the previous section. Since it could be assumed that all on-site purchases were made in the county, it was not necessary to separate the observations into the local- and non-local-resident groups.



There is one difference between estimating travel costs and estimating on-site costs. It is recalled that travel costs were estimated on a per-person (or per-visit) basis. In contrast, on-site costs are estimated on a per-person per-day basis. That is, the various components of on-site cost were divided by the number of "visitor days" the party stayed at the lake.<sup>13</sup> The reason for computing on-site costs on a per-day basis is that it is hypothesized that the average number of days spent at the site during each visit will increase as the water quality of the lake improves. This point will be expanded upon later in the chapter. Column 2 of Table 10 shows the average daily cost per person for each component of on-site costs.

Total on-site costs for Klamath Lake in 1968 can now be computed. Gibbs estimated the average length of stay per visit to be 1.61 days. Multiplying this by the number of visits (146,491) yields 235,851 visitor days for Klamath Lake in 1968. Multiplying this by the total on-site cost per visitor day yields \$474,410 as the estimated value of on-site costs for Klamath Lake in 1968. A breakdown of this cost into its components is presented in column 3 of Table 10.

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<sup>13</sup> "Visitor-days" is the product obtained by multiplying the number of people in the party by the number of days they spent at the site. If five people stay five days, they account for 25 visitor days.

Table 10. Mean and total on-site cost by component for Klamath Lake, 1968.

(1)	(2)	(3)
Component	Mean	Total Cost by Component (mean) (number of days)
Cafes	\$ .2132	\$ 50,283
Grocery	.2985	70,402
Lodging	.3360	79,246
Camping	.0209	4,929
Automobile	.0517	12,193
Boat	1.0473	247,007
Bait	.0169	3,976
Rentals	.0266	6,274
Total	\$2.0111	\$474,310

#### Cost of Investment Items

The final category of recreational expenditures that may result from water quality improvements at Klamath Lake is special purchases, particularly investment items. As the water quality of Klamath Lake improves, more people will recreate at the lake. Some of the recreationists may not have the equipment needed for various types of recreation activities. Therefore, they may choose to purchase the investment items they need to recreate at the lake. The increased sales of investment items may have a significant impact upon the economy because of the high cost of many of these items such as boats, motors, camping equipment, etc.

Unfortunately, data limitations prevent measuring the effects that water quality improvement of Klamath Lake may have upon the demand for recreational investment items. To estimate this effect would require information concerning the importance placed upon a readily accessible site, such as Klamath Lake, by potential recreationists. Several factors are probably considered when decisions are made concerning the purchasing of recreational investment items. One of these may be the characteristics of sites available for using the investment items. However, other factors may also be important to the potential recreationists. Some examples may be the income of the family, the amount of time available for leisure and the ages of children in the family. Therefore, the level of investment purchases that may result from water quality improvements cannot be estimated from the data collected at Klamath Lake.

Although the level of recreational investment purchases cannot be estimated, their exclusion from the study does not necessarily mean that the local benefits that will be estimated here represent an underestimate of the true benefits. Two factors explain why this may be the case. First, because some restrictive assumptions must be made, other recreational expenditures may be overestimated. For example, it is necessary to assume that the improved water quality of Klamath Lake will not effect the number of people visiting other recreation sites in the county. However, this may not be a valid

assumption. It seems probable that some recreationists will substitute Klamath Lake for other sites in the area as the quality of the water improves. If this occurs, the level of recreational expenditures may not increase (it may even decline) even though Klamath Lake is used more extensively. This can be illustrated by the following example. Assume that a group of recreationists living in Klamath Falls travel to Lake of the Woods to recreate. However, as the quality of the water of Klamath Lake improves, the party chooses to recreate at Klamath Lake instead of Lake of the Woods. Thus, the demand for recreation at Klamath Lake has increased but the demand has decreased for Lake of the Woods. This substitution may decrease the recreational expenditures in the county because the travel cost associated with traveling to Klamath Lake would be less than that associated with traveling to Lake of the Woods. Therefore, the net effect upon recreational spending, resulting from water quality improvements at Klamath Lake, may be negative in some instances. Because the magnitude of the substitution effect cannot be determined, it has not been included in the analysis. Thus, excluding the effect of investment purchases may be balanced by overestimates caused by the substitution of Klamath Lake for other recreational sites in the county.

There is one more argument for ignoring the effects of recreational investment purchases in the study. As mentioned in Chapter III, Klamath County has numerous recreational facilities.

More than 100 lakes are located in the county. Presently, the residents of the county have numerous alternative sites available for recreation if they choose to use them. Therefore, changes in water quality of Klamath Lake may have only a small effect upon the purchases of investment items. Many of the people who would use the lake may have already purchased their equipment for use at other sites. Therefore, large quantities of new equipment may not be purchased even though more people visit Klamath Lake.

#### Recreational Expenditures for 1968

Now that on-site costs and travel costs have been discussed and estimated, they may be aggregated to obtain the total expenditures in Klamath County associated with recreation at Klamath Lake in 1968. Travel costs were estimated to be \$263,624 and on-site costs were \$474,310. Therefore, the total is \$737,934. This figure represents the total annual cost incurred in Klamath County by recreationists at Klamath Lake, given the present water quality of the lake. Table 11 shows how much of the total figure was spent in the various sectors of the economy. This was determined by assigning each component of travel cost and on-site cost to the appropriate sectors of the model. It should be noted that the total estimated above does not equal the total in Table 11. The difference (\$6,709) is due to camping fees incurred in Klamath County while traveling to and from the site. It

was assumed that these camping fees were paid to the state or federal government and not to any of the sectors of the local economy. However, camping fees incurred while at the site were allocated to the Resorts and Marinas sector since all camping facilities at the site are privately owned by the resorts.

Table 11. Total recreational expenditures and percentages by sector, associated with recreation at Klamath Lake in 1968.

(1)	(2)	(3)
Sector	Amount	Percent of Total Recreational Expenditures made in Klamath County
Service Stations	\$352,529	48.21%
Cafes & Taverns	66,221	9.06
Grocery	163,570	22.37
Lodging	115,532	15.80
Resorts & Marinas	11,203	1.53
Product-Oriented	22,170	3.03
Total	\$731,225	100.00%

It is interesting to note that only six sectors of the economy are directly affected by recreational expenditures. Column 3 of Table 11 shows the percentage of the recreational expenditures that each of the six sectors received. The Service Stations sector received almost half of total recreational expenditures made in the county.

#### Effects of Changes in Water Quality

Before an estimate can be made concerning how much

recreational expenditures will increase as the water quality of Klamath Lake improves, two relationships must be specified. First, as the water quality improves, one would expect an increase in the number of visits at the lake. Therefore, the relationship between water quality and number of visits must be determined. Second, it was hypothesized that the average number of days spent at the site per visit may increase as water quality improves. This relationship must also be determined. Both of these relationships were estimated by Gibbs. A brief discussion of the relationships will be presented here since the estimates derived are important in this study.

Gibbs used the following relationship to estimate the increase in the number of visits resulting from a change in the water quality of the lake:

$$\text{Number of Visits} = f(W, F, Si, k)$$

Where W = sum of the use-intensity rating for swimming, water skiing, and boating;

F = use-intensity rating for fishing;

Si = the size of the lake measured in acres; and

k = the average travel cost per visit.<sup>14</sup>

As water quality improves, the lake will be more conducive to those activities in the relationship and the use-intensity ratings for the various activities will increase. Holding k and Si constant makes it

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<sup>14</sup> The travel cost used in the equation is the one estimated by Gibbs and not the one estimated for this study.

possible to estimate the increase in the number of visits to the lake resulting from proposed water quality changes.<sup>15</sup>

Consultations with personnel at the Pacific Northwest Water Laboratory indicated that the solution to the water quality problem of Klamath Lake may proceed in two steps. The first would be removal of the algae from the water while the second would consist of lowering the water temperature of the lake and improving beaches.

Removal of the algae (step 1) would cause the use-intensity ratings of all of the recreational activities to increase. This, Gibbs estimated, would increase the number of visits to the lake to 234, 947. If, in addition to removing the algae, the water temperature was lowered and beaches were improved (step 2), the use-intensity ratings for swimming and fishing would increase again and the number of visits was estimated to increase to 377, 497.

It was mentioned earlier that Gibbs estimated demand curves for Klamath Lake with varying degrees of water quality.<sup>16</sup> The price variable was average on-site costs per visitor day while the quantity variable was the average number of days spent at the site per visit. As the water quality of Klamath Lake improves the demand curve for

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<sup>15</sup> Holding  $S_i$  constant assumes that the physical solution to the water quality problem will not alter the size of the lake.

<sup>16</sup> The "degrees of water quality" were the present quality of the water and those qualities associated with step 1 and step 2 described above.



recreation shifts to the right. Thus, for any given value of on-site cost, the average length of stay per visit will increase. It was stated earlier that the average length of stay per visit, given the present water quality conditions, was 1.61 days. After step 1 the number of days per visit increased to an estimated 2.41 days while completion of step 2 increased it to an estimated 2.83 days.

#### Increase in Recreational Expenditures

The estimates of the number of visits and the length of stay per visit can now be used to estimate the net increase in expenditures associated with recreation at Klamath Lake as the quality of the water improves. Table 12 contains the estimates for the components of travel cost. The net increase in total expenditures was estimated by multiplying the means in Table 9 by the net increase in the number of visits to the site resulting from water quality improvements. That is, upon completion of step 1, the number of visits to the lake would increase from 146,491 to 234,947. Therefore, the net increase is 87,895 visits. This figure was multiplied by the means in Table 9 to obtain the estimates in column 2 of Table 12. The same procedure was used to estimate the net increase in expenditures associated with step 2.

The net increase in on-site costs was estimated in the same manner. The net increase in visitor days associated with step 1 is

Table 12. Net increase in expenditures, for each component of travel cost, associated with improvements of water at Klamath Lake.

(1) Component	(2)	(3)
	Water Quality Improvements Step 1	Step 2
Auto	\$ 55,998	\$147,461
Cafes	9,563	25,183
Grocery	55,901	147,206
Lodging	21,771	57,331
Other	10,964	28,823
Total	\$154,197	\$406,004

the difference between the number of visitor days estimated for step 1 and the number of visitor days estimated for 1968:

$$\begin{aligned}
 \text{Net visitor days (step 1)} &= (234,386)(2.41) - (146,491)(1.61) \\
 &= 564,870 - 235,851 \\
 &= 329,019 \text{ visitor days.}
 \end{aligned}$$

Completion of step 2 would result in an estimated net increase of 833,739 visitor days. The net increases in visitor days were then multiplied by the mean values of each component of on-site cost listed in Table 10 to obtain the net increase in expenditures for each component of on-site cost. The estimates are listed in Table 13.

One process remains to be completed. The various components of travel cost and on-site cost must again be assigned to the appropriate sector of the economy. The sectoral distribution of recreational expenditures is shown in Table 14. The figures represent estimates of

Table 13. Net increase in expenditures, for each component of on-site cost, associated with improvements of water quality at Klamath Lake.

(1) Component	(2)	(3)
	Water Quality Improvements Step 1	Step 2
Cafes	\$ 70,147	\$177,754
Grocery	98,212	248,871
Lodging	110,550	280,136
Camping	6,877	17,425
Auto	17,011	43,105
Boat	344,581	873,175
Bait	5,570	14,100
Rentals	8,752	22,177
Total	\$661,700	\$1,676,743

Table 14. Net increase in recreationists' expenditures, by economic sector, associated with improvements in water quality of Klamath Lake.

(1) Sector	(2)	(3)
	Water Quality Improvements Step 1	Step 2
Cafes & Taverns	\$ 79,716	\$ 202,937
Grocery	154,113	396,077
Lodging	132,321	337,467
Resorts & Marinas	15,629	39,602
Service Stations	417,590	1,063,741
Product-Oriented	16,534	42,923
Total	\$815,897	\$2,082,747

how much recreationists will purchase from those sectors as the water quality of Klamath Lake improves.

### An Estimate of the Impact of Recreational Expenditures

From Table 14 it can be seen that recreational expenditures will increase an estimated \$815,897 if the algae were removed from Klamath Lake. If, in addition, the water temperature is lowered and beaches are improved, recreational expenditures will increase to an estimated \$2,082,747. The following question now arises: What will be the total increase in output of the economy resulting from the increased recreational expenditures? To answer this question, we must turn to the input-output model.

The expenditures of recreationists represent an exogenous change upon the economy. That is, the increase in expenditures is caused by a change in the recreation experience at Klamath Lake. This change should not alter the structure of the local economy. Therefore, the appropriate way to view the increase in recreational expenditures is as a change in the final demand of the model. Therefore, the final demand of the six sectors in Table 14 were increased by the value of the recreational expenditures made in that sector. The new final demand vectors (one each for step 1 and step 2) were post-multiplied by the  $(I - A)^{-1}$  matrix presented in Chapter IV. The total output effects are listed in Table 15.

Table 15. Estimation of the total increase in sales, by sector, resulting from increased recreationists' expenditures associated with water quality improvements at Klamath Lake.

Sector	Change in Sales	
	Step 1	Step 2
1. Agriculture	\$ 22,882	\$ 58,631
2. Agricultural Services	4,342	11,118
3. Lumber	1,968	5,037
4. Manufacturing & Processing	39,581	101,417
5. Lodging	132,331	337,493
6. Cafes & Taverns	79,720	202,962
7. Service Stations	472,837	1,204,480
8. Construction	7,688	19,626
9. Professional	1,422	3,628
10. Product-Oriented	92,702	237,298
11. Service-Oriented	14,141	36,062
12. Communications & Transportation	27,756	70,924
13. Financial	6,503	16,587
14. Grocery	163,192	419,354
15. Resorts & Marinas	15,666	39,697
16. Automotive	12,145	30,955
17. Local Government	10,334	26,382
Total	\$1,105,210	\$2,821,651

The total increase in output associated with step 1 is \$289,313 greater than the original value of recreational expenditures. That is, the estimated \$815,897 spent in the economy by recreationists would generate an estimated additional increase in sales of \$289,313 in the economy. In comparison, the estimated level of recreational expenditures associated with step 2 (2,082,742) would generate an estimated additional \$728,904 of output in the economy.

It is interesting to note that even though only six sectors are directly affected by the increase in recreational expenditures, all of the sectors of the economy are affected indirectly because of the economic interdependencies that exist between the sectors of the economy. This provides a good illustration of the importance of the from-to model in a study such as this one. If the relationships between the various sectors of the economy had not been specified, the total impact of the estimated recreational expenditures associated with steps 1 and 2 would have been underestimated.

The total change in sales can also be estimated by another procedure. In Chapter IV it was stated that the output multiplier of a sector measures the total change in output in the economy resulting from a one dollar change in the sales of the sector. Therefore, multiplying the output multiplier by the net increase in sales of the six sectors in Table 14, and summing the products, will also estimate the total change in output of the economy. This method is illustrated for

step 1 in Table 16.

Table 16. Estimation of the total increase in sales of the economy resulting from the removal of algae (step 1) from Klamath Lake: The output multiplier approach.

Sector	Direct Increase in Sales	Output Multiplier	Direct and Indirect Increase in Sales
1. Cafes & Taverns	\$ 79,716	1.70	\$ 135,517
2. Grocery	154,113	1.51	232,711
3. Lodging	132,321	1.47	194,512
4. Resorts & Marinas	15,629	1.50	23,444
5. Service Stations	417,590	1.20	501,108
6. Product-Oriented	<u>16,534</u>	1.18	<u>19,510</u>
Total	\$815,897		\$1,106,802

The small difference in the two estimates (\$1,106,802 versus \$1,105,210) is due to errors introduced by rounding off the output multipliers.

Although the output multiplier approach of estimating the total change in output of the economy is simpler, it does not provide as much information as the first method used. The first method estimates the increase in output of each sector while the second method only allows an estimation of the increase in output of the economy as a whole. The additional information provided by the first method may be useful to decision makers. This point will be expanded upon in the next chapter.

The final question can now be stated: How much will the income

of households in Klamath County increase if the stated water quality conditions can be achieved? The answer can be obtained in either of two ways. The first method uses the estimates in Table 14 and income-output coefficients derived in Chapter IV. It is recalled that the income-output coefficient measures the total increase in household income in the county, given a one dollar change in the sales of that sector. Therefore, multiplying the increase in output estimated for each sector in Table 14 by its income-output coefficient, and summing the product for the six sectors, will give the total increase in household income in the community. This method is used to obtain the estimates in Table 17.

The other method utilizes the output effects of Table 15 and the Household row ( $a_{19_j}$ ) of the direct coefficient matrix (Table 5). The  $a_{19_j}$  represents the direct increase in payments to household resulting from a one dollar increase in the sales of that sector. Thus, multiplying the estimated increase in sales of each sector by that sector's household coefficient, and summing over all the sectors, will also estimate the rise in household incomes in the county. The estimates obtained by this method are listed in Table 18. Again, the slight difference in the estimates obtained by the two methods is due to rounding error at the fourth decimal place of the  $a_{19_j}$ 's and the income-output coefficients.

The analysis estimates that county household incomes would



Table 17. Estimation of the increase in county household income resulting from improvements in water quality: The income-output coefficient method.

Sector	Direct Increase in Sales	Income- Output Coefficient	Increase in County House- hold Income
<u>Step 1</u>			
1. Cafes & Taverns	\$ 79,710	.4966	\$ 39,584
2. Grocery	154,113	.2102	32,395
3. Lodging	132,321	.4866	64,387
4. Resorts & Marinas	15,629	.2764	4,320
5. Service Stations	417,590	.1906	79,593
6. Product-Oriented	16,534	.2317	3,831
Total	\$ 815,897		\$224,110
<u>Step 2</u>			
1. Cafes & Taverns	\$ 202,937	.4966	\$100,778
2. Grocery	396,077	.2102	83,255
3. Lodging	337,467	.4866	164,211
4. Resorts & Marinas	39,602	.2764	10,946
5. Service Stations	1,063,741	.1906	202,749
6. Product-Oriented	42,923	.2317	9,945
Total	\$2,082,747		\$571,884

Table 18. Estimation of the increase in household incomes, by sectors, resulting from improvements in water quality: The household coefficients method.

Sector	Household Coefficient	Improvements in Water Quality			
		Step 1		Step 2	
		Direct & Indirect Increase in Sales	Increase in Household Income	Direct & Indirect Increase in Sales	Increase in Household Income
1. Agriculture	.3337	\$ 22,882	\$ 7,636	\$ 58,631	\$ 19,565
2. Agricultural Services	.1049	4,342	455	11,118	1,166
3. Lumber	.2853	1,968	561	5,037	1,437
4. Manufacturing & Processing	.1547	39,581	6,123	101,417	15,689
5. Lodging	.3676	132,331	48,645	337,493	124,062
6. Cafes & Taverns	.3424	79,720	27,296	202,962	69,494
7. Service Stations	.1521	472,837	71,919	1,204,480	183,201
8. Construction	.2557	7,688	1,966	19,626	5,018
9. Professional Services	.5527	1,422	786	3,628	2,005
10. Product-Oriented	.1786	92,702	16,557	237,298	42,381
11. Service-Oriented	.3703	14,141	5,236	36,062	13,354
12. Communications & Transportation	.2882	27,756	7,999	70,924	20,440

(Continued on next page)

Table 18 (Continued).

Sector	Household Coefficient	Improvements in Water Quality			
		Step 1		Step 2	
		Direct & Indirect Increase in sales	Increase in Household Income	Direct & Indirect Increase in sales	Increase in Household Income
13. Financial	.2510	\$ 6,503	\$ 1,632	\$ 16,587	\$ 4,163
14. Grocery	.0995	163,192	16,238	419,354	41,726
15. Resorts & Marinas	.1551	15,666	2,430	39,697	6,157
16. Automotive	.1674	12,145	2,033	30,995	5,189
17. Local Government	.6399	10,334	6,613	26,382	16,882
Total		\$1,105,210	\$224,125	\$2,821,651	\$571,929

## VI. SUMMARY AND CONCLUSIONS

### Results and Implications

The objectives of this study were aimed at evaluating the economic benefits accruing to the local community from improvements made on the quality of Klamath Lake as a recreational site. The water quality improvements were evaluated in two steps which were considered significant by biologists. Step 1 was the removal of the algae from the lake, while step 2 involved lowering the water temperature of the lake and improving beaches.

The data in Tables 17 and 18 may be used to summarize the results of the study. If the algae were removed from Klamath Lake (step 1), county household income would increase an estimated \$224,000. If the water temperature of the lake was also lowered and beaches were improved (step 2), the total increase in county household income would be an estimated \$571,900. These figures represent the benefits that accrue to the local community as a result of water quality improvements. These benefits should be considered when an evaluation is made of the feasibility of improving the water quality of Klamath Lake.

In evaluating the economic benefits of projects, some confusion exists concerning whether or not secondary benefits accruing to the local region should be included. The questions raised by this argument

may seem to reduce the results of this study to an "interesting exercise" and little else. However, the author does not consider that to be the case. The benefits estimated in this study represent a real gain to the local community. If given the opportunity, the local community may be willing to pay part of the cost of improving the water quality of the lake. For example, assume that half of the benefits that accrue to the county are considered to be net benefits, when viewed from a national standpoint. The other half of the benefits result from transfers from other regions of the nation to Klamath County. Therefore, the net benefits viewed by the national decision maker will be smaller than those estimated in this study. This reduction in benefits may result in the project not being funded. To prevent this, the local community may be willing to pay part of the cost of the project if their benefits are still greater than their cost. From a welfare standpoint, application of the compensation principle may result in leaving Klamath County better off and the rest of the nation no worse off. If this were the case, the estimated benefits accruing to the county may be used to determine the willingness of the local community to support the project.

Several studies have been conducted to improve benefit-cost analysis as a tool in the decision-making process. New evaluation procedures for water resources projects proposed by the Water Resources Council have included regional development objectives in

the analysis. If these procedures are adopted by other government agencies, the results of this study may take an added importance.

The input-output model developed in this study may also be used for analysis of other changes that may result in economic stresses on the economy. The model provides information to the local decision makers for evaluating community development alternatives. For example, estimates of how the output of each sector will be affected by water quality improvements have been made. It is estimated that the output of Agriculture will increase almost \$23,000 if the algae were removed from the lake. Likewise, the sales of the Service Stations sector will increase an estimated \$472,000, etc. The impact upon each sector can be studied to determine if some of the sectors of the economy need to be expanded to serve the needs of the expanding community. The same type of analysis can be used to study other changes in the economy.

### Limitations of the Study

The limitations of this study can be separated into two categories. The first are limitations imposed by the methodology while the other is imposed by the data that were available for the study.

The methodological limitations surrounding input-output analysis were enumerated in Chapter II. One of the first problems encountered in constructing an input-output model is defining the

criteria for the aggregation of business activity into sectors. Although homogeneity among the business activities in a sector is the primary objective, the researcher must often compromise this objective to obtain a reasonable number of sectors in the model. Several of the sectors of the Klamath County Model contain a wide variety of economic activities. Changes in the product mix of these sectors could alter the interindustry flows depicted in the model. It should again be mentioned that the assumption of fixed input coefficients used in the model is also a limitation when making predictions.

In Chapter V, a use-intensity relationship was used to estimate the increase in the number of visits to Klamath Lake as the water quality of the lake improves. For example, it was estimated that the use-intensity rating for fishing would increase from medium to high as the water temperature of the lake is lowered. It is hypothesized that the lower water temperatures would increase the size of the sports fishery of the lake. However, other factors such as "fishing success" may be more important in determining the use-intensity rating for fishing than the size of the fishery in the lake, even though the two variables may be correlated. Definition of a more sophisticated relationship for estimating the number of visits that will occur at different levels of water quality would add confidence to the estimates obtained in this study. However, defining a better relationship may be a monumental task because of the complexity of the problem.

Nevertheless, the limitations of the relationship used in this study should be noted.

Lack of data also imposed limitations upon the study. As stated in Chapter III, data were collected from fewer firms than anticipated. Five hundred interviews were desired while only 438 were obtained. Additional information would have been helpful in constructing the transactions matrix.

A more severe restriction was imposed by the small sample of recreationists interviewed at Klamath Lake in the Gibbs study. Only 43 interviews were used. The 43 interviews accounted for 140 of the estimated 146,491 visits to Klamath Lake in 1968. Thus, the sample contained less than one-tenth of one percent of the visits to the lake. Also, all of the interviews were conducted during the summer months. It is doubtful that expenditures made by recreationists at the lake during the winter are the same as those made during the summer.

A final limitation of the study is the inability to estimate the effect that improved water quality of Klamath Lake may have upon investment in recreational items in the local economy. The author is not certain whether this should be classified as a limitation imposed by lack of data or by lack of methodology. Perhaps, if more data were available, a method could be developed to estimate the effects. However, the necessary data may not be available until after the water quality of the lake is improved.



### Suggestions for Future Research

Whenever an input-output model is constructed, a follow-up study is usually suggested to measure the stability of the direct coefficients. This study is no exception. Whether or not the direct coefficients exhibit enough stability over extended time periods to make meaningful predictions is a question that has haunted most input-output analysts. Perhaps an explanation for this is the cost of constructing an input-output model. The cost of collecting the data a second time probably cannot be justified strictly on the basis of checking the results of the first study. However, a follow-up study of Collin's work<sup>17</sup> in Clatsop County is being planned.

Four input-output models have been constructed for different regions of Oregon.<sup>18</sup> Although the primary industries of these economies have varied somewhat, the structure of each of the economies have exhibited some surprisingly similar characteristics. For example, many of the interrelationships among the various sectors have been relatively constant in the four studies. An analysis to determine the reason of this stability could be valuable in community development studies. Perhaps it could provide the information necessary to estimate the effects of changes in other economies

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<sup>17</sup> See Collin (1970).

<sup>18</sup> See Collin (1970; Bromley (1967); and Stoevener (1964).

without incurring the cost of constructing an input-output model.

In conclusion, one final point should be mentioned. This study and the study conducted by Gibbs (1969) have estimated the national and regional benefits resulting from improvements in water quality at Klamath Lake. However, the same benefits may be forthcoming from another project at a lower cost. For example, let us assume that the benefits (to whomever they may accrue) resulting from water quality improvements of Klamath Lake exceed the cost of cleaning up the lake. This does not mean the project should be undertaken. An alternative project may yield the same benefits at a lower cost to society. In other words, the opportunity cost of the money that would be spent on improving the water quality of Klamath Lake should be determined in its alternative uses. A benefit-cost ratio greater than unity is not a sufficient condition for improving the water quality of Klamath Lake if economic efficiency is the desired goal. In the future, economists must push for measurement of the alternative uses for limited funds.

## BIBLIOGRAPHY

- Bartsch, Alfred F. 1968. Director, Pacific Northwest Water Laboratory, Federal Water Pollution Control Administration. Eutropication Problems in Reservoirs. Seminar conducted by Water Resources Research Institute. Oregon State University, Corvallis, Oregon. October 17.
- Beattie, Bruce R. 1970. Economic efficiency and distributive consequences of interbasin water transfers: A framework for analysis. Ph. D. thesis. Corvallis, Oregon State University. 146 numb. leaves.
- Board of Governors of the Federal Reserve System. 1968. Economic expansion in 1968. Federal Reserve Bulletin 54:941-952.
- Bond, Carl E., Charles R. Hazel and David Vincent. 1968. Relations of nuisance algae to fishes in Upper Klamath Lake. Corvallis. 119 numb. leaves. (Oregon State University, Dept. of Fisheries and Wildlife. Terminal progress report on Research Grant WP00625 of the U.S. Federal Water Pollution Control Administration) (Unpublished manuscript)
- Brems, Hans. 1959. Output, employment, capital, and growth. New York, John Wiley. 345 p.
- Bromley, Daniel Wood. 1967. An interindustry analysis of the importance of grazing on federal lands to the economy of Grant County, Oregon. Master's thesis. Corvallis, Oregon State University. 135 numb. leaves.
- Bromley, D. W., G. E. Blanch and H. H. Stoevener. 1968. Effects of selected changes in federal land use on a rural economy. Corvallis. 27 p. (Oregon State University. Agricultural Experiment Station Bulletin 604)
- Cameron, Burgess. 1952-53. The production function in Leontief models. The Review of Economic Studies 20:62-69.
- Carter, H. O. 1966. Input-output--uses and problems in regional analysis for agriculture. In: Regional economic development. Proceedings of methodology workshop. May 4, 1966. Denver, Colorado. Comp. by Dept. of Agricultural Economics, Oklahoma State University. Stillwater, Oklahoma. p. 56-83.

- Chenery, Hollis, B. and Paul G. Clark. 1959. Interindustry economics. New York, John Wiley. 345 p.
- Collin, Theodore G. 1970. An interindustry analysis of the effects of a new industry on the public and private sectors in Clatsop County, Oregon. Master's thesis. Corvallis, Oregon State University. 90 numb. leaves.
- Doeksen, Gerald A. and Charles H. Little. 1967. Estimation of the leakage of output and income from a regional economy using input-output analysis. Stillwater. 12 numb. leaves. (Oklahoma State University. Agricultural Economics Paper AE6718)
- Evans, W. D. 1954. Input-output computations. In: The structural interdependence of the economy; proceedings of international conference on input-output analysis. Varenna, June 27-July 10, 1954. ed. by Tibor Barna. New York, John Wiley. p. 53-102.
- Gibbs, Kenneth Charles. 1969. The estimation of recreational benefits resulting from an improvement of water quality in Upper Klamath Lake: An application of a method for evaluating the demand for outdoor recreation. Ph. D. thesis. Corvallis, Oregon State University. 156 numb. leaves.
- Hansen, W. L. and C. M. Tiebout. 1963. An intersectoral flows analysis of the California economy. Review of Economics and Statistics 45:409-418.
- Input-output bibliography 1960-1963. 1964. New York, United Nations. 159 p. (St. STAT/SER.m/39)
- Kalter, Robert J. and William B. Lord. 1968. Measurement of the impact of recreation investments on a local economy. American Journal of Agricultural Economics 50:243-256.
- Kimball, Norman D. and Emery N. Castle. 1963. Secondary benefits and irrigation project planning. Corvallis. 35 p. (Oregon State University. Agricultural Experiment Technical Bulletin 69)
- Klamath County Chamber of Commerce. n. d. (a) Map of Klamath Falls and Klamath County, Oregon. Klamath Falls, Oregon. 1 sheet.

- Klamath County Chamber of Commerce. n. d. (b) Some quick facts about Klamath County agriculture. Klamath Falls, Oregon. 1 p. (Fact sheet)
- 
- n. d. (c) Some quick facts about Klamath County, Oregon. Klamath Falls, Oregon. 1 p. (Fact sheet)
- Klamath County Planning Conference. 1968. Klamath County resource plans for the future. Klamath County Board of Commissioners and Oregon State University Extension Service. 47 p.
- Leven, Charles. 1961. Regional income and product accounts: Construction and application. In: Design of regional accounts, ed. by W. Hochwald, Baltimore, Johns Hopkins Press. p. 148-195.
- Miernyk, William H. The elements of input-output analysis. 1965. New York, Random House. 156 p.
- Moore, Frederick T. and James W. Peterson. 1955. Regional analysis: An interindustry model of Utah. The Review of Economics and Statistics 37:368-383.
- Oregon. Department of Employment, in cooperation with the Bureau of Employment Security U.S. Dept. of Labor. 1966. The manpower resource of Klamath County. 55 p.
- Oregon. Secretary of State. 1968. Oregon Blue Book, 1967-1968. Salem, Oregon. 300 p.
- Oregon State University. Cooperative Extension Service. 1964. Resource analysis Klamath County. January 6, 1964. Corvallis, Oregon. 84 numb. leaves. (Preliminary draft)
- Oser, Jacob. 1963. The evolution of economic thought. New York, Harcourt, Brace and World. 399 p.
- Pacific Northwest Bell Telephone Company. 1968. Pacific Northwest Bell telephone directory for Klamath Falls 1968-69. [Portland] 147 p.
- Phillips, Almarin. 1955. The Tableau Economique as a simple Leontief model. Quarterly Journal of Economics 69:137-144. February.

- Polk, R. L. and Company. 1967. Polk's Klamath Falls (Klamath County, Oregon) city directory, 1967. Monterey Park, California. Various paging.
- Riley, V. and R. J. Allen. 1955. Interindustry economic studies. Operations research office, bibliographic references series no. 4. Baltimore, Johns Hopkins. 280 p.
- Stigler, George J. 1966. The theory of price. 3d ed. New York, Macmillan. 355 p.
- Stoevener, Herbert H. and E. N. Castle. 1965. Input-output models and benefit-cost analysis in water resources research. *Journal of Farm Economics* 47:1572-1579.
- Stoevener, Herbert H. 1964. Water use relationships as affected by water quality on the Yaquina Bay. In: Western resources conference's new horizons for resources research: issues and methodology. Boulder, University of Colorado Press. p. 87-99.
- Taskier, C. E. 1961. Input-output bibliography 1955-1960. New York, United Nations. 222 p. (ST. STAT/7)
- U. S. Bureau of the Census. 1966. Census of Business: 1963. Vol. 2. Retail trade area statistics. Part 39. Oregon. Washington, D. C. 34 p.
- 
- \_\_\_\_\_ 1966. Census of Business: 1963. Vol. 7. Selected services area statistics. Part 39. Oregon. Washington, D. C. 30 p.
- 
- \_\_\_\_\_ 1966. Census of Business: 1963. Vol. 5. Wholesale trade area statistics. Part 39. Oregon. Washington, D. C. 15 p.
- U. S. Bureau of Reclamation. 1957. A half century of progress on the Klamath Federal Reclamation Project. Washington, D. C. 16 p. (U.S. Congress. House Committee on Interior and Insular Affairs. Committee print no. 7)
- U. S. Dept. of Agriculture. Cooperative Extension Service, in cooperation with the Oregon Crop and Livestock Reporting Service. 1969. Oregon commodity data sheet: oats, sheep, potatoes, barley, milk and cream, hay, hogs, eggs, cattle, grass and legume seeds, wheat. Corvallis, Oregon.

## APPENDICES

# APPENDIX 1

OREGON STATE UNIVERSITY

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Hello, I'm \_\_\_\_\_. I'm conducting a survey for Oregon State University and would like to ask you a few questions about your business if you don't mind. Everything you say is confidential, and the results are tabulated for the area as a whole -- not for any one person or business.

1 - \$\_\_\_\_\_ First, may I ask what your total sales of merchandise and services were during 1968. This can be either calendar year or fiscal year, whichever is easier for you?

2 - \$\_\_\_\_\_ What was the approximate amount of your sales to private individuals during 1968. Do not include businesses or government -- just private consumers or individuals?  
0 None

3 - \$\_\_\_\_\_ During 1968, did you sell any merchandise or services to government units outside Klamath County? (If YES) What was the total amount of these sales to government units outside Klamath County?

\$\_\_\_\_\_ Fed. During 1968, did you sell any merchandise or services to government units inside Klamath County? (INT: If NO, circle all three 0's)  
0 None

\$\_\_\_\_\_ State (If YES) What was the amount of your sales to federal government units in Klamath County? What was the amount of your sales to agencies of the Oregon State government in Klamath County? And, what was the amount of your sales to local city and county governments?  
0 None

\$\_\_\_\_\_ City/  
0 None County

4 - \$\_\_\_\_\_ Out- What was the total amount of your sales to businesses outside Klamath County in 1968. Again, either the calendar or fiscal year?  
0 None side

5 - \$\_\_\_\_\_ Inside What was the total amount of your sales to businesses inside Klamath County in 1968?  
0 None

6 - Now, would you please think of the sales you made to businesses within Klamath County during 1968. (HAND RESPONDENT CARD) On this card are some types of businesses. As I read off each type, will you please tell me the amount or percentage of your sales, if any, you made to that type of business in Klamath County? (INT: Go through list one at a time. There must be an answer recorded for each type of business. If answer is "none," write in "0" on appropriate line)

\$\_\_\_\_\_ (a) Agriculture

\$\_\_\_\_\_ (b) Agricultural services

\$\_\_\_\_\_ (c) Lumber

\$\_\_\_\_\_ (d) Manufacturing

\$\_\_\_\_\_ (e) Lodging

\$\_\_\_\_\_ (f) Cafes and Taverns

\$\_\_\_\_\_ (g) Service stations

\$\_\_\_\_\_ (h) Construction

\$\_\_\_\_\_ (i) Professional services

\$\_\_\_\_\_ (j) Product Oriented Wholesale and Retail (unless listed elsewhere)

\$\_\_\_\_\_ (k) Service Oriented Wholesale and Retail

\$\_\_\_\_\_ (l) Communications and Transportation

\$\_\_\_\_\_ (m) Financial Institutions

\$\_\_\_\_\_ (n) Grocery Wholesale or Retail

\$\_\_\_\_\_ (o) Resorts and Marinas

\$\_\_\_\_\_ (p) Auto and Trailer Sales

\$\_\_\_\_\_ (q) Other (Specify \_\_\_\_\_)



- / - 1 Corporation (Ask 8 & 9)      Is this business a corporation, or some other kind  
 2 Other (Skip to #10)      of ownership?
- 
- 8 - \$ \_\_\_\_\_      About how much in compensation was paid to corporation  
      0 None      officers during 1968. Please include all compensation  
                  including bonuses, profit-sharing and firm contribu-  
                  tions to retirement?
- 
- 8a - \$ \_\_\_\_\_      How much of this compensation, if any, was paid to  
                  officers outside Klamath County?
- 
- 9 - \$ \_\_\_\_\_      About how much in wages were paid to employees of the  
      0 None      corporation during 1968? Please include all wages  
                  including bonuses, profit-sharing and firm contribu-  
                  tions to retirement?
- 
- 9a - \$ \_\_\_\_\_      How much of these wages, if any, were paid to employees  
      0 None      outside of Klamath County?
- 
- (INTERVIEWER: If you asked #8 & #9, skip now to #11. Questions #10 and 10a are  
 to be asked only of businesses which are not corporations)
- 
- 10 - \$ \_\_\_\_\_      Including yourself, how much was paid in wages to  
                  all employees of the firm during 1968?
- 
- 10a - \$ \_\_\_\_\_      How much of these wages, if any, were paid to  
      0 None      employees outside of Klamath County?
- 
- ASK OF EVERYONE
- 11 - \$ \_\_\_\_\_      Did this business buy any new equipment, machinery,  
      0 No purchases      buildings or other capital items during 1968?  
      (If NONE, skip to #18)      (If YES) What was the total amount of these capital  
                  item purchases during 1968?
- 
- 12 - \$ \_\_\_\_\_      Of the capital items purchases you made in 1968, how  
      0 None      much, if any, were purchased from individuals?
- 
- 13 - \$ \_\_\_\_\_      Were any of these 1968 capital items purchased from  
      0 None      government units outside Klamath County?
- 
- 14 - \$ \_\_\_\_\_ Fed.      Were any of these 1968 capital items purchased from  
      0 None      government units inside Klamath County? (INT: If NO,  
                  circle all three 0's)
- \$ \_\_\_\_\_ State      (If YES) What was the amount of your 1968 capital  
      0 None      items purchased from federal government units in  
                  Klamath County?
- \$ \_\_\_\_\_ City/  
      0 None      County      What was the amount of your capital item purchases  
                  from agencies of the State of Oregon in Klamath County?  
                  What was the amount of your capital item purchases from  
                  local city and county governments in 1968?
- 
- 15 - \$ \_\_\_\_\_      Of these capital item purchases you made in 1968,  
      0 None      how much, if any, were purchased from firms or  
                  businesses outside of Klamath County?
- 
- 16 - \$ \_\_\_\_\_      Of the capital item purchases you made in 1968,  
      0 None      what amount was bought from firms or businesses  
                  inside Klamath County?
-

- 17 - Now, will you please think of the purchases of capital items which you made from businesses within Klamath County during 1968. On this card are the same types of businesses which you read before. As I call off each type, will you please tell me the amount or dollar percentage, if any, which was purchased from that business group in Klamath County? (INT: Go through list one at a time. There must be an answer recorded for each business type. (If NONE, write in "0"))

\$ \_\_\_\_\_ (a) Agriculture  
 \$ \_\_\_\_\_ (b) Agricultural Services  
 \$ \_\_\_\_\_ (c) Lumber  
 \$ \_\_\_\_\_ (d) Manufacturing  
 \$ \_\_\_\_\_ (e) Lodging  
 \$ \_\_\_\_\_ (f) Cafes and Taverns  
 \$ \_\_\_\_\_ (g) Service stations  
 \$ \_\_\_\_\_ (h) Construction  
 \$ \_\_\_\_\_ (i) Professional Services  
 \$ \_\_\_\_\_ (j) Product Oriented Wholesale and Retail  
 \$ \_\_\_\_\_ (k) Service Oriented Wholesale and Retail  
 \$ \_\_\_\_\_ (l) Communication and Transportation  
 \$ \_\_\_\_\_ (m) Financial Institutions  
 \$ \_\_\_\_\_ (n) Grocery Wholesale and Retail  
 \$ \_\_\_\_\_ (o) Resorts and Marinas  
 \$ \_\_\_\_\_ (p) Auto and Trailer Sales  
 \$ \_\_\_\_\_ (q) Other (Specify \_\_\_\_\_)

ASK OF EVERYONE		(HAND RESPONDENT LIST OF POSSIBLE TAXES)
18 -	\$ _____ Fed.	What is the approximate amount of taxes which your firm paid to the federal government in 1968?
	\$ _____ State	How much in taxes did your firm pay the State of Oregon in 1968?
	\$ _____ City/County	What was the approximate amount of taxes which your firm paid to this county or to cities within the county in 1968?
19 -	\$ _____ 0 No or None	Did your firm pay any taxes to states outside of Oregon in 1968? (If YES) About how much?
19a -	\$ _____ 0 No or None	Did your firm pay any taxes to city and county governments outside Klamath County in 1968? (If YES) About how much?
20 -	1 Yes (Continue with #21) 2 No (Skip to #28)	Did your firm receive any interest, rent, royalties or dividends during 1968?
21 -	\$ _____	What was your firm's total receipts from interest, rent, royalties or dividends during 1968?
22 -	\$ _____ 0 None	How much of these receipts, if any, were paid to you by private individuals?
23 -	\$ _____	During 1968, did you receive any interest, rent, royalties or dividends from government units <u>outside</u> Klamath County? (If YES) What was the total amount?

24 - \$ \_\_\_\_\_ Fed. During 1968, did you receive any interest, rent,  
 0 None / royalties or dividends from government units inside  
 Klamath County? (If NO, circle all three 0's)

\$ \_\_\_\_\_ State (If YES) How much was received from federal govern-  
 0 None ment? From the Oregon State government?

\$ \_\_\_\_\_ City/ From this county or cities within the  
 0 None County county?

25 - \$ \_\_\_\_\_ During 1968, did you receive any interest, rent,  
 0 None royalties or dividends from businesses outside  
 Klamath County? (If YES) What was the total amount?

26 - \$ \_\_\_\_\_ During 1968, did you receive any interest, rent,  
 0 None royalties or dividends from businesses inside  
 Klamath County?

(If YES) What was the total amount?  
 (If NO, skip to #28)

27 - Again, here is a list of types of businesses in Klamath County. As I read off each one, will you please tell me the amount or percentage, if any, which came from interest, rent, royalties or dividends from any of these types of businesses within Klamath County. (INT: There must be an answer recorded on each line)

- \$ \_\_\_\_\_ (a) Agriculture
- \$ \_\_\_\_\_ (b) Agricultural Services
- \$ \_\_\_\_\_ (c) Lumber
- \$ \_\_\_\_\_ (d) Manufacturing
- \$ \_\_\_\_\_ (e) Lodging
- \$ \_\_\_\_\_ (f) Cafes and Taverns
- \$ \_\_\_\_\_ (g) Service Stations
- \$ \_\_\_\_\_ (h) Construction
- \$ \_\_\_\_\_ (i) Professional Services
- \$ \_\_\_\_\_ (j) Product Oriented Wholesale and Retail
- \$ \_\_\_\_\_ (k) Service Oriented Wholesale and Retail
- \$ \_\_\_\_\_ (l) Communications and Transportation
- \$ \_\_\_\_\_ (m) Financial Institutions
- \$ \_\_\_\_\_ (n) Grocery Wholesale and Retail
- \$ \_\_\_\_\_ (o) Resorts and Marinas
- \$ \_\_\_\_\_ (p) Auto and Trailer Sales
- \$ \_\_\_\_\_ (q) Other (Specify \_\_\_\_\_)

#### ASK OF EVERYONE

28 - \$ \_\_\_\_\_ What was the total amount of depreciation taken by  
 your firm in 1968?

29 - 1 Higher (Ask 29a) Was your inventory higher or lower at the end of 1968  
 2 Lower (Ask 29a) than it was at the beginning of the year?  
 3 Same (Skip to #30)  
 4 D.K. or no inventory

29a - \$ \_\_\_\_\_ About how much (higher) (lower) was your inventory  
 at the end of 1968?

- 30 - X I hereby certify this interview was actually taken with the person listed below and represents a true and accurate account of the interview.

\_\_\_\_\_  
(Respondent)                      (Firm)                      (Date)

\_\_\_\_\_  
Phone No.

\_\_\_\_\_  
(Interviewer's Signature)

---

FOR OFFICE USE ONLY

Interview verified by \_\_\_\_\_

Date of verification \_\_\_\_\_

## APPENDIX 2

D-3

OREGON STATE UNIVERSITY

July, 1968

Hello, I'm \_\_\_\_\_. I'm working on a recreation survey for Oregon State University and would like to ask you a few interesting questions if you don't mind!

1 -	1 Visit lake (continue) 2 Other purpose (DISCONTINUE)	Was the main purpose of your trip to visit this particular lake, or are you taking your trip for some other purpose?
2 -	_____ _____ (AM or PM)	Date Time May I ask when you arrived at this particular site--the date and approximate time?
3 -	_____ _____ (AM or PM)	Date Time Now, when do you plan to leave this particular site--again the date and approximate time of day or night?
4 -	_____ _____ _____ State	City/Town County State Where do you live at the present time --the city or town, county and state?
4a -	1 In city/town (Skip to 5) 2 Suburban area (Skip to 5) 3 Rural outside (Ask 4b)	Do you live right in the city (town), a suburban area, or a rural area outside of the city (town)?
4b -	_____ 1 Nearer site 2 Away from site	Miles How many miles do you live out of the city (Town)? (INT: Mark whether nearer or farther away from site)
5 -	_____	Number Including yourself, how many persons are there in your party which is stopping at this particular place?
6 -	1 Immediate family 2 Other relatives 3 Unrelated individuals 4 Other (explain below)	Does your party consist mainly of your immediate family, mainly of other relatives, or mainly of unrelated individuals, such as neighbors and friends?
7 -	_____	Number Including yourself, how many persons are there in your immediate family?
<p>To help the University figure out how valuable recreation is to the state, I'd like to ask you about your party's expenditures <u>from your home to this area.</u></p>		
8 -	\$ _____	Enroute Approximately how much did your party spend for food and liquor in cafes, restaurants or taverns while you were enroute to this particular site? (Just your best estimate)
	\$ _____	Here About how much will your party probably spend in restaurants, cafes or taverns while you are stopping at this particular site? (Just your best estimate)

9 -	\$ _____	Home	Approximately how much did your party spend for this trip in grocery or liquor stores before you left home? (Just your best estimate)
	\$ _____	Enroute	About how much did your party spend in grocery or liquor stores while you were enroute to this particular site? (Just your best estimate)
	\$ _____	Here	What do you think your party will spend in grocery and liquor stores while you are stopping at this particular place? (Just your best estimate)

---

10 -	\$ _____	Enroute	While you were enroute to this site, about how much did your party spend for lodging in motels, hotels or trailer parks? (Just your best estimate)
	\$ _____	Here	What do you think your party will spend for lodging in motels, hotels or trailer parks while you are stopping at this site? (Just your best estimate)

---

11 -	\$ _____	Enroute	How about camping fees -- how much, if any, did your party spend for camping fees while you were enroute to this site? (Just your best estimate)
	\$ _____	Here	What do you think your party will probably pay for camping fees while you are here at this site? (Just your best estimate)

---

12 -	_____	Miles	How many miles, if any, did your party drive yesterday while at this site?
	_____	Purpose	What was the purpose of your drive yesterday?
	_____	Miles	(If not at site yesterday) About how many miles, if any, will your party probably drive today while at this site?
	_____	Purpose	For what purpose will today's drive be for?

---

13 - Now please think of the gasoline and oil that will be purchased for your party's car and boat for this entire trip.

_____	% before leaving	First, about what percent of gas and oil for the car and boat was purchased for the trip before you left home? (Just your best estimate)
_____	% both ways	Now, think of all the gas and oil that will be purchased between home and here and between here and back home. Approximately what percentage of the gas and oil will be purchased between home and the time you get back home from here, that is, both ways? (Just your best estimate)
_____	% at this site	What percentage of all gas and oil purchased for the car and boat will you probably make while you are stopping at this site? (Just your best estimate)

---

14 - 1 Yes (ask 14a)                      Did your party bring a boat with you to this site?  
 2 No (skip to no. 15)                      -----

- 14a - \_\_\_\_\_ Gallons About how many gallons of agsoline does your boat use a day  
Gas at this particular site?
- \_\_\_\_\_ Quarts How many quarts of oil does your boat use in a day while  
Oil here?

(INTERVIEWER: Refer to question no. 6. Ask question 15 series only if code 2, 3, or 4 is circled in no. 6)

- 15 - 1 Mine (ask 15a) Whose car did you bring on the trip -- yours or someone  
2 Someone else (skip to 15b) else's in your party?  
-----
- 15a - \_\_\_\_\_ How much, if any, did other members of your party con-  
\$ \_\_\_\_\_ tribute for gas, oil and automotive expenses thus far on the  
----- trip?  
-----
- 15b - \_\_\_\_\_ How much, if any, have you contributed thus far to the owner  
\$ \_\_\_\_\_ of the car for gas, oil and automotive expenses?
- 
- 16 - \_\_\_\_\_ How much money, if any, has your party spent on boat  
\$ \_\_\_\_\_ launching fees while on this trip?

- 17 - Thus far, we have talked about expenses for the automobile trip, boat, food and liquor, and for lodging and camping fees. Can you think of any other types of expenses you have had coming here, such as camera supplies, souvenirs, etc. (If YES) What type?

1 No

2 Yes

Type \_\_\_\_\_

Total cost of these expenses \$ \_\_\_\_\_

- 17a - What other types of expenses will you have while stopping at this site?

1 No

2 Yes

Type \_\_\_\_\_

Estimated cost of these expenses \$ \_\_\_\_\_

- 18 - (HAND CARD TO RESPONDENT) Here is a list of items which either you or other members of your party may own, which you have brought with you to this site. Looking over the list, will you please tell me which owned items were brought with you? Do not include rented items. (INT: Mark X for each item. Then ask remaining questions on your card for each X'd item)

Items	Amt. Paid		Type & Location of	
	Purchased	for Item	Store where Purch?	Maintenance
_____ Boat				
_____ Outboard Motor				
_____ Boat Trailer				
_____ Fishing Tackle (rod, reel, tackle box, etc.)				
_____ Camper (van, truck, trailer camper, etc.)				
_____ Tent trailer				

	Purchased	Amt. Paid for Item	Type & Location of Store where Purch?	Maintenance
<u>      </u> Tent				
<u>      </u> Back pack				
<u>      </u> Sleeping bag				
<u>      </u> Stove				
<u>      </u> Lantern				
<u>      </u> Cooler				
<u>      </u> Boat equipment <u>not</u> included in price of boat (preserver, fire extinguisher, etc.)				
<u>      </u> Water skis, ropes, etc.				
<u>      </u> Special clothing (such as rubber boots, coats, rainwear, swimming suits, etc.)				
<u>      </u> Any other items? (If YES) What?				
<u>      </u>				
<u>      </u>				
<u>      </u>				

- 19 - (HAND RENTAL CARD) Looking at this list of items, will you please tell me which, if any, of these items you or other members of your party have rented for this particular trip? (INT: Mark X for each item. Then, for each X'd item, ask the remaining questions on your card for each X'd item)

<u>Items</u>	Rental Rate (Daily, Hourly) Weekly)	Type & Location of Store where Rented	Total Rent Expect to Pay for Item
<u>      </u> Boat			
<u>      </u> Outboard Motor			
<u>      </u> Boat Trailer			
<u>      </u> Fishing tackle (rod, reel, tackle box, etc.)			



<u>Items</u>	Rental Rate		Type & Location of Store where Rented	Total Rent Expect to Pay for Item
	(Daily, Hourly, Weekly)			
_____ Tent trailer				
_____ Tent				
_____ Back pack				
_____ Sleeping Bag				
_____ Water skis				
_____ Life vests				
_____ Other equipment for boats				
_____ Any other items? (If YES) What?				
_____				
_____				
_____				

20 - \$ \_\_\_\_\_  
0 None

About how much will you spend at this site for various baits--  
just that amount that will be used at this particular site?

- 21 - 1 (a) Less than \$3, 500  
2 (b) \$3, 500 - \$4, 999  
3 (c) \$5, 000 - \$6, 999  
4 (d) \$7, 000 - \$7, 999  
5 (e) \$8, 000 - \$8, 999  
6 (f) \$9, 000 - \$9, 999  
7 (g) \$10, 000 - \$10, 999  
8 (h) \$11, 000 - \$11, 999  
9 (i) \$12, 000 - \$12, 999  
0 (j) \$13, 000 - \$14, 999  
1 (k) \$15, 000 - \$16, 999  
2 (l) \$17, 000 - \$19, 999  
3 (m) \$20, 000 - \$24, 999  
4 (n) \$25, 000 or over

(HAND RESPONDENT INCOME CARD)

Would you please look at this card and tell me which one of  
these groups best fits your total family income before taxes  
for last year?

Just call your answer by letter, please.

(INT: If \$25, 00 or over, get range from respondent)

22 - INTERVIEWER: Mark below the type of activity the respondent was doing when you first  
approached (him) (her), or the type of activity the respondent just finished doing.

\_\_\_\_\_ Activity

23 - 1 Male  
2 Female

1 Under 21 years of age  
2 21 - 29 years  
3 30 - 39  
4 40 - 49  
5 50 - 59  
6 60 or over

Age and sex of respondent

---

24 - \_\_\_\_\_ Site where interview taken

---

25 - \_\_\_\_\_ Telephone number of respondent (for verification  
(Area code) \_\_\_\_\_ purposes only)

---

X I hereby certify this interview was actually taken with the person described above, and represents a true and accurate account of the interview.

\_\_\_\_\_, 1968  
(Interviewer's signature) (Date)

---

COMMENTS ON INTERVIEW (if any):