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Input-output models have been used for many years and have been applied to a variety of problems. These models typically are used in economic planning and impact assessment. In a purely descriptive sense, an input-output model enhances one's understanding of an economy.

Although input-output models are commonly used as an economic tool, these models do become outdated over time. The most common source of obsolescence is reflected in the structural coefficients, i.e., the purchasing patterns of sectors within an economy may change. There are several procedures for updating models to account for such changes. The location of a new industry (sector) within the modeled economy also results in the need to update a model. In this case, the model must be expanded to incorporate the new sector.

The present research develops an *ex-ante* method for incorporating a new sector into an input-output model. The *ex-ante* procedure is applied by incorporating a new sector (coal fired power plant) into the Morrow County (Oregon) input-output model. Implications of the existence of excess capacity in the Morrow County economy are evaluated.

It is concluded that the *ex-ante* procedure may lead to questionable results when projected increases in sales exceed a sector's excess capacity. Two of the basic assumptions of input-output analysis may be violated: constant structural coefficients and perfectly elastic supply. In other words, the economy may not be able to adjust perfectly and instantaneously to the projected interindustry transactions of the new sector.

The *ex-ante* procedure developed for the present research requires further evaluation. An *ex-post* analysis would give some indication as to whether the assumptions underlying static input-output analysis, as noted above, are indeed violated when projected sales exceed excess capacity. However, *ex-post* analysis may not provide a definite answer. It is important to realize that an economy changes through time; thus, there will be other variables acting on the economy in the interim.

The *ex-ante* procedure used here implicitly assumes that there is a demand for the new sector's product. This assumption may be reasonable when a new sector has already made a decision to locate (e.g., the coal fired power plant in Morrow County), but may not be reasonable when such a decision has not been made. In short, the procedure makes no assumptions about the feasibility of the industrial location decision.

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CHAPTER I

MODIFICATIONS OF STATIC INPUT-OUTPUT MODELS TO REFLECT SECTORAL CHANGE

INTRODUCTION

In May, 1980, the Department of Agricultural and Resource Economics (Oregon State University) entered into a contractual agreement with the Morrow County Court to construct a primary data input-output model of the Morrow County (Oregon) economy. More precisely, the contract called for the development of an inter-industry model. There were two major purposes for constructing the model. The first objective was to document the county's dependency on basic resource-using industries. The second objective was to develop a tool which could be used for economic impact assessments at the county level.

The desire by Morrow County officials to have an inter-industry model of the county economy was, in part, a direct result of the rapid economic growth which the county has been experiencing in recent years. During the period 1973 to 1978, Morrow County was the second fastest growing county in the United States. The total growth in personal income was 254 percent [U.S. Department of Commerce, 1980 (b)]. A major factor contributing to the growth of the Morrow County economy was, and is, the expansion of irrigated agriculture in the northern end of the county (see Figure 1). Irrigated acreage increased from 12,500 acres in 1965 to an estimated 62,000 acres in 1980.

The growth in irrigated agriculture stimulated growth in other sectors of the county economy. For example, a food processing plant was constructed in Boardman (in 1975) in response to the growth in potato production--a crop associated solely with sprinkler irrigation systems first introduced in 1965. The plant initially had 162 full time equivalent employees and has expanded its employment in subsequent years (Obermiller, 1975). The most recent industrial development in Morrow County has been the construction of a coal-fired power plant (CFPP) by Portland General Electric. This plant is located just south of Boardman.

Accompanying the growth in irrigated agriculture and manufacturing has been rapid population growth in Morrow County. During the period 1973 to 1978, the population of Morrow County grew by 54 percent. This is in contrast to 11 and 4 percent increases for Oregon and the United States, respectively. The population of Morrow County was 4,600 in 1973 and grew to 7,100 in 1978 [U.S. Department of Commerce, 1980 (a)].

Study Area

The geographical boundaries of Morrow County are the limits of the county economy for purposes of the present study. This definition was adopted for the logical reasons that the Morrow County Court provided funding for the development of the input-output model, and in a geopolitical sense the county, in Oregon is an economic unit.

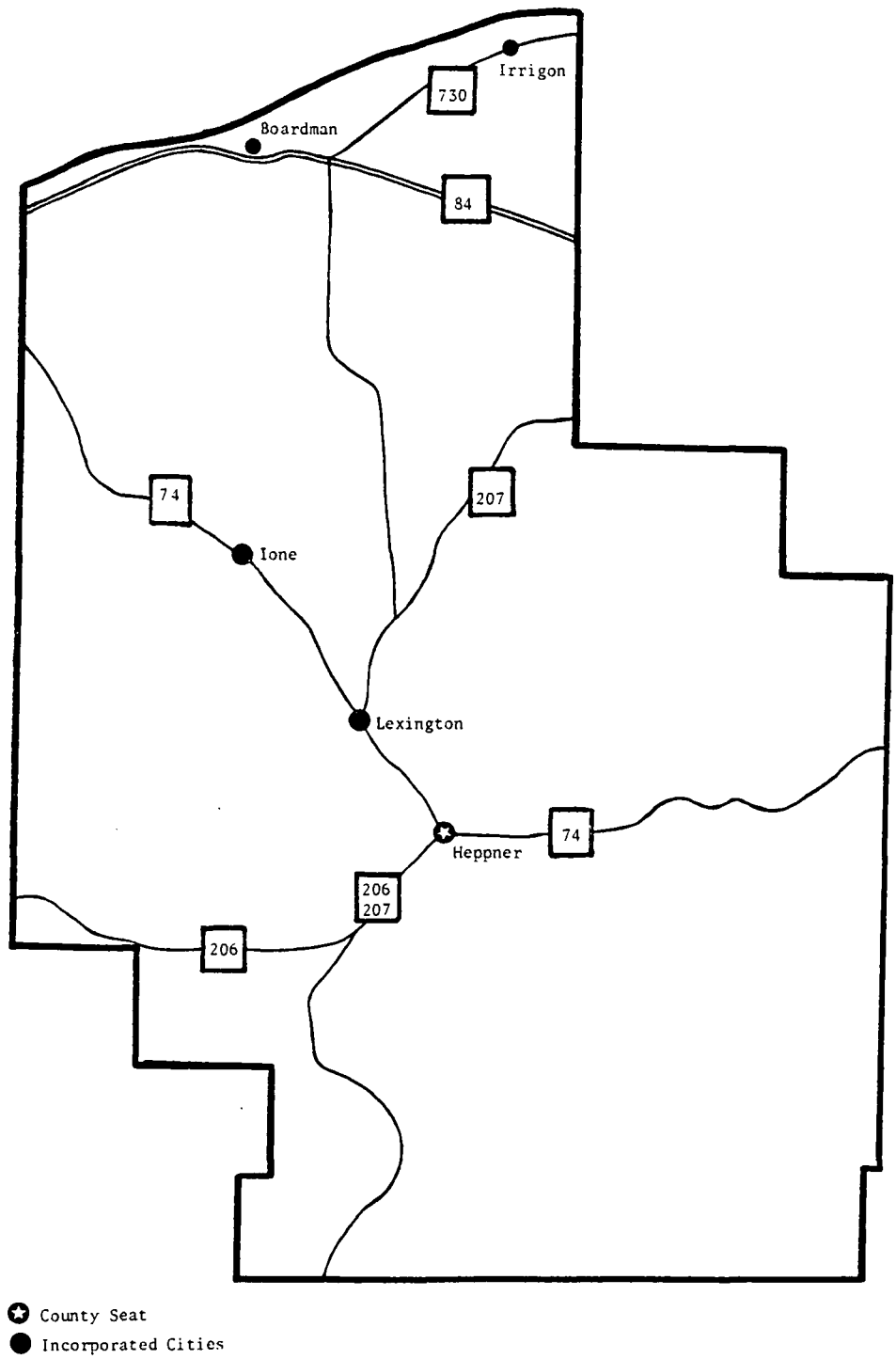

Figure I. Map of Morrow County

Morrow County can be divided into two sections--north and south (see Figure 1). The south end contains the county seat (Heppner), and is the traditional business center of the southern half of the county. The major income producing activities in the south end are dryland wheat, cow-calf operations, and wood products. Dryland wheat and cow-calf operations are the traditional forms of agriculture in the county.

The north end is the recipient of the rapid growth which the county recently has been experiencing. The growth initially was generated by an expansion in irrigated agriculture; as noted above. In response to the growth in irrigated agriculture, the food processing plant was constructed in Boardman. In turn, many new service industries opened in the community. The construction and operation of the CFPP has provided an additional and continuing stimulus to growth in the north end.

The Problem

The construction of the coal-fired power plant created a one-time stimulus for the Morrow County economy; but, the operation of the plant will have a prolonged effect on local economic activity. Morrow County business leaders expected the inter-industry model to provide some insight as to the effect of the operational CFPP on the local economy; that is, the plant could be assumed to have a significant impact through its interactions with established businesses within the county.

The above question (expectation) presented a problem in developing the Morrow County inter-industry model. The survey data for the model was collected (in the summer of 1980) for the 1979 calendar year. The power plant was not operating in 1979, and is not scheduled for on-line production until 1982. In addition, the CFPP did not conform with the standard inter-industry sector definitions for any of the existing sectors of the Morrow County economy. Thus, the effect of the plant's operation on the local economy could not be treated as a change in final demand for an existing industry's (sector's) output. Rather, the plant could only be treated as a distinctly new sector in the inter-industry model.[1/]

The process of establishing the coal-fired power plant as a new sector in the Morrow County inter-industry model is not straightforward. The 1979 survey data did not contain observations of the CFPP interactions with existing firms in the local economy, because the plant was not operating in 1979. An *ex-ante* procedure was required to incorporate the plant (new sector) into the model and to assess its effects on the local economy. The development of an *ex-ante* procedure for incorporating a new sector into an existing inter-industry model, and the effect of the coal-fired power plant on the Morrow County economy, are the topics addressed in this thesis.

1/ A one firm sector does not present disclosure problems in that the CFPP is owned by Portland General Electric which is a public utility.

Objectives

The objectives of the present study are as follows: 1) to construct a static inter-industry model of Morrow County (Oregon); 2) to develop an *ex-ante* procedure for incorporating a new sector into an existing inter-industry model; 3) to examine the aggregative and distributional effects which the CFPP would have on the Morrow County economy; 4) to evaluate the effect which firms with transactions patterns different from the CFPP might have on the county economy; and 5) to evaluate the extent to which the *ex-ante* procedure developed for objective (2) is an adequate representation of reality.

Study Organization

In accomplishing the objectives presented above, a survey was conducted of firms, households, and government agencies located within Morrow County during the summer of 1980. Information was collected on the selling and purchasing patterns of these units. As was noted earlier, these observations were collected for the 1979 calendar year. The survey was conducted via personal interviews with firms and government agencies, and by mail survey for households. The data collected through the survey process were used to develop an inter-industry model of the Morrow County economy.

The third objective was accomplished by interviewing Portland General Electric as to its projected purchases and sales from/to

both local and nonlocal economic sectors when the CFPP is fully operational. The projected transactions data were converted to 1979 dollars and used, via the *ex-ante* procedure (second objective) presented in Chapter IV, to incorproate the CFPP as a new sector in the model. The aggregative and distributional effects of the power plant were evaluated using the new inter-industry model of Morrow County (expanded to incorporate the CFPP sector). The impacts of the new sector were calculated by examining changes in gross regional output, total sales by sector, household income, and employment by sector. Structural changes were evaluated by examining the inter-industry tables with and without the CFPP sector.

The fourth objective addresses the effect which firms (sectors) with different transaction patterns will have on the structure and development of the Morrow County economy. This objective is accomplished by simulating the local economic system as it might exist with the CFPP making endogenous sales. (The CFPP will, in actuality, only make exogenous sales when it is fully operational).

The validity of the *ex-ante* procedure for incorporating a new sector is evaluated by examining the excess capacity existing in Morrow County during the survey period (1979); that is, whether the increased sales of local sectors, resulting from the introduction of the new purchasing sector, exceed the existing sectors' excess capacities. If capacity constraints are exceeded, it is questionable as to whether the assumptions by which the *ex-ante* procedure is developed are applicable. This discussion is developed further in Chapter IV.

The organization of the remainder of this thesis is as follows: In the next chapter (Chapter II), the theory of input-output analysis is reviewed. In Chapter III, the inter-industry model of Morrow County, without the CFPP, is presented. The *ex-ante* procedure for incorporating a new sector into an existing inter-industry model is developed in Chapter IV. Chapter IV also contains the discussion of the inter-industry model of Morrow County in which the local economy with a CFPP making endogenous sales is simulated. Summaries and conclusions with respect to the present study are offered in the final chapter.

CHAPTER II

THE THEORY AND METHODS OF INPUT-OUTPUT ANALYSIS

Historical Perspective

Input-output analysis has been used as an economic tool for many years. The origins of this type of economic analysis predate the table of inter-industry relations developed by Leontief in 1931. The Soviets published a table of inter-industry relations for their economy in 1925. The first empirical application of input-output analysis to the United States economy was by Leontief in 1936.

The basic concepts of input-output analysis and inter-industry relations can be traced to Quesnay's "Tableau Economique" in 1758 and Walras' general equilibrium model of the 1870's. The theoretical framework of Leontief's input-output model drew heavily on Walras' model and, to a lesser degree, on the work of Pareto (Chenery and Clark, 1959).

The Walras model specified a system of equations which would determine all of the prices in an economy when solved simultaneously (Miernyk, 1965). Each price in this system has its own equation. Miernyk points out that the Walras model portrays the interdependence of producing sectors of the economy and the competing demands of each sector for factors of production. The system of equations represents,

in part, consumer income and expenditures and allows consumers to substitute purchases from one sector of the economy to another. The model also takes into account the costs of production in each sector, total demand for and supply of commodities, and supply and demand of factors of production.

Miernyk (1965) noted that the Walras model is not empirically implementable, even if sufficient data were available, due to the complexity of the system of equations. Given the practical limitations of the theoretical model, Leontief simplified the Walras model so that the equations could be estimated empirically (Dorfman, 1954). The simplification process involved two assumptions (Richardson, 1972):

1. The large number of commodities in the Walras model were aggregated into a relatively few outputs--one for each sector.

2. The equations for the supply of labor and final demand were not used, and the remaining production equations were expressed in their simplest form.

These assumptions artificially reduce the number of equations and unknowns and allow the theoretical model to be empirically estimated.

Chenery and Clark (1959) noted that Leontief excluded the effects of limited factor supplies but adopted Walras' assumption of fixed production coefficients. Thus, Leontief eliminated the effect of price on consumer demand, intermediate inputs, supply of labor, etc. In turn, the Leontief model precludes many of the adjustments which are characteristic of the Walrasian system.

In the Leontief model, supply and demand are equated by horizontal shifts in the demand curve, given constant relative prices. Supply is assumed to be perfectly elastic (Chenery and Clark, 1959). Thus, supply and demand are equated by adjustments in production levels, rather than by changes in price as would be experienced by moving along the supply and demand curves. The Leontief system is assumed to be in equilibrium at given prices (Richardson, 1972).

Development of a Theoretical Input-Output Model

The above assumptions can be used to develop an input-output model that divides an economy into sectors based on the production activities of the units which compose the economy. As noted above, each sector produces one product (or many products which are perfect substitutes in consumption).[2/] It is also assumed that each sector's product(s) is (are) unique, and that all firms within a sector face the same production function. Each sector in the model has a distinct production function (Chenery and Clark, 1959). The production functions for each sector are assumed to demonstrate fixed factor proportions (production coefficients) and are homogeneous of degree one (Chenery and Clark, 1959; Richardson, 1972). Thus, input-output

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2/ If substitutes are aggregated into sectors, the input coefficients will be unstable if the production processes composing the aggregate do not have similar input structures (Chenery and Clark, 1959).

analysis is based on the premise that it is possible to divide the productive activities of an economy into sectors whose relations are meaningful and can be expressed in simple input functions.

The division of an economy into sectors is used to facilitate the description of the interactions of producing units in an economy; that is, the flow of goods and services between producing and consuming sectors. Leontief states that input-output economics is "... essentially a method of analysis that takes advantage of the relatively stable pattern of the flow of goods and services among the elements of our economy to bring a much more detailed statistical picture of the system into the range of manipulation by economic theory." (Leontief, 1966). Or, as Chenery and Clark (1959) have stated:

> "Since [input-output] analysis is concerned with interrelations arising from production, the main function of [input-output] accounts is to trace the flows of goods and services from one productive sector to another."

Thus, input-output analysis is a simplified procedure for viewing an economy through empirical techniques.

As alluded to above, a distinction is drawn between sectors located within an economy (endogenous) and sectors located outside of an economy (exogenous). Endogenous sectors represent producing units within the economy being modeled. Exogenous sectors represent producing units located outside the economy being modeled, as well as nonproduction accounting relationships, e.g., depreciation, investment, net inventory change. The distinction between endogenous and

exogenous sectors is similar to the one drawn in the Keynesian model between induced and autonomous elements of an economy (Chenery and Clark, 1959). Hence, input-output models, as presented in this thesis are static and emphasize current account transactions.

Differences Between the Leontief Model and the Keynesian Model

As was noted above, in certain respects the Leontief input-output model is similar to the Keyneisan aggregate income model. This is not always the case. For example, the traditional Leontief input-output model treats households as an exogenous sector (Miernyk, 1965). This is what is known as the "open Leontief model," but the Leontief model can also be closed with respect to household transactions.[3/]

The "open Leontief model" conflicts with traditional Keynesian economics (Bromley, 1967). In the open model, a consumption function is irrelevant since consumption, which is part of final demand, is independent of output, employment, and thus, income. Consumption is thus determined exogenously from the model, i.e., in the Keynesian notation it would be an autonomous element. However, it is possible to apply the opposite set of assumptions and include households as an endogenous sector.

In essence, the above discussion indicates that input-output analysis is a unique accounting procedure, but it provides more

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3/ The openness of an input-output model is measured by the proportion of flows to and from exogenous sectors (in the model) in proportion to the total flows in the respective economy. The openness of a model can be adjusted to suit particular research needs, i.e., sectors can be defined as endogenous or exogenous depending on the economy being modeled and the research objectives.

information about an economy than a Keynesian national income accounting framework. This point can be clarified by distinguishing between Keynesian national income accounts and input-output models. The dominant concern of national income accounts is the composition of final demand, while input-output accounts focus more on the inter-relationships and transactions that lie behind changes in final demand (Richardson, 1972).

The Keynesian system is concerned with broad aggregates. The basic equation of the Keynesian system of national income accounts can be expressed as follows (Rowan and Mayer, 1972):

$$GNP = C + I + G + (X-M) \tag{1}$$

where:

GNP = total output (gross national product)

C = total consumption

I = total investment

G = total governmental expenditures

X = total exports

M = total imports.

and

$$\text{total income} = \text{total expenditures} = \text{total output}. \tag{2}$$

The remainder of the Keynesian relationships, and multipliers, are developed with respect to the above relationships. In the simplified case where an economy contains only one sector, the Leontief input-output system can be reduced to the Keynesian equations.

The above comparison can be stated quite simply, as follows:

> "The (input-output) system is therefore able to show the differing effects on the rest of an economy of an increase in the demand for individual commodities, which in a Keynesian model would be indistinguishable parts of production and consumption." (Chenery and Clark, 1959).

Thus, input-output analysis provides specific information with respect to the sectoral distribution of goods and services in an economy, whereas, the Keynesian model can only address broad aggregative relationships.

Distinction Between Input-Output Economics and Inter-industry Economics

Input-output analysis is a subset of a much broader discipline of economics known as inter-industry economics. For present discussion purposes, only two types of inter-industry models are of interest.[4/] The models of interest are the Leontief input-output model and an inter-industry transaction model.[5/] The Leontief model begins with a production function for each endogenous sector of an economy and develops a matrix of inter-industry transactions (transactions table), whereas the inter-industry transactions model begins with a transactions table and assumes the existence of the underlying production functions.

4/ Chenery and Clark (1959) present a discussion of various types of inter-industry models in Chapter 4 of their book.

5/ The model developed for Morrow County in Chapter III is an inter-industry transactions model, as was noted in Chapter I.

Assumptions of Input-Output Analysis

The basic assumptions of input-output analysis have been alluded to either explicitly or implicitly in the preceding sections of this chapter. The purpose of this section is to present a concise specification of these assumptions. There are three basic assumptions underlying input-output analysis. Following Chenery and Clark (1959):[6]

1. Each commodity is supplied by a single producing sector in the model. Corollaries:
   a. all firms in a sector have the same production function, and
   b. each sector has only one primary output.[7]
2. The inputs purchased by a sector are solely a function of the sector's output.
3. The end result of several types of production is the sum of the individual production activities (additivity).

Thus, firms are divided into sectors by their principal products and underlying production functions. Corollary (b) of assumption (1) rules out joint products, although the researcher will encounter such occurrences in practice, and multiproduct firms (Richardson, 1972).

---

[6] The general microeconomic assumptions of profit maximization, optimal resource allocation and consumer utility maximization are not used in the development of input-output models. Thus, input-output models do not tell the researcher whether an economy is operating at peak efficiency (Miernyk, 1965).

[7] The assumption of firms within a sector facing the same production function is made in general equilibrium models, as well as in Marshallian partial equilibrium models (Richardson, 1972).

The second assumption is often stated in stronger terms; that is, the purchases of a sector are a linear function of the sector's output. The general form of the input-output production function has fixed production coefficients and is homogenous of degree one. Such a production function implies constant returns to scale, and therefore, rules out external economies or diseconomies. The third assumption (additivity) is guaranteed when the fixed factor proportion production function is used.

The above assumptions make it possible to accept the simplified production functions used in input-output models (Bromley, 1967). The simplified functions are used for empirical convenience. For example, an input-output model would become unwieldy rather quickly if all of the production coefficients in the model were allowed to vary.[8/] Thus, the assumption of fixed factor proportions is used.

A production function which has fixed factor proportions can be represented graphically as in Figure II. The L shaped curves on this graph are isoquants which represent combinations by which the two factors of production (X_1 and X_2) can be used in the production process (Ferguson and Gould, 1975). Isoquants such as the ones portrayed in Figure II represent a production process which uses inputs in fixed proportions. That is, as output increases from 10 to 20 units (curve B to curve C), the use of the

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8/ As was noted earlier, fixed production coefficients is a common assumption in economic models and analyses.

inputs (X_1 and X_2) increases, but the ratio in which they are used remains constant. This phenomena is represented by a movement along the ray OA.

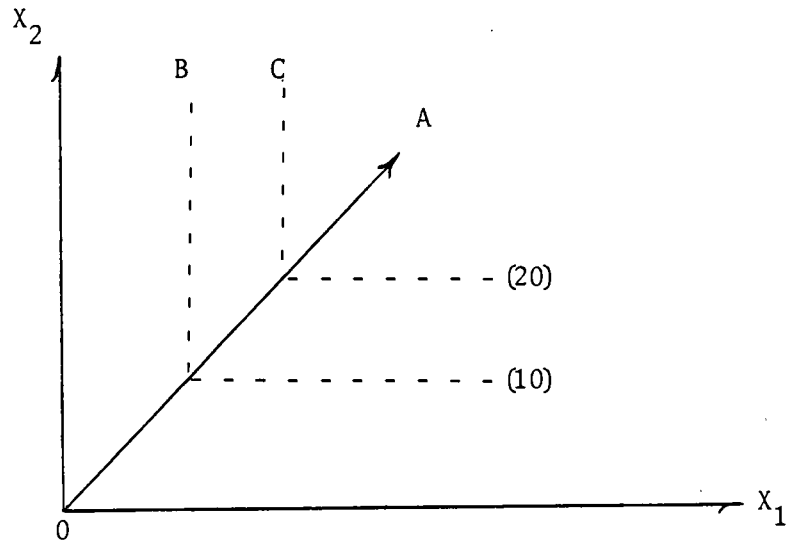

Figure II. Fixed Factor Proportion Isoquant Map

In the construction of an input-output model, a matrix of direct coefficients is derived. These coefficients portray the purchasing patterns of sectors endogenous to the economy being modeled, and it is assumed that these coefficients are constant, i.e., fixed factor proportions exist. In reality, the direct coefficients do change over time, but they may be an adequate representation of reality in the short-run (Carroll, 1980). In the long-run, updating of the coefficients is necessary.

The stability of the direct coefficients depends on the sector specification and the underlying production systems in the model. Changes in these coefficients are caused by changes in the composition of the demand for a sector's output, relative prices, trading patterns, and/or technology (Chenery and Clark, 1959; Richardson, 1972). The assumption of constant direct coefficients is extremely important for such uses of intput-output models as forecasting.

The assumptions discussed in the present section lay the foundation for the structural framework of input-output models, as developed in the remaining sections of this chapter. While reading the remainder of this thesis, it is important to keep in mind that the "... validity of (the above) assumptions depend (on the) nature of production of single plants and the way they are aggregated" (Chenery and Clark, 1959).

Transactions Table

The transactions table (or transactions matrix as noted earlier) provides the basic input-output accounting framework. This is a matrix which depicts the flow of goods and services associated with producing sectors to and from other sectors (inside and outside) of the economy being modeled. These flows are measured in gross dollars. Table I is a hypothetical transactions table.

TABLE I. A HYPOTHETICAL TRANSACTIONS TABLE

Purchasing Sectors (j) / Producing Sectors (i)	Purchasing Sectors a (1)	b (2)	c (3)	Total Intermediate Sales	Final Demand	Total Sales
		-A-			-B-	
a (1)	x_{ij}	x_{ij}	x_{ij}	W_i	Y_i	X_i
b (2)	x_{ij}	x_{ij}	x_{ij}	W_i	Y_i	X_i
c (3)	x_{ij}	x_{ij}	x_{ij}	W_i	Y_i	X_i
Total Intermediate Purchases	U_j	U_j	U_j	$(\Sigma U_j = \Sigma W_i)$		
		-C-				
Primary Inputs	V_j	V_j	V_j		$(\Sigma V_j = \Sigma Y_i)$	
Total Purchases	X_j	X_j	X_j			$(\Sigma X_j = \Sigma X_i)$

The submatrix (*A*) in the upper left of the table defines the endogenous producing sectors. As the reader will note, each endogenous sector is identified twice; once as a row and once as a column. This is a type of double entry bookkeeping whereby each sector appears as a selling unit and as a purchasing unit. The accounting framework is specified such that all receipts from sales are paid out for goods and services (Miernyk, 1965).

The i'th row (i = 1, 2, 3) of the transactions matrix represents the distribution of the i'th sector's sales to other endogenous sectors as intermediate purchases (j = 1, 2, 3) and to final demand (Y). The x_{ij} represent the sales to (purchases from) other producing sectors as inputs to (outputs from) their production processes, and:

$$\sum_{j=1}^{3} x_{ij} = W_i \qquad \text{for } j = 1, 2, 3 \tag{3}$$

where the W_i are the total intermediate sales of the i'th sector, i.e., total sales as inputs to other producing sectors.

The Y_i in the upper right submatrix (*B*) are the i'th sector's sales to final demand, i.e., sales to exogenous sectors. Final demand is the difference between the total supply of a sector's output and the amount purchased for intermediate purchases. Hence, final demand in a static model contains inventory depletion, i.e., sales from inventories (Chenery and Clark, 1959). Final demand also

contains other accounting functions such as capital investment, in addition to export (exogenous) sales. In application, the final demand column can be divided into a number of subsectors consistent with the specificity required by the objectives of a given study.

The X_i are the i'th sector's total sales,

where:

$$X_i = \sum_{j=1}^{3} x_{ij} + Y_i \qquad \text{for } i = 1, 2, 3 \tag{4}$$

Equation (4) can be rewritten as follows:

$$X_i = W_i + Y_i \qquad \text{for } i = 1, 2, 3 \tag{5}$$

The interactions among exogenous sectors are generally unknown, e.g., sales by exogenous sectors to other exogenous sectors. Thus, it is impossible to specify equations such as (4) and (5) for these purely exogenous interactions. The inability to model the interactions of exogenous sectors does not conflict with the purpose of input-output models, i.e., to describe the interactions among endogenous sectors of an economy.

The j'th column (j = 1, 2, 3) in the transactions table represents the composition, and distribution, of the j'th sector's purchases from other sectors in the model. Viewing the transactions table from this perspective, the x_{ij}'s represent the j'th sector's purchases from other endogenous sectors, and:

$$\sum_{i=1}^{3} x_{ij} = U_j \qquad \text{for } j = 1, 2, 3 \qquad (6)$$

where U_j are the total intermediate (endogenous) purchases of the j'th sector, i.e., purchases of inputs from other local producing sectors.

The V_j [lower left submatrix (C)] represents the j'th sector's purchases from exogenous sectors. These sales are denoted as primary inputs by Chenery and Clark (1959). In the traditional "open Leontief model, "primary inputs are subdivided into imports and value added. When households are incorporated as an endogenous sector, this distinction no longer holds. Primary inputs incorporate accounting functions as does the final demand column, e.g., depreciation and inventory accumulation (Richardson, 1972). As with final demand, primary inputs can be divided into as many subsectors as may be required for the specificity of a given study.

The X_j are the j'th sector's total purchases, where:

$$X_j = \sum_{i=1}^{3} x_{ij} + V_j \qquad \text{for } j = 1, 2, 3 \qquad (7)$$

Equation (7) can be rewritten as follows:

$$X_j = U_j + V_j \qquad \text{for } j = 1, 2, 3 \qquad (8)$$

Once again, these equations are only specified for endogenous sectors due to the reasons cited above (inter-industry transactions among exogenous sectors are unknown).

The final point in the above paragraph can be generalized. The difference between endogenous and exogenous sectors is that endogenous sectors must have balanced budgets ($X_i = X_j$ for all $i = j$). Primary inputs and final demand must only balance in the aggregate $\left(\sum_{j=1}^{3} V_j = \sum_{i=1}^{3} Y_i \right)$ (Chenery and Clark, 1959).

As has been noted, the column sum (X_j) must equal the row sum (X_i) for each endogenous sector ($i = j$). This is consistent with the double entry accounting framework of an input-output model. Total purchases equaling total sales is a direct result of Euler's theorem (Henderson and Quandt, 1980). Euler's theorem states that in the absence of economies of scale (production functions homogeneous of degree one), the total payments will exactly equal the total product.

Direct Coefficients

The transactions matrix (table) is useful for understanding the gross flows, in dollar terms, of goods and services within an economy. The direct coefficients which are developed from the transactions matrix shed more light on the underlying structure of the economy. These coefficients are defined as follows:

$$a_{ij} = x_{ij}/X_j \qquad \text{for } i, j = 1, 2, 3 \qquad (9)$$

where

a_{ij} = the technical coefficients,

x_{ij} and X_j are as defined in the transactions table (Table I).

The direct coefficients describe the j'th sector's purchasing pattern, and each coefficient represents the direct input requirements from each supplying sector necessary to support a unit change in output. As was noted in the assumptions, purchases are linear functions of the sector's output. This can be expressed functionally as follows:

$$\sum_{j=1}^{n} a_{ij} X_j = X_i \qquad \text{for } i = 1, 2, 3 \qquad (10)$$

The above equation is consistent with the assumption of additivity. Chenery and Clark (1950) have pointed out that the direct coefficients are fixed production coefficients which are technologically determined.

Equation (9) can be solved in terms of x_{ij} and substituted into equation (4) yielding the following relationship.

$$X_i = \sum_{j=1}^{3} a_{ij} X_j + Y_i \qquad \text{for } i = 1, 2, 3 \qquad (11)$$

Equation (11) is used in the next section of the present chapter to develop a matrix of direct plus indirect coefficients.

Miernyk (1965) noted that, in the matrix of direct coefficients, at least one column must add to unity and no endogenous sector's

column can add to more than unity. The meaining of Miernyk's statement is that an input-output model must have at least one endogenous sector, and that each endogenous sector's purchases must equal its sales. In turn, the balanced accounting framework of a static input-output model is guaranteed.

It is important to note one final property of the technical coefficients. Since firms of different sizes are aggregated into sectors, the technical coefficients are a weighted average of the firms composing the sector (Chenery and Clark, 1959). As long as the relative composition (size of firms) within a sector is maintained, the technical coefficients will remain constant (*ceteribus paribus*).

Direct Plus Indirect Coefficients

The direct coefficients do not explain the total effect on an economy of a unit change in final demand. If the final demand for the output of a sector endogenous to an economy increases by one unit, the local producing sectors must increase their sales in order to accommodate the change in demand for their products (inputs). In turn, the supplying sectors must purchase additional inputs to provide the sector experiencing the initial change in final demand with the needed inputs. In each of these iterations, a portion of the stimulus in income, injected into the economy by the change in final demand, leaks out of the economy through purchases of primary inputs. Thus, the iterations continue until all of the income generated by the initial change in final demand leaks from the economy through purchases of primary inputs (purchases from exogenous sectors).

The rippling effect caused by the change in final demand is measured by using the matrix of direct plus indirect coefficients. This phenomenon is more commonly known as the multiplier effect. The matrix of direct plus indirect coefficients is obtained by re-writing equation (11) in matrix notation and solving for output (X) in terms of final demand (Y), as follows:

$$X = AX + Y \tag{12}$$

where

X = is a vector of total sales (X_i),

A = is a matrix of direct coefficients (a_{ij}), and

Y = is a vector of final demand sales (Y_i).

Equation (12) can be solved purely in terms X, as follows:

$$X = AX + Y \tag{12}$$

$$X - AX = Y$$

$$X(I-A) = Y \qquad \text{(I is an identity matrix)}$$

$$X = (I-A)^{-1} Y \tag{13}$$ 9/

Equation (13) expresses gross output (X) as purely a function of demand (Y), given constant relative prices. (Richardson, 1972). The traditional Leontief inverse matrix $[(I-A)^{-1}]$ is contained in equation (13). The inverse matrix is the matrix of direct plus indirect coefficients.

9/ The $(I-A)^{-1}$ matrix is an inverse matrix, one obtained via a manipulation procedure similar to division or multiplication by a reciprocal.

The matrix of direct plus indirect coefficients is used to trace the direct plus indirect effect on an economy of a unit change in sales to final demand by a given sector in the economy. A column in the Leontief inverse matrix represents the direct plus indirect increases in sales recorded by each of the endogenous sectors as a result of a unit change in the respective sector's final demand.

Thus, as has been repeatedly noted, an input-output model is driven by changes in sales to final demand [see Equation (13)]. (Chenery and Clark, 1959; Miernyk, 1965; Richardson, 1972). Equation (13) can be restated as follows:

$$\hat{X} = (I-A)^{-1} \hat{Y} \qquad (14)$$

where

$\hat{X}$ = total projected change in output resulting from a change in sales to final demand, and

$\hat{Y}$ = a projected change in final demand.

For any given change in final demand ($\hat{Y}$) it is possible to calculate the corresponding effect on output ($\hat{X}$) using equation (14). Such projections are dependent on the assumption that the structural coefficients, from which the inverse matrix is developed, remain constant through the time horizon of the projections.

By the Hawkins-Simons condition, all coefficients in the matrix of direct plus indirect coefficients are greater than or equal to zero (Miernyk, 1965). This condition merely states that no sector's

actions result in a net leakage from the economy. In addition, it states that firms do not pay other firms to take their products, i.e., negative prices do not exist.

Multipliers

There are several types of multipliers used in input-output analysis, e.g., employment, income, and output. The multipliers of concern for the present discussion are output multipliers.[10/] Output multipliers are obtained by summing the columns of the matrix of direct plus indirect coefficients. Each endogenous sector has a unique multiplier. The output multipliers are interpreted as the direct plus indirect effect on an economy of a unit change in a sector's sales to final demand.[11/] *Ceteris paribus*, the size of a sector's multiplier depends on the sector's purchasing pattern and its degree of interdependence with other endogenous sectors. As a sector's endogenous purchases and the degree of interdependence among endogenous sectors increase, the sector's multiplier generally will increase in value.

Richardson has noted that output multipliers serve two main purposes: 1) to facilitate impact projections, and 2) to measure the degree of interdependence of a given sector with the rest of the endogenous producing sectors.

10/ Richardson (1972) presents a good discussion of the various multipliers used with input-output analysis in his book.

11/ Readers interested in a more detailed discussion of output multipliers should examine a discussion paper on this topic by Lewis, *et al* (1979).

The higher a sector's multiplier, the larger will be the impact of a unit change in sales to final demand, and the greater is the degree of interdependence between the given sector and other endogenous sectors in the model. These two conclusions go hand-in-hand. It makes sense that as a sector's degree of interdependence with other endogenous sectors increases, a change in the final demand for the output of the given sector will have a larger total impact on the economy. In other words, the more interdependent an economy is in terms of economic structure, the higher will be the output multipliers (Leontief, 1966).

Concluding Remarks

The theoretical framework of a static input-output model was developed in this chapter. The static model is not the only type of input-output (inter-industry) model; rather, it forms a base from which other models have been developed, e.g., interregional and dynamic models. The structure and assumptions presented above apply to the static Leontief input-output model and more specifically to the inter-industry transactions model developed for Morrow County.

The following quotation presents a good summary of the static model.

> "The input-output table is a neutral image of an economy, emphasizing neither supply nor demand forces, but rather recording equilibrium values at one point in time. Quite simply, it is a social accounting array, with details of

> industrial transactions, based on identities that equate the value of each sector output to the value of its inputs ..." (Giarratani, 1978).

The static model described in this chapter and by Giarratani can be replaced by a dynamic model which is theoretically more appealing. Such a model allows for economic adjustment over time and contains a matrix of capital adjustment coefficients, as well as other useful features.

Leontief (1966) has stated that input-output analysis is "... our bridge between theory and facts in economics." He also notes, "... the advantage of input-output analysis is that it permits the disentanglement and accurate measurement of indirect effects." Input-output models are an empirical representation of the inter-industry relations among sectors of an economy, and of the relationships between autonomous demand and the levels of production of individual sectors.

CHAPTER III

THE MORROW COUNTY INPUT-OUTPUT MODEL

The Morrow County input-output model was developed for the primary purposes of economic planning and economic impact assessment at the county level. The rapid economic growth of the Morrow County economy in recent years prompted County officials to fund the development of such a model. County officials had several timely issues which they desired to address by the use of the input-output model. The effect of a soon-to-be operational coal fired power plant (CFPP) on the local economy was one of the issues. The present chapter contains a discussion of the Morrow County economy, described by means of an input-output model, prior to the appearance of the power plant.

Sector Specification

The development of an input-output model requires the grouping of firms (producing units) into sectors. Firms are assigned to sectors in an operational manner by assigning firms with common purchasing patterns and similar principal products or services to

a single sector (Chenery and Clark, 1959; Miernyk, 1965).[12/] The classification of firms into sectors is rationalized by recognizing the natural divisions of production sequences which result from combinations of technological, economic and locational factors.

Sectors for the present study were developed in consultation with Morrow County business leaders and using information obtained in prior input-output models, e.g., Grant and Union Counties. Sectors were specified with three objectives in mind: 1) to accurately reflect the structure of the county's economy, 2) to accomplish the objectives of the project, and 3) to be consistent with the assumptions of input-output analysis. The sectors of the Morrow County input-output model are presented in Table II.

Firms were initially assigned to the sectors specified in Table II by reference to their Standard Industrial Classification (SIC) numbers.[13/] Firms for which SIC codes were unavailable were assigned

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12/ As was noted in Chapter II, it is assumed that each sector only produces one product, or many products which are perfect substitutes. In application, this assumption may not hold. Chenery and Clark note that secondary products may be allocated to appropriate sectors or left in the sector of the principal product. In the present model, secondary products are combined with the respective sector's primary product. For example, the interindustry activities of restaurants which are operated in conjunction with a motel are accounted for in the lodging sector, assuming that the motel generates over half of the businesses' total revenue.

13/ The SIC codes for Morrow County firms were obtained from the Oregon Department of Human Services, Employment Division. The codes were obtained only for firms with covered payrolls (Oregon Department of Human Services, 1980).

TABLE II. SECTORS OF THE MORROW COUNTY INPUT-OUTPUT MODEL (without the CFPP sector)

1.	Animal Production
2.	Irrigated Crop Production
3.	Dryland Crop Production
4.	Food Processing
5.	Wood Products
6.	Agricultural Services
7.	Construction
8.	Maintenance and Repair
9.	Communication, Transportation and Utilities
10.	Wholesale and Retail Trade
11.	Finance, Insurance and Real Estate
12.	Automobile Sales and Service
13.	Professional Services
14.	Lodging
15.	Cafes and Taverns
16.	Other Wholesale and Retail Services
17.	Port of Morrow
18.	Local Government
19.	Local Agencies of State and Federal Government
20.	Local Households
21.	Nonlocal Households
22.	Nonlocal Government
23.	Nonlocal Business
24.	Inventory Depletion/Inventory Accumulation
25.	Depreciation/Capital Investment

* Definitions of the sectors are contained in Appendix A.

to sectors by their listings in the yellow pages of local phone books. A few of the firms were not initially assigned to appropriate sectors and were subsequently reclassified during the survey process.

As was described in Chapter II, sectors of input-output models are classified as endogenous or exogenous to the model. Keeping this in mind, within the present model, sectors 1 through 20 (in Table II) are endogenous, and sectors 21 through 25 are exogenous.

In the theoretical input-output model described in Chapter II, exogenous sectors are labeled primary inputs and final demand (see Table I). In the present model, these headings have been subdivided into five distinct, exogenous sectors. Since the current model is static, the exogenous sectors represent external producing and consuming sectors, as well as accounting rows and columns.

Sample Selection

The sampling procedure used in the present study was not statistically rigorous.[14/] The procedure used is similar to the sampling technique used for the Douglas County (Oregon) input-output model (Youmans, *et al.*, 1973). For the present study, large firms were sampled at a 100 percent rate, a 50 percent sample was drawn for medium sized firms, and a 25 percent sample was drawn for small

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14/ A sampling technique which is statistically rigorous was used for the Tillamook County (Oregon) input-output model (Ives, 1977). The researchers conducting this study used a statistical smapling technique to develop stratified sector samples (Cochran, 1963).

firms. A rough rule of thumb was followed with respect to minimum sample size. Sampling within sectors was at a minimum 45 percent of the sector population or nine firms, whichever was greater.

Firms are divided into the small, medium and large groupings based on their total 1979 wage payments. Some small firms, especially sole proprietorships, do not report their wage payments, and hence, were assumed to be the firms which were obtained from Morrow County phone books. Large and medium firms were distinguished on the basis of their wage payments.[15/] The distinction between large and medium firms is somewhat arbitrary. These groups were divided by examining the wage data of each sector for obvious divisions, i.e., two populations.[16/]

The above procedure results in a stratified random sample. The reasoning behind a stratified sample is that the purpose of the model is to represent business activity, i.e., inter-industry flows of goods and services. Thus, a stratified sample which is weighted towards larger firms will capture a larger percentage of the business activity than a purely random sample (Cochran, 1963).

15/ Data on wage payments was obtained from the Oregon Department of Human Services, Employment Division (Oregon Department of Human Services, 1980).

16/ This sampling procedure implicitly assumes that there is a direct relation between total wage payments of a firm and the firm's total sales.

Households and agricultural sectors were sampled differently. A 25 percent random sample was drawn of households listed in Morrow County phone books. A survey of Morrow County agricultural operations was conducted concurrently with the input-output survey. The individuals conducting the agricultural survey collected the data from these units which was necessary to construct the input-output model. The agricultural survey was weighted toward the size of the farm or ranch operation based on total sales.

Survey Procedures and Results

Three different survey forms were used in the data collection process. Households and agricultural sectors each had their own unique forms. Businesses and government units were sampled with the third form. (Copies of the survey forms are contained in Appendix A). Households were sampled by mail survey. Each survey form contained a cover letter explaining the reasons for the study and provided directions for completing the survey form.

Agricultural units, businesses and government were surveyed by personal interviews. Interviews were preceded by letters (in July 1980) explaining the study and identifying the research team.[17/] Data were collected for the 1979 calendar year. The mail survey of households was conducted concurrently with the personal interviews.

17/ Some of the interviews with agricultural units were conducted in August, 1980.

Units sampled by means of personal interview were contacted by telephone prior to the interview. At this time, the manager of a firm could either consent to, or refuse, an interview. Firms which refused interviews, and firms which the interview team were unable to contact, were replaced in the sample. Replacement firms were randomly sampled within the strata, i.e., medium sized firms were replaced by randomly selected medium sized firms. Large firms were replaced by medium firms as the original sample of large firms was 100 percent.

The results of the survey process are presented in Table III. It should be noted that the sampling percentages are low in the Food Processing and Household sectors. The sample percentage is low in the Food Processing sector because the interview team was unable to obtain an interview with the dominant firm in this sector. Household results were low to due a poor return on the mail survey.

The return percentage (2.3 percent of total population) on the household survey was determined to be insufficient for empirical application. Thus, the household survey data were not used. As a replacement, information obtained from producing units with respect to their sales to households was used in the development of the transactions table.[18/]

18/ This procedure did not provide information on households' inter-industry transactions with other local households and exogenous sectors. Observations for these entries in the transactions table were obtained from the household survey. An average error, developed from the sectors which reported sales to households, was used to adjust these entries.

TABLE III. SAMPLING INFORMATION FOR DEVELOPMENT OF THE MORROW COUNTY (OREGON) INPUT-OUTPUT MODEL

Sector Number	Sector Name	Number of Firms, Government Units, or Households in County Sector	Sample		
			Number of Interviews Completed	Percent of All Firms Interviewed	Household Payments by Interviewed Firms as a Percent of Total Sector Payments to Households
1	Animal Production	NA [a/]	14[b/]		
2	Irrigated Crop Production	NA	8[c/]		
3	Dryland Crop Production	NA	29[d/]		
4	Food Processing	5	3	60.0	13.7
5	Wood Products	8	4	50.0	98.0
6	Agricultural Services	17	11	64.7	85.5
7	Construction	40	11	27.8	61.7
8	Maintenance & Repair	4	3	75.0	75.0
9	Communication, Transportation, & Utilities	18	4	22.2	55.0
10	Wholesale & Retail Trade	57	15	26.3	42.6
11	Finance, Insurance, & Real Estate	24	6	25.0	24.8
12	Automotive Sales & Service	32	11	34.4	57.5
13	Professional Services	16	8	50.0	80.7
14	Lodging	13	5	38.5	28.1
15	Cafes & Taverns	14	7	50.0	75.8
16	Other Wholesale & Retail Services	30	12	40.0	39.4
17	Port of Morrow	1	1	100.0	100.0
18	Local Government	7	7	100.0	100.0
19	Local Agencies of State & Federal Government	29	10	34.5	28.1
20	Households	1,372	31	2.3	2.3

[a/] N.A. indicates that the entry is not available.

[b/] Represents 20.0 percent of total sales by animal producers.

[c/] Represents 74.2 percent of sales by irrigated crop producers.

[d/] Represents 12.6 percent of sales by dryland crop producers.

The survey data were used to project total sector sales and purchases. The projections were accomplished by using expansion coefficients for each sector (Table IV). The expansion coefficients were calculated by determining the percentage of a sector's business activity which was sampled. Percentages were determined by wage payments for reporting firms and number of firms for nonreporting firms. Percentages for agricultural sectors were determined using county agricultural sales data. These percentages were used to determine an expansion coefficient for each endogenous sector. A thorough explanation of the procedure for calculating the expansion coefficients is presented in Appendix B.

Study Results

Transactions Table

The transactions table reflects the inter-industry transactions among sectors endogenous to Morrow County. The inter-industry transactions are developed by multiplying a sector's expansion coefficient by the respective sector's sample sales and purchases. The Morrow County transactions table is presented in Appendix C.

Interesting and informative information can be gleaned from the transactions table. For example, total sales, exports, and imports of endogenous sectors are presented in Table V. Total sales of endogenous sectors range from $161,000 for Maintenance and Repair to $47,979,000 as returns to Local Households. The gross regional

TABLE IV. EXPANSION COEFFICIENTS FOR PROJECTING MORROW COUNTY INPUT-OUTPUT POPULATION VALUES FROM THE SAMPLE DATA

	Sector	Coefficient
1.	Animal Production	5.00
2.	Irrigated Crop Production	1.35
3.	Dryland Crop Production	7.94
4.	Food Processing	7.31
5.	Wood Products	1.02
6.	Agricultural Services	1.17
7.	Construction	1.62
8.	Maintenance & Repair	1.33
9.	Communication, Transportation, & Utilities	1.82
10.	Wholesale & Retail Trade	2.35
11.	Finance, Insurance, & Real Estate	4.03
12.	Automotive Sales & Service	1.74
13.	Professional Service	1.24
14.	Lodging	3.56
15.	Cafes & Taverns	1.32
16.	Other Wholesale & Retail Services	2.54
17.	Port of Morrow	1.00
18.	Local Government	1.00
19.	Local Agencies of State & Federal Government	3.56
20.	Households	N.A.*

* As was noted earlier, sample data from the household survey was not used in developing the present model, except in conjunction with other data for certain entries.

TABLE V. VALUE OF TOTAL OUTPUT, EXPORTS, AND IMPORTS AMONG SECTORS OF THE MORROW COUNTY (OREGON) ECONOMY IN 1979

Sector	Total Gross Output		Export Sales		Import Purchases	
	Value ($000)	Percent of Total Output	Value ($000)	Percent of County Exports	Value ($000)	Percent of County Imports
1. Animal Production	10,576	3.9	10,214	6.1	5,557	3.5
2. Irrigated Crop Production	37,915	13.9	36,154	21.7	31,052	19.7
3. Dryland Crop Production	22,678	8.3	19,290	11.6	5,881	3.7
4. Food Processing	39,585	14.5	35,456	21.3	21,077	13.4
5. Wood Products	35,918	13.1	31,590	19.0	22,200	14.1
6. Agricultural Services	15,038	5.5	5,453	3.3	11,945	7.6
7. Construction	6,817	2.5	3,166	1.9	5,308	3.4
8. Maintenance & Repair	161	0.1	0	0	82	0.1
9. Communication, Transportation, & Utilities	3,300	1.2	744	0.4	1,786	1.1
10. Wholesale & Retail Trade	14,181	5.2	1,065	0.6	11,594	7.4
11. Finance, Insurance, & Real Estate	3,116	1.1	438	0.3	670	0.4
12. Automotive Sales & Service	5,691	2.1	1,106	0.7	3,690	2.3
13. Professional Services	1,435	0.5	198	0.1	559	0.4
14. Lodging	1,586	0.6	981	0.6	776	0.5
15. Cafes & Taverns	1,648	0.6	544	0.3	850	0.5
16. Other Wholesale & Retail Services	784	0.3	177	0.1	300	0.2
17. Port of Morrow	591	0.2	0	0	47	---
18. Local Government	7,044	2.6	3,467	2.1	2,762	1.8
19. Local Agencies of State & Federal Government	17,195	6.3	13,850	8.3	5,045	3.2
20. Households	47,979	17.6	2,599	1.6	26,119	16.6
Subtotal	*273,238*	*100.0*	*166,492*	*100.0*	*157,300*	*100.0*
Local Investment by Nonlocal Business	13,251					
*Morrow County Total**	*286,489*					

* The reported totals are correct but may differ slightly from column sums due to rounding error.

output of Morrow County was $286,489,000 in 1979. Exports range from none in two sectors to approximately $36 million for Irrigated Crop Production. Roughly the same pattern holds for imports as for exports. Maintenance and Repair and the Port of Morrow have the lowest imports, and Irrigated Crop Production has the largest total imports ($31 million).

Additional information can be acquired by viewing exports and imports as percentages of total county exports and imports, respectively. This information also is presented in Table V. Irrigated Crop Production brings the most money into the economy through export sales (21.7 percent of total exports) but also is the primary source of income leakage from the economy through import purchases (19.7 percent of total imports).

Exports and imports also can be analyzed in relation to each sector's total sales and purchases. This information is presented in Table VI. Looking first at exports as percentages of a sector's total sales, Animal Production has the largest proportional percentage of exports (96.7). Irrigated Crop Production has the highest percentage of sector imports (81.9). It is interesting to note that Maintenance and Repair, which had the lowest total imports in absolute terms, actually imports a large percent of the sector's total purchases (50.9).

Sectors which export a large percentage of their sales are known as basic sectors (Vieth, 1976). Basic sectors bring dollars into an economy which, in turn, support the service sectors (Bell,

TABLE VI. MORROW COUNTY EXPORTS AND IMPORTS AS A PERCENT OF SECTOR SALES

	Sector	Exports as a Percent of Total Sales	Imports as a Percent of Total Sales
1.	Animal Production	96.7	52.5
2.	Irrigated Crop Production	95.4	81.9
3.	Dryland Crop Production	85.1	25.9
4.	Food Processing	89.6	53.3
5.	Wood Products	88.0	61.8
6.	Agricultural Services	36.3	79.4
7.	Construction	46.4	77.9
8.	Maintenance & Repair	0.0	50.9
9.	Communication, Transportation, & Utilities	22.6	54.1
10.	Wholesale & Retail Trade	7.5	81.8
11.	Finance, Insurance, & Real Estate	14.1	21.5
12.	Automotive Sales & Service	19.4	64.8
13.	Professional Services	13.8	39.0
14.	Lodging	61.9	48.9
15.	Cafes & Taverns	33.0	51.6
16.	Other Wholesale & Retail Services	22.6	38.3
17.	Port of Morrow	0.0	8.0
18.	Local Government	49.2	39.2
19.	Local Agencies of State & Federal Government	80.6	29.3
20.	Households	5.4	54.4
Morrow County Average		*60.9*	*57.8*

1967). A convenient cut-off point for basic sectors in the present study is sectors with export sales which comprise at least eighty percent of the respective sector's total sales. The sectors which meet this criteria are 1 through 5, as would be expected. In addition, Local Agencies of State and Federal Government have export sales of 80.9 percent, with the interpretation being that these agencies receive 80.9 percent of their budgets from sources external to Morrow County, e.g., Salem and Washington, D.C.

Exports and imports can be viewed in a more illustrative manner by examining the net trade balances of endogenous sectors (see Table VII). Sectors with positive entries in the table bring dollars into the local economy as a net result of their inter-industry transactions. All of the basic sectors have positive trade balances, as expected. It will be noted that Lodging also has a positive trade balance. The majority of the firms in this sector are located in Boardman along Interstate 80. Thus, they serve a transient clientele, i.e., a clientele which resides outside of Morrow County.

In the present model, Local Households have a negative trade balance. Household transactions result in a net leakage from the local economy. A negative trade balance for Local Households is an indication that the service sectors are underdeveloped with respect to the present county population and their demand for consumer goods and services.

TABLE VII. NET TRADE BALANCES AMONG SECTORS OF THE MORROW COUNTY (OREGON) ECONOMY IN 1979

	Sector	Net Trade Balance (Exports-Imports in $000)	Percent of Value of Sector Output
1.	Animal Production	4,657	44.0
2.	Irrigated Crop Production	5,102	13.5
3.	Dryland Crop Production	13,409	59.1
4.	Food Processing	14,379	36.3
5.	Wood Products	9,390	26.1
6.	Agricultural Services	- 6,492	-43.2
7.	Construction	- 2,142	-31.4
8.	Maintenance & Repair	- 82	-50.9
9.	Communication, Transportation, & Utilities	- 1,042	-31.6
10.	Wholesale & Retail Trade	-10,529	-74.2
11.	Finance, Insurance, & Real Estate	- 232	- 7.4
12.	Automotive Sales & Service	- 2,584	-45.4
13.	Professional Services	- 361	-25.2
14.	Lodging	205	12.9
15.	Cafes & Taverns	- 306	-18.6
16.	Other Wholesale & Retail Services	- 123	-15.7
17.	Port of Morrow	- 47	- 8.0
18.	Local Government	705	10.0
19.	Local Agencies of State & Federal Government	8,805	51.2
20.	Households	-23,520	-49.0
Morrow County Total		*9,192* *	*3.4*

* The reported total is correct but may differ slightly from the column sum due to rounding error.

The above conclusion makes sense when one considers the rapid economic growth which Morrow County has been experiencing. The growth is being generated by the basic sectors. A possible interpretation is that the growth of the service sectors is lagging behind the growth in the basic sectors and the resulting expansion in local population.

Referring to Table VII, the proportionally strongest sectors in terms of net trade balances are the traditional forms of agriculture in Morrow County (Animal Production and Dryland Crop Production). The newer agricultural sector which has been responsible for much of the recent growth in Morrow County (Irrigated Agriculture) has a much smaller net trade balance in percentage terms. This contrast indicates that a well developed structure of agribusiness service industries, within Morrow County, supports the traditional forms of agriculture, while this underlying infrastructure has yet to develop for Irrigated Agriculture.

The transactions table also contains producing sectors' purchases from households (see Table VIII). Households (people) sell their services in return for wages and salaries. In addition, households receive income as profits, interest, dividends and rents. In turn, households use their income to purchase goods and services. Household purchases are primarily made from service sectors.

Purchases from Local Households range from $39,000 by the Port of Morrow to $11,754,000 by Local Agencies of State and Federal

TABLE VIII. PURCHASES FROM LOCAL HOUSEHOLDS BY SECTORS OF THE MORROW COUNTY (OREGON) ECONOMY IN 1979

Sector	Value of Purchases from Local Households ($000)	Purchases from Local Households as Percent of Total Purchases by Sector
1. Animal Production	944	8.92
2. Irrigated Crop Production	1,303	3.44
3. Dryland Crop Procution	5,653	24.93
4. Food Processing	8,888	22,45
5. Wood Products	5,323	14.82
6. Agricultural Services	1,085	7.22
7. Construction	812	11.91
8. Maintenance & Repair	51	31.81
9. Communication, Transportation, & Utilities	399	12.11
10. Wholesale & Retail Trade	1,534	10.82
11. Finance, Insurance, & Real Estate	1,353	43.44
12. Automotive Sales & Service	460	8.08
13. Professional Services	554	38.59
14. Lodging	63	3.96
15. Cafes & Taverns	347	21.10
16. Other Wholesale & Retail Services	223	28.38
17. Port of Morrow	39	6.59
18. Local Government	3,626	51.47
19. Local Agencies of State & Federal Government	11,754	68.36
20. Households	962	2.01
Morrow County Total	*45,373*	*16.61*

Government. The total purchases from Local Households by endogenous sectors is $45,373,000. This is 16.6 percent of the total purchases made by all endogenous sectors.

However, in a proportional sense, the above relationship is slightly different. The intrasector purchases of Local Households comprise only two percent of that sector's total purchases. Of the basic sectors, Irrigated Agriculture makes the smallest proportional purchases from Local Households (3.4 percent). Local Agencies of State and Federal Government make the largest purchases from Local Households in percentage terms (68.4).

Four sectors make five percent (or more) of their puchases from Nonlocal Households (see Table IX). The large percentage of purchases from Nonlocal Households by Construction firms may be explained by the fact that the power plant was being constructed during the survey year (1979). Many of the construction workers

TABLE IX. SECTORS WITH GREATER THAN FIVE PERCENT OF PURCHASES MADE FROM NONLOCAL HOUSEHOLDS

	Sector	Percent
2	Irrigated Crop Production	6.8
7	Construction	16.0
9	Communication, Transportation, & Utilities	7.9
13	Professional Services	9.6

employed at the plant site were nonlocal workers who came to perform a special task. The percentages for the other three sectors may indicate that there are not currently sufficient qualified employees for these sectors residing in Morrow County. Alternatively, individuals employed by these sectors may prefer to reside outside of Morrow County, e.g., Pendleton.

In summary, the information presented above provides insight as to the inter-industry transactions within the Morrow County economy. In addition, the information provided is indicative of the wealth of information which is available in the transactions table of an input-output model. Transactions tables also serve another useful purpose as the base from which the matrix of direct, and hence direct plus indirect, coefficients is developed. A brief discussion of the Morrow County matrix of direct coefficients is presented in the next section.

Direct Coefficients

The direct coefficients are calculated using equation (9) in Chapter II. The matrix of direct coefficients for the Morrow County input-output model is presented in Appendix C. As was noted in Chapter II, each column entry in the matrix of direct coefficients represents the respective sector's direct requirements from other endogenous and exogenous sectors.

The second column in Table VIII was obtained simply by extracting the housebold row entries from the matrix of direct coefficients. The matrix of direct coefficients also contains a sector's imports as a percent of total purchases. (Exports as a percent of total sales requires a separate calculation).

Thus, the matrix of direct coefficients contains illustrative information with respect to each endogenous sector's purchases from other sectors. This information is presented in percentage, rather than gross, terms as in the transactions table. A discussion of the meaning of the direct coefficients was developed in Chapter II; and the significance of many of the coefficients in this matrix for the Morrow County model was discussed in the previous section of this chapter. Hence, an indepth discussion of the direct coefficients is not needed here.

Direct Plus Indirect Coefficients

The direct plus indirect coefficients portray the iterative effect on an endogenous sector of a unit change in the sales to final demand by a single endogenous sector, as was noted in Chapter II. The matrix of coefficients is calculated by solving equation (12) for equation (13); that is, by solving for output as a function of final demand. The column sums in this matrix are the output multipliers.

The output multipliers for the Morrow County input-output model are presented in Table X. (The matrix of direct-plus indirect coefficients is in Appendix C). The output multipliers range in value from 1.18 for the Port of Morrow to 2.18 for Local Agencies of State and Federal Government. This range of multiplier values can be compared to those of other eastern Oregon counties.

The multipliers for the Baker County input-output model range from 1.51 for the U.S. Forest Service to 3.19 for Local Agencies of State and Federal Government (Obermiller, *et al.*, 1981). The multipliers for the Grant County model range from 1.03 for Transportation to 2.79 for Local Government (Miller, 1980).

The multipliers for the Morrow County model are, with few excpetions, much lower than those of the Baker County and Grant County models. This is the result of the Morrow County economy being relatively more open. The economy has a relatively higher proportion of imports and exports to total transactions than either the Baker or Grant County economies. It portrays a relatively weaker interdependence among the producing sectors within Morrow County.[19/]

It was stated at the outset of the present chapter that in solving for the matrix of direct plus indirect coefficients output is expressed purely as a function of final demand. This statement

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19/ As was noted in Chapter II, the multipliers are a measure of a sector's interdependence with other endogenous sectors, i.e., as the degree of interdependence increases, so will the value of the respective sector's multipliers, *ceteris paribus*.

TABLE X. OUTPUT MULTIPLIERS OF EACH SECTOR OF THE MORROW COUNTY INPUT-OUTPUT MODEL

	Sector	Multipliers
1.	Animal Production	1.67
2.	Irrigated Crop Production	1.19
3.	Dryland Crop Production	1.98
4.	Food Processing	1.60
5.	Wood Products	1.46
6.	Agricultural Services	1.22
7.	Construction	1.32
8.	Maintenance & Repair	1.65
9.	Communication, Transportation, & Utilities	1.41
10.	Wholesale & Retail Trade	1.28
11.	Finance, Insurance, & Real Estate	2.04
12.	Automotive Sales & Service	1.47
13.	Professional Services	1.76
14.	Lodging	1.54
15.	Cafes & Taverns	1.64
16.	Other Wholesale & Retail Services	2.00
17.	Port of Morrow	1.18
18.	Local Government	2.01
19.	Local Agencies of State & Federal Government	2.18
20.	Households	1.68
Morrow County Average		*1.57*

is supported by the relation presented in Table XI. In Table XI, the elements of column one when multiplied by their adjacent elements in column two results in the entries which are presented in column three. It will be noted that the sum of the elements in column three equals the total business activity of Morrow County in 1979 (see Table V). Only sectors which have final demand sales contribute to the induced business activity in Morrow County.

The final column of Table XI is the induced economic activity of each sector as a percentage of the total economic activity in Morrow County. The basic agricultural and wood processing sectors are responsible for more than ninety percent of the direct induced economic activity in Morrow County. Irrigated Agriculture, as an example, directly or indirectly contributes 15.8 percent of the total economic activity in Morrow County. This point is in contrast to the sector's weak trade balance mentioned earlier. Although this sector appears to have relatively weak backward linkages in the local economy, its forward linkages generate a large portion of the county's income.

Concluding Remarks

The preceding sections contain information which leads to the conclusion that Morrow County has a relatively open economy. Yet, the economy has strong basic sectors which bring income into the local economy and are, thereby, contributing to the growth of Morrow County.

TABLE XI. CONTRIBUTION OF FINAL DEMAND SALES BY EACH SECTOR OF THE MORROW COUNTY (OREGON) ECONOMY TO TOTAL COUNTY BUSINESS ACTIVITY IN 1979

	Sector	Value of Final Demand Sales ($000)	Business Income Multiplier	Value of Induced Business Activity ($000)	Percent of Total County Business Activity
1.	Animal Production	10,319	1.67	17,205	6.30
2.	Irrigated Crop Production	36,239	1.19	43,262	15.83
3.	Dryland Crop Production	21,027	1.98	41,602	15.23
4.	Food Processing	37,176	1.60	59,379	21.73
5.	Wood Products	31,590	1.46	46,098	16.87
6.	Agricultural Services	7,143	1.22	8,701	3.18
7.	Construction	4,739	1.32	6,246	2.29
8.	Maintenance & Repair	0	1.65	0	0
9.	Communication, Transportation, & Utilities	757	1.41	1,068	0.39
10.	Wholesale & Retail Trade	1,260	1.28	1,619	0.59
11.	Finance, Insurance, & Real Estate	516	2.04	1,051	0.38
12.	Automotive Sales & Service	1,583	1.47	2,330	0.85
13.	Professional Services	198	1.76	348	0.13
14.	Lodging	981	1.54	1,508	0.55
15.	Cafes & Taverns	548	1.64	898	0.33
16.	Other Wholesale & Retail Services	181	2.00	363	0.13
17.	Port of Morrow	0	1.18	0	0
18.	Local Government	3,467	2.01	6,954	2.55
19.	Other Agencies of State & Federal Government	13,871	2.18	30,219	11.06
20.	Households	2,606	1.68	4,374	1.60
Morrow County Total *		*174,201*	*1.57*	*273,238*	*100.0*

* The reported totals are correct but may not equal column sums due to rounding error.

Bell has stated that the growth of an economy is dependent on exports (Bell, 1967). As the income of export sectors (basic sectors) grows, the sales of service sectors will, in turn, grow, i.e., the income of service sectors is a function of the income of the basic sectors. Bell notes that this is especially true where the basic sectors are large importers, and the service sectors are low exporters. Bell's conclusion is supported by Tiebout [Tiebout, 1956(b)]. Tiebout notes that as the size of an economy decreases, the dependency of the economy on its economic base will increase [Tiebout, 1956(a)].

Morrow County has strong basic production sectors. It was noted that the basic sectors contribute more than ninety percent of the induced economic activity in Morrow County. The newest sector (Irrigated Agriculture) has a strong induced effect on local economic activity, although the sector does not have a large net trade balance. Thus, the strength of the Morrow County economy lies in its basic sectors; and the growth which the county has been experiencing is stimulated by the expansion of the basic sectors, in particular, Irrigated Agriculture.

CHAPTER IV

INTRODUCING A NEW SECTOR INTO A STATIC INPUT-OUTPUT MODEL: AN EX-ANTE PROCEDURE

The incorporation of a new sector into an existing input-output model is in essence a method of updating. The updating of static models, such as the one developed in Chapter III, is a necessary procedure if such a model is to remain useful through time. In addition to the introduction of new sectors, the purchasing patterns within sectors are susceptible to change, i.e., the direct coefficients are not constant over time.

Direct coefficients change when either technology or the composition of demand (or supply) for a sector's product (inputs) changes, thereby changing relative prices. As was noted in Chapter II, the direct coefficients are assumed to be constant. Yet, it has been pointed out that there is, "... no logical reason for coefficients to remain constant over time." (Tiebout, 1957).

The direct coefficients are especially susceptible to change when sectors are composed of somewhat heterogeneous (due to aggregation biases within sectors) firms which vary in their relative sizes (Carroll, 1980). Economies which are growing rapidly can be expected to experience such changes as well as the development of new sectors in the economy.

A study of the Clatsop County (Oregon) economy revealed that direct coefficients do change through time (Carroll, 1980). Carroll

examined alternative methods of updating models for changes in the direct coefficients. The conclusion reached in Carroll's research is that collection of new data and derivation of a new model is more accurate, and may be cheaper, than the existing procedures for updating. Carroll notes that his conclusion is supported by Miernyk (Miernyk, 1975).

In the present chapter, a procedure is developed for incorporating a new sector into an input-output model; and the procedure is applied to the coal fired power plant in Morrow County. The literature pertaining to the incorporation of a new sector into an input-output model is limited. This scarcity could be due, at least in part, to the conclusions reached by Carroll and Miernyk.

A new model (based on observed inter-industry transactions) can only be developed if the new sector is currently operating within the economy. In other words, the inter-industry transactions must be observable. If the new sector's inter-industry transactions are not observable, an *ex-ante* procedure is required to project the new sector's inter-industry interactions within the economy. The information provided by an *ex-ante* analysis may be quite useful for decision makers. The procedure facilitates an analysis of the effect which a new sector (firm) will have on a local economy.

In the remainder of the present chapter, the development and application of an *ex-ante* procedure for incorporating a new sector into an input-output model is presented. The *ex-ante* procedure is used to incorporate the CFPP into the Morrow County model.

Review of the Literature

Two studies which use input-output analysis to examine the effect of a new sector on an existing economy are reviewed below. The first study is an *ex-ante* analysis of the location of an aluminum plant in Clatsop County, Oregon (Collin, 1970). The second study is an *ex-post* analysis of industrialization in Lasalle Parish, Louisiana (Guedry and Rosera, 1979; Guedry and Smith, 1980).

Collin (1970) evaluated the potential impact of an aluminum plant on the Clatsop County economy. In the study, an input-output model for the existing sectors of the economy was developed and used to evaluate the impact of the aluminum plant by incorporating it into the model as a new sector. However, the author failed to document the procedure used to incorporate the new sector (aluminum plant) into the model (Collin, *et al.*, 1971).

In an attempt to replicate Collin's procedure, the author of the present research applied the procedure developed in the next section of this chapter to the Clatsop County data. The procedure developed in the present thesis did not provide the same results, with respect to impact calculations, as was reported in the Collin thesis. For example, Collin (1970) calculated the direct plus indirect increases in sales of the wood products sector, resulting from the inter-industry transactions of the new sector, to be $10,333; whereas the procedure used by the present author resulted in an impact calculation of $8,114. The conflict between the two

results cannot be resolved due to the limited documentation provided by Collin.

The *ex-post* analysis of industrialization on Lasalle Parish (Louisiana) is interesting in its evaluation of the effect of industrialization on a rural economy. The impact of industrialization is analyzed by assessing changes in sales, employment, and household income. Changes in the structure of the Lasalle Parish economy were evaluated by examining input-output matrices of the economy, e.g., transactions table, direct coefficients and direct plus indirect coefficients, with and without a sector for industrialization.

In addition to the above studies, Miernyk (1965) has discussed a procedure for incorporating a new sector into an input-output model. Miernyk proposes expanding the existing model by one row and one column and using coefficients from another model with a similar sector. The use of information from another model (secondary data) to represent sector coefficients may be acceptable when better information is unavailable, but will not necessarily reflect the true structure of the new sector and/or its actual pattern of inter-industry transactions.

Procedures and Assumptions for Incorporating A New Sector

The *ex-ante* procedure for incorporating a new sector into an input-output model is developed below. The next section in the

present chapter contains an application of the *ex-ante* procedure to the Morrow County economy with the coal fired power plant.

The *ex-ante* procedure abides by the basic assumptions of input-output analysis. Two of the assumptions are critical to the analysis. These two assumptions are as follows:

1. relative prices are constant, and
2. factor and import supply are perfectly elastic.

Assumption (1) implies constant technology and stable demand for a sector's product. In addition, constant relative prices are necessary to have constant direct coefficients.

The assumption of constant direct coefficients is modified slightly for the present analysis. The direct coefficients of endogenous sectors may change due to the introduction of the new sector, but it is assumed that the only influence of the new sector is due to import substitution, i.e., only the primary input coefficients in the matrix of direct coefficients are allowed to change while direct coefficients representing local sector purchases from the new sector are introduced. The *ceteris paribus* assumptions hold for all other coefficients in the matrix of direct coefficients.

To incorporate a new sector into a model, data must be obtained on the sector's projected pattern of purchasing and selling. This may be accomplished using secondary data, as noted by Miernyk (1965). A more appealing procedure is to obtain projections from the firm or firms within the new sector. If primary data are obtained, they

should be converted to constant dollars with respect to the sample data from which the original model was developed.

The second step in the process is critical. This is the method by which the new sector's projected purchases and sales are incorporated into the model. That is, for an *ex-ante* procedure the researcher only has projected inter-industry transactions, not actual observations. Thus, a procedure must be developed which projects the new sector's linkages with existing sectors, i.e., direct and indirect relations must be extrapolated.

The new sector is incorporated by expanding the input-output matrices by one row and one column. The column of the matrix of direct coefficients is completed by developing the new sector's coefficients via equation (9), as presented in Chapter II. This step is straightforward, as the supply of factor inputs is assumed to be perfectly elastic.

Development of the row coefficients for the new sector is rather tricky. If the firms which comprise the new sector have been surveyed, then information is available on the unit's projected sales. Given the input-output assumption of nonsubstitutability among endogenous sectors (all endogenous sectors produce a unique output), the new sector can only supply existing endogenous sectors if import substitution occurs. The question is, will the existing sectors purchase what the new sector projects that it will sell locally? More fundamentally, does potential supply equal the quantity demanded at the given price level?

A procedure for determining demand for the new sector's product is by a phone survey of firms within existing sectors. In essence, this is a method of updating the structural coefficients. This procedure is dubbed an "*ex-ante* method" and is based on the advice of experts (Carroll, 1980).

If it has been determined that existing sectors will not purchase all that the new sector projects that it will sell, the researcher must be extremely careful in doing this evaluation. It is not the purpose of the research process to affect a firm's location decision. Accordingly, the information provided in the present study is more applicable to community and regional planning than to firm level feasibility analysis.

Having developed a new matrix of direct coefficients, the next step is to develop a new matrix of direct plus indirect coefficients.[20/] The new matrix of direct coefficients is derived by solving equation (12) for equation (13) (see Chapter II). The researcher now works backward to obtain a new transactions table.

The new transactions table is derived by treating the new sector's sales as a change in final demand and multiplying these purchases by the new matrix of direct plus indirect coefficients. This step determines the direct plus indirect increases in sales

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20/ In the case where a firm makes all of its sales as exports, the above process of determining import substitution (row coefficients of the matrix of direct coefficients) is unnecessary. In addition, in this specialized case, the direct plus indirect coefficients of existing sectors in the model will remain unchanged, as do the direct coefficients.

of endogenous sectors resulting from the purchases of the new sector. As Richardson (1972) has stated:

> "We can multiply the inverse matrix $[(I-A)^{-1}]$ by any size and composition of final demand in order to obtain the (increase) in the level of output for each industry."

The increases in sales of endogenous sectors are derived, using equation (14) in Chapter II, by substituting in the new inverse matrix. The result of this procedure is a vector of increased sales by endogenous sectors.

The vector of increased sales is converted into each sector's respective purchases necessary to accommodate the increase in demand (sales), by converting the vector into a diagonal matrix and premultiplying by the new matrix of direct coefficients. This procedure is carried out as follows:

$$T^* = A_N \cdot I^* \qquad (15)$$

where

T^* = a matrix of the direct plus indirect inter-industry transactions resulting from the purchases of the new sector,

A_N = the new matrix of direct coefficients, and

I^* is a diagonal matrix of the direct plus indirect increases in sales of endogenous sectors. 21/

21/ A diagonal matrix contains zeros for all off-diagonal elements. The present matrix (I^*) contains the direct plus indirect increases in sales of endogenous sectors on the diagonal.

The matrix (T^*) derived in equation (15) is in actuality a modified transactions table. This matrix portrays the induced inter-industry transactions resulting from the purchases of the new sector.

The new transactions table is obtained by adjusting the existing transactions table for the new sector's purchases and sales, and adding it to the modified transactions table (T^*) derived by equation (15). The new transactions table is obtained as follows:

$$T_N = T_E^* + T^* \qquad (16)$$

T_N = is the new transactions table which fully incorporates the new sector into the model,

T_E^* = is the existing transactions table modified to accommodate the projected sales and purchases of the new sector, and

T^* = is as denoted for equation (15).

The new transactions table (T_N) is expanded to incorporate the new sector's inter-industry transactions, as well as the direct plus indirect increases in sales and purchases of existing sectors. The procedure, presented above, which derives the new transactions table (T_N) is supported by Miernyk (1965). Miernyk points out that for any change in final demand a transactions table is projected based on the changes in final demand.

It is important to note that the new transactions table is implicitly balanced; that is,

$$X_i = X_j \qquad \text{for all } i = 1 \qquad (17)$$

where

X_i = the total sales of sector i(j), and

X_j = the total purchases of sector j(i).

This result is straightforward if one considers the process which is used to develop the new transactions table. The direct plus indirect increases in sales are calculated. These increases are allocated over each sector's direct coefficients to determine the required purchases by each sector to meet the new level of demand. Since the sum of each endogenous sector's direct coefficients (a_{ij}) is equal to unity, the increase in purchases for any sector will be exactly equal to the sector's increase in sales. Taking this logic one step further, the initial or existing transactions table (T_E^*) is balanced so when it is added to another matrix which is balanced (T^*) the resulting matrix (T_N) is balanced.

The process of incorporating a new sector into an existing input-output model, via the *ex-ante* procedure, is complete and the three matrices basic to input-output analysis can be revised. It is now possible to compute the impact of the new sector on the local economy and to evaluate the projected structural changes within the economy. In essence, a large part of the impact analysis and structural evaluation is implicitly completed.

Incorporating the Coal Fired Power Plant into The Morrow County Input-Output Model

Incorporating the New Sector

The Morrow County input-output model is a unique application of the *ex-ante* procedure developed in the preceding section. At the time the data were collected for the model, the CFPP was being constructed. The power plant's inter-industry transactions were not observable. For the model to remain useful more than a few months beyond its completion, an *ex-ante* procedure was required to incorporate the CFPP into the model as a new sector.[22/]

The survey data for existing sectors within the Morrow County economy were collected for the 1979 calendar year. Information on the CFPP projected pattern of selling and purchasing was obtained from Portland General Electric officials (see Table XII). Since the plant is not scheduled for on-line production until 1982, the data were converted to 1979 dollars. The information obtained from Portland General Electric indicates that the CFPP is a unique sector; that is, the plant makes all of its sales as exports.

The above fact results in the direct coefficients of existing sectors, endogenous to the model, remaining constant since there is no import substitution. In turn, the direct plus indirect coefficients of existing sectors will remain unchanged, as was noted in the preceding section.

22/ As noted earlier in this paper, the CFPP did not fit any of the existing sector definitions in the Morrow County model, nor were its inter-industry transactions observable.

TABLE XII. PROJECTED PURCHASING AND SELLING PATTERN OF THE COAL FIRED POWER PLANT

	Sector	Sales ($1,000)	Purchases ($1,000)
1.	Animal Production		
2.	Irrigated Crop Production		
3.	Dryland Crop Production		
4.	Food Processing		
5.	Wood Products		
6.	Agricultural Services		
7.	Construction		
8.	Maintenance & Repair		600
9.	Communication, Transportation, & Utilities		
10.	Coal Fired Power Plant		
11.	Wholesale & Retail Trade		
12.	Finance, Insurance, & Real Estate		
13.	Automobile Sales & Service		25
14.	Professional Services		
15.	Lodging		
16.	Cafes & Taverns		
17.	Other Wholesale & Retail Services		
18.	Port of Morrow		
19.	Local Government		3,484
20.	Local Agencies of State & Federal Government		380
21.	Households		6,264
22.	Nonlocal Households	42,000	16,800
23.	Nonlocal Government		3,000
24.	Nonlocal Business	42,000	42,247
25.	Inventory Depletion		
26.	Depreciation		11,200
Total Transactions		*84,000*	*84,000*

The information obtained from Portland General Electric was used to develop the new matrix of direct coefficients (see Appendix D). The new inverse matrix was derived in the traditional manner. The new transactions table was derived using equations (14) and (15). The input-output matrices which incorporate the CFPP as a new sector in the model are presented in Appendix D.

The Effect of the CFPP on Sales

The gross regional output of Morrow County is projected to increase by $102.4 million due to the CFPP inter-industry transactions (see Table XIII). The increases for individual sectors ranged from a high of $9.7 million for Local Households to a low of less than $1,000 for the Dryland Crop Production sector.

The information presented in the first column of Table XIII is actually the vector of direct plus indirect increases in sales which is obtained when the vector of purchases (see Table XII) is premultiplied by the matrix of direct plus indirect coefficients, as in equation (14).

The second column of Table XIII contains the indirect increases in sales of endogenous sectors. This information is obtained by subtracting the vector of the CFPP direct purchases from the vector of direct plus indirect increases in sales. It will be noted that the CFPP inter-industry transactions do not result in indirect sales for the CFPP sector, which is a result of the CFPP not making endogenous sales.

TABLE XIII. DIRECT PLUS INDIRECT AND INDUCED INCREASES IN SALES OF ENDOGENOUS SECTORS

	Sector	Direct plus Indirect Increases ($1,000)	Induced Increases ($1,000)
1.	Animal Production	3	3
2.	Irrigated Crop Production	2	2
3.	Dryland Crop Production	0	0
4.	Food Processing	34	34
5.	Wood Products	150	150
6.	Agricultural Services	101	101
7.	Construction	388	388
8.	Maintenance & Repair	620	20
9.	Communication, Transportation, & Utilities	277	277
10.	Coal Fired Power Plant	84,000	0
11.	Wholesale & Retail Trade	1,880	1,880
12.	Finance, Insurance, & Real Estate	283	283
13.	Automobile Sales & Service	784	784
14.	Professional Services	253	253
15.	Lodging	100	100
16.	Cafes & Taverns	216	216
17.	Other Wholesale & Retail Services	115	115
18.	Port of Morrow	3	3
19.	Local Government	3,958	474
20.	Local Agencies of State & Federal Government	474	174
21.	Households	9,707	3,443
Morrow County		*102,348*	*7,620*

The Effect of the CFPP on Employment

As firms in Morrow County increase their sales to meet the increased demand resulting from the CFPP purchase, more labor is required. This fact is reflected in the increased sales by (purchases from) Local Households (see Table XIII). In addition to income, changes in employment can be examined (see Table XIV).

The effect on employment ranges from no change in several sectors to 133.8 people, measured in full time equivalents (FTE), for local government. The projected increase in employment for Morrow County is 385.2 FTE. This is compared to an actual FTE of 5,770 for Morrow County in 1979 (Oregon Department of Human Services, 1981). The projected changes in employment are calculated by employment multipliers. The procedure for developing these multipliers is documented in Appendix E. These multipliers express employment as linear functions of a sector's output (sales).

One might question the projected increase in employment by Local Government. Does the projection appear to be too high? It is important to remember that government agencies are, in general, service oriented and are labor intensive. On the other hand, the employment multipliers are linear functions of output and, therefore, do not reflect economies of scale if they exist.

TABLE XIV. DIRECT PLUS INDIRECT INCREASES IN EMPLOYMENT, BY SECTOR

	Sector	Employment Generated (FTE)
1.	Animal Production	0.1
2.	Irrigated Crop Production	0.1
3.	Dryland Crop Production	0.0
4.	Food Processing	N.A.*
5.	Wood Products	2.5
6.	Agricultural Services	0.2
7.	Construction	7.0
8.	Maintenance & Repair	40.6
9.	Communication, Transportation, & Utilities	5.2
10.	Coal Fired Power Plant	N.A.
11.	Wholesale & Retail Trade	24.3
12.	Finance, Insurance, & Real Estate	13.8
13.	Automobile Sales & Service	14.7
14.	Professional Services	32.8
15.	Lodging	8.4
16.	Cafes & Taverns	16.1
17.	Other Wholesale & Retail Services	14.4
18.	Port of Morrow	N.A.
19.	Local Government	204.2
20.	Local Agencies of a State & Federal Government	0.8
Morrow County		*385.2*

* N.A. indicates that there were insufficient data to estimate the employment effect.

Structural Change

The effect of the CFPP on the structure of the Morrow County economy can be conveniently analyzed by examining the row coefficients for the CFPP. All entries for endogenous sector purchases from the CFPP are zero. On the other hand, the CFPP itself does make endogenous purchases. The CFPP direct coefficients (column coefficients) are presented in Table XV. The CFPP makes 7.4 percent of its purchases as imports and has a net trade balance of $21,953,000, or 26 percent of total sales.

Since the matrix of direct plus indirect coefficients is derived from the structural coefficients, the coefficients for existing sectors in this matrix remain unchanged. In turn, the gross output multipliers of existing sectors do not change (see Appendix D). As the output multipliers reflect a sector's interdependence with other endogenous sectors, the CFPP does not influence the degree of interdependence among existing endogenous sectors in the Morrow County economy.

Given that the CFPP does not make endogenous sales, leakages from the local economy from import purchases by existing sectors are unchanged. The CFPP does export all of its sales and qualifies as a basic sector. The plant's inter-industry transactions result in a positive net trade balance. Thus, the plant's transactions bring income into the local economy, and the plant is a continuing stimulus to economic growth in Morrow County.

TABLE XV. COLUMN COEFFICIENTS FOR THE COAL FIRED POWER PLANT FROM THE MATRIX OF DIRECT COEFFICIENTS

	Sector	Coefficient
1.	Animal Production	0
2.	Irrigated Crop Production	0
3.	Dryland Crop Production	0
4.	Food Processing	0
5.	Wood Products	0
6.	Agricultural Services	0
7.	Construction	0
8.	Maintenance & Repair	.0071
9.	Communication, Transportation, & Utilities	0
10.	Coal Fired Power Plant	0
11.	Wholesale & Retail Trade	0
12.	Finance, Insurance, & Real Estate	0
13.	Automobile Sales & Service	.0003
14.	Professional Services	0
15.	Lodging	0
16.	Cafes & Taverns	0
17.	Other Wholesale & Retail Services	0
18.	Port of Morrow	0
19.	Local Government	.0415
20.	Local Agencies of State & Federal Government	.0045
21.	Households	.0745
	Subtotal - All Local Sectors	*.1299*
22.	Nonlocal Households	.2000
23.	Nonlocal Government	.0357
24.	Nonlocal Business	.5029
	Subtotal - All Nonlocal Sectors	*.7386*
25.	Inventory Depletion	0
26.	Depreciation	.1333
Total - All Sectors		*1.0083*

Evaluating the Validity of the *Ex-Ante* Procedure

The *ex-ante* procedure was based on two input-output assumptions which require evaluation as to their appropriateness. In addition, impact projections were made which need to be evaluated as to the confidence which can be placed in them. These two concerns are interrelated. The impact projections and assumptions are evaluated via analyses of existing excess capacities, and employment levels. Do projected increases in sales of endogenous sectors exceed the sector's 1979 level of excess capacity? In addition, is the population base (labor force) large enough to supply the projected increases in employment requirements?

Excess Capacity

Firms, in general, attempt to maintain a target level of excess capacity. Excess capacity is used as an investment opportunity when demand is expected to increase, and as a hedge when demand is unstable (Scherer, 1980). Scherer states that the price structure of American industries is such that excess capacity can be maintained. The more control a firm has over market price, the less excess capacity it will maintain.

For example, the 1979 level of excess capacity in U.S. manufacturing sectors was 17 percent (Economic Report of the President, 1980). The excess capacity for primary production processes was 16 percent, and for advancedproduction processes it was 18 percent.

The average excess capacity during the period 1965 through 1978 was 17 percent.

It is assumed that the above conclusions with respect to American industries' desire to maintain a certain level of excess capacity applies to firms in Morrow County. The exact level of excess capacity within sectors of the County economy may vary. When demand is expected to increase permanently, firms will adjust their excess capacity to the new level of production, i.e., they will attempt to maintain a certain level of excess capacity relative to production (Wenders, 1971). The CFPP is an example of this situation. The plant's purchases result in permanent increases in demand for the products of endogenous sectors.

If firms attempt to adjust their excess capacity, it is questionable as to whether the structural coefficients of these sectors will remain constant. For example, if new technology is acquired in the investment process, the assumption of constant technology is no longer appropriate. In addition, if the adjustment of excess capacity requires investment, and the investment requires funding from lending institutions, the assumption of constant relative prices is jeopardized from another perspective. This is especially true given the high interest rates which are persisting in the economy, i.e., the new investment may be more expensive than the existing plant.

To apply the above discussion to the Morrow County input-output model, increased sales are compared to the 1979 levels of excess capacity within the various sectors (see Table XVI). Information on excess capacity was obtained during the survey process. In three sectors projected increases in sales exceed the 1979 level of excess capacity (8, 9 and 18). The difference is extremely large for the Maintenance and Repair sector. In fact, the projected increase in sales for the sector exceeds the sector's 1979 total sales by 280 percent. In turn, it is questionable whether this sector will meet the increased demand even if investment is undertaken to expand capacity, at least in the short-run. This consideration places the general assumption of perfectly elastic supply of factor inputs in jeapordy.

Ninety-seven percent of the projected increase in sales of the Maintenance and Repair sector is due to estimated direct purchases by the CFPP ($600,000). The circumstances may be such that the CFPP will have to make its maintenance purchases as imports. This proposition was supported in the initial interview process. Individuals noted that they generally go outside of Morrow County for their maintenance purchases. If the CFPP makes maintenance purchases as imports, the sector's direct coefficients will change, i.e., a larger percentage of imports will be observed relative to the initially estimated proportion. In turn, the sector's gross output

TABLE XVI. INCREASED SALES AND EXCESS CAPACITY (for 1979) IN THE MORROW COUNTY (OREGON) ECONOMY, BY SECTOR

	Sector	Increased Sales (Direct plus Indirect) ($1,000)	Increased Sales as a Percent of Excess Capacity (x100)	Excess Capacity (1979) ($1,000)
1.	Animal Production	3	-	N.A.
2.	Irrigated Crop Production	2	-	N.A.
3.	Dryland Crop Production	0	-	N.A.
4.	Food Processing	34	1.8	1,940
5.	Wood Products	150	.2	91,881
6.	Agricultural Services	101	4.0	2,557
7.	Construction	388	15.7	2,467
8.	Maintenance & Repair	620	20,667.7	3
9.	Communication, Transportation, & Utilities	270	103.5	261
10.	Coal Fired Power Plant	0	-	N.A.*
11.	Wholesale & Retail Trade	1,880	20.8	9,033
12.	Finance, Insurance, & Real Estate	283	22.6	1,253
13.	Automobile Sales & Service	784	21.8	3,592
14.	Professional Services	253	58.7	431
15.	Lodging	100	25.5	392
16.	Cafes & Taverns	216	18.9	1,146
17.	Other Wholesale & Retail Services	115	23.40	491
18.	Port of Morrow	3		0
19.	Local Government	3,958	-	N.A.
20.	Local Agencies of State & Federal Government	474	-	N.A.
21.	Households	9,707	-	N.A.

* N.A. indicates that the entry is not available.

multiplier is decreased, i.e., the sector's interactions with other endogenous sectors are reduced.

In conclusion, it has been noted that under certain conditions two of the basic assumptions of input-output analysis may be violated when a new industry (sector) locates in an economy. One must keep in mind that an *ex-ante* procedure is being used to make projections of what the effect of the new sector might be on the local economy. *A priori* estimates of the new sector's purchasing patterns were used. Thus, the projections merely provide estimates of what the effects might be. On the other hand, the critique of the *ex-ante* procedure highlights the fact that an economy does experience change. A growing economy may not exhibit constant purchasing patterns (direct coefficients) and may require updating of an input-output model of its economy more often than a stable economy.

Employment

Projections were made as to the increased employment by Morrow County firms associated with the projected CFPP inter-industry transactions. The projected increase in employment for Morrow County is 385.2 FTE. The 1979 labor force was 5,770 FTE, and the unemployment rate was 4.8 percent. It is unlikely that the increased demand for labor could be drawn from the unemployed as 4.8 percent

is below what is considered to be the natural rate of unemployment for the nation (Gordon, 1978).[23/]

The Morrow County population had been growing at an average of 13 percent per year prior to 1979. Assuming that the county labor force grows at the same rate as the population, the labor force will increase by 1,381 FTE by 1982. This may not be a realistic projection, but it certainly exceeds the increase of 385 FTE projected by the model.

Simulating the Coal Fired Power Plant with Endogenous Sales

The CFPP is a unique sector in that all of its sales are as exports. This characteristic affects the sector's influence on the structure of the Morrow County economy. The purpose of the present section is to allow the CFPP to make hypothetical sales to endogenous sectors' and to evaluate the effect of this activity on the structure of the Morrow County economy.

This objective is accomplished by allowing the CFPP to supply 20 percent of the purchases of the Communication, Transportation & Utilities sector. The 20 percent is assumed to be manifested as import substitution, and the matrix of direct coefficients is adjusted accordingly. A new inverse matrix is then derived from the adjusted matrix of direct coefficients (see Appendix F).

[23/] Gordon (1978) states that "... the natural unemployment rate is the economy's long-run equilibrium level of unemployment that occurs when output equals its long-run natural level and is a situation in which the actual inflation rate turns out to be exactly what people anticipate." The natural rate was roughly 5.4 percent in the mid-1970's.

The new inverse matrix provides interesting information. For example, by making input substituting sales, the CFPP increases the degree of interdependence among endogenous sectors. That is, the gross output multipliers increase in value (see Appendices D and F). This point can be highlighted by examining the row coefficients from the inverse matrices with and without the CFPP making endogenous sales (see Table XVII). When the CFPP does not make endogenous sales, the row entries for all other sectors are zero. The single positive row entry associated with hypothetical sales to the Communications, Transportation, & Utilities sector generates indirect effects on endogenous transactions manifest in the matrix of direct and indirect coefficients.

The row coefficient for the CFPP is now 1.001. This means that the plant's inter-industry transactions will result in induced sales by the CFPP, while in the former case this did not cocur. The coefficient was 1.000.

Thus, when a sector makes endogenous sales, it increases the degree of interdependence among endogenous sectors. In addition, the induced activity will result in a larger increase in the gross regional output in comparison to a sector which only makes exogenous sales.

Concluding Remarks

An *ex-ante* procedure for incorporating a new sector into a static input-output model was developed in this chapter. The

TABLE XVII. ROW COEFFICIENTS FOR THE CFPP SECTOR FROM THE INVERSE MATRICES

	Sector	CFPP Without Endogenous Sales	CFPP With Endogenous Sales
1.	Animal Production	0	.005
2.	Irrigated Crop Production	0	.001
3.	Dryland Crop Production	0	.004
4.	Food Processing	0	.002
5.	Wood Products	0	.004
6.	Agricultural Services	0	.001
7.	Construction	0	.002
8.	Maintenance & Repair	0	.004
9.	Communication, Transportation, & Utilities	0	.003
10.	Coal Fired Power Plant	1	1.001
11.	Wholesale & Retail Trade	0	.003
12.	Finance, Insurance, & Real Estate	0	.003
13.	Automobile Sales & Service	0	.002
14.	Professional Services	0	.005
15.	Lodging	0	.008
16.	Cafes & Taverns	0	.004
17.	Other Wholesale & Retail Services	0	.007
18.	Port of Morrow	0	.001
19.	Local Government	0	.005
20.	Local Agencies of State & Federal Government	0	.004
21.	Households	0	.006

procedure was used to incorporate the CFPP into the Morrow County model. In turn, the *ex-ante* procedure was evaluated by comparing impact projections with excess capacity and employment potential in the Morrow County economy. It was concluded that under certain conditions two of the basic assumptions of input-output analysis may be violated, i.e., constant direct coefficients and perfectly elastic supply of factor inputs. The assumptions may be violated when projected increases in sales exceed a sector's excess capacity. The interpretation is that firms may not be able to adjust perfectly and instantaneously to a change in final demand.

The present chapter also contained a discussion (implicitly) of the effect on a local economy of firms with differing transactions patterns. Firms such as the CFPP, which purchase endogenously and sell exogenously, increase the overall size of an economy (total income) but do not affect the interdependence among existing endogenous sectors. Typically, one would expect basic sectors to conform with this type of transactions pattern. Conversely, firms which sell locally increase the degree of interdependence among endogenous sectors. This point was portrayed by simulating the power plant with endogenous sales. Sectors with a large percentage of endogenous sales are typically service sectors. If either basic or service sectors engage in local sales, this will contribute not only to the overall size of an economy, but also to the degree of interdependence among existing sectors endogenous to the economy.

CHAPTER V

SUMMARY AND CONCLUSIONS

The Objectives

The objectives of this study were to (1) construct a static inter-industry model of Morrow County (Oregon), (2) develop an *ex-ante* procedure for incorporating a new sector into an existing inter-industry model, (3) to examine the aggregative and distributional effects which a coal-fired power plant would have on the Morrow County economy, (4) evaluate the effect which firms with transactions patterns different from the CFPP would have on the county economy, and (5) evaluate the extent to which the *ex-ante* procedure developed for objective (2) is an adequate representation of reality.

Summary

A static input-output model (without the CFPP) of Morrow County (Oregon) was constructed in the summer and fall of 1980 (objective 1). Subsequently, an *ex-ante* procedure was developed to incorporate a new sector into an existing model (objective 2). The new sector was incorporated by expanding the original input-output matrices by one row and one column. The original matrix of direct coefficients was adjusted first, and the new matrix of direct plus indirect coefficients was derived in the traditional

manner. In turn, these two new matrices were used to derive the new transactions table. This was accomplished by treating the new sector's endogenous purchases as a change in sales to final demand for the appropriate sectors. The *ex-ante* procedure abides by the traditional assumptions of a static input-output model.

The third objective was accomplished by using the *ex-ante* procedure to incorporate the power plant into the Morrow County input-output model. The new and the old models (with and without the CFPP sector) were used to calculate the impact of, and evaluate the structural change in, the Morrow County economy resulting from the CFPP inter-industry transactions.

The *ex-ante* procedure was evaluated (objective 4) by comparing the projected increases in sales, by endogenous sectors, with levels of excess capacity in 1979. In addition, the projected increases in employment were compared with the potential increase in the Morrow County labor force. A discussion was presented which questioned the validity of certain input-output assumptions (e.g., constant direct coefficients and perfectly elastic supply of factor inputs) when projected increases in sales exceed excess capacity.

The fifth objective was accomplished by simulating the CFPP with endogenous sales.[24/] The purchasing pattern of the power plant

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[24/] As was noted in Chapter IV, the CFPP is a unique sector in that all of its sales are made as exports.

was assumed to remain constant, but the hypothetical assumption was made that the plant supplied twenty percent of the Communications, Transportation & Utilities sector's purchase requirements.

Conclusions

The view of the Morrow County economy, as described by the input-output model, results in the conclusion that the economy is relatively open and is highly dependent on its basic sectors for income and, in turn, growth. A large percentage of the county's sales and purchases are as exports and imports, 60.9 and 57.8 percent, respectively. The basic sectors account for more than 50 percent of the county's exports.

As would be expected in a relatively open economy, the endogenous sectors of the county economy are not very interdependent. This conclusion is supported by the low values of the gross output multipliers.

The CFPP was incorporated into the Morrow County input-output model via the ex-ante procedure developed in Chapter IV, as noted above. The projected impact of the plant on the local economy is an increase of $102 million in gross regional output and an increase in employment of 385 full time equivalents. The CFPP is not expected to affect the trading patterns of existing sectors within the model. This is due to the fact that the plant will not make endogenous sales. As a result, the purchasing patterns of existing sectors

will not be altered by the plant's inter-industry transactions, although total purchases will increase.

Thus, the overall size of the Morrow County economy will increase. The only expected structural change is the appearance of the CFPP as a purchasing sector. Import substitution does not occur. The CFPP was identified as a basic sector which will bring income into the county and will be a continuing stimulus to economic growth.

The coal fired power plant was used to simulate a sector with endogenous sales.[25/] This was done to compare the effect on the Morrow County economy of new sectors with different patterns of purchasing and selling. With the CFPP making endogenous sales, the direct coefficients of endogenous sectors no longer remain constant. The direct coefficients change for sectors making direct purchases from the CFPP sector. In addition, the direct plus indirect coefficients change for all endogenous sectors, including the CFPP sector. This result can be viewed by comparing the inverse matrix without the CFPP making endogenous sales (Appendix D) to the inverse with the CFPP making endogenous sales (Appendix F). Thus, the direct plus indirect coefficients of existing sectors will change (i.e., interdependence among endogenous sectors will increase), and the plant's inter-industry transactions will result in an induced

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25/ All endogenous sales were assumed to occur as import substitution.

increase in sales by endogenous sectors. This is an increase over and above the direct plus indirect increase projected without the CFPP making endogenous sales.

Other conclusions were drawn with respect to the appropriateness of the *ex-ante* procedure for incorporating a new sector. The evaluation concluded that certain input-output assumptions (constant technical coefficients and perfectly elastic supply of factor inputs) may be violated if projected sales exceed a sector's excess capacity. The violation of the assumption of perfectly elastic supply may be handled in a static model by implicitly setting supply constraints. For example, the coal fired power plant's projected purchases from the Maintenance & Repair sector exceed the sector's 1979 capacity by 280 percent. The CFPP purchasing pattern could be adjusted so that the plant would make maintenance and repair purchases as imports. The direct coefficients may change due to changes in relative prices. The researcher cannot readily deal with the changes in these coefficients due to data and modeling constraints. It is important to note that the changes in the direct coefficients discussed here arise from a firm attempting to adjust excess capacity in response to a change in the quantity demanded of its product.

Implications for Future Research

The evaluation of the *ex-ante* procedure, developed in Chapter IV, resulted in questions concerning two of the basic assumptions of input-output analysis when projected sales exceed a sector's excess capacity. The assumptions in question are: constant technical coefficients and perfectly elastic supply. Supply may be limiting, or as firms adjust capacity relative prices and/or technology may change.

An appealing way of dealing with the above problem is by modeling an economy with a dynamic input-output model; although a dynamic model will not answer (alleviate) all of the questions (problems). A dynamic input-output model has been developed for the Grant County (Oregon) economy (Johnson, 1979). A similar model could be developed for Morrow County as the data required to develop such a model are readily available.

As would be expected, the dynamic model developed for Grant County allows a time path of adjustment within the local economy when a change in final demand occurs. In addition, investment is treated in an independent matrix, rather than as a row and column in a static model. Capacity is treated as a lagged function of desired capacity, and the model allows for supply constraints.

The traditional static model is expressed in a simple balance equation ($X = AX + X$) which can be solved such that output can be

expressed purely as a function of final demand ($X = (I-A)^{-1}Y$). The balance equation is expanded for a dynamic model, as follows:

$$X(t) = AX(t) + Y(t) + I(t) + N(t) \qquad (18)$$

where

X & Y = are as defined in Chapter II,

I = is a matrix of investment derivatives,

N = is a vector of changes in inventories for each commodity, and

t = is the period in time.

The dynamic input-output model, as expressed in equation (18), allows for adjustments within the economy to a unit change in final demand of a given sector, rather than assuming that the adjustment process is instantaneous as is done for the static model.

All of the coefficients of the dynamic model are assumed to be constant through time, as are the coefficients in a static model. The advantage of the dynamic model is that it provides a time path of adjustment within an economy. This feature, in addition to the supply constraints, would solve part of the problems which may occur when projected sales exceed the current level of excess capacity. On the other hand, a dynamic input-output model, as developed above, does not account for changes in relative prices and/or technology. This is due to the assumption of fixed coefficients. Thus, the coefficients of a dynamic model require updating as do the coefficients of a static model.

Concluding Remarks

The present study provided estimates of the sectoral impacts resulting from the lcoation of the CFPP in Morrow County (Oregon). The question was asked, could existing sectors supply the power plant's input requirements? More appropriately, were the assumptions of a static input-output model appropriate for making the impact projections? Demand for the power plant's output was assumed to exist. This assumption seemed appropriate in that the power plant had already made the decision to locate. In the case where such a decision has not been made, such an assumption may be inappropriate.

The present study also contained a critique of the *ex-ante* procedure for incorporating a new sector into an existing model. It was concluded that an economy may not be able to adjust perfectly and instantaneously to a change in final demand. Thus, a static model may not be appropriate for projecting the impact of a new sector. Rather, a dynamic model such as the one summarized in the preceding section may provide better projections. The dynamic model provides for a time path of adjustment, as opposed to the instantaneous adjustment process assumed for static models.

Given the limitations of the present study, the results do provide initial projections of the sectoral impacts of the new

sector. The present study does not provide information as to whether the new sector will alleviate unemployment, stimulate population growth, employment, will be good for an economy, or other such issues. Rather, the analysis results in estimates of which local economic sectors experience gross income gains, and to what extent one sector gains relative to all others.

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A P P E N D I C E S

APPENDIX A

MORROW COUNTY INPUT-OUTPUT SURVEY FORMS AND EXPLANATORY LETTERS

Guide to Contents

1. Pre-survey explanatory letter mailed to all Morrow County livestock operators: July 14, 1980

2. Pre-survey explanatory letter mailed to all Morrow County crop producers: July 21, 1980

3. Morrow County agricultural producer survey forms

4. Pre-survey explanatory letter mailed to all Morrow County business establishments and units of government: July 2, 1980

5. Pre-survey explanatory letter mailed to all Morrow County business establishments and units of government in the sample: July 9, 1980

6. Morrow County input-output questionnaire used for business and government

7. Morrow County 1979 purchases table used in conducting input-output survey interviews

8. Morrow County sector identification card used in conducting input-output survey interviews

9. Explanatory letter accompanying input-output survey form mailed to sample of Morrow County households: July 11, 1980

10. Morrow County input-output survey form mailed to households

11. 1979 household purchases form included in input-output survey questionnaire mailed to households

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July 14, 1980

As you know, agriculture is very important to the economy of Morrow County. Livestock operations contribute substantially to agriculture in the county. There is reason for concern, however, about the future of Morrow County's livestock industry. For this reason, the Morrow County Court has contracted with the Department of Agricultural and Resource Economics of Oregon State University to conduct a study of the Morrow County economy. The Morrow County Resource Committee asked that the study be done.

The study that Oregon State University is doing will determine just how important farming and ranching are to the local economy. Any changes that may affect the livestock sector can be incorporated into the economic model that will be constructed. Types of changes to be analyzed include possible changes in Forest Service permits, private range improvements, changes in hay and calf prices, and others. This study will provide the Morrow County Court and local farmers and livestock producers with reliable information on the effects of any grazing choices or range improvements, not only on those farmers and ranchers directly affected, but on the entire county economy.

The results will only be as good as the information that we obtain. This is where we need your help. A five-person survey crew from Oregon State University will be working in Morrow County during the last half of this month, conducting interviews both with ranchers who run on BLM lands and with those who do not have a BLM permit. The interviews last about an hour, and require some detailed information about the 1979 production year. We hope that you will be able to meet with an interviewer, at a time and place of convenience to you, sometime before the end of the month. A member of the survey team will be calling you within the next few days to set up a convenient time for a meeting.

Complete confidentiality will be maintained throughout this study. Once obtained, all of the responses will be added together, and only these totals will be evaluated. There will be no way for individual farmers or ranchers to be identified from the results.

Thank you for your time and cooperation. If you have any questions about this study, please feel free to contact me, Harold Kerr (county extension agent), Don McElligott (County Commissioner), or Shirley Rugg (chairman of the Morrow County Resource Committee).

Sincerely,

Frederick W. Obermiller
Associate Professor
Extension Resource Economist

ds

Department of
Agricultural and
Resource Economics

Oregon State University

Corvallis, Oregon 97331 (503) 754-2942

July 21, 1980

As you know, agriculture is very important to the economy of Morrow County. Dryland and irrigated crop production, as well as livestock operations all contribute substantially to the economy of the county. There is reason for concern, however, about the future of Morrow County's agriculture. For this reason, the Morrow County Court has contracted with the Department of Agricultural and Resource Economics of Oregon State University to conduct a study of the Morrow County economy. The Morrow County Resource Committee asked that the study be done.

The study that Oregon State University is doing will determine just how important farming and ranching are to the local economy. Any changes that may affect agriculture can be incorporated into the economic model that will be constructed. Types of changes to be analyzed include possible changes in water availability, changes in crop prices, changes in hay and calf prices, and others. This study will provide the Morrow County Court and local farmers and livestock producers with reliable information on the effects of changes in prices or resource availabilities, not only on those farmers and ranchers directly affected, but on the entire county economy.

The results will only be as good as the information that we obtain. This is where we need your help. A five-person survey crew from Oregon State University is working in Morrow County conducting interviews with local farmers and ranchers. The interviews last about an hour, and require some detailed information about the 1979 production year. We hope that you will be able to meet with an interviewer, at a time and place of convenience to you, sometime within the next two weeks. A member of the survey team will be calling you within the next few days to set up a convenient time for a meeting.

Complete confidentiality will be maintained throughout this study. Once obtained, all of the responses will be added together, and only these totals will be evaluated. There will be no way for individual farmers or ranchers to be identified from the results.

Thank you for your time and cooperation. If you have any questions about this study, please feel free to contact me, Harold Kerr (county extension agent), Don McElligott (County Commissioner), or Shirley Rugg (chairman of the Morrow County Resource Committee).

Sincerely,

Frederick W. Obermiller
Associate Professor
Extension Resource Economist

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MORROW COUNTY AGRICULTURAL SURVEY

Oregon State University
Summer 1980

PRODUCER IDENTIFICATION CODE: _____

Date of Interview: _____ Time of Interview: _____

This survey is a cooperative effort on the part of the Morrow County Court, the Morrow County Chamber of Commerce, and Oregon State University. Its general purpose is to evaluate the contribution of farming, ranching, and other types of industry to the Morrow County economy. One objective is to determine the impacts of changes in the availability of land, water, and credit on local producers and the agricultural industry. Another is to determine the relationships between farm and ranch operations. To achieve these objectives, information is needed from local producers. I would like to ask you some questions about your operation in 1979. Please be assured that any information you choose to give will be strictly confidential.

A. CATTLE INVENTORY

1. Which of the following categories best describe your livestock operation in 1979? (*Check one*)

   Cow-calf _____
   Cow-calf/yearling _____
   Feeder or stocker _____
   Other (specify) _____

2. At the beginning of your 1979 cattle breeding season, how many of the following kinds of animals were in your animal inventory? (*Enter the appropriate number*)

   Bulls _____
   Cows _____
   Replacement heifers to be bred in 1979 _____
   Replacement heifers to be bred in 1980 _____
   Yearling steers _____
   Yearling heifers (to be sold) _____
   Weaned steers _____
   Weaned heifers (to be sold) _____
   Horses _____

3. How often do you replace breeding bulls and do you replace all of them at one time? Describe replacement schedule.

   _____
   _____
   _____

4. What is your average selling weight of cull bulls and normal month sold? _____ *(lbs.)* at _____ *(month)*.

5. How many cows and replacement heifers were exposed to bulls in 1979? *(Enter the appropriate number)*.

Cows	_____
Replacement heifers	_____

6. How many cows and replacement heifers were culled for slaughter, by month, in 1979; and what were their average selling weights? *(Enter the appropriate numbers)*.

	Number sold		Estimated selling weight	
	Cows	Heifers	Cows	Heifers
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Total				

7. How many animals by class and season died in 1979? *(Enter the appropriate numbers)*.

	Bulls	Cows	Replacement heifers	Yearling steers	Yearling* steers	Weaned steers	Weaned* heifers
Spring							
Summer							
Fall							
Winter							

* *Heifers to be sold, not to be kept for replacement.*

8. How many calves were born alive and then weaned by month in 1979; and what were their average selling weights? *(Enter the appropriate numbers).*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Calves born alive													
Calves weaned													
Est. weaning wt.													
Steers													
Heifers													

9. How many veal calves were sold last year; and what were their average selling weights? *(Enter the appropriate numbers).*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Veal calves sold													
Est. selling wt.													
Steers													
Heifers													

10. How many weaners were sold last year; and what were their average selling weights? *(Enter the appropriate number).*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Steers sold													
Heifers sold													
Est. selling wt.													
Steers													
Heifers													

11. How many yearlings were sold, by month, in 1979; and what were their average selling weights? *(Enter the appropriate numbers).*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Steers sold													
Heifers sold													
Est. selling wt.													
Steers													
Heifers													

12. Did you sell any cattle in 1979 specifically as breeding stock? If yes, list kind, age, value per animal, and months sold.

No _____

Yes _____

13. Did you fatten any cattle in your own feedlot in 1979? _____ *(yes or no).* *If answer is no, go to question 14).*

a. What is your feedlot capacity at this point in time? _____ *(head).*

How many entered your feedlot in 1979?

Steers _____
Heifers _____

What weight do they normally enter the feedlot?

Steers _____
Heifers _____

b. How many fat *(fed)* animals were sold, by month, in 1979; and what were their average selling weights? *(Enter the appropriate numbers).*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Steers sold													
Heifers sold													
Est. selling wt.													
Steers													
Heifers													

14. How many cattle did you purchase in 1979 by class, season, and estimated weight? *(Enter the appropriate numbers).*

	Spring	Summer	Fall	Winter	Total
Weaners					
Steers purchased					
Heifers purchased					
Est. purchase wt.					
Steers					
Heifers					
Yearlings					
Steers purchased					
Heifers purchased					
Est. purchase wt.					
Steers					
Heifers					
Replacement					
Number purchased					
Open heifers					
Bred heifers					
Open cows					
Bred cows					

Est. purchase wt.	_____	_____	_____	_____	_____
Open heifers	_____	_____	_____	_____	_____
Bred heifers	_____	_____	_____	_____	_____
Open cows	_____	_____	_____	_____	_____
Bred cows	_____	_____	_____	_____	_____

15. How many horses did you purchase in 1979? _____ *(number)*.

16. Did you use AI services in 1979? _____ *(yes or no)*. If yes, how many cows and replacement heifers did you AI breed? _____ *(cows)* and _____ *(heifers)*.

17. Did you pregnancy test bred animals in 1979? _____ *(yes or no)*.

18. What is the normal conception rate of your cows _____ *(percent)*, and your heifers _____ *(percent)*?

B. LAND RESOURCES

1. How many acres of land did you own that were a part of your operation in 1979? _____ *(acres)*.

2. How many of these acres are cropland, including fallow or idle acres? _____ *(acres)*.

3. List all grain or other crops *(except hay crops)* actually produced on your deeded cropland in 1979.

Crop	Acres	yield/acre	If irrigated: Method	If irrigated: acre feet applied	Type of fertilizer or chemical treatments and rates

4. List all irrigated hay crops producted on your deeded land in 1979.

Crop	Acres	Produced on cropland (yes/no)	Estimated yield per acre	Number of cuttings & cutting months	Irrigation method	Acre feet water applied	Type of fertilizer or chemical treatments and rates

5. List all dryland hay crops produced on your deeded land in 1979.

Crop	Acres	Produced on cropland (yes/no)	Estimated yield per acre	Number of cuttings & cutting months	Type of fertilizer or chemical treatments and rates

6. Did you rent or lease additional cropland in 1979 _____ *(yes or no)*. If yes, please specify crops *(including hay crops)* produced.

Crop	Acres	Estimated yield/acre	Rental or lease cost	If irrigated: method	If irrigated: acre feet applied	Type of fertilizer or chemical treatment and rates

7. Did you graze aftermath from any of your deeded or rented croplands or haylands in 1979? _____ *(yes or no)?* If yes, please specify type of aftermath grazed.

Crop	Acres	Deeded or leased	Estimated use (AUM or No. of head per acre)	Percent of total aftermath utilized	Months used	Type of livestock used

8. List by range or pasture type all your deeded lands in dryland range or dryland pasture production in 1979.

Range or pasture type	Acres	Forested (yes/no)	Percent acreage improved	Type of improvement	Percent suitable for improvement	Estimated utilization* (AUM's or head-days) Mar-May	June-Aug.	Dec.-Nov.	Dec.-Feb.	Percent of total production utilized	Type of fertilizer or chemical treatment and rates

* If zero, obtain estimate of total production (AUM's)

9. List by pasture type all your deeded lands in irrigated pasture production *(include natural flood irrigation)* in 1979.

Pasture type	Acres	Estimated Utilization* (AUM's or head days) Mar-May	June-Aug	Sept-Nov	Dec-Feb	Percent of total production utilized	Irrigation Method	Acre feet water applied	Type of fertilizer or chemical treatments and rates

* If zero, obtain estimate of total production (AUM's)

10. If you leased or rented additional public or private grazing in 1979, please specify:

	Allotment name	Site Characteristics	AUM's obtained	Months used	Direct lease or rent costs	Additional expenditures of labor and other costs incurred to graze these lands *(e.g., additional labor, supplies, fuel, custom hauling, etc.)*
From BLM:						
From Forest Service:						
From state lands:						
From other private lands:						

C. CAPITAL RESOURCES

1. What was the assessed valuation of your deeded farm/ranch property in 1979? _____$

2. Did you have any outstanding mortgages on your deeded lands in 1979? _____ *(yes or no)*. If yes, please specify:

Amount	Remaining amount of mortgage in years	Annual principal payments	Interest rate	Month(s) payable	Obtained in county *(yes/no)*

3. Did you have any production loans that were outstanding in 1979, including loans for seed, fertilizer, etc., made through dealers of these supplies? _____ *(yes or no)*. If yes, please specify:

Amount	Length of loan	Payment schedule & amounts	Annual Interest rate	Purpose of Loan*	Obtained in county *(yes/no)*

* *Was production loan primarily for support of crop or livestock enterprise?*

4. If interest rates were lower and if more credit were made available to you, would you use more credit? *(check one)*

   Definitely _____

   Possibly _____

   No _____

5. List major pieces of equipment and machinery owned in 1979, including those purchased in 1979.

Item	Age in years	Approximate purchase price	Total useful* life of equipment in your operation	Annual hours of use each year approximate	Purchased in county *(yes/no)*

* Estimated from year of purchase.

6. How important is it to you to own, as opposed to renting or leasing, your own: *(check one response in each column)*

	Cattle	Land	Equipment & machinery
Very important	____	____	____
Somewhat important	____	____	____
Not important	____	____	____
Undecided	____	____	____

D. LABOR RESOURCES

1. How many people worked on your farm and/or ranch in 1979?

	Employee number	Dates worked (or approximate number of days)
Hired full-time labor	____	____
	____	____
	____	____
	____	____
	____	____
Hired part-time labor	____	____
	____	____
	____	____
	____	____
	____	____
	____	____
	____	____
	____	____
	____	____
Yourself	____	____
Other family members	____	____
	____	____
	____	____
	____	____
	____	____
	____	____
	____	____

2. What is the total compensation (*both cash and non-cash*) paid to full-time hired labor? $_____; non-cash _____.

3. What is the total compensation *(both cash and non-cash)* paid to part-time hired labor? $_____; non-cash _____.

4. If family members are paid for their labor, indicate cash compensation.

_____

_____.

E. EXPENSES AND REVENUES

1. List all purchases of hay, feeds, supplements and additives made in 1979. *(exclusive of feedlot feeds, etc.)*

	Amounts purchase lbs./tons/cwt.	Cost delivered to ranch $/unit	Percent purchased in county
Grass hay			
Alfalfa hay			
Alfalfa-grass hay			
Other hays			
Feeds			
Supplements & salts			
Additives			

2. For hay purchases made from sources inside Morrow County, were those sources primarily ranchers with allotments _____ *(yes or no)*, ranchers without allotments _____ *(yes or no)*, farmers _____ *(yes or no)*, or other types of sellers _____ *(Specify)* _____.

3. List sources of income other than livestock sales made in 1979.

Crops sold	Amount (lbs./tons/cwt.)	Price/unit	Month(s) sold	Percent sold in county
Grains				
Hays				
Other crops				
Timber				
Off-farm employment (including custom hire and machinery rentals)				
Self				
Other family				
Other sources of income:				

4. List the following receipts and expenses made in 1979.

Receipts	Total	% sold in county
Cull bulls, cows, heifers		
Veal calves		
Weaners		
Yearlings		
Fat animals		
Breeding stock		

4. (cont.)

Expenses	Total	% purchased in county
Cattle purchases		
Horse purchases		
Vet fees and supplies (excluding breeding related)		
AI services (include hormone treatments, vet costs, etc.)		
Insurance		
Fire		
Crop		
Liability		
Life		
Other		
Marketing expenses		
Crops		
Livestock		
Hired trucking		
Crops		
Livestock		
Taxes		
Property		
Income		
State		
Federal		
Seed		
Fertilizer		
Cash crops		
Hay/pasture		
Chemicals		
Fuels		
Oils		
Lubricants		
Custom hire		
Fence materials (new construction)		
Building materials (new construction)		
Repair items		
Building		
Machinery		
Fences		
_____		
Utilities		
Electricity		
Phone		
Heating oil		
_____		
_____		
Miscellaneous		
Accounting		
Legal		
_____		

F. MANAGEMENT CHARACTERISTICS

These final questions relate to you, personally, as a farm or ranch manager. Do not answer them if you do not want to do so. However, your answers are important because they can help establish what actually will happen in Morrow County if changes occur in federal grazing or in the availability of land, water, or credit.

1. Sex *(Observe)* M_____ F_____

2. What is your age? _____*(years)*

3. How many years have you been a farmer or rancher? _____*(years)*

4. How many years has your family been in agriculture? _____*(years)*

5. What is the last grade you completed in school? *(circle one)*

   1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 +

6. Did you have any vocational/agricultural training in school? _____*(yes or no)*.
   If yes, how many years? _____*(years)*

7. Do you feel that the local agricultural extension service has been helpful to the farmers and ranchers in this area? *(check one)*

   Very helpful _____
   Somewhat helpful _____
   Not helpful _____
   Undecided _____

8. Have agricultural extension courses been offered in the area? _____*(yes or no)*
   If yes, have you participated in any of these courses? _____*(yes or no)*
   If yes, would you comment on any courses that have been particularly helpful for you as a farmer or rancher? _____

   _____

   _____

   _____

I would now like to ask you a few questions about your operation, both how it is and how you would like to see it in the future.

9. Would it be possible to increase the income you receive from your farm or ranch? _____*(yes or no)* If yes, how? _____

   _____

   _____

10. Which of the following are the most limiting resources to increasing your farm or ranch earnings? *(rank the first two choices, and number them 1 and 2)*

    Land _____
    Labor _____
    Cattle _____
    Credit _____
    Other _____

11. If your operation were only able to cover your annual cash costs year after year, would you:

    look for additional sources of income from your ranch? _____ *(yes or no)*
    look for part-time work off your ranch? _____ *(yes or no)*
    sell your ranch and seek other employment? _____ *(yes or no)*

12. If there were a reoccurrence of the 1977 drought, lasting for 2 or 3 years, what would you do? *(rank the first two choices, and number them 1 and 2).*

    Purchase additional feed _____
    Reduce present level of hay sales (if any) _____
    Lease additional pasture or range _____
    Reduce herd size _____
    Increase forage and/or feed production on your base properties _____
    Other (specify) _____

13. If the Forest Service were to reduce your grazing permit by one-half, would your response be the same as that given above? _____*(yes or no)*. If no, what would you do? *(rank the first two choices, and number them 1 and 2)*

    Purchase additional feed _____
    Reduce present level of hay sales (if any) _____
    Lease additional pasture or range _____
    Reduce herd size _____
    Increase forage and/or feed production on your base properties _____
    Other (specify) _____

14. What is your major reason for being a farmer or rancher? *(check one)*

    It's a way to make money _____
    Your family was in ranching (or farming), and you just naturally took it up _____
    It's a good "way of life" _____
    Other (specify) _____

That's all of our questions. Thank you very much for taking the time to help. In a few weeks, when we return to Corvallis, we could make a copy of your responses and return the copy to you. Would you like a copy? _____*(yes or no).*

I certify that the interview was taken with the rancher identified above and that the information recorded is a true representation of the interview.

_____
Interviewer's signature

Department of
Agricultural and
Resource Economics

Oregon State University

Corvallis, Oregon 97331 (503) 754-2942

July 2, 1980

At the request of the Morrow County Resource Committee, the County Court has asked Oregon State University to analyze the structure of the county economy. The purpose of this economic study is to document the contribution of land, water, and recreational resources to local economic activity; identify opportunities for further economic diversification in Morrow County; and evaluate the impacts of external changes (such as national housing starts) or policies (such as water rights regulations) on the county's economy. To be reliable, such a study requires local data. Consequently, the University will be sending a survey team to Morrow County to conduct interviews with members of the business and agricultural community. The survey team will be conducting interviews during the last two weeks in July.

Only some of the businesses in Morrow County will be asked to furnish information. Your business may be randomly selected to be interviewed for the economic analysis. The information you choose to give will be used to construct an "input-output" model of the Morrow County economy.

If your firm is one of those selected for interviewing, you will be notified by mail within a week. Shortly thereafter, a member of the OSU survey staff will be contacting you to schedule an appointment for an interview. During the interview, the staff member will be asking you for estimates of your 1979 sales and purchases, to and from various kinds of businesses and households, inside and outside of Morrow County.

If you have any questions concerning this study, please feel free to contact me, Judge Don McElligott (Morrow County Court), Harold Kerr (county extension agent), or any of the following members of the Morrow County Resource Committee: Shirley Rugg, Dick McElligott, Raymond French, Allen Hughes, Ray Alsup, Warren H. McCoy, Allen Nistad, Leroy Gardner, Mike Sweeney, Matt Doherty, Dr. L.D. Tibbles, Jim Thompson, Ed Tarnasky, Don Peterson, Tom Martin, Frank Lamb, Henry Kreos, Joanne McCauley, "Bus" Clough, Ben Siminoe, Bob Adelman, Glen Ward, Fred Tombs, Judy Buschke, or "Lucky" Felt.

Sincerely yours,

Frederick W. Obermiller
Associate Professor
Extension Resource Economist

Department of
Agricultural and
Resource Economics

Oregon State University

Corvallis, Oregon 97331 (503) 754-2942

July 9, 1980

Dear Morrow County Business Owner or Manager:

As part of the economic study being conducted by the Morrow County Court in conjunction with Oregon State University, your business has been one of those randomly selected to be interviewed. A member of the OSU survey team will be contacting you within the next few days to schedule an appointment for an interview. During the interview, which may last up to an hour, the staff member would like to ask you for *estimates of your 1979 sales and purchases, to and from various types of businesses and households, inside and outside Morrow County.*

We hope that you will take the time to participate in the interview. We recognize that your cooperation is voluntary, and wish to assure you that any information you choose to provide will be strictly confidential. All responses will be added together and only totals evaluated. Results cannot be traced to only one firm or individual.

Once again, if you have any questions concerning this study, please feel free to contact me, Judge Don McElligott (Morrow County Court), Harold Kerr (county extension agent), or any of the following members of the Morrow County Resource Committee: Shirley Rugg, Dick McElligott, Raymond French, Allen Hughes, Ray Alsup, Warren H. McCoy, Allen Nistad, Leroy Gardner, Mike Sweeney, Matt Doherty, Dr. L.D. Tibbles, Jim Thompason, Ed Tarnasky, Don Peterson, Tom Martin, Frank Lamb, Henry Krebs, Joanne McCauley, "Bus" Clough, Ben Siminoe, Bob Adelman, Glen Ward, Fred Tombs, Judy Buschke, or "Lucky" Felt.

Sincerely yours,

Frederick W. Obermiller
Associate Professor
Extension Resource Economist

CONFIDENTIAL

MORROW COUNTY INPUT-OUTPUT QUESTIONNAIRE

Oregon State University

Summer 1980

FIRM IDENTIFICATION CODE: _____

Date of Interview: _____ Time of Interview: _____ A.M./P.M.

This survey is a cooperative effort on the part of the Morrow County Court and Oregon State University to evaluate the structure of Morrow County's economy. I would like to ask you a few questions about your business sales and expenditures in 1979. I want to assure you that any information you choose to provide will be strictly confidential; furthermore, this information will be tabulated along with other business interview data to yield results for the county as a whole -- not any one firm or person.

1. First, could you tell me, what are the major income producing products or services you sell? (*list major ones*) _____

2. Next, approximately what was your total business income from all sales of merchandise and services in 1979? $_____

3. Now I would like you to think a bit about who it is to whom you are selling. We are interested mainly in finding out to what extent your sales may be to customers inside or outside of Morrow County, and whether your sales are to other businesses, private individuals, or various units of the government. Good approximations are all we need. The information can be given either as dollar amounts or as percentages of your total sales.

   (a) First of all, what was the approximate amount or percentage of your sales made to other businesses inside Morrow County? $_____ or _____%

   (b) What was the approximate amount or percentage of your sales made to private individuals or households residing in Morrow County? $_____ or _____%

   (c) What was the approximate amount or percentage of your sales made to town and county governments in Morrow County? $_____ or _____%

   (d) What was the approximate amount or percentage of your sales made to state or federal agencies located in Morrow County? $_____ or _____%

Turning next to your sales going outside of Morrow County, what was the approximate amount or percentage of sales going to:

(e) Other business there? $_____ or _____%

(f) Private individuals or households not residing in Morrow County? $_____ or _____%

(g) Agencies of federal, state, or local government outside of Morrow County? $_____ or _____%

4. Was your inventory of merchandise for sale higher ( ), lower ( ), or about the same ( ) at the end of 1979 as it was at the beginning of the year? *(If the same, skip to question 6.)*

5. About how much higher or lower? $_____

6. Next I would like to ask you about the purchases for your business. On this sector identification card (*hand respondent sector identification card*) are listed various economic sectors from whom you may have purchased during 1979. Would you please go down this list and tell me whether or not you purchased at all from each sector, and if so, approximately how much you purchased? Please note that we are interested only in the purchases you made for current use in your business or for resale, not in any investment expenditures.

(Interviewer: Record amount in Current Expenditures column of Purchases Table.)

7. Now please think about any investment purchases you may have made during 1979. These are expenditures for any items which you expect to use for more than one year such as machinery, equipment, land, and buildings. Again referring to the Sector Identification Card, would you tell me the approximate amounts, if any, which you spent in each sector?

(Interviewer: Record amount in Investment Purchases column of Purchases Table.)

(a) How much additional business (relative to 1979) could you do without having to increase the numbers or size of machinery, equipment, land, and buildings? $_____ or _____%

(b) At that point, how much additional investment in machinery, equipment, land, and buildings would be needed to support 50 percent more business? $_____ or _____%

8. What was the approximate amount you charged for depreciation in your business during 1979? $_____ or _____%

9. Finally, I would like to ask you about wages, dividends, taxes and rents for 1979.

(a) What was the approximate amount of taxes you paid to Morrow County town and county governments (including licenses and special fees)? $_____ or _____%

(b) What was the approximate amount of taxes or fees you paid to state and federal agencies located in Morrow County (including payroll taxes)? $_____ or _____%

(c) What was the approximate amount of taxes or fees you paid to nonlocal government (state and federal income taxes, etc.)? $_____

This is all the information we need at the present time. Thank you very much for your help. Would you like a copy of the economic report when it is completed? _____ *(yes or no)?*

I certify that the interview was taken with the firm listed above and that the information recorded is a true representation of the interview.

_____
Interviewer's Signature

FIRM IDENTIFICATION CODE: _____

1979 Purchases Table

(Morrow County Input-Output Study)

	Sector (Inside Morrow County)		Purchased for Current Use	Investment Purchases
1.	Animal production	$ or %		
2.	Irrigated crop production	$ or %		
3.	Dryland crop production	$ or %		
4.	Animal processing	$ or %		
5.	Crop processing	$ or %		
6.	Ethanol production	$ or %		
7.	Timber harvesting and hauling	$ or %		
8.	Lumber and wood products processing	$ or %		
9.	Agricultural services	$ or %		
10.	Forestry services	$ or %		
11.	Mining and mineral product processing	$ or %		
12.	General construction	$ or %		
13.	Heavy construction	$ or %		
14.	Chemicals and fertilizers	$ or %		
15.	Maintenance and repair	$ or %		
16.	Other manufacturing and processing	$ or %		
17.	Coal-fire power plants	$ or %		
18.	Transportation	$ or %		
19.	Communication and utilities	$ or %		
20.	Wholesale and retail trade	$ or %		
21.	Finance, insurance, and real estate	$ or %		
22.	Automotive sales and services	$ or %		
23.	Professional services	$ or %		
24.	Lodging	$ or %		
25.	Cafes and taverns	$ or %		
26.	Other wholesale and retail services	$ or %		
27.	Port of Morrow	$ or %		
28.	Local government[a/]	$ or %		
29.	Local agencies of state and federal government[a/]	$ or %		
30.	Households[b/]	$ or %		
31.	Nonlocal households[b/]	$ or %		
32.	Nonlocal government[a/]	$ or %		
33.	Nonlocal business	$ or %		
	TOTAL (complete after interview)			

a/ Excluding taxes and fees.

b/ Including rent, wages, dividends, and profits.

MORROW COUNTY SECTOR IDENTIFICATION CARD

1. Animal Production

   Producers that receive the largest portion of their income from the sale of livestock and poultry and any associated products.

2. Irrigated Crop Production

   Producers that receive the largest portion of their income from sale of irrigated crops, vegetables, or fruits.

3. Dryland Crop Production

   Producers that receive the largest portion of their income from sale of nonirrigated crops such as wheat.

4. Animal Processing

   Meat packing and dressing, dairies, feedlots.

5. Crop Processing

   Grain elevators; oil mills, canneries, bakeries, potato or alfalfa processors, etc.

6. Ethanol Production

   Includes the direct purchase of ethanol or ethanol by-products from a commercial manufacturer (does not include at-pump purchases).

7. Timber Harvesting and Hauling

   Logging camps and logging contractors engaged in cutting timber.

8. Lumber and Wood Products Processing

   Sawmills, peeler mills, shake mills, piling and post mills, plywood manufacturers, etc.

9. Agricultural Services

   Establishments engaged primarily in soil preparation; crop, veterinary and other animal, farm labor, and management services; feed, seed, farm implement and machinery dealers.

10. Forestry Services

    Contractors providing services related to timber production, wood technology, forestry economics, firefighting and reforestation.

11. Mining and Mineral Product Processing

    Establishments engaged in sand and gravel mining; stone, clay, and glass products; pre-mixed concrete and asphalt paving and manufacturing.

12. General Construction

    Firms that contract for building, electrical, plumbing, painting, heating, roofing, flooring, carpenters, excavators, land leveling, masons, well drillers, cabinet makers, tile layers, sheet metal work, plasters.

13. Heavy Construction

    Firms that contract in highway, street, bridge, tunnel, water, sewer, pipe line, and communication and power line construction, blasting, irrigation project construction, and clearing.

14. Chemicals and Fertilizers

    Firms engaged in the production of organic and inorganic chemicals for agriculture, industrial and commercial use.

15. Maintenance and Repair

    Firms engaged in miscellaneous repair services (e.g., electrical, television, jewelry), (does <u>not</u> include automotive repair).

16. Coal-Fired Power Plants

17. Other Manufacturing and Processing

    Soft-drink bottlers, typesetters, miscellaneous printers and publishers, manufacturers of must miscellaneous consumer and producer products (include only those purchases made <u>directly</u> from manufacturer--not wholesale or retail purchases).

18. Transportation

    Railroad, taxi cabs, buses, auto leasing, moving and storage, trailer rentals, school bus, trucking, air (transport and passenger), travel agencies and shipping agents.

19. Communication and Utilities

Radio and television stations, telephone company, newspaper, periodicals, electric, gas, and sanitary service.

20. Wholesale and Retail Trade

Clothing stores, department and variety stores, furniture and appliance stores, drug stores, state-owned liquor stores, wholesale/retail groceries and supermarkets, hardware and machinery stores, and all wholesale dealers supplying the above stores if located in Morrow County (does not include auto and auto parts stores).

21. Finance, Insurance, and Real Estate

Banks, credit unions, loan agencies, insurance, and real estate transactions.

22. Automotive Sales and Services

New and used auto and trailer sales, parts and accessories, gasoline service stations, automotive repairs, towing, automotive upholstry, boat dealers, tire recapping.

23. Professional Services

Doctors, psychiatrists, dentists, chiropractors, optometrists; nursing and personal care facilities, hospitals, medical and dental laboratories; lawyers and legal services; engineers, architects, accountants, bookkeepers; ambulance service.

24. Lodging

Hotels, motels, apartments, rooming and boarding houses, camps and trailer parks.

25. Cafes and Taverns

Restaurants, cafes, taverns, bars, drive-ins, night-clubs.

26. Other Wholesale and Retail Services

Landscape and horticulture services, public warehousing and storage, laundries and cleaning services, photographers, personal and business services, advertisers, recreation, membership organizations, tailors, barber and beauty shops, privately-owned kindergarten and child nurseries.

27. Port of Morrow

Land rentals or sales, sewage disposal fees, bond handling fees, water fees, property taxes, or any other services provided by the Port of Morrow.

28. Households (local)

Transactions with private individuals who are Morrow County residents, such as house rent, yard work, babysitting, house work and errands.

29. Local Government

Water supply, sanitary services, property taxes, local school and library fees, and any other services provided by Morrow County or towns in the county.

30. Local Agencies of State and Federal Government

Payments to local agencies such as U.S. Postal Service, U.S. Forest Service, BLM, State Fish and Game, etc., for example licenses and fees.

31. Nonlocal Households

Transactions with private individuals who live outside Morrow County such as rent to a nonlocal landlord.

32. Nonlocal Government

Payments to state and federal government such as income taxes, and public university tuition and fees.

33. Nonlocal Business

Transactions with businesses located outside Morrow County.

Department of
Agricultural and
Resource Economics

Oregon State University

Corvallis, Oregon 97331 (503) 754-2942

July 11, 1980

The Morrow County Court is concerned with the present and future uses of the water, land, timber, and recreation resources in Morrow County. With help from Oregon State University, a study is being conducted to evaluate the county-wide impacts of changes in the use of county resources. The study also will document opportunities for economic diversification in Morrow County, and will show how changes in national conditions affect local jobs and incomes. A survey of Morrow County households is part of this study. Therefore, information from you, the householder, is important -- because the gains or losses in Morrow County employment and income will directly affect you.

We hope that you will take the time to answer all of the questions in the enclosed questionnaire. These questions relate to your 1979 household income and purchases. We recognize that your cooperation is voluntary, and wish to assure you that any information you choose to give will be strictly confidential. All responses will be added together and only totals will be evaluated. Results cannot be traced to any one person or household. Your name should not be included on the questionnaire.

Thank you for your consideration and time. With the results of this study as a basis, more informed and objective decisions can be made regarding Morrow County's future. If you have any questions concerning this study, please feel free to contact me, Judge Don McElligott (Morrow County Court), Harold Kerr (county extension agent), or any of the following members of the Morrow County Resource Committee: Shirley Rugg, Dick McElligott, Raymond French, Allen Hughes, Ray Alsup, Dr. L.D. Tibbles, Jim Thompson, Ed Tarnasky, Don Peterson, Tom Martin, Warren H. McCoy, Allen Nistad, Leroy Gardner, Mike Sweeney, Matt Doherty, Frank Lamb, Henry Kreps, Joanne McCauley, "Bus" Clough, Ben Siminoe, Bob Adelman, Glen Ward, Fred Toombs, Judy Buschke, or "Lucky" Felt.

Sincerely,

Frederick W. Obermiller

Frederick W. Obermiller
Associate Professor
Extension Resource Economist

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enclosure

CONFIDENTIAL

MORROW COUNTY INPUT-OUTPUT STUDY

Oregon State University

Summer 1980

This survey is a cooperative effort on the part of the Morrow County Court and Oregon State University to evaluate the structure of Morrow County's economy. We would like to ask you a few questions about your total household income and purchases in 1979. All information you choose to give will be treated with the strictest confidence; furthermore, this information will be tabulated along with other households' survey data to yield results for the county as a whole -- not any one household. Please do not put your name on this survey form. For any information you give, we would like only your best approximation, either in dollar amounts, or where appropriate, as percentages of your total household income or total purchases.

1. First, would you please check (✓) below the approximate range of your total 1979 household income:

a.	_____ below 10,000	h.	_____ 25,000 - 29,999
b.	_____ 10,000 - 12,499	i.	_____ 30,000 - 34,999
c.	_____ 12,500 - 14,999	j.	_____ 35,000 - 39,999
d.	_____ 15,000 - 17,499	k.	_____ 40,000 - 44,999
e.	_____ 17,500 - 19,999	l.	_____ 45,000 - 49,999
f.	_____ 20,000 - 22,499	m.	_____ over 50,000
g.	_____ 22,500 - 24,999		

2. Think for a moment about that portion of your total 1979 household income due to wages and salaries.

   a. About what dollar amount or percent of total household income came from wages or salary payments? $_____ or _____%

   b. About what dollar amount or percent of total income came from wages or salaries earned in jobs outside Morrow County? $_____ or _____%

3. Next, we would like some information on sources of your 1979 household income other than wages and salaries.

   a. If any member of your household received social security payments, veterans' benefits, or any other type of state or federal benefits, about what dollar amount, or percent of total income, came from these benefits? $_____ or _____%

   b. If any member of your household received any other pension or retirement benefits from businesses outside Morrow County, about what dollar amount, or percent of the total, came from these sources? $_____ or _____%

c. Some members of your household may have had non-wage or salary income in 1979 other than those mentioned in (a) or (b) above. This might include rent, inheritance, or payments from other households outside Morrow County. If so, please indicate the approximate dollar amount or percentage of total household income in 1979 from such sources? $_____ or _____%

4. Next, we would now like to ask you about your household purchasing pattern in 1979.

a. Total household purchases may not equal total household income due to savings, borrowing, or for other reasons. Please indicate how much your household actually spent in 1979 either in dollars or as a percent of total household income. $_____ or _____%

b. These household purchases were made from many different economic sectors inside and outside of Morrow County. *Please go through the attached list, sector by sector, and enter your total purchases from each sector in the first column.* In the second column, indicate the dollar amount or the percentage of purchases within the particular sector that were made from firms inside Morrow County.

5. How many members of your household held full-time jobs in Morrow County in 1979? _____ What are the total number of months of employment by all household members with full-time jobs in Morrow County? _____.

6. How many members of your household held part-time jobs in Morrow County in 1979? _____ What were the total number of months of employment by all household members with part-time jobs in Morrow County? _____

This complete all the information we need. Please mail this questionnaire in the enclosed, self-addressed envelope. No envelope or stamp is necessary. Once again, thank you for your help.

Sectors From Which You May Have Made Direct Purchases in 1979	Total Purchases	Inside Morrow County
1. Animal Production Producers that receive the largest portion of their income from the sale of livestock and poultry and any associated products (possible direct purchase by you from ranchers of eggs or beef for example).	$_____	$ or % _____
2. Irrigated Crop Production Producers that receive the largest portion of their income from sale of irrigated crops, vegetables, or fruits (possible direct purchase by you from farmers of potatoes, fresh vegetables and fruit, etc.).	$_____	$ or % _____
3. Dryland Crop Production Producers that receive the largest portion of their income from sale of nonirrigated crops such as wheat (possible direct purchase by you from farmers of grass hay or straw, for example).	$_____	$ or % _____
4. Animal Processing Meat packing and dressing, dairies, feedlots	$_____	$ or % _____
5. Crop Processing Grain elevators; oil mills, canneries, bakeries, potato or alfalfa processors, etc.	$_____	$ or % _____
6. Ethanol Production Includes the direct purchase of ethanol or ethanol by-products from a commercial manufacturer (does not include at-pump purchases).	$_____	$ or % _____
7. Timber Harvesting and Hauling Logging camps and logging contractors engaged in cutting timber.	$_____	$ or % _____
8. Lumber and Wood Products Processing Sawmills, peeler mills, shake mills, piling and post mills, plywood manufacturers, etc.	$_____	$ or % _____
9. Agricultural Services Establishments engaged primarily in soil preparation; crop, veterinary and other animal, farm labor, and management services; feed, seed, farm implement and machinery dealers.	$_____	$ or % _____
10. Forestry Services Contractors providing services related to timber production, wood technology, forestry economics, firefighting and reforestation.	$_____	$ or % _____
11. Mining and Mineral Product Processing Establishments engaged in sand and gravel mining; stone, clay, and glass products; pre-mixed concrete and asphalt paving and manufacturing.	$_____	$ or % _____
12. General Construction Firms that contract for building, electrical, plumbing, painting, heating, roofing, flooring, carpenters, excavators, land leveling, masons, well drillers, cabinet makers, tile layers, sheet metal work, plasters.	$_____	$ or % _____
13. Heavy Construction Firms that contract in highway, street, bridge, tunnel, water, sewer, pipe line, and communication and power line construction, blasting, irrigation project construction, land clearing.	$_____	$ or % _____

	Sectors From Which You May Have Made Direct Purchases in 1979	Total Purchases	Inside Morrow County
14.	Chemicals and Fertilizers Firms engaged in the production of organic and inorganic chemicals for agriculture, industrial and commercial use.	$_____	$ or % _____
15.	Maintenance and Repair Firms engaged in miscellaneous repair services (e.g., electrical, television, jewelry), (does not include automotive repair).	$_____	$ or % _____
16.	Coal-Fired Power Plants	$_____	$ or % _____
17.	Other Manufacturing and Processing Soft-drink bottlers, typesetters, miscellaneous printers and publishers, manufacturers of most miscellaneous consumer and producer products (include only those purchases made directly from manufacturer - not wholesale or retail purchases).	$_____	$ or % _____
18.	Transportation Railroad, taxi cabs, buses, auto leasing, moving and storage, trailer rentals, school bus, trucking, air (transport and passenger), travel agencies and shipping agents.	$_____	$ or % _____
19.	Communication and Utilities Radio and television stations, telephone company, newspaper, periodicals, electric, gas, and sanitary service.	$_____	$ or % _____
20.	Wholesale and Retail Trade Clothing stores, department and variety stores, furniture and appliance stores, drug stores, state-owned liquor stores, wholesale/retail groceries and supermarkets, hardware and machinery stores, and all wholesale dealers supplying the above stores if located in Morrow County (does not include auto and auto parts stores).	$_____	$ or % _____
21.	Finance, Insurance, Real Estate Banks, credit unions, loan agencies, insurance, and real estate transactions.	$_____	$ or % _____
22.	Automotive Sales and Services New and used auto and trailer sales, parts and accessories, gasoline service stations, automotive repairs, towing, automotive upholstry, boat dealers, tire recapping.	$_____	$ or % _____
23.	Professional Services Doctors, psychiatrists, dentists, chiropractors, optometrists; nursing and personal care facilities, hospitals, medical and dental laboratories; lawyers and legal services; engineers, architects, accountants, bookkeepers; ambulance service.	$_____	$ or % _____
24.	Lodging Hotels, motels, apartments, rooming and boarding houses, camps and trailer parks.	$_____	$ or % _____
25.	Cafes and Taverns Restaurants, cafes, taverns, bars, drive-ins, night-clubs.	$_____	$ or % _____
26.	Other Wholesale and Retail Services Landscape and horticulture services, public warehousing and storage, laundries and cleaning services, photographers, personal and business services, advertisers, recreation, membership organizations, tailors, barber and beauty shops, privately-owned kindergarten and child nurseries.	$_____	$ or % _____

	Sectors From Which You May Have Made Direct Purchases in 1979	Total Purchases
27.	Port of Morrow Water transportation, ferries, towing and tug service, cargo handling, commercial boat charter, or any other services provided by the Port of Morrow.	$_____
28.	Households (local) Transactions with private individuals who are Morrow County residents, such as house rent, yard work, babysitting, house work and errands.	$_____
29.	Local Government Water supply, sanitary services, property taxes, local school and library fees, and any other services provided by Morrow County or towns in the county.	$_____
30.	Local Agencies of State and Federal Government Payments to local agencies such as U.S. Postal Service, U.S. Forest Service, BLM, State Fish and Game, etc., for example licenses and fees.	$_____
31.	Nonlocal Households Transactions with private individuals who live outside Morrow County such as rent to a nonlocal landlord.	$_____
32.	Nonlocal Government Payments to state and federal government such as income taxes, and public university tuition and fees.	$_____

APPENDIX B

A PROCEDURE FOR DEVELOPING EXPANSION COEFFICIENTS TO PROJECT POPULATION ESTIMATES OF INTER-INDUSTRY TRANSACTIONS

Development of Expansion Coefficients

The procedure by which expansion scalars are derived is straightforward. The procedure rests on two basic assumptions, as follows:

1. Wage payments and total payments to households are fixed proportions of total sales within a sector.
2. Firms which do not report their wages are assumed to be approximately the same size within a sector.

Assumption (1) reflects the input-output assumption of fixed technical coefficients. Assumption (2) is used in the absence of more realistic a priori information on nonreporting firms.

The first step is to develop scalars by which population estimates of payments to households may be estimated. The scalar for reporting firms is derived as follows:

$$W_i^P / W_i^S = \alpha_i \geq 1 \qquad i = 1, 2, \ldots n \qquad \text{(B-1)}$$

where

W_i^P = is the ith sector's reported wages (as reported to the Oregon Department of Human Services),

W_i^S = is the wages payments of the firms in the ith sector which were sampled (wage payments as reported to the Oregon Department of Human Services), and

α_i = an expansion scalar for the ith sector.

The scalar for nonreporting firms is derived in a similar manner, as follows:

$$N_i^P / N_i^S = \gamma_i \geq 1 \qquad i = 1, 2, \ldots n \qquad \text{(B-2)}$$

where

N_i^P = the number of nonreporting firms in the ith sector,

N_i^S = the number of nonreporting firms sampled in the ith sector, and

γ_i = is an expansion scalar for the ith sector.

It is necessary to develop two distinct scalars as there are two types of firms within an economy, as noted in Chapter III.

It is possible to estimate 'α' by regression analysis. Regression analysis would provide statistics which inform the researcher as to the confidence which can be placed in the estimate of α. If assumption (1) holds, the regression equation will reduce to equation (B-1).

The scalars developed in equations (B-1) and (B-2) are used to project population estimates of payments to households, by sector. This is accomplished as follows:

$$H_i^{PR} = \alpha_i \times H_i^{SR} \qquad (i = 1, 2, \ldots, n \qquad \text{(B-3)}$$

where

H_i^{PR} = population estimates of payments to households by reporting firms in sector i,

α_i = is as defined by equation (B-1), and

H_i^{SR} = payments to households by reporting firms in the sample of sector i.

Population estimates for nonreporting firms are projected as follows:

$$H_i^{PNR} = \gamma_i \times H_i^{SNR} \qquad i = 1, 2, \ldots, 3 \qquad \text{(B-4)}$$

where

H_i^{PNR} = population estimates of payments to households by nonreporting firms in sector i,

γ_i = is as defined by equation (B-2), and

H_i^{SNR} = payments to households by nonreporting firms in the sample of sector i.

It is estimated population payments to households are combined with the sample payments to households to derive each sector's expansion coefficient. This is accomplished as follows:

$$\beta_i = \frac{H_i^{PR} + H_i^{PNR}}{H_i^{SR} + H_i^{SNR}} \qquad i = 1, 2, \ldots, n \qquad \text{(B-5)}$$

where

β_i = the expansion coefficient for the ith sector, and

H_i^{PR}, H_i^{PNR}, H_i^{SR} and H_i^{SNR} are as previously defined.

The β_i for each sector is applied to the respective inter-industry sample transactions to derive population estimates. The population estimates are then adjusted to derive a balanced transactions table.

The expansion scalars derived for the Morrow County input-output are presented in Table IV, Chapter III. It is important to note that there may be peculiarities of the data which will hinder the estimation of expansion scalars, e.g., firms with losses during the survey

year. The researcher can only handle these problems on a case-by-case basis.

APPENDIX C

INPUT-OUTPUT TABLES WITHOUT THE COAL FIRED POWER PLANT SECTOR

TABLE C-1. TRANSACTIONS TABLE WITHOUT THE COAL FIRED POWER PLANT SECTOR, 1970 $1,000s

Sales to Local & Nonlocal Sectors / Purchases from Local & Nonlocal Sectors	Animal Production	Irrigated Crop Production	Dryland Crop Production	Food Processing	Wood Products	Agricultural Services	Construction	Maintenance & Repair	Communication, Transportation, & Utilities	Wholesale & Retail Trade	Finance, Insurance, & Real Estate	Automobile Sales & Service	Professional Services	Lodging	Cafes & Taverns	Other Wholesale & Retail Services	Port of Morrow	Local Government	State Agencies of Federal Government	Households	Subtotal - All Local Sectors	Nonlocal Households	Nonlocal Government	Nonlocal Business	Subtotal - All Nonlocal Sectors	Inventory Accumulation	Capital Investment	TOTAL SALES
1. Animal Production	105	7	62	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	257	0	66	10,158	10,224	23	86	10,370
2. Irrigated Crop Production	48	0	0	1,634	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,670	0	0	36,154	36,154	75	10	37,910
3. Dryland Crop Production	411	0	1,239	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,622	0	62	10,322	10,200	1,207	0	13,070
4. Food Processing	582	638	375	648	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	185	2,800	10	98	55,549	55,210	1,720	0	59,546
5. Wood Products	581	0	0	0	2,252	0	0	0	0	0	0	0	0	0	0	0	0	6	58	651	3,328	0	226	31,264	31,530	0	0	35,210
6. Agricultural Services	1,082	2,232	3,768	196	0	209	2	0	0	0	0	0	0	0	0	0	0	54	3	366	8,225	58	0	5,400	2,453	66	1,646	17,910
7. Construction	0	0	0	0	0	1	150	0	46	13	0	24	0	18	8	5	16	22	38	1,222	8,078	525	116	6,829	3,168	60	3,504	8,227
8. Maintenance & Repair	0	0	0	66	12	4	4	0	8	16	8	4	8	10	8	0	8	28	2	17	187	0	0	0	0	0	0	182
9. Communication, Transportation, & Utilities	170	155	197	8	503	45	41	1	30	154	5	38	16	50	18	18	2	82	26	985	5,542	164	400	68	744	0	13	5,300
10. Wholesale & Retail Trade	181	150	1,093	1	22	12	15	1	21	58	2	1,088	6	5	170	22	1	16	38	6,300	18,921	990	0	64	1,268	188	83	14,188
11. Finance, Insurance, & Real Estate	146	72	185	20	45	24	95	8	32	181	365	25	12	85	41	96	0	76	0	627	8,200	416	8	28	438	0	78	1,110
12. Automobile Sales & Service	0	0	21	42	82	82	68	3	82	45	24	181	1	15	6	48	5	116	283	8,138	2,388	1,045	12	98	2,100	58	416	5,881
13. Professional Services	1	0	27	81	8	5	8	2	16	28	1	4	11	5	5	8	4	78	0	965	1,127	163	0	82	190	0	0	1,159
14. Lodging	108	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	492	826	452	25	524	288	0	0	1,380
15. Cafes & Taverns	0	4	0	0	0	1	12	0	8	8	0	0	1	8	1	0	1	1	0	1,058	2,100	344	0	0	544	0	0	2,648
16. Other Wholesale & Retail Services	0	0	0	0	0	4	5	1	14	42	18	5	2	4	11	6	5	8	0	485	602	154	0	25	177	4	0	784
17. Port of Morrow	0	0	0	564	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	581	0	0	0	0	0	0	581
18. Local Government	129	155	257	181	187	155	18	1	28	60	14	10	14	99	10	5	5	140	0	1,796	3,377	0	1,292	8,175	3,187	0	0	7,566
19. Local Agencies of State & Federal Government	58	0	71	1,632	696	203	38	0	77	169	52	56	21	95	56	27	0	10	0	88	3,336	98	11,584	2,182	13,250	0	21	17,122
20. Households	944	1,208	5,652	8,588	5,328	1,085	812	51	198	1,534	1,355	460	554	68	342	228	19	3,626	12,754	962	46,373	1,621	978	6	2,532	0	2	49,972
Subtotal - All Local Sectors	4,524	5,131	14,372	14,258	10,104	2,215	1,308	24	808	2,243	1,321	1,914	432	188	638	422	28	4,823	18,127	31,981	97,037	2,660	14,783	168,373	126,182	3,547	8,943	271,238
21. Nonlocal Households	0	2,563	0	0	9	54	1,293	0	260	2	1	8	133	13	0	0	0	158	41	109	4,710	0	0	0	1	0	0	
22. Nonlocal Government	353	35	2,088	110	4,848	72	132	15	135	220	127	67	68	29	14	75	8	1,365	1,160	9,970	22,252	0	0	0	0	0	0	
23. Nonlocal Business	5,164	28,451	5,793	20,962	17,252	11,135	1,033	67	1,351	11,222	542	3,414	152	660	426	225	98	1,230	3,664	15,756	127,122	0	0	0	0	0	13,251	13,251
Subtotal - All Nonlocal Sectors	5,517	31,049	7,881	21,077	22,109	11,312	3,171	82	1,746	11,524	670	3,497	353	778	438	300	47	2,753	5,045	26,113	153,300							
24. Inventory Depletion	22	19	585	1,634	1,667	81	105	5	66	15	548	75	0	0	106	6	0	70	20	0	3,018	0	0	0	0	0	0	
25. Depreciation	198	1,714	1,838	8,616	1,648	1,092	96	12	622	279	66	75	222	386	30	28	478	0	0	0	12,896	0	0	0	0	0	0	
TOTAL PURCHASES	10,579	38,210	28,378	38,588	38,212	25,212	8,215	183	3,226	13,128	3,113	5,892	1,130	1,529	2,048	787	582	9,248	17,188	69,988	323,318						13,251	388,479

TABLE C.1. MATRIX OF DIRECT COEFFICIENTS WITHOUT THE COAL FIRED POWER PLANT SECTOR, 1979

	Animal Production	Irrigated Crop Production	Dryland Crop Production	Food Processing	Wood Products	Agricultural Services	Construction	Maintenance & Repair	Communication, Transportation, & Utilities	Wholesale & Retail Trade	Finance, Insurance, & Real Estate	Automobile Sales & Service	Professional Services	Lodging	Cafes & Taverns	Other Wholesale & Retail Services	Port of Morrow	Local Government	Other Agencies of State & Federal Government	Households	Nonlocal Households	Nonlocal Government	Nonlocal Business	Inventory Accumulation	Capital Investment
1. Animal Production	.0099	.0002	.0028	.0016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	.0003	0	.0043	.0541	.0060	.0048
2. Irrigated Crop Production	.0030	0	0	.0413	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*	0	0	.1927	.0195	.0006
3. Dryland Crop Production	.0389	0	.0346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	.0001	.0042	.1025	.4515	0
4. Food Processing	.0507	.0167	.0165	.0172	0	0	0	0	0	.0028	0	0	0	0	0	0	0	0	0	.0029	.0005	.0061	.1885	.4471	0
5. Wood Products	.0160	0	0	0	.0907	0	0	0	0	0	0	0	0	0	0	0	0	0	.0009	.0019	.0136	0	.0218	.1667	0	0
6. Agricultural Services	.1024	.0589	.1662	.0050	0	.0139	.0003	.0113	0	0	0	0	0	0	0	0	0	.0048	.0005	.0076	.0011	0	.0288	.0114	.0962
7. Construction	0	0	0	0	0	.0001	.0220	0	.0140	.0008	0	.0041	.0001	.0085	.0047	.0058	.0203	.0046	.0022	.0362	.0025	.0078	.0156	.0179	.0879
8. Maintenance & Repair	0	0	0	.0012	.0003	.0005	.0006	0	.0006	.0011	.0009	.0007	.0014	.0112	.0029	0	.0042	.0032	.0001	.0004	*	0	0	*	0
9. Communication, Transportation, & Utilities	.0161	.0051	.0087	.0002	.0140	.0030	.0060	.0087	.0090	.0108	.0010	.0057	.0110	.0318	.0095	.0231	.0031	.0074	.0015	.0205	.0059	.0267	.0003	0	.0007
10. Wholesale & Retail Trade	.0455	.0140	.0923	*	.0006	.0011	.0051	.0036	.0215	.0039	.0008	.1913	.0043	.0034	.0776	.0302	.0015	.0020	.0022	.3732	.0208	0	.0003	.0292	.0049
11. Finance, Insurance, & Real Estate	.0141	.0018	.0258	.0005	.0013	.0016	.0140	.0092	.0174	.0128	.1170	.0061	.0075	.0538	.0250	.1229	0	.0104	0	.0141	.0087	.0002	.0001	0	.0045
12. Automobile Sales & Service	0	0	.0009	.0012	.0024	.0041	.0092	.0165	.0249	.0030	.0078	.0229	.0009	.0094	.0036	.0512	.0088	.0161	.0136	.0653	.0218	.0008	.0003	.0153	.0244
13. Professional Services	.0001	*	.0012	.0021	*	.0003	.0009	.0103	.0040	.0017	.0002	.0007	.0074	.0033	.0021	.0063	.0071	.0110	0	.0201	.0034	0	.0002	0	0
14. Lodging	.0096	0	0	0	0	*	.0016	.0003	0	0	0	0	0	0	0	.0003	0	0	0	.0103	.0090	.0017	.0028	0	0
15. Cafes & Taverns	0	.0001	0	0	0	.0001	.0020	.0008	.0023	.0006	.0024	0	.0006	.0010	.0003	0	.0008	.0002	0	.0219	.0113	0	0	.0010	0
16. Other Wholesale & Retail Services	0	0	0	0	0	.0003	.0004	.0058	.0042	.0035	.0089	.0016	.0012	.0024	.0070	.0070	.0009	.0011	*	.0097	.0032	0	.0001	.0011	0
17. Port of Morrow	0	0	0	.0148	0	0	0	0	0	0	.0005	0	0	0	0	0	0	0	0	.0001	0	0	0	0	0
18. Local Government	.0122	.0041	.0149	.0089	.0044	.0170	.0019	.0070	.0078	.0042	.0045	.0017	.0099	.0623	.0062	.0109	.0023	.0199	*	.0374	0	.0464	.0016	0	0
19. Other Agencies of State & Federal Government	.0055	0	.0009	.0417	.0194	.0135	.0085	0	.0253	.0119	.0101	.0099	.0146	.0600	.0338	.0358	0	.0014	0	.0019	.0021	.7748	.0115	0	.0012
20. Households	.0892	.0344	.2493	.2245	.1488	.0722	.1191	.3181	.1211	.1082	.4344	.0808	.3859	.0396	.2110	.2838	.0659	.5147	.6836	.0201	.0338	.0654	0	0	.0004
Subtotal - All Local Sectors	*.4361*	*.1336*	*.8342*	*.3601*	*.2818*	*.1375*	*.3816*	*.3918*	*.2452*	*.1863*	*.3885*	*.3233*	*.6648*	*.2857*	*.3837*	*.3733*	*.1148*	*.5881*	*.7054*	*.4556*	*.3999*	*2.0002*	*1.0000*	*1.0000*	*.1256*
21. Nonlocal Households	0	.0676	0	0	0	.0022	.1603	0	.0790	.0002	.0002	.0015	.0956	.0079	0	0	0	.0224	.0024	.0083	0	0	0	0	0
22. Nonlocal Government	.0372	.0009	.0921	.0028	.1378	.0048	.0194	.0911	.0411	.0190	.0407	.0118	.0451	.0623	.0148	.0952	.0127	.1938	.0675	.2078	0	0	0	0	0
23. Nonlocal Business	.4883	.7305	.1672	.5297	.480	.7874	.5991	.4172	.4217	.7985	.1740	.6351	.2491	.4187	.5021	.2868	.0652	.1759	.2236	.3783	0	0	0	0	.7744
Subtotal - All Nonlocal Sectors	*.8335*	*.8190*	*.8393*	*.5325*	*.828?*	*.7944*	*.7788*	*.5083*	*.5418*	*.8177*	*.8149*	*.6484*	*.5898*	*.4889*	*.5169*	*.3820*	*.0779*	*.3921*	*.2935*	*.5861*	*0*	*0*	*0*	*0*	*.7744*
24. Inventory Depletion	.0035	.0005	.0258	.0415	.0464	.0054	.0153	.0286	.0199	.0011	.1759	.0131	0	0	.0642	.0074	0	.0099	.0011	0	0	0	0	0	0
25. Depreciation	.0369	.0452	.0808	.0661	.0542	.0729	.0141	.0715	.1932	.0162	.0707	.0128	.1654	.2243	.0353	.0352	.8074	0	0	0	0	0	0	0	0
TOTAL - ALL SECTORS	*1.0000*	*1.0001*	*2.0000*	*1.0001*	*1.0000*	*2.0002*	*.9998*	*1.0000*	*1.0000*	*1.0001*	*1.0000*	*.9998*	*1.0000*	*.9998*	*1.0001*	*.9999*	*1.0002*	*1.0001*	*1.0000*	*1.0000*	*.9998*	*2.0002*	*1.0000*	*1.0000*	*1.2500*

TABLE C-3. MATRIX OF DIRECT PLUS INDIRECT COEFFICIENTS WITHOUT THE COAL FIRED POWER PLANT SECTOR, 1979

	Animal Production	Irrigated Crop Production	Dryland Crop Production	Food Processing	Wood Products	Agricultural Services	Construction	Maintenance & Repair	Communication, Transportation, & Utilities	Wholesale & Retail Trade	Finance, Insurance, & Real Estate	Automobile Sales & Service	Professional Services	Lodging	Cafes & Taverns	Other Wholesale & Retail Services	Port of Morrow	Local Government	Other Agencies of State & Federal Government	Households
1. Animal Production	1.0103	.0002	.0031	.0018	.0001	•	.0001	.0001	.0001	.0001	.0002	.0001	.0002	.0001	.0001	.0002	•	.0002	.0003	.0004
2. Irrigated Crop Production	.0062	1.0007	.0008	.0421	•	•	•	.0001	•	.0001	.0001	•	.0001	•	.0001	.0001	•	.0001	.0001	.0002
3. Dryland Crop Production	.0415	•	1.0579	.0001	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
4. Food Processing	.0537	.0172	.0196	1.0194	.0007	.0004	.0006	.0014	.0007	.0034	.0021	.0011	.0017	.0006	.0013	.0017	.0003	.0022	.0028	.0040
5. Wood Products	.0428	.0009	.0056	.0047	1.1029	.0016	.0021	.0057	.0028	.0022	.0086	.0021	.0070	.0028	.0046	.0068	.0013	.0101	.0137	.0169
6. Agricultural Services	.1140	.0603	.1817	.0103	.0017	1.0150	.0016	.0146	.0015	.0012	.0046	.0011	.0038	.0019	.0025	.0036	.0008	.0099	.0064	.0090
7. Construction	.0075	.0023	.0143	.0120	.0082	.0043	1.0287	.0149	.0217	.0067	.0222	.0099	.0181	.0165	.0167	.0238	.0242	.0284	.0320	.0431
8. Maintenance & Repair	.0006	.0001	.0007	.0016	.0006	.0004	.0009	1.0005	.0009	.0013	.0016	.0011	.0020	.0117	.0034	.0008	.0044	.0040	.0009	.0012
9. Communication, Transportation, & Utilities	.0233	.0070	.0203	.0083	.0208	.0059	.0105	.0139	1.0115	.0149	.0160	.0117	.0231	.0376	.0184	.0359	.0057	.0234	.0211	.0282
10. Wholesale & Retail Trade	.0857	.0252	.1687	.0588	.0412	.0224	.0377	.0801	.0620	1.0332	.1126	.2233	.0933	.0409	.1371	.1270	.0201	.1221	.1521	.2144
11. Finance, Insurance, & Real Estate	.0239	.0040	.0419	.0081	.0068	.0047	.0205	.0209	.0202	.0189	1.1478	.0138	.0201	.0674	.0381	.1526	.0028	.0277	.0186	.0267
12. Automobile Sales & Service	.0148	.0046	.0287	.0234	.0181	.0123	.0214	.0246	.0196	.0143	.0502	1.0345	.0343	.0258	.0268	.0868	.0155	.0603	.0683	.0791
13. Professional Services	.0046	.0014	.0096	.0038	.0046	.0028	.0044	.0138	.0082	.0050	.0127	.0041	1.0175	.0081	.0089	.0163	.0091	.0245	.0166	.0241
14. Lodging	.0116	.0006	.0038	.0031	.0021	.0011	.0033	.0043	.0019	.0015	.0059	.0014	.0048	1.0018	.0031	.0049	.0009	.0063	.0080	.0116
15. Cafes & Taverns	.0042	.0014	.0083	.0068	.0047	.0024	.0056	.0093	.0065	.0039	.0155	.0032	.0110	.0052	1.0072	.0104	.0028	.0138	.0172	.0251
16. Other Wholesale & Retail Services	.0025	.0007	.0048	.0034	.0024	.0015	.0025	.0103	.0066	.0052	.0166	.0040	.0066	.0053	.0110	1.0137	.0020	.0032	.0087	.0125
17. Port of Morrow	.0008	.0003	.0004	.0151	•	•	•	.0001	•	.0001	.0006	•	.0001	.0001	.0001	.0001	1.0000	.0001	.0001	.0002
18. Local Government	.0243	.0078	.0349	.0220	.0135	.0219	.0088	.0233	.0158	.0106	.0239	.0085	.0294	.0716	.0194	.0307	.0061	1.0457	.0317	.0461
19. Other Agencies of State & Federal Government	.0136	.0024	.0093	.0454	.0236	.0149	.0108	.0045	.0263	.0140	.0171	.0142	.0193	.0636	.0383	.0413	.0013	.0077	1.0071	.0098
20. Households	.1814	.0566	.3641	.3020	.2071	.1061	.1582	.3809	.1813	.1477	.5732	.1376	.4636	.1760	.3014	.4455	.0863	.6111	.7729	1.1258
MULTIPLIERS	1.6674	1.1938	1.9735	1.5972	1.1593	1.3181	1.3129	1.5542	1.4106	1.2318	2.0365	1.4718	1.7553	1.5369	1.8385	2.0020	1.1935	2.0059	2.1795	1.8734

APPENDIX D

INPUT-OUTPUT TABLES WITH THE COAL FIRED POWER PLANT SECTOR

TABLE D-1. TRANSACTIONS TABLE WITH THE COAL FIRED POWER PLANT SECTOR IN 1979 DOLLARS ($1,000)

Purchases from Local & Nonlocal Sectors / Sales to Local & Nonlocal Sectors	Animal Production	Irrigated Crop Production	Dryland Crop Production	Food Processing	Wood Products	Agricultural Services	Construction	Maintenance & Repair	Communication, Transportation, & Utilities	Coal-Fired Power Plant	Wholesale & Retail Trade	Finance, Insurance, & Real Estate	Automobile Sales & Service	Professional Services	Lodging
1. Animal Production	105	7	63	65	0	0	0	0	0	0	0	0	0	0	0
2. Irrigated Crop Production	42	0	0	1,636	0	0	0	0	0	0	0	0	0	0	0
3. Dryland Crop Production	413	0	1,239	0	0	0	0	0	0	0	0	0	0	0	0
4. Food Processing	537	633	575	683	0	0	0	0	0	0	40	0	0	0	0
5. Wood Products	381	0	0	0	3,270	0	0	0	0	0	0	0	0	0	0
6. Agricultural Services	3,083	8,332	5,764	196	0	310	3	0	6	0	0	0	0	0	0
7. Construction	0	0	0	0	0	1	156	0	50	0	12	0	27	*	14
8. Maintenance & Repair	0	0	0	46	12	4	5	0	2	600	10	2	3	3	18
9. Communication, Transportation, & Utilities	120	195	196	6	505	40	43	7	32	0	174	4	37	10	54
10. Coal-Fired Power Plant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11. Wholesale & Retail Trade	483	530	2,093	1	22	17	37	3	77	0	68	3	1,338	7	8
12. Finance, Insurance, & Real Estate	149	72	565	20	45	34	101	7	44	0	205	394	38	13	91
13. Automobile Sales & Service	0	0	33	47	37	88	67	15	69	22	44	18	149	1	18
14. Professional Services	1	*	27	81	2	5	8	8	14	0	37	1	5	18	8
15. Lodging	102	0	0	0	0	*	11	*	0	0	0	0	4	0	0
16. Cafes & Taverns	0	4	0	0	0	3	14	1	3	0	8	8	0	1	1
17. Other Wholesale & Retail Services	0	0	0	0	0	4	3	5	15	0	55	30	11	2	0
18. Port of Morrow	0	0	0	585	0	0	0	0	0	0	0	2	0	0	0
19. Local Government	129	655	337	331	150	257	14	5	28	3,484	87	16	11	17	105
20. Local Agencies of State & Federal Government	58	0	21	1,654	699	205	61	0	65	380	163	34	64	25	101
21. Households	844	1,303	5,653	8,496	3,346	1,098	818	248	435	6,764	1,737	1,477	333	653	67
Subtotal - All Local Sectors	4,393	5,331	14,378	14,283	10,148	3,939	3,310	307	975	10,735	8,630	3,291	3,103	753	483
22. Nonlocal Households	0	2,563	0	0	0	38	1,153	0	282	16,800	3	1	10	161	15
23. Nonlocal Government	393	35	2,088	110	4,960	75	140	71	187	3,000	306	134	78	78	105
24. Nonlocal Business	5,166	26,435	3,793	20,965	17,124	11,818	4,317	326	1,508	45,247	11,822	191	4,115	433	706
Subtotal - All Nonlocal Sectors	5,550	31,053	8,391	22,095	18,239	12,328	3,913	397	1,337	93,047	13,130	330	4,189	684	854
25. Inventory Depletion	37	10	385	1,636	1,674	65	111	12	71	0	17	598	65	0	0
26. Depreciation	390	3,714	1,633	2,618	1,938	1,104	102	56	691	11,200	260	70	32	279	576
TOTAL PURCHASES	10,679	37,917	22,677	38,417	[illegible]	15,138	7,238	782	3,574	84,000	18,057	3,333	6,478	1,849	3,517

Purchases from Local & Nonlocal Sectors / Sales to Local & Nonlocal Sectors	Cafes & Taverns	Other Wholesale & Retail Services	Port of Morrow	Local Government	Other Agencies of State & Federal Government	Households	Subtotal - All Local Sectors	Nonlocal Household	Nonlocal Government	Nonlocal Business	Subtotal - All Nonlocal Sectors	Inventory Accumulation	Capital Investment	TOTAL SALES
1. Animal Production	0	0	0	0	*	20	180	0	64	10,150	20,214	13	12	19,579
2. Irrigated Crop Production	0	0	0	0	*	*	1,678	0	0	36,154	38,139	75	10	37,917
3. Dryland Crop Production	0	0	0	0	0	1	1,953	0	62	19,222	19,290	1,737	0	22,678
4. Food Processing	0	0	0	0	0	120	2,663	10	83	35,348	35,458	1,720	0	39,819
5. Wood Products	0	0	0	10	54	763	4,479	0	126	31,264	31,390	0	0	38,068
6. Agricultural Services	0	0	0	53	2	440	7,896	53	0	6,400	3,653	64	1,646	15,138
7. Construction	0	5	12	31	30	2,044	3,664	121	110	3,829	3,188	69	1,304	7,306
8. Maintenance & Repair	5	0	5	35	2	20	787	*	0	0	0	*	0	787
9. Communication, Transportation, & Utilities	18	33	2	68	27	1,181	2,320	224	400	60	749	0	18	3,577
10. Coal-Fired Power Plant	0	0	0	0	0	0	0	42,000	0	42,000	84,000	0	0	84,300
11. Wholesale & Retail Trade	145	37	1	22	30	8,899	13,807	999	0	66	1,365	113	43	16,962
12. Finance, Insurance, & Real Estate	47	111	0	116	0	814	2,888	418	3	20	458	0	78	3,358
13. Automobile Sales & Service	7	48	5	177	240	3,766	4,389	1,046	12	40	1,100	30	418	6,478
14. Professional Services	4	6	0	131	0	1,160	1,430	161	0	37	189	0	0	1,858
15. Lodging	0	*	0	0	0	583	702	432	25	524	981	0	0	1,980
16. Cafes & Taverns	1	0	*	2	0	1,265	1,316	544	0	0	544	4	0	1,868
17. Other Wholesale & Retail Services	18	8	1	13	*	550	718	154	0	23	177	0	0	899
18. Port of Morrow	0	0	0	0	0	7	594	0	0	0	8	0	0	594
19. Local Government	12	10	1	219	*	2,160	7,535	0	1,793	2,175	5,167	0	0	12,308
20. Local Agencies of State & Federal Government	63	30	0	18	0	113	4,738	99	11,584	2,157	15,850	0	31	17,989
21. Households	303	356	30	3,663	13,078	1,188	53,230	1,621	670	0	2,539	0	7	57,814
Subtotal - All Local Sectors	717	519	29	6,381	18,188	38,234	128,185	47,350	14,948	137,373	150,435	7,347	3,798	370,388
22. Nonlocal Households	0	0	0	286	98	479	37,734	0	0	0	0	0	0	
23. Nonlocal Government	28	46	8	2,153	1,192	11,847	27,263	0	0	0	8	8	0	
24. Nonlocal Business	854	258	30	1,913	3,850	14,936	[illegible]	0	0	0	0	0	15,281	27,281
Subtotal - All Nonlocal Sectors	944	344	47	4,353	3,193	31,405	[illegible]							
25. Inventory Depletion	120	7	0	109	20	0	5,138	0	0	0	0	0	0	
26. Depreciation	66	22	479	0	0	0	28,332	0	0	0	0	0	0	
TOTAL PURCHASES	1,867	901	584	11,303	17,964	57,538	378,382						15,251	389,557

TABLE D-2. MATRIX OF DIRECT PLUS INDIRECT COEFFICIENTS WITH THE COAL FIRED POWER PLANT SECTOR

Sector	Animal Production	Irrigated Crop Production	Dryland Crop Production	Food Processing	Wood Products	Agricultural Services	Construction	Maintenance & Repair	Communication, Transportation & Utilities	Coal Fired Power Plant	Wholesale & Retail Trade	Finance, Insurance, & Real Estate	Automobile Sales & Service	Professional Services	Lodging	Cafes & Taverns	Other Wholesale & Retail Services	Port of Morrow	Local Government	Local Agencies of State & Fedcr Government	Households
1. Animal Production	1.0103	.0003	.0031	.0018	.0001	*	.0001	.0001	.0001	*	.0001	.0002	.0001	.0002	.0001	.0001	.0002	*	.0002	.0003	.0004
2. Irrigated Crop Production	.0062	1.0007	.0008	.0421	*	*	*	.0001	*	*	.0001	.0001	.0001	.0001	*	.0001	.0001	*	.0001	.0001	.0002
3. Dryland Crop Production	.0415	*	1.0579	.0001	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4. Food Processing	.0538	.0173	.0196	1.0194	.0007	.0004	.0006	.0014	.0007	.0004	.0034	.0021	.0011	.0017	.0007	.0013	.0017	.0003	.0022	.0028	.0040
5. Wood Products	.0428	.0009	.0056	.0047	1.1029	.0016	.0024	.0057	.0028	.0018	.0023	.0086	.0021	.0070	.0028	.0046	.0068	.0013	.0101	.0137	.0169
6. Agricultural Services	.1141	.0603	.1817	.0103	.0017	1.0150	.0016	.0146	.0015	.0012	.0013	.0046	.0011	.0038	.0019	.0025	.0037	.0008	.0099	.0064	.0090
7. Construction	.0075	.0023	.0143	.0120	.0083	.0043	1.0287	.0149	.0217	.0046	.0067	.0222	.0099	.0181	.0165	.0167	.0238	.0242	.0284	.0320	.0431
8. Maintenance & Repair	.0006	.0001	.0007	.0016	.0006	.0004	.0009	1.0005	.0009	.0074	.0013	.0016	.0011	.0020	.0117	.0034	.0008	.0044	.0040	.0010	.0012
9. Communication, Transportation & Utilities	.0233	.0070	.0203	.0083	.0208	.0050	.0105	.0189	1.0145	.0033	.0149	.0150	.0117	.0231	.0376	.0184	.0359	.0057	.0234	.0211	.0282
10. Coal Firec Power Plant	*	*	*	*	*	*	*	*	*	1.0000	*	*	*	*	*	*	*	*	*	*	*
11. Wholesale & Retail Trade	0.857	.0252	.1687	.0588	.0412	.0224	.0377	.0801	.0620	.0224	1.0333	.1126	.2233	.0934	.0409	.1371	.1270	.0201	.1221	.1521	.2144
12. Finance, Insurance, & Real Estate	.0239	.0040	.0419	.0081	.0068	.0048	.0205	.0209	.0202	.0034	.0189	1.1478	.0138	.0201	.0674	.0381	.1526	.0029	.0277	.0186	.0267
13. Automobile Sales & Service	.0148	.0046	.0287	.0234	.0181	.0123	.0214	.0446	.0396	.0093	.0144	.0502	1.0345	.0343	.0258	.0268	.0868	.0156	.0603	.0683	.0791
14. Professional Services	.0046	.0014	.0096	.0088	.0046	.0028	.0044	.0188	.0082	.0030	.0050	.0127	.0041	1.0175	.0081	.0089	.0163	.0091	.0245	.0166	.0241
15. Lodging	.0116	.0006	.0038	.0031	.0021	.0011	.0033	.0043	.0019	.0012	.0015	.0059	.0014	.0048	1.0018	.0031	.0049	.0009	.0063	.0080	.0116
16. Cafes & Taverns	.0042	.0014	.0083	.0068	.0047	.0024	.0056	.0093	.0065	.0026	.0039	.0155	.0032	.0110	.0052	1.0072	.0104	.0028	.0138	.0172	.0251
17. Other Wholesale & Retail Services	.0025	.0008	.0048	.0034	.0024	.0015	.0025	.0103	.0066	.0014	.0052	.0167	.0040	.0066	.0053	.0110	1.0137	.0020	.0082	.0087	.0125
18. Port of Morrow	.0008	.0003	.0004	.0151	*	*	*	.0001	*	*	.0001	.0006	*	.0001	.0001	.0001	.0002	1.0000	.0001	.0001	.0002
19. Local Government	.0243	.0073	.0349	.0220	.0135	.0220	.0088	.0234	.0158	.0471	.0106	.0289	.0085	.0294	.0716	.0194	.0307	.0061	1.0457	.0317	.0461
20. Local Agencies of State & Federal Government	.0136	.0024	.0093	.0454	.0236	.0149	.0108	.0045	.0263	.0057	.0140	.0171	.0142	.0193	.0636	.0383	.0413	.0013	.0077	1.0071	.0098
21. Households	.1814	.0566	.3641	.3020	.2071	.1061	.1582	.3810	.1813	.1156	.1477	.5732	.1376	.4636	.1760	.3015	.4455	.0863	.6111	.7729	1.1258
Multipliers	*1.6675*	*1.1940*	*1.9785*	*1.5972*	*1.4532*	*1.2180*	*1.3130*	*1.6535*	*1.4106*	*1.2304*	*1.2847*	*2.0366*	*1.4718*	*1.7561*	*1.5371*	*1.6386*	*2.0024*	*1.1838*	*2.0058*	*2.1785*	*1.6784*

APPENDIX E

ESTIMATION OF EMPLOYMENT MULTIPLIERS

Estimation Procedure

The employment multipliers for the present study were developed in a two step process. First, employment is regressed on total sales for firms within each endogenous sector (except households). The slope coefficients from each sector's equation is used to develop the respective sector's employment multiplier. This process was used by Miernyk in his study of the Boulder (Colorado) economy (Miernyk, 1967). Richardson presents a discussion of this technique for estimating employment multipliers in his book: Input-Output and Regional Economics (Richardson, 1972).

Employment is regressed on total sales as follows:

$$E_{il} = a_i + b_i S_{il} \qquad \begin{matrix} i = 1, 2, \ldots, n - 1 \\ l = 1, 2, \ldots, L \end{matrix} \qquad \text{(E-1)}$$

where

E_{il} = the employment by the lth firm in the ith sector in 1979,

S_{il} = the total sales of the lth firm in the ith sector in 1979,

a_i and b_i = are the regression coefficients for the ith sector,

and

$n - 1$ = the number of endogenous sector (not including households), and

l = is the number of firms sampled in the ith sector.

Using the (b_i) coefficients, the employment multipliers are calculated for each sector, as follows:

$$e_i = \sum_{i=1}^{n} c_{ij} b_i \qquad i = 1, 2, \ldots n \qquad \text{(E-2)}$$

where

e_i = is the employment multiplier for the ith sector,

c_{ij} = the elements of the matrix of direct plus indirect coefficients, and

b_i = the regression coefficient (slope) for the ith sector.

The employment multipliers (e_i) portray the direct plus indirect increase in employment of a sector resulting from a unit change in sales of the respective sector.

Application

Equation (E-1) required a specific assumption with respect to employment. As noted in Chapter III, there are two types of firms in the sample -- reporting and nonreporting. Employment figures for reporting firms were obtained from the Oregon Department of Human Services; whereas employment by nonreporting firms was not available. It is assumed the nonreporting firms employ one FTE (full time equivalent).[1/]

The above assumption was tested by estimating two regressions for each sector which contained both types of firms. The first

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1/ Nonreporting firms with output levels such that more than one individual would be required (in the estimation of the researcher) were not used as observations in estimating the regressions.

equation used the data of reporting and nonreporting firms. The second equation used only the observations of reporting firms. In all but one case, the statistical significance of the regression decreases when the observations for nonreporting firms were removed from the estimation process. Thus, the observations for nonreporting firms were used.

The results of equation (E-1) are presented in Table E-1. Regressions were not estimated for sectors 4, 10 and 17 due to insufficient observations. In turn, the (b_i) coefficients for these three sectors were entered as zeros in equation (E-2). The regressions were significant at a ninety percent level of confidence in all but three sectors, i.e., these being Maintenance & Repair, Cafes & Taverns, and Local Agencies of State and Federal Government.

In Miernyk's study, the correlation coefficients for all sectors were in excess of 0.65; and 16 out of 17 are greater than 0.50.

The results of equation (E-2) are presented in Table E-2. The matrix of direct plus indirect coefficients from the expanded model (incorporates the CFPP sector) was used to calculate the employment multipliers.

TABLE E-1. RESULTS OF REGRESSING EMPLOYMENT ON TOTAL SALES, BY SECTOR

	Sector	b Coefficient (Slope)	r^2	Number of Observations	Calculated F Value	a Coefficient (Constant)
1.	Animal Production	.0000128	.56	13	14.2	.67
2.	Irrigated Crop Production	.0000582	.99	6	2,754.2	-.58
3.	Dryland Crop Production	.0000064	.25	27	8.44	1.15
4.	Food Processing	NA *	NA	2	NA	NA
5.	Wood Products	.0000114	.99	4	39,442.9	.23
6.	Agricultural Services	.0000012	.89	10	67.6	3.10
7.	Construction	.0000136	.89	11	73.1	.08
8.	Maintenance & Repair	.0000396	.45	3	.1	-.19
9.	Communication, Transportation & Utilities	.0000132	.93	4	25.0	4.48
10.	Coal Fired Power Plant	NA	NA	NA	NA	NA
11.	Wholesale & Retail Trade	.0000100	.41	14	8.4	1.96
12.	Finance, Insurance & Real Estate	.0000239	.82	6	18.0	-.17
13.	Automobile Sales & Service	.0000128	.86	11	56.9	-.10
14.	Professional Services	.0000739	.40	8	4.0	-2.58
15.	Lodging	.0000543	.88	5	21.3	-1.43
16.	Cafes & Taverns	.0000454	.36	7	2.8	4.18
17.	Other Wholesale & Retail Services	.0000625	.83	8	29.5	.36
18.	Port of Morrow	NA	NA	1	NA	NA
19.	Local Government	.0000257	.99	7	2,140.9	2.72
20.	Local Agencies of State & Federal Government	.0000008	.09	8	.6	2.51

* N.A. indicates that insufficient data was available to estimate the coefficient.

TABLE E-2. EMPLOYMENT MULTIPLIERS FOR THE MORROW COUNTY INPUT-OUTPUT MODEL, BY SECTOR

	Sector	Multiplier
1.	Animal Production	.0000213
2.	Irrigated Crop Production	.0000695
3.	Dryland Crop Production	.0000127
4.	Food Processing	N.A.*
5.	Wood Products	.0000166
6.	Agricultural Services	.0000015
7.	Construction	.0000179
8.	Maintenance & Repair	.0000655
9.	Communication, Transportation & Utilities	.0000186
10.	Coal Fired Power Plant	N.A.
11.	Wholesale & Retail Trade	.0000129
12.	Finance, Insurance, & Real Estate	.0000487
13.	Automobile Sales & Service	.0000188
14.	Professional Services	.0001298
15.	Lodging	.0000835
16.	Cafes & Taverns	.0000744
17.	Other Wholesale & Retail Services	.0001251
18.	Port of Morrow	N.A.
19.	Local Government	.0000516
20.	Local Agencies of State and Federal Government	.0000017

* N.A. indicates that insufficient data was available to estimate the multiplier.

APPENDIX F

MATRIX OF DIRECT PLUS INDIRECT COEFFICIENTS SIMULATING THE COAL FIRED POWER PLANT WITH ENDOGENOUS SALES

TABLE F-1. MATRIX OF DIRECT PLUS INDIRECT COEFFICIENTS SIMULATING THE COAL FIRED POWER PLANT WITH ENDOGENOUS SALES

Sector	Animal Production	Irrigated Crop Production	Dryland Crop Production	Food Processing	Wood Products	Agricultural Services	Construction	Maintenance & Repair	Communication, Transportation & Utilities	Coal-Fired Power Plant	Wholesale & Retail Trade	Finance, Insurance, & Real Estate	Automobile Sales & Service	Professional Services	Lodging	Cafes & Taverns	Other Wholesale & Retail Services	Port of Morrow	Local Government	Local Agencies of State & Federal Government	Households
1. Animal Production	1.0103	.0003	.0031	.0018	.0001	*	.0001	.0001	.0001	*	.0001	.0002	.0001	.0002	.0001	.0001	.0002	*	.0022	.0003	.0004
2. Irrigated Crop Production	.0062	1.0007	.0008	.0421	*	*	*	.0001	*	*	.0001	.0001	.0001	.0001	*	.0001	.0001	*	.0001	.0001	.0002
3. Dryland Crop Production	.0015	*	1.0579	.0001	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4. Food Processing	.0538	.0173	.0196	1.0194	.0008	.0004	.0006	.0014	.0008	.0004	.0034	.0021	.0011	.0017	.0002	.0013	.0017	.0003	.0022	.0028	.0040
5. Wood Products	.0428	.0009	.0056	.0047	1.1029	.0016	.0024	.0057	.0031	.0018	.0023	.0086	.0021	.0070	.0029	.0046	.0068	.0013	.0102	.0137	.0169
6. Agricultural Services	.1141	.0603	.1817	.0103	.0017	1.0150	.0016	.0146	.0018	.0012	.0013	.0046	.0011	.0038	.0019	.0025	.0037	.0008	.0099	.0064	.0090
7. Construction	.0075	.0023	.0143	.0121	.0083	.0043	1.0288	.0149	.0227	.0047	.0067	.0022	.0099	.0181	.0165	.0167	.0239	.0242	.0284	.0320	.0431
8. Maintenance & Repair	.0006	.0002	.0007	.0016	.0007	.0005	.0009	1.0005	.0024	.0074	.0014	.0017	.0012	.0020	.0119	.0035	.0008	.0044	.0040	.0010	.0012
9. Communication, Transportation & Utilities	.0233	.0070	.0203	.0083	.0209	.0060	.0105	.0189	1.0152	.0033	.0149	.0160	.0117	.0231	.0376	.0184	.0359	.0057	.0234	.0211	.0282
10. Coal-Fired Power Plant	.0047	.0014	.0041	.0017	.0042	.0012	.0021	.0038	.2030	1.0007	.0030	.0032	.0023	.0046	.0075	.0037	.0072	.0011	.0047	.0042	.0056
11. Wholesale & Retail Trade	.0858	.0252	.1688	.0589	.0413	.0225	.0378	.0802	.0665	.0224	1.0334	.1126	.2234	.0935	.0410	.1372	.1271	.0201	.1222	.1522	.2145
12. Finance, Insurance, & Real Estate	.0239	.0040	.0419	.0081	.0068	.0048	.0205	.6209	.0209	.0034	.0189	1.1479	.0138	.0202	.0674	.0381	.1526	.0029	.0277	.0186	.0267
13. Automobile Sales & Service	.0148	.0046	.0287	.0235	.0181	.0123	.0214	.0446	.0415	.0093	.0144	.0502	1.0345	.0344	.0259	.0268	.0869	.0156	.0604	.0683	.0792
14. Professional Services	.0046	.0014	.0096	.0088	.0046	.0028	.0044	.0188	.0088	.0030	.0050	.0127	.0042	1.0176	.0082	.0089	.0163	.0091	.0245	.0166	.0241
15. Lodging	.0116	.0006	.0038	.0031	.0021	.0011	.0033	.0043	.0021	.0012	.0015	.0059	.0014	.0048	1.0019	.0031	.0049	.0009	.0063	.0080	.0116
16. Cafes & Taverns	.0042	.0014	.0083	.0068	.0047	.0024	.0056	.0093	.0070	.0026	.0040	.0155	.0032	.0110	.0053	1.0072	.0104	.0028	.0139	.0172	.0251
17. Other Wholesale & Retail Services	.0025	.0008	.00048	.0034	.0024	.0015	.0025	.0103	.0069	.0014	.0052	.0167	.0040	.0066	.0053	.0110	1.0137	.0020	.0082	.0087	.0125
18. Port of Morrow	.0008	.0003	.0004	.0151	*	*	*	.0001	.0001	*	.0001	.0006	*	.0001	.0001	.0001	.0002	1.0000	.0001	.0001	.0002
19. Local Government	.0245	.0079	.0351	.0221	.0137	.0020	.0089	.0235	.0254	.0472	.0108	.0290	.0086	.0296	.0719	.0195	.0311	.0061	1.0459	.0319	.0465
20. Local Agencies of State & Federal Government	.0136	.0024	.0093	.0454	.0236	.0149	.0109	.0045	.0274	.0057	.0141	.0171	.0142	.0193	.0636	.0384	.0413	.0013	.0078	1.0071	.0099
21. Households	.1820	.0568	.3646	.3022	.2076	.1063	.1584	.3814	.2049	.1156	.1480	.5736	.1379	.4641	.1769	.3019	.4463	.0364	.6116	.7734	1.1265
Multipliers	1.6731	1.1958	1.9834	1.5995	1.4645	1.2196	1.3207	1.6579	.16606	1.2313	1.2886	2.0405	1.4748	1.7618	1.5461	1.6431	2.0111	1.1850	2.0117	2.1837	1.6852

* is less than .00005.