DEVELOPMENT OF INTERINDUSTRY ANALYSIS FOR USE WITHIN A PUBLIC SERVICE PLANNING FRAMEWORK TO ESTIMATE GENERATION OF SOLID WASTES IN SOUTH CENTRAL OKLAHOMA

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PREFACE

A public service planning framework offers an approach to problem solving at the sub-state level. Interindustry analysis can be applied within a public service framework to assess need for public services whenever service requirements can be associated with sales of economic units to final demand categories. Final demand is a proxy for markets. Variables affecting markets affect employment and needs of industries and households for public services. This study is directed toward making interindustry analysis a more relevant tool for planners and administrators.

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CHAPTER I

INTRODUCTION

If rural areas do not enjoy economies of scale in provision of public services and their ability to finance services diminishes or fails to grow relative to urban areas, then the cost of being wrong can be much higher when allocating scarce community resources for public services. Hopefully, rural planning can reduce opportunity costs and insure more efficient resource allocation in sub-state planning regions.

Estimating Needs for Public Services

One problem area of local governments is estimating need for public services. Needs for public services have not been neglected but changes as a result of variation in the level and kinds of economic activities have often been overlooked. Estimates of the amount of solid waste for disposal, numbers of school children requiring public education services, and gallons of water needed by various economic sectors can contribute to the planning process. Most planning groups realize that change in the community's employment will have an impact greater than the direct effects alone, and accordingly local decision makers indicate an interest in employment and income multipliers.

In the rural areas of Oklahoma planning commissions, county commissioners, school boards, and city commissioners attempt to meet anticipated service requirements. Regardless of the quality of information available they make decisions. All of the data at their disposal constitutes an information system, the components of which are ingredients for planning. Rural planning (not different from area planning) is the organization of pertinent data to facilitate planning and decision making at the local and regional level. The means of rural planning are resources and policies and their potential combinations under the direction of planning groups.

Data Information Systems

A data information system becomes a tool of the decision maker when it can organize and facilitate collection of relevant information about the problems faced by local and regional planning groups. Observations in a region, or community, can be recorded in three categories with regard to public services: estimating the cost of a service, financing of a service, and estimating service levels. Regional accounts have been developed to furnish this information and can be applied to almost any public service. One such system [25, pp. 186-204] considers current production and income as a core account, and associated accounts of non-human resources, human resources, and regional government.[1] Also included is an intraregional account to describe relationships between two or more sub-regions. The core account and resources account can assist in estimating needs for public services,

[1] Numerals in [ ] refer to bibliography references.

and through interpretation of tax laws general revenues are determined for financing services. A government account along with cost estimates of public services shows an expenditure side of the model.

The portion of a data information system most difficult to determine and which often requires primary data is a current production and income account. Given information about types of economic units in a region and human resources, a direct application can be made to the determination of need for certain public services. Human resources may be estimated from census data. The core account frequently takes the form of interindustry analysis. The interindustry analysis records the linkages between producing sectors of a regional economy and the final markets in such a way as to estimate the entire region's economic activities. The interdependencies among firms and their final markets are estimated by sales from similar types of firms or sectors to other groupings of firms or sectors; intermediate sales, and final demand markets; consumption, government, investment, and exports.

Objectives and Organization

The thrust of this exposition is toward estimating needs for public service levels using interindustry analysis. Equal changes in different sectors will have differential impacts on the entire region's economic activity, after indirect and induced affects have had a chance to work themselves out. The resulting variation in requirements for public services must be met by planners and administrators. The intent of this thesis is to:

(1) Provide a framework for rural planning.

(2) Construct an interindustry analysis for a multi-county planning region in South Central Oklahoma.

(3) Apply interindustry analysis to estimating need for a public service; solid waste management.

Planning theory, results and application of interindustry analysis compose the remainder of the thesis. Chapter II examines a general interindustry model and explains alternative methods for handling household consumption and state and local governments. Chapter II also provides an explanation of a public service planning framework for sub-state regions.[2] The empirical results of the interindustry model for an Oklahoma sub-state planning region in South Central Oklahoma are given in Chapter III. Chapter IV offers an example of an application of interindustry analysis to estimate the amount of solid waste generated in a sub-state region in 1970 and anticipated changes in solid wastes associated with changes in employment. Chapter V summarizes principal results and makes recommendations for further study.

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[2]A sub-state region is a geographical area less than state size in which various levels of government and the private sector cooperate to attain specific or general goals related to public welfare.

CHAPTER II

RURAL PLANNING AND A REGIONAL ECONOMIC MODEL

A description of rural or sub-state planning isolates relevant policy variables and those inputs useful in planning alternative courses of action. An ingredient for rural planning is from-to analysis, a version of interindustry analysis describing area interdependencies usually in terms of income or employment. A framework for rural planning underscores the programmatic nature of sub-state planning. Local decision makers who understand the regional interindustry model and can define their relevant policy variables can more effectively employ the model's empirical results presented in Chapter III.

Framework for Rural Planning

Several factors motivate the need for a logical, easy to use planning framework. The cost of being wrong can be much higher when allocating community resources for public services in downward transitional areas[1] than in areas experiencing rapid growth. National policies for rural areas call attention to rural planning as plans and

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[1]Downward transitional areas have been defined as areas in economic decline due to aging industrial structure and diminishing primary resource base. (Author's note: Also, technological change lowering the labor requirements in primary industries may lead to a smaller labor force.) John Friedman, [7, pp. 42, 43].

quantitative material are added to descriptive information in applying for federal and state assistance, and in evaluation of regional problems at a national level. Direct effects of changes in regional employment are easy to measure but secondary impacts of employment changes are often difficult to uncover. Commercial interests can better evaluate the business environment when economic activities within a region can be estimated. If a framework for planning is successfully established for regional development districts throughout the United States research can be aimed at a better understanding of current regional disparities in unemployment, per capita income, and the quality of life as measured by the provision of public services.

The goals of a framework for rural planning are related to difficulties in evaluating changes which occur in a region. Changes in population density reflect shifts in technology and economic activity. Technological change in agriculture and other basic industries such as mining has made a large portion of the labor force of rural areas redundant resulting in underemployment and migration from rural to urban areas. Growth in alternative employment opportunities has not occurred rapidly enough to check this trend. These changes in the regional structure can be related to levels of services furnished by local government to the region's population.

A simple framework for rural planning includes delineation of components of planning under local control, a system for relating local policy variables to specific goals when estimates of uncontrollable components are available. Local planning decisions are more programmatic than at any other level of government [10, p. 372]. Local leadership is charged with the region's ability to determine service

requirements, allocate funds, and administer programs for education, police and fire protection, water and sewage systems, and solid waste disposal. Local jurisdictions often lack resources and policy means to extend themselves far beyond this degree of program planning in which their primary concern is the attainment of specified levels of services. Difficulty in satisfying the latter goal may be tied to failure to enjoy potential economies of scale in the provision of certain public services due to political, geographic, and funding problems.

The problems encountered in regional planning, especially in rural areas, have attracted the interest of regional economists who propose accounting and information systems to assist local planners in increasing efficiency in provision of public services. One framework for rural planning developed by Sonenblum and Stern is an extension of "the logic of planning" [31, p. 112] in which informational components of the planning process consist of sets of exogenous variables, endogenous variables, technological and behavioral relationships, and a system for valuing both policy actions and their consequences. An objective function specifies desired community or regional public service levels in both quantitative and quality terms. Two types of exogenous variables are important to the analyst, those which he can manipulate and those over which he has no control. The first type of exogenous variable is local policy tools and the second constitute national, state, or private sector policies and decisions. Estimates of the latter variables need to be available to local planners. Endogenous variables consist of those which the planner wishes to change in a direction to satisfy the values of the objective function and other variables irrelevant within broad ranges to the analysis. Relevant endogenous variables represent values of the objective function. The values of the objective function are

difficult to express because they are a composite of quality goals as well as specific output levels. A system linking exogenous to endogenous variables can be a mathematical description of the regional economy and quantitative factors necessary for the analysis. The purpose of this framework is to relate changes in exogenous variables to movements of endogenous variables which as they change affect the value of the regional objective function. Given the estimates of uncontrollable exogenous variables, regional exogenous variables can be changed as required such that regional output of public services represented by endogenous variables more closely approximates assumed values of a regional objective function.

Figure 1 illustrates a framework for public service planning at the sub-state level. The organization of the diagram relies upon the logic of planning. Uncontrollable exogenous variables are represented by federal and state expenditures and private sector decisions. Controllable exogenous variables take the form of regional economic policies, regional responses to uncontrollable exogenous variables and regional public service policies. Levels of public services, expressed as endogenous variables, are related to exogenous variables, both controlled or uncontrolled by means of a regional economic model which includes distribution of population and economic activities. A state planning and coordinating office provides technical advice and information concerning uncontrollable exogenous variables and assistance in organization of information necessary to exercise the regional policy variables. An evaluation system aids in adjusting regional policy variables such that public services approach the desired levels.

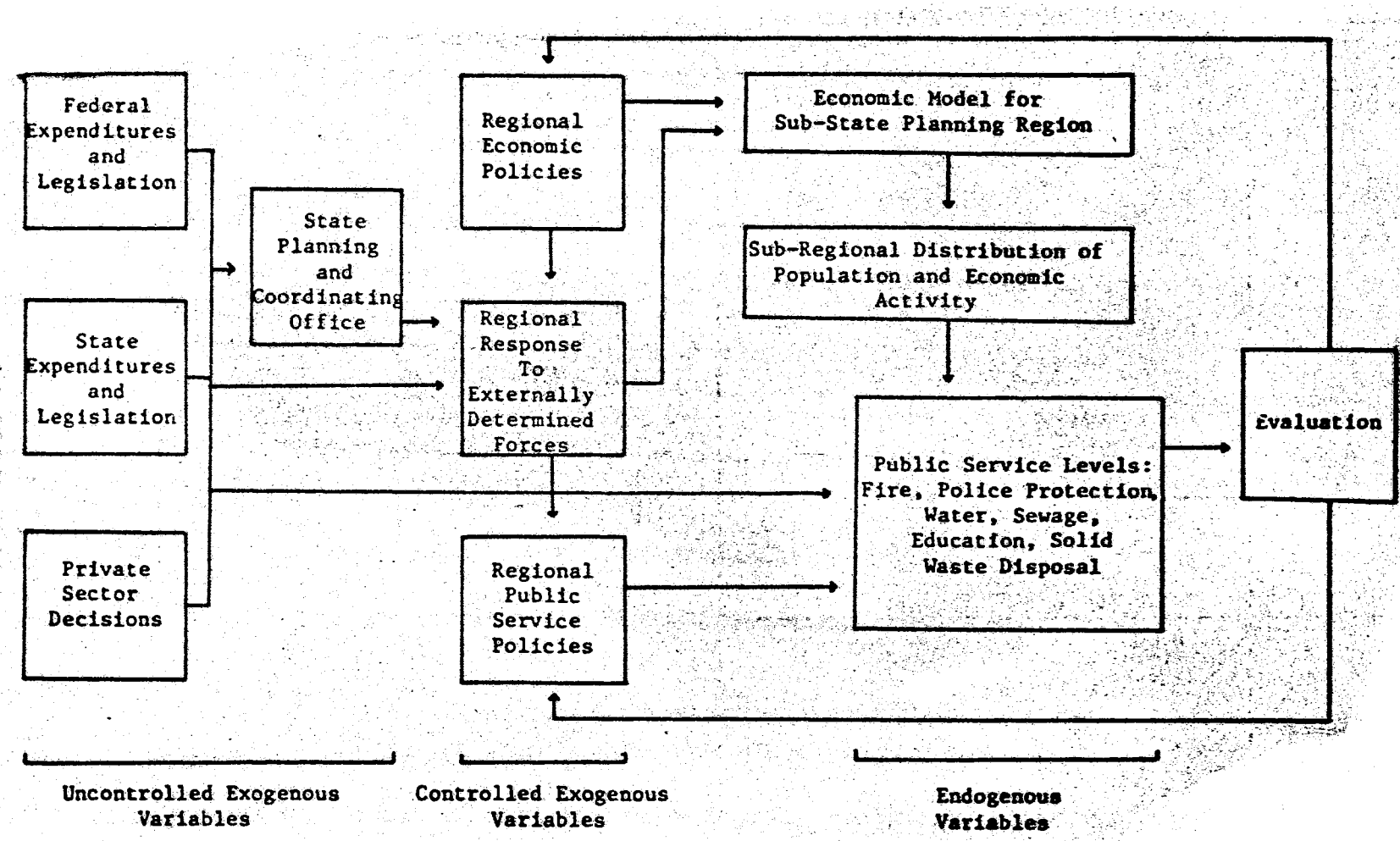

Figure 1. Public Service Planning Framework for a Sub-State Level

Source: Adapted from Sonenblum, Sidney and Louis H. Stern, "The Use of Economic Projections in Planning," Journal of the American Institute of Planners, Vol. XXX, May, 1964.

Federal, state, and private sector activities influence regional public service levels. The federal government has at its disposal monetary and fiscal powers which can affect regional employment, investment, and consumption spending. Interest rate changes, investment tax credit, urban renewal, housing developments, increased defense expenditures, highway projects, and assistance in developing public services all have an impact on local jurisdictions. Federal regulatory commissions have power to govern some trade relationships and agencies disseminate information and carry on research affecting development.

Federal legislation can have a direct impact upon provision of public services in sub-state planning regions. The Resource Recovery Act of 1970, the Public Works and Economic Development Act of 1965, Farmers Home Administration, and Rural Electrification Administration are examples in which federal government assistance may be delivered directly to the sub-state level. The Resource Recovery Act of 1970 administered by the Environmental Protection Agency authorizes grants for part of the costs of some recycling and improved solid waste disposal facilities.[2] The Public Works Act makes possible partial grants and loans for obtaining, developing, or improving public services when requirements are met by the applicant relative to the organization of local jurisdictions and needs within the area. The Farmers Home Administration loans have been instrumental in the establishment of rural water districts. The Rural Electrification Administration makes loans principally to cooperatives furnishing their members with telephone and electric services.

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[2]Chapter IV contains a more complete treatment of legislation dealing with solid waste management.

State government expenditures and legislation affect regional public service levels by state funding, distribution of state services, and legislation. State assistance for local public service projects influences quality and amounts of local public services, local priorities for public service investment, and indirectly affects regional employment. Location of state services such as highway departments, state hospitals, colleges, and state offices affect requirements for public services, employment, state spending within the jurisdiction, and investment. State legislation regarding the provision of public services such as enabling acts, and authorization to state agencies to set and enforce regulations pertaining to disposal of solid wastes, sanitation in food manufacturing plants and eating and drinking places, and legislation establishing uniform practices for local government. Other state legislation enables local jurisdictions sale of general obligation and revenue bonds to finance industrial development and regulates trading practices.

Actions of federal and state government influence decisions in the private sector regarding investment, employment, and specified standards deemed consistent with public welfare. Specifically, federal and state policies encourage or discourage investment.

Federal, state, and private sector decisions, in general, act in two ways, directly upon the level of public services (some local service responsibilities are shared by these three groups), or by reaction of the regional governments. The state planning and coordinating office often plays an important role in coordinating regional government activities and furnishing technical advice and information about federal and state programs as well as cooperating with some private investors.

This office may also help regional governments to assemble information needed to refine and develop regional economic and regional public service policies.

Regional economic policies and regional public service policies condition the sub-state region's response to externally developed forces. Local governments may encourage or retard establishment of new enterprises through control of the spatial location of economic activities and residential locations, assistance in construction of facilities for prospective manufacturing concerns, attempting to limit manufacturing to certain types of firms judged to have a more favorable impact on employment and income while keeping costs of providing public services lower. Some communities may have a negative attitude about expansion of business firms. Other measures utilized in economic policy are local sales and ad valorem taxes, licensing and the estimated affect on firms of public service policies.

Public service policies are conditioned primarily by the amount of revenue local jurisdictions have available to increase or maintain public service levels. Some policies affecting service levels and indirectly economic activities are local government employment, distribution of public services, priorities for expansion of services, zoning and ordinances, and subsidization of some services with revenue from others, and service charges.

A regional economic model associated with the sub-state region's distribution of population and economic activities assists local governments in projecting requirements for public services. A projection is only an indication of the expected direction of change rather than an absolute level to be met, but this information might reduce stop

gap measures for service crisis at the local jurisdiction. The rationale underlying use of the regional model for projections is that in addition to the direct effects it captures the secondary and induced effects of regional employment.

A public service planning framework describes actions affecting service levels. Local jurisdictions become aware of federal and state policies and private sector decisions through communications of government agencies, media and the state planning and coordinating office. Many private investment decisions in the region are known to local jurisdictions since service requirements change due to investment. Response to these externally determined forces are conditioned by regional economic policies and public service policies. The impact of changes in employment upon the requirements for public services may be projected through the use of an economic model for the sub-state planning region which incorporates information about population and economic activity. Changes in public service needs due to influences of externally determined forces are evaluated in light of existing regional public service policies, and economic policies; and adjustments are made in these variables so that the mix of public expenditures can be rearranged to better meet the needs of the community.

A Regional Interindustry Model

From-to analysis in terms of employment is an appropriate model for regional economic analysis. First, from-to in terms of employment avoids difficulties of a value added income approach for which it is hard to obtain data for a defined regional area. Secondly, regional firms rely heavily on imported inputs [13, p. 171] and final demand

categories also make considerable purchases outside the region. The general from-to model ignores regional imports and concentrates on trading relationships within a region.

The from-to interindustry model is a series of linear equations [11]. Each equation represents a grouping of business firms with similar functions. Two general types of customers purchase output of regional firms; endogenous firms which use products (X_i's) as inputs in production processes and exogenous or final demand categories (Y_i's) which consume the goods and services rather than produce for resale within the region:

$$X_1 = X_{11} + X_{12} + X_{13} + \ldots X_{1n} + Y_1$$

$$X_2 = X_{21} + X_{22} + X_{23} + \ldots X_{2n} + Y_2$$

$$X_3 = X_{31} + X_{32} + X_{33} + \ldots X_{3n} + Y_3$$

$$\vdots$$

$$X_i = X_{i1} + X_{i2} + X_{i3} + \ldots X_{in} + Y_i$$

$$\vdots$$

$$X_n = X_{n1} + X_{n2} + X_{n3} + \ldots X_{nn} + Y_n$$

For a time period in which data are collected, X_i represents total sales of a regional endogenous sector. X_{ij} represents the intermediate sales of a regional endogenous sector to other regional endogenous

sectors as inputs in their production processes and the Y_i's are sales to exogenous final demand categories.

Development of the interindustry model for projection purposes requires calculations of four main tables; distribution, transactions, direct requirements, and total (direct and indirect) requirements. A fifth table, total direct and indirect employment in final demand, furnishes information about the regional impacts of exogenous sectors.

The distribution table is the base of the model. Rows in the distribution table, one for each endogenous sector, sum to 100 percent since each row estimates all of the sales (X_i) of one endogenous sector to other endogenous sectors and exogenous sectors. An endogenous column of the distribution table estimates regionally produced inputs used by that endogenous sector. Actually, employment or value added may be applied to the distribution table to obtain a transaction or flow table. Multiplication of regional employment by sector (e_i) times the respective X_i row of the distribution table gives an employment transaction table. Sales of endogenous sectors to intermediate and final demand sectors are now in terms of employment. The transactions table is mainly a step in calculation of trade-production coefficients (a_{ij}). These coefficients estimate the units of direct employment required from all endogenous sectors per employee in each endogenous sector; arithmetically this relationship is expressed as

$$a_{ij} = \frac{X_{ij}}{X_j}.$$

These values are appropriate to the analysis if endogenous sector's production functions are linearly homogenous of degree one, and no change in trade-production coefficients occurs due to external

economies. Increasing successive inputs by equal increments results in equal successive units of output and this spatial distribution of production and consumption must remain the same.

A matrix of direct coefficients shows direct employment requirements from all sectors for each endogenous sector's output in terms of one unit of that sector's employment. However, changes in deliveries to final demand by any endogenous sector result in an amount of employment greater than the direct effect. These changes occur because change in employment in an endogenous sector leads to changes in employment in other endogenous sectors furnishing the first sector with inputs. Total repercussions of changes in direct employment are estimated by a fourth table of interdependent coefficients referred to as the total requirements matrix. The direct and indirect requirements matrix reveals total employment in each endogenous sector (X_j) for a one unit increase in employment serving final demand. Application of the direct and indirect coefficients is made by projecting values of Y_i's and solving for the X_{ij}'s and X_j's required to satisfy projected final demand. Since $X_{ij} = a_{ij}(X_j)$, the basic model may be rewritten in the following form:

$$X_1 = a_{11}(X_1) + a_{12}(X_2) + a_{13}(X_3) \ldots + a_{1n}(X_n) + Y_1$$

$$X_2 = a_{21}(X_1) + a_{22}(X_2) + a_{23}(X_3) \ldots + a_{2n}(X_n) + Y_2$$

$$\vdots$$

$$X_n = a_{n1}(X_1) + a_{n2}(X_2) + a_{n3}(X_3) \ldots + a_{nn}(X_n) + Y_n$$

Matrix algebra expresses the model in the following form:

$$X = AX + Y$$

rearranged to:

$$X - AX = Y$$

reduced to:

$$X(I - A) = Y$$

where I is an identity matrix, A is the matrix of direct coefficients (trade-production coefficients), X is total regional output in terms of employment, and Y is the final demand categories. Application of a matrix inversion routine provides the following form:

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

Given direct employment and an inverse matrix of total requirements (direct and indirect) per unit of employment both serving final demand, total regional employment by sector may be calculated. Therefore the $(I - A)^{-1}$ matrix does include regional interdependencies. The sum of each column in the inverse matrix[3] is total (direct and indirect) employment per unit of employment serving final demand. These values are sector multipliers. A higher sector multiplier indicates relatively stronger backward linkages in the regional economy, therefore equal changes in final demand for all sectors will have a greater impact for endogenous sectors with higher sector multipliers.

Final demand multipliers are calculated by multiplying each final demand category times the inverse matrix to obtain total employment serving final demand sectors directly and indirectly. The difference

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[3]Uniquely reserved for those interindustry models defined in terms of employment units.

between direct employment by sector and total employment for final demand categories are direct and indirect final demand multipliers. An induced multiplier may be calculated for consumption and state and local government by taking the ratio of employment in these final demand categories to employment not included. Multiplication of the induced regional multiplier times sector multipliers gives regional sector multipliers by induced final demand category.

Regional output is defined by

$$X_i = a_{i1}X_1 + a_{i2}X_2 + \ldots + a_{in}X_n + Y_i$$

and regional employment is defined by

$$E_r = a_{e1}X_1 + a_{e2}X_2 + \ldots + a_{en}X_n$$

where a_{ej} is the employment-output ratio of sector j. Total output and regional employment may now be expressed in terms of final demand:

$$X_i = b_{i1}Y_1 + b_{i2}Y_2 + \ldots b_{in}Y_n$$

$$E_r = b_{e1}Y_1 + b_{e2}Y_2 + \ldots b_{en}Y_n$$

where

$b_{ej} = \sum_{i=1}^{n} a_{ei}b_{ij}$, and b_{ij}'s are elements of the $(I - A)^{-1}$ matrix.

The change in total employment from a change in final demand may be found by taking the partial of E_r with respect to Y_j:

$$\frac{\partial E_r}{\partial Y_j} = b_{ej}.$$

The sector multiplier in terms of one unit of additional employment used in deliveries to final demand is found by dividing $\frac{b_{ej}}{a_{ej}}$ where a_{ej} is direct employment from the j^{th} sector.

Regionally induced consumption may be calculated by transferring total employment to individual final demand categories. The resulting equation is the

$$E_r = C + LG + I + FG + EX$$

distribution of total employment to final demand categories of consumption, local government, investment, federal government and exports. The proportion of total employment in consumption is

$$C = cE_r.$$

Rewriting gives:

$$E_r = cE_r + LG + I + FG + EX$$

Rearranging:

$$E_r = \frac{1}{1-c} [LG + I + FG + EX]$$

The value of $\frac{1}{1-c}$ is the regional induced consumption multiplier and when multiplied times total employment in the remaining final demand sectors results in total employment. The calculation also applies to consumption and state and local government induced.

Final demand multipliers are calculated under the assumption that indirect employment in a final demand category is a function of direct employment. For example, total employment serving federal government in final demand is the sum of direct and indirect employment:

$$FG = FG^d + FG^{id}$$

and

$$FG^{id} = gFG^d.$$

g then is the ratio of indirect to direct government employment:

$$g = \frac{FG^{id}}{FG^d}$$

and total employment serving federal government is explained as

$$FG = FG^d + gFG^d$$

or

$$FG = FG^d(1 + g).$$

Similar calculations can be made for other final demand markets.

Final demand impact multipliers may be calculated by multiplying the regional induced multiplier times final demand multipliers. This shows impact of additional employment serving a final demand category when additional consumption of new employment is considered:

$(\frac{1}{1-c})(1 + g)$ = federal government final demand impact multiplier with regionally induced consumption. Regional sector multipliers are computed with regionally induced consumption:

$(\frac{1}{1-c})(\frac{b_{ej}}{a_{ej}})$ = sector multiplier with regional induced consumption.

An alternative, but empirically equal [1, pp. 309-317] method for computing regional consumption induced multipliers adds one additional equation to the simultaneous set:

$$X_i = a_{i1}X_1 + a_{i2}X_2 + \ldots + a_{in}X_n + c_iE_r + Y_i'$$

$$E = a_{e1}X_1 \quad a_{e2}X_2 \quad \ldots + a_{en}X_n \qquad + E_y$$

where c_i is the ratio of local consumption final demand to regional employment and hence $\sum_i c_i E_r$ is a linearly homogenous local consumption function, Y_i' is the remaining final demand excluding local consumption, and E_y is federal government plus other institutional employment not included elsewhere. A comparable solution for X_i and E_r in terms of Y_i' and E_y is

$$X_i = b_{i1}Y'_i + b_{12}Y'_2 + \ldots + b_{in}Y_n + b_{iy}E_y$$

$$E_r = b_{e1}Y'_1 + b_{e2}Y'_2 + \ldots + b_{en}Y'_n + b_{ey}E_y.$$

Sector employment multipliers with induced regional consumption are:

$$\frac{\partial E_r}{\partial Y'_j} \cdot \frac{1}{a_{ej}} = \frac{b_{ej}}{a_{ej}} \text{ and } \frac{\partial E_r}{\partial E_y} = b_{ey}.$$

Interpretation of the multipliers indicate the direct, indirect, and induced changes in regional employment per unit of direct employment used for delivery to final demand. The latter multiplier b_{ey} shows the total change in regional employment per each addition to federal employment.

Assumptions and Limitations of Interindustry Analysis

Assumptions for interindustry analysis and their critique call attention to some limitations worth considering before implementing the regional interindustry model. Two basic assumptions for from-to analysis are full employment and stable trade-production relationships. Deviation from these assumptions influences reliability of the model for describing regional economic activity.

Regional trade-production coefficients are subject to variation for import or export substitution, external economies, and departure from the assumption of linearly homogenous production functions. Export substitution results from a switch of direct employment to indirect employment for a new or expanded firm serving final demand. Import substitution arises when regional employment enters into production of inputs for regional markets in place of outside purchases.

External economies influence input costs and returns of regional firms. For example, a complex of food processing plants may benefit from a cost reduction in packaging materials obtained from the nearby location of a paper products plant. Close proximity of expanding markets may cut marketing costs increasing firm revenue. External economies may also be realized from special transportation advantages such as location near an inland water way or new interstate highway. Only uniform additions to economic activity will maintain spatial location and stability of the production-trade coefficients.

Linearly homogenous production functions of degree one assumed for all production sectors of the economy, including state and local governments, imply constant capital-output and labor-output coefficients. Under this assumption resources are paid the value of their marginal products and maintenance of the assumption requires divisibility of inputs to any desired degree. Internal economies or diseconomies of scale resulting from technological change, relative price changes, or additional specialization of the labor force are not considered. Errors of aggregation occur from combining firms with different production functions into the same sector.

Stability of trade-production coefficients also means that the model is static. However, the results of an interindustry analysis may be applicable for several years. Doeksen's static input-output model predicted over a five year period with an error of less than three percent [3, pp. 73, 74].

Full employment is defined as absence of appreciable degrees of unemployment and excess capacity. Unemployment and excess capacity preclude a full multiplier effect and both are likely to be present in

a downward transitional area. Several factors often inhibit attainment of full resource employment; imperfections in resource markets (monopoly and monopsony), lack of information, and government intervention; recession or a shift to the left of a sector's demand curve due to changes in the ceteris paribus conditions of demand; declines in primary resource productivity; technological changes leading to lower labor requirements; and depreciation of plant and equipment without replacement. Increasing final demand under conditions of underemployment or unemployment may lead only to increased participation of the labor force. Failure to meet the assumptions of full employment causes multipliers to overestimate employment changes.

Interindustry analysis is an important contribution to regional analysis since no other static model can capture the interdependencies among producing sectors and final demand. The strength of interindustry analysis lies in its ability to go beyond the direct effect of employment changes due to variation in the level of final demand and estimate indirect and induced effects.

CHAPTER III

EMPIRICAL RESULTS OF THE SOUTH CENTRAL OKLAHOMA STUDY

An interindustry model for South Central Oklahoma is based on questionnaire data obtained from businesses representing different producing activities within the region. A distribution table, transactions flow table, and direct and indirect requirements were developed from the data to describe the regional economy. This analysis, however, is not without its limitations.

Planning Region Nine, Figure 2, was selected as a sub-state area suitable for implementation of a regional interindustry analysis. The area coincides with that of the Association of South Central Oklahoma Governments. Labor force data and population of counties in Planning Region Nine appear in Table I.

An interindustry model groups business firms with similar functions into sectors. Regional firms were classified into 33 endogenous sectors and five exogenous sectors were named: federal government, state and local government, investment, household consumption, and exports. Sales of each endogenous sector to all other sectors can be estimated as a percent of a sector's output. The questionnaire[1] asked potential respondents their percentage of sales going to other counties and

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[1]Mail questionnaires were utilized in an effort to keep costs within budget constraints of sub-state planning groups should they desire to undertake similar studies.

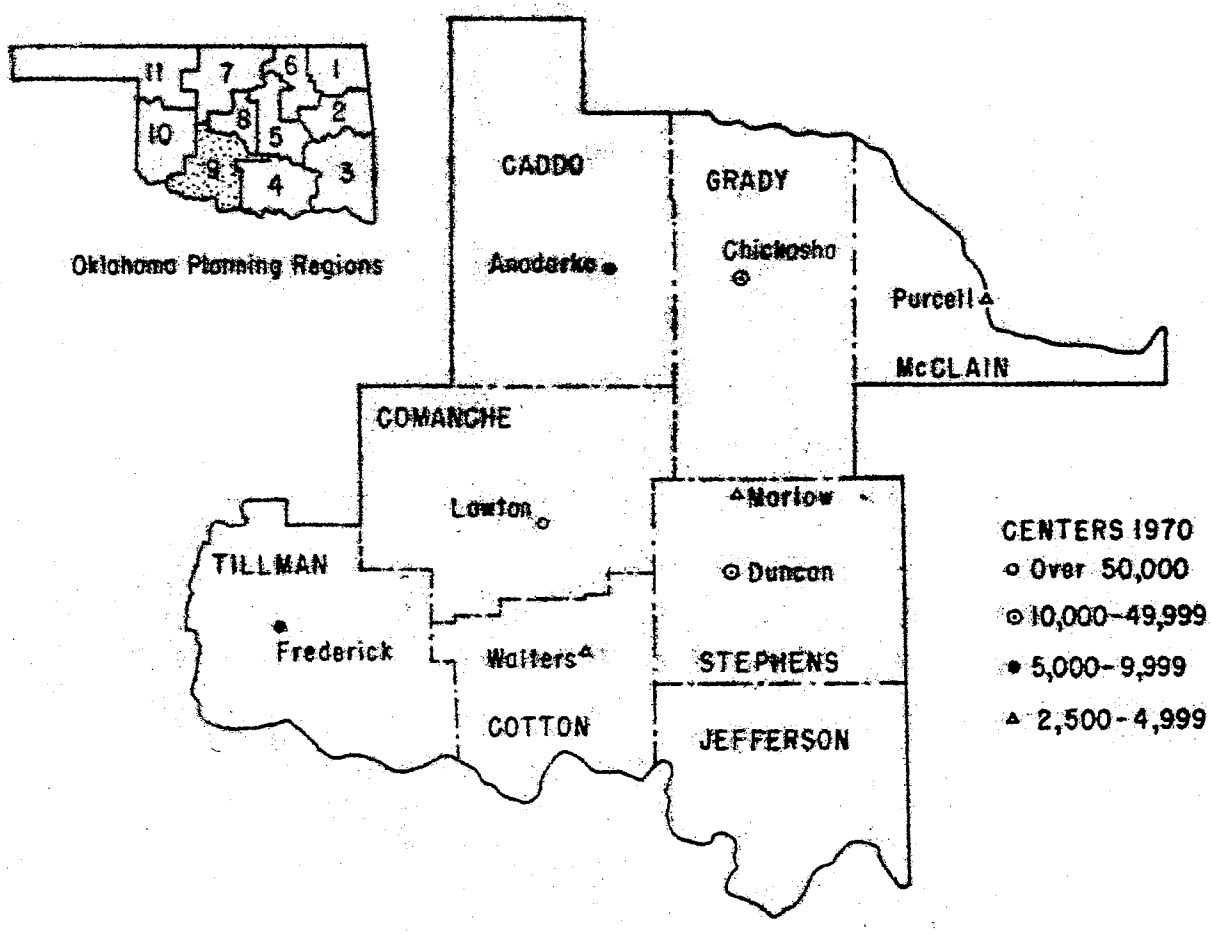

Figure 2. Planning Region Nine and Association of South Central Oklahoma Governments.

Source: The Governor's Office of Community Affairs and Planning and U. S. Census of Population, Preliminary 1970, United States Bureau of the Census.

TABLE I

LABOR FORCE DATA AND POPULATION OF PLANNING REGION NINE, 1970

County	Population[a]	Average Monthly Employment[b]					Average Monthly Unemployment	
		Total Civilian Labor Force	Agriculture	Dom. Ser. Self Empl. Unpaid Family Workers	Wage and Salary Private	Government	Number	Rate
Total	243,346	72,800	11,370	8,399	34,926	14,493	3,612	4.9
Caddo	28,931	8,260	2,340	630	3,370	1,450	470	5.7
Comanche	108,144	26,500	975	3,025	12,775	8,300	1,425	5.4
Cotton	6,832	2,750[c]	975	297	1,018	328	132	4.8
Grady	29,354	9,750	2,050	900	4,640	1,690	470	4.8
Jefferson	7,125	2,220	690	320	760	330	120	5.4
McClain	14,157	3,540	1,020	440	1,350	550	180	5.1
Stephens	35,902	13,970[c]	1,480	1,977	8,893	1,155	465	3.3
Tillman	12,901	5,810	1,840	810	2,120	690	350	6.0

[a] U. S. Census of Population, Preliminary 1970, United States Bureau of the Census.

[b] Oklahoma Employment Security Commission, Research and Planning Division.

[c] Observations for four months only in Stephens and Cotton Counties.

percentage of sales to intermediate demand sectors and final demand categories. A final question asked for employment during high, low and previous months so that sales of each firm could be weighted by firm employment. A sample of the questionnaire appears in Figure 4 in Appendix A.

Appendix A, Sources of Interindustry Analysis Data for Planning Region Nine, indicates sources of firm population, methods of aggregation of firms into sectors, and provides some information about sampling of regional firms. Control totals estimating employment by sector in each county, data collection procedures, and steps followed in data processing are also included in Appendix A.

Distribution Table

A distribution table forms the basis for calculation of other tables in the interindustry analysis, provides an overview of the 1970 regional trade relationships and indicates something about the input structure of endogenous sectors. Given raw county data aggregated into appropriate sectors and the control totals from Appendix A, one row of the distribution table is obtained by weighting each sector by the ratio of county employment to regional employment in that sector and summing for all eight counties. This procedure when accomplished for all 33 sectors results in a 33 x 38 matrix, Table II, in which each row sums to 100 percent of a sector's sales. The table may be used to distribute regional employment or income.

The distribution table reveals 1970 regional trade relationships. Select any row and read across it in order to obtain an idea of the markets served by endogenous firms. Food Manufacturing makes 40

TABLE II

PERCENTAGE DISTRIBUTION OF INDUSTRY SALES, PLANNING REGION NINE, 1970

SECTOR[a]		Farms Ranches (1)	Ag Services (2)	Mining (3)	Const. (4)	Transport. (5)	Finance R.E. (6)	Utilities (7)	Food Mfg. (8)	Apparel Mfg. (9)	Wood Paper (10)	Printing Publishing (11)	Petroleum Refining (12)	Leather Plastic Rubber (13)	Concrete (14)	Metal Mfg. (15)	Const. Materials (16)	General Sales (17)
Farms Ranches[b]	(1)	.21826	.00049	---[c]	.00289	.00067	.01129	.00032	.09649	.00114	.00008	.00025	---	.00015	.00032	---	.00008	.00033
Agricultural Services	(2)	.32920	.04367	.00007	.00049	.00138	.00002	.00026	.00010	.04826	---	---	---	---	---	.00015	.00052	.00017
Mining	(3)	.00164	.02728	.27022	---	---	---	---	---	---	---	---	.27236	---	---	---	---	---
Construction	(4)	.00743	.00152	.00153	.05839	.00029	.00238	.00828	.00315	.00028	---	.00010	.00021	---	.00016	.00176	.00315	.00226
Transportation	(5)	.01356	.24078	.07703	.00168	.00107	.00101	.00185	.00788	.00181	.00008	.00085	.13148	---	---	.01523	.03202	.00118
Finance-Real Estate	(6)	.12391	.01592	.00586	.00772	.00419	.01203	.01465	.00425	.00080	.00051	.00396	.00051	.00021	.00255	.00485	.00480	.01221
Utilities	(7)	.02725	.00869	.05902	.00354	.00283	.04362	.00862	.00671	.00917	.00023	.00168	.02361	.00272	.00169	.00453	.00381	.01029
Food Manufacturing	(8)	.00485	.00130	.00112	.00152	.00098	.00121	.00166	.01099	.00027	.00007	.00074	.00099	.00017	.00027	.00041	.00094	.00148
Apparel Manufacturing	(9)	---	.00002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Wood-Paper	(10)	---	---	---	.13590	---	.00084	---	.00166	---	---	---	---	---	---	---	.00868	---
Printing-Publishing	(11)	.00883	.01663	.00574	.01086	.00133	.03472	.03347	.00270	.00517	---	.00281	.01418	.00270	.00270	.02225	.01403	.10968
Petroleum Refining	(12)	.00154	---	.00422	.00461	.01078	---	.00156	.00005	---	---	---	.00183	.00154	---	.00157	.00923	---
Leather-Plastic-Rubber	(13)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	.11439	---	.00693
Concrete Products	(14)	.01636	.00236	.00056	.44561	.00113	---	.00205	.00034	---	---	---	.001528	.00003	.00078	.02098	.02545	.00175
Metal Manufacturing	(15)	.00131	.00127	.05306	.00054	.00001	.00002	.00039	.00061	---	---	---	.00060	.00025	.00001	.00790	.00020	---
Construction Materials	(16)	.03460	.00355	.00206	.12482	.00013	.01586	.00431	.00070	.00515	.00053	.00008	.00098	---	.00017	.00168	.02052	.00066
General Sales	(17)	.00768	.00003	.00003	.00127	---	.00023	.00003	.00024	.00339	.00024	.00005	.00049	---	---	.01136	.00038	.00131
Food Sales	(18)	.00369	.00003	.00006	---	---	---	.00047	---	---	---	---	---	---	---	.00060	---	---
Gasoline Service	(19)	.11435	.00685	.00160	.01602	.03597	.00269	.01115	.01878	---	.00200	.00162	.00235	---	.00073	.00476	.00982	.00142
Auto Sales	(20)	.03322	.00338	.00044	.00427	.00360	.00279	.00371	.00184	.00037	---	.00088	.00133	---	.00163	.00506	.00121	.00066
Clothing	(21)	.00235	---	---	.00024	---	.00024	---	---	---	---	---	---	---	---	.00047	---	---
Furniture	(22)	.00236	.00011	.00528	.00272	---	.00034	.00025	.00003	---	---	---	---	.00034	.00048	.00400	.00016	.00070
Eating	(23)	.00085	.00068	---	---	---	.00038	.00258	---	.00169	---	.00034	.00102	---	---	.00051	---	---
Miscellaneous Retail	(24)	.03567	.00384	.00233	.00682	.00093	.00545	.00317	.00197	.00040	.00012	.00079	.00055	.00006	.00131	.00185	.00085	.00190
Lodging	(25)	---	.00983	.00014	---	.01780	---	.00167	.00723	.00652	.00580	.00580	.00580	.00580	.00580	.00666	.00614	.00614
Personal Services	(26)	---	---	---	.00011	.00011	---	.00013	---	---	---	---	---	---	---	---	---	---
Business Services	(27)	.00289	.00693	.00171	.00837	---	.13055	.03176	.00076	.00011	.00003	.00037	.00329	.00003	.00003	.00099	.00338	.06839
Professional Services	(28)	.03130	.00327	.01463	.01103	.00205	.01611	---	.00487	---	.00016	.00009	.00055	---	.00027	.00036	.00245	.00288
Automobile Repair	(29)	.08292	.06189	.00033	.01138	.00843	.01562	.00497	---	---	---	.00220	.00414	---	.00235	.01626	.00228	---
Recreation	(30)	.00039	.00039	---	.00039	.00039	.00264	.00138	.00038	.00052	---	---	.00008	---	---	---	.00213	.00183
Miscellaneous Repair	(31)	.00332	.00065	.00070	.00243	.00232	.00795	.00215	.00024	.00024	.00024	.00188	.01787	---	.00045	.00166	.00204	.03153
Medical	(32)	.00049	.00065	.00020	.00057	---	.00012	.00017	.00023	---	.00001	.00008	.00007	---	.00009	.00024	.00009	.00005
Wholesale	(33)	.03340	.00614	.02991	.04978	.02180	.00026	.00064	.07675	---	.00044	.00078	.00002	---	---	.04712	.00531	.00084

[a] For a complete description see Table XI.

[b] Calculated from: Doeksen, Gerald A., "A Social Accounting System and Simulation Model Projecting Economic Variables and Analyzing the Structure of the Oklahoma Economy," Unpublished Ph.D. Thesis, Department of Agricultural Economics, Oklahoma State University, 1971.

[c] Dashes indicate zero.

[d] Consumption of military personnel and dependents allocated to federal government, Appendix B.

[e] Row distribution may not sum to 100 percent due to rounding.

TABLE II (Continued)

		Food Sales (18)	Gasoline Services (19)	Auto Sales (20)	Clothing (21)	Furniture (22)	Eating (23)	Misc. Retail (24)	Lodging (25)	Personal Services (26)	Business Services (27)	Professional Services (28)	Automobile Repair (29)	Recreation (30)	Miscellaneous Repair (31)	Medical (32)	Wholesale (33)
Farms Ranches	(1)	.00033	.00016	.00025	.00016	.00008	.00066	.00024	---	.00008	.00008	.00008	---	---	---	.00017	---
Agricultural Services	(2)	.00017	.00020	.00032	.00017	.00017	.00017	.00017	---	---	---	---	---	---	---	---	---
Mining	(3)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Construction	(4)	.00520	.00175	.00098	.00085	.00059	.00147	.00162	.00127	.00116	.00046	.00116	.00047	.00049	.00027	.00550	---
Transportation	(5)	.00010	.00010	.01250	.00095	.00064	---	.00009	.00009	.00007	.00010	.00031	.00070	---	.00065	.00070	---
Finance-Real Estate	(6)	.00710	.00604	.00707	.00354	.00599	.00403	.00579	.00353	.00446	.00063	.00442	.00385	.00066	.00205	.00671	---
Utilities	(7)	.01296	.00669	.00453	.00503	.00478	.00816	.00572	.01093	.01151	.00149	.00574	.00300	.00147	.00294	.00407	---
Food Manufacturing	(8)	.39500	.01748	.00137	.00094	.00121	.02873	.00546	.00905	.00144	.00128	.00121	.00083	.00589	.00027	.00243	---
Apparel Manufacturing	(9)	---	---	---	.00371	.15920	---	---	---	---	---	---	---	---	---	---	---
Wood-Paper	(10)	---	---	---	---	.03264	---	---	---	---	---	---	---	---	---	---	---
Printing-Publishing	(11)	.12816	.00114	.04799	.03751	.04786	.00589	.01840	.00541	.00572	.00019	.00940	.00446	.00909	.00188	.00366	---
Petroleum Refining	(12)	---	.21227	.00002	---	---	.00002	---	.00002	.00461	.00923	---	.00002	---	---	.00002	---
Leather-Plastic-Rubber	(13)	.00026	---	.00635	.00087	---	---	.00043	---	.00009	---	---	---	.00009	---	---	---
Concrete Products	(14)	.00414	.00323	.00448	.00226	---	.00226	.00031	.00743	.00466	.00113	.00113	.00301	.00197	.00288	.00431	---
Metal Manufacturing	(15)	.00002	.00003	.01346	---	.00001	.00001	.00127	.00001	.00010	.00004	---	.00010	---	.00007	.00034	---
Construction Materials	(16)	.00272	.00192	.00088	.00135	.00269	.00174	.00102	.00093	.00076	.00044	.00425	.00013	.00029	.00041	.00092	---
General Sales	(17)	.00038	.00409	.00422	.00072	.00045	.00252	.00102	.00077	.00037	.00039	.00038	.00003	---	.00003	.00076	---
Food Sales	(18)	.00665	---	---	---	---	.00725	.00013	---	---	---	.00090	---	---	---	.00075	---
Gasoline Service	(19)	.00133	.00937	.01146	.00017	.00986	.00090	.00333	.00274	.00120	.00168	.00169	.00441	.00018	.00246	.00043	---
Auto Sales	(20)	.00079	.01043	.01106	.00101	.00246	.00096	.00101	.00030	.00082	.00043	.00606	.00871	.00013	.00233	.00034	---
Clothing	(21)	---	---	.00118	---	---	---	---	---	.00024	---	---	---	---	---	.00508	---
Furniture	(22)	.00005	.00004	.00005	.00004	.00081	.00001	.00010	.00016	---	.00005	.00016	.00001	---	.00026	.00028	---
Eating	(23)	---	---	.00051	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Retail	(24)	.00128	.00044	.00114	.00075	.00455	.00094	.00486	.00058	.00085	.00022	.00492	.00042	.00023	.00061	.00370	---
Lodging	(25)	.00459	.00459	.00614	.00614	.00614	.00614	.03076	---	---	---	.00824	---	---	---	---	---
Personal Services	(26)	.00625	---	---	.00146	.00035	.00625	---	.04445	---	---	.00009	.00625	---	---	.00066	---
Business Services	(27)	.02499	.01300	.06886	.00663	.01860	.01044	.00712	.02363	.00646	.05807	.00110	.00414	.02774	.02265	.19310	---
Professional Services	(28)	.00194	.00053	.00333	.00380	.00728	.00215	.00811	.00746	.00402	.00317	.00609	.00219	---	.00134	.01007	---
Automobile Repair	(29)	.00039	.04409	.03834	.00007	.00795	.00039	.00599	.00007	.00004	---	.00047	.02331	---	.00869	.00130	---
Recreation	(30)	.00016	.00084	.00185	.00086	.00220	.00084	.00008	.00172	.00016	.00123	.00057	.00008	.00107	---	.00159	---
Miscellaneous Repair	(31)	.00311	.00452	.03593	.00060	.00251	.00078	.00065	.00167	.00069	.00005	.00620	.00123	.00065	.00009	.00012	---
Medical	(32)	.00012	.00015	.00009	.00005	---	.00012	.00012	---	---	---	.00026	.00014	---	.00012	.00017	---
Wholesale	(33)	.07715	.07066	.04454	.00023	.00019	.15235	.02054	.00270	.01585	.00055	.00032	.02465	.00019	.00886	.00488	---

TABLE II (Continued)

		FINAL DEMAND					
		Consumption	State Local Government	Public Private Investment	Federal[d] Government	Exports	Total[e]
Farms Ranches	(1)	.05560	.00033	---	.04564	.56338	100.00
Agricultural Services	(2)	.18265	.00189	.02757	.06454	.29768	100.00
Mining	(3)	.00579	.00281	.00544	.00281	.41166	100.00
Construction	(4)	.21605	.01635	.24142	.00506	.40696	100.00
Transportation	(5)	.09817	.00780	.00011	.12775	.22165	100.00
Finance-Real Estate	(6)	.44364	.03761	.00347	.10749	.12289	100.00
Utilities	(7)	.41427	.03181	---	.23777	.00840	100.00
Food Manufacturing	(8)	.06547	.04118	.00007	.06098	.33071	100.00
Apparel Manufacturing	(9)	---	---	---	.00246	.83462	100.00
Wood-Paper	(10)	.01643	.00163	.00186	---	.80040	100.00
Printing-Publishing	(11)	.12354	.04176	.03181	.11625	.07204	100.00
Petroleum Refining	(12)	.00809	.00529	.00002	.05194	.67155	100.00
Leather-Plastic-Rubber	(13)	---	---	---	---	.87061	100.00
Concrete Products	(14)	.20062	.04992	---	.04834	.13915	100.00
Metal Manufacturing	(15)	.00220	.00141	.01982	.00025	.89456	100.00
Construction Materials	(16)	.57625	.08267	.02279	.06375	.01831	100.00
General Sales	(17)	.71863	.03730	.01387	.16544	.02179	100.00
Food Sales	(18)	.91034	.01008	---	.03503	.02405	100.00
Gasoline Service	(19)	.55683	.04670	.00050	.02364	.09116	100.00
Auto Sales	(20)	.59969	.02689	.04095	.18361	.03752	100.00
Clothing	(21)	.92909	.00110	---	.00126	.05876	100.00
Furniture	(22)	.67626	.00750	.01092	.25723	.02929	100.00
Eating	(23)	.63546	.00005	---	.25380	.10225	100.00
Miscellaneous Retail	(24)	.72273	.03502	.02758	.06619	.05508	100.00
Lodging	(25)	.09254	.01269	---	.04608	.68506	100.00
Personal Services	(26)	.50134	.00417	---	.41128	.01710	100.00
Business Services	(27)	.09446	.00663	---	.02717	.12556	100.00
Professional Services	(28)	.72188	.00710	.00716	.03514	.07719	100.00
Automobile Repair	(29)	.37145	.03291	.00061	.22854	.02268	100.00
Recreation	(30)	.67766	.00364	.00039	.28547	.00921	100.00
Miscellaneous Repair	(31)	.71822	.00689	.00378	.00287	.13373	100.00
Medical	(32)	.89830	.02136	.00003	.01299	.06299	100.00
Wholesale	(33)	.05063	.03746	.06842	.04173	.10680	100.00

percent of sales to retail food outlets, three percent to eating and drinking establishments, and almost 50 percent to final demand categories broken down in the following manner; seven percent individual and households, four percent state and local government, six percent federal government and 33 percent regional exports. Only seven sectors mining, printing and publishing, food manufacturing, transportation, concrete products, business services and wholesaling made more than 50 percent of their sales to endogenous sectors.

An additional interpretation of the distribution table helps visualize input structure required of endogenous sectors for their deliveries to final demand. Reading down an endogenous column in Table II gives an indication of the percentage of local inputs in terms of employment required from regional endogenous sectors. For example, petroleum refining required 27 percent of mining output, 13 percent of transportation, and two percent of miscellaneous repair services. For all sectors regional sales to endogenous firms are low implying a great amount of sector inputs are imported into the region.

Transactions Table

A transactions matrix shows employment flows to regional sectors, serves to compute a direct requirements matrix and provides one method of computing induced effects of additional employment servicing final demand. Regional sector control totals are multiplied by the respective rows in the distribution table, the results are recorded in Table III. The interpretation of the transactions table is similar to that of the distribution table only now in terms of employment. For example, food manufacturing serves the following sectors with output from

TABLE III

DESCRIPTION OF REGIONAL SALES BY EMPLOYMENT TRANSACTIONS, PLANNING REGION NINE, 1970

SECTOR[a]		Farms Ranches (1)	Ag Services (2)	Mining (3)	Const. (4)	Transport. (5)	Finance R.E. (6)	Utilities (7)	Food Mfg. (8)	Apparel Mfg. (9)	Wood Paper (10)	Printing Publishing (11)	Petroleum Refining (12)	Leather Plastic Rubber (13)	Concrete (14)	Metal Mfg. (15)	Const. Materials (16)	General Sales (17)
Farms Ranches	(1)	2481.63	5.57	---[b]	32.80	7.63	128.36	3.67	1097.10	12.96	.93	2.79	---	1.66	3.63	---	.88	3.76
Agricultural Services	(2)	404.26	53.62	.09	.60	1.69	.02	.32	.13	59.26	---	---	---	---	---	.19	.64	.21
Mining	(3)	3.74	62.20	616.10	---	---	---	---	---	---	---	---	620.98	---	---	---	---	---
Construction	(4)	19.23	3.94	3.95	151.16	.75	6.16	21.44	8.17	.74	---	.26	.55	---	.40	4.56	8.15	5.85
Transportation	(5)	24.02	426.66	136.50	2.98	1.89	1.78	3.28	13.95	3.21	.14	1.50	232.98	---	---	26.98	56.74	2.09
Finance-Real Estate	(6)	395.78	50.84	18.71	24.66	13.39	38.42	46.78	13.57	2.55	1.62	12.66	1.63	.66	8.15	15.49	15.33	38.99
Utilities	(7)	42.43	13.53	91.90	5.51	4.40	67.92	13.42	10.44	14.28	.36	2.62	36.76	4.23	2.63	7.05	5.93	16.02
Food Manufacturing	(8)	4.51	1.21	1.05	1.41	.91	1.13	1.55	10.23	.25	.06	.69	.92	.16	.25	.39	.88	1.38
Apparel Manufacturing	(9)	---	.03	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Wood-Paper	(10)	---	---	---	30.85	---	.19	---	.38	---	---	---	---	---	---	---	1.97	---
Printing-Publishing	(11)	4.56	8.60	2.97	5.62	.69	17.95	17.30	1.40	2.68	---	1.45	7.33	1.40	1.40	11.50	7.25	56.70
Petroleum Refining	(12)	1.02	---	2.80	3.06	7.16	---	1.03	.03	---	---	---	1.22	1.02	---	1.04	6.13	---
Leather-Plastic-Rubber	(13)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9.38	---	.57
Concrete Products	(14)	7.71	1.11	.27	209.88	.53	---	.97	.16	---	---	---	.72	.01	.37	9.88	11.99	.83
Metal Manufacturing	(15)	5.14	5.01	208.86	2.11	.03	.08	1.55	2.41	---	---	---	2.34	.96	.03	31.09	.78	---
Construction Materials	(16)	19.31	1.98	1.15	69.65	.07	8.85	2.40	.39	2.87	.30	.04	.55	---	.09	.94	11.45	.37
General Sales	(17)	13.42	.06	.06	2.22	---	.40	.06	.43	5.93	.43	.09	.85	---	---	19.84	.67	2.29
Food Sales	(18)	5.88	.05	.10	---	---	---	.75	---	---	---	---	---	---	---	.95	---	---
Gasoline Service	(19)	91.48	5.48	1.28	12.81	28.78	2.15	8.92	15.03	---	1.60	1.30	1.88	---	.58	3.81	7.86	1.14
Auto Sales	(20)	44.29	4.50	.59	5.70	4.80	3.71	4.94	2.45	.49	---	1.18	1.78	---	2.17	6.75	1.61	.88
Clothing	(21)	1.80	---	---	.18	---	.18	---	---	---	---	---	---	---	---	.36	---	---
Furniture	(22)	1.34	.06	3.00	1.54	---	.20	.14	.02	---	---	---	---	.19	.27	2.27	.09	.40
Eating	(23)	2.22	1.77	---	---	---	1.00	6.77	---	4.43	---	.89	2.66	---	---	1.33	---	---
Miscellaneous Retail	(24)	43.45	4.67	2.84	8.31	1.14	6.63	3.86	2.40	.49	.15	.96	.67	.07	1.59	2.25	1.04	2.32
Lodging	(25)	---	5.18	.08	---	9.38	---	.88	3.81	3.44	3.06	3.06	3.06	3.06	3.06	3.51	3.24	3.24
Personal Services	(26)	---	---	---	.19	.19	---	.24	---	---	---	---	---	---	---	---	---	---
Business Services	(27)	3.60	8.65	2.14	10.45	---	162.92	39.64	.95	.13	.03	.47	4.11	.03	.03	1.23	4.21	85.35
Professional Services	(28)	64.60	6.75	30.20	22.77	4.23	33.25	---	10.05	---	.33	.19	1.14	---	.56	.74	5.06	5.94
Automobile Repair	(29)	38.23	28.53	.15	5.25	3.89	7.20	2.29	---	---	---	1.01	1.91	---	1.08	7.49	1.05	---
Recreation	(30)	.13	.13	---	.13	.13	.89	.47	.13	.18	---	---	.03	---	---	---	.72	.62
Miscellaneous Repair	(31)	.95	.19	.20	.69	.66	2.27	.62	.07	.07	.07	.54	5.11	---	.13	.47	.59	9.02
Medical	(32)	1.14	1.52	.48	1.34	---	.29	.39	.55	---	.02	.18	.15	---	.22	.57	.22	.11
Wholesale	(33)	67.88	12.48	60.78	101.15	44.30	.53	2.31	155.96	---	.90	1.58	.04	---	---	95.75	10.78	1.70

[a] For a complete sector description see Table XI.

[b] Dashes indicate zero.

[c] Military personnel and dependents' household consumption allocated to federal government, Appendix B.

[d] Row totals may not equal endogenous sector employment due to rounding errors.

[e] Derivation of sector employment is explained in Appendix A.

TABLE III (Continued)

		Food Sales (18)	Gasoline Services (19)	Auto Sales (20)	Clothing (21)	Furniture (22)	Eating (23)	Misc. Retail (24)	Lodging (25)	Personal Services (26)	Business Services (27)	Professional Services (28)	Automobile Repair (29)	Recreation (30)	Miscellaneous Repair (31)	Medical (32)	Wholesale (33)
Farms Ranches	(1)	3.73	1.76	2.79	1.76	.88	7.55	2.71	---	.88	.88	.89	---	---	---	1.91	---
Agricultural Services	(2)	.21	.25	.39	.21	.21	.21	.21	---	---	---	---	---	---	---	---	---
Mining	(3)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Construction	(4)	13.47	4.54	2.54	2.20	1.53	3.81	4.21	3.30	3.00	1.18	2.99	1.21	1.26	.71	14.24	---
Transportation	(5)	.17	.17	22.14	1.69	1.14	---	.17	.17	.12	.18	.56	1.24	---	1.16	1.24	---
Finance-Real Estate	(6)	22.67	19.28	22.58	11.30	19.13	12.88	18.49	11.26	14.23	2.01	14.12	12.29	2.11	6.55	21.45	---
Utilities	(7)	20.18	10.41	7.05	7.83	7.45	12.70	8.90	17.02	17.93	2.32	8.94	4.67	2.30	4.58	6.34	---
Food Manufacturing	(8)	367.74	16.27	1.28	.88	1.13	26.75	5.08	8.42	1.34	1.19	1.13	.78	5.49	.25	2.26	---
Apparel Manufacturing	(9)	---	---	---	5.90	253.28	---	---	---	---	---	---	---	---	---	---	---
Wood-Paper	(10)	---	---	---	---	7.41	---	---	---	---	---	---	---	---	---	---	---
Printing-Publishing	(11)	66.26	.59	24.81	19.39	24.74	3.04	9.51	2.80	2.96	.098	4.86	2.30	4.70	.97	1.89	---
Petroleum Refining	(12)	---	140.95	.01	---	---	.01	---	.01	3.06	6.13	---	.01	---	---	.01	---
Leather-Plastic-Rubber	(13)	.02	---	.52	.07	---	---	.04	---	.01	---	---	---	.01	---	---	---
Concrete Products	(14)	1.95	1.52	2.11	1.06	---	1.06	.15	3.50	2.19	.53	.53	1.42	.93	1.36	2.03	---
Metal Manufacturing	(15)	.08	.11	52.97	---	.03	.05	4.98	.05	.38	.15	---	.38	---	.27	1.32	---
Construction Materials	(16)	1.52	1.07	.49	.75	1.50	.97	.57	.52	.42	.25	2.37	.07	.16	.23	.51	---
General Sales	(17)	.67	7.15	7.37	1.26	.79	4.39	1.78	1.34	.65	.68	.67	.06	---	.06	1.32	---
Food Sales	(18)	10.59	---	---	---	---	11.53	.21	---	---	---	1.44	---	---	---	1.20	---
Gasoline Service	(19)	1.06	7.50	9.17	.13	7.89	.72	2.66	2.19	.96	1.34	1.35	3.53	.14	1.97	.34	---
Auto Sales	(20)	1.05	13.90	14.74	1.35	3.28	1.27	1.35	.40	1.09	.58	8.07	11.61	.17	3.10	.46	---
Clothing	(21)	---	---	.91	---	---	---	---	---	.18	---	---	---	---	---	3.90	---
Furniture	(22)	.03	.03	.03	.02	.46	---	.06	.09	---	.03	.09	---	---	.15	.16	---
Eating	(23)	---	---	1.33	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Retail	(24)	1.56	.54	1.39	.92	5.54	1.14	5.92	.70	1.03	.26	5.99	.52	.28	.74	4.51	---
Lodging	(25)	2.42	2.42	3.24	3.24	3.24	3.24	16.21	---	---	---	4.34	---	---	---	---	---
Personal Services	(26)	11.16	---	---	2.61	.63	11.16	---	79.38	---	---	.16	11.16	---	---	1.18	---
Business Services	(27)	31.19	16.22	85.94	8.27	23.21	13.03	8.89	29.50	8.07	72.47	1.38	5.17	34.62	28.27	240.99	---
Professional Services	(28)	4.00	1.09	6.87	7.84	15.03	4.44	16.74	15.40	8.30	6.54	12.57	4.52	---	2.77	20.78	---
Automobile Repair	(29)	.18	20.32	17.68	.03	3.66	.18	2.76	.03	.02	---	.22	10.75	---	4.00	.60	---
Recreation	(30)	.05	.28	.63	.29	.74	.28	.03	.58	.05	.42	.19	.03	.36	---	.54	---
Miscellaneous Repair	(31)	.89	1.29	10.28	.17	.72	.22	.19	.48	.20	.02	1.77	.35	.19	.03	.04	---
Medical	(32)	.29	.35	.22	.11	---	.29	.29	---	---	---	.61	.33	---	.29	.39	---
Wholesale	(33)	156.77	143.58	90.51	.47	.38	309.58	41.73	5.48	32.21	1.12	.65	50.10	.38	18.00	9.91	---

TABLE III (Continued)

		FINAL DEMAND					
		Consumption	State Local Government	Public Private Investment	Federal Government	Exports	Total[d] Endogenous Sector Employment[e]
Farms Ranches	(1)	632.18	3.76	---	518.94	6405.59	11370
Agricultural Services	(2)	224.29	2.32	33.85	79.26	365.55	1228
Mining	(3)	13.20	6.41	12.40	6.41	938.58	2280
Construction	(4)	559.35	42.32	625.03	13.12	1053.61	2589
Transportation	(5)	173.96	13.82	.20	226.37	392.76	1772
Finance-Real Estate	(6)	1417.00	120.13	11.09	343.33	392.52	3194
Utilities	(7)	645.02	49.53	---	370.21	13.08	1557
Food Manufacturing	(8)	60.95	38.34	.06	56.77	307.89	931
Apparel Manufacturing	(9)	---	---	---	3.91	1327.88	1591
Wood-Paper	(10)	3.73	.37	.42	---	181.69	227
Printing-Publishing	(11)	63.87	21.59	16.45	60.10	37.25	517
Petroleum Refining	(12)	5.37	3.51	.01	34.49	445.91	664
Leather-Plastic-Rubber	(13)	---	---	---	---	71.39	82
Concrete Products	(14)	94.49	23.51	---	22.77	65.54	471
Metal Manufacturing	(15)	8.65	5.56	78.01	.99	3520.99	3936
Construction Materials	(16)	321.55	46.13	12.72	35.57	10.22	558
General Sales	(17)	1255.45	65.16	24.23	289.03	38.07	1747
Food Sales	(18)	1449.26	16.05	---	55.77	38.28	1592
Gasoline Service	(19)	445.46	37.36	.40	18.91	72.93	800
Auto Sales	(20)	799.39	35.84	54.58	244.76	50.02	1333
Clothing	(21)	712.61	.84	---	.97	45.07	767
Furniture	(22)	383.44	4.25	6.19	145.85	16.61	567
Eating	(23)	1664.90	.14	---	664.95	267.90	2620
Miscellaneous Retail	(24)	880.28	42.65	33.60	80.62	67.09	1218
Lodging	(25)	48.77	6.69	---	24.28	361.02	527
Personal Services	(26)	895.39	7.44	---	734.55	30.53	1786
Business Services	(27)	117.89	8.27	---	33.91	156.70	1248
Professional Services	(28)	1489.96	14.66	14.78	72.53	159.32	2064
Automobile Repair	(29)	171.24	15.17	.28	105.36	10.45	461
Recreation	(30)	229.05	1.23	.13	96.49	3.11	338
Miscellaneous Repair	(31)	205.41	1.97	1.08	.82	38.25	286
Medical	(32)	2103.81	50.03	.07	30.42	147.52	2342
Wholesale	(33)	102.87	76.11	141.24	84.80	210.93	2032

five or more employees; farms and ranches five, food manufacturing 10, food sales 368, gasoline service stations 16, eating and drinking establishments 27, recreation five, lodging eight, household consumption 61, state and local government 38, federal government 57, and exports 308.

Division of the values in each column of the transactions table by total employment in each sector named at the head of the column results in a matrix of direct requirements showing sales in terms of employment to each endogenous sector per employee. The 33 x 33 matrix of direct coefficients assists in calculating the total employment serving final demand. Use of final demand columns of the transactions table to calculate final demand multipliers for regional exogenous sectors will be taken up in a later section.

Total Requirements (Direct and Indirect)

Direct and indirect requirements estimate regional endogenous impact of additions to employment due to a one employee increase in any sector's sales to final demand. A one unit employee increase in sales to final demand of a specified sector results in increased sales of regional endogenous sectors to the specified sector by an amount equal to the direct employment effects. Firms augmenting their sales to the specified sectors increase their purchases of local and imported inputs. Suppliers of inputs to firms serving the sector with additional final demand also augment their purchases of local and imported inputs. Firms make adjustments and the interdependencies work themselves out resulting in an increase in employment greater than the direct effect. Subtraction of direct requirements matrix from an identity matrix and

inverting[2] gives the total requirements (direct and indirect) recorded in Table IV.

Column totals of Table IV are sector multipliers, $\frac{b_{ej}}{a_{ej}}$ in Chapter II, estimating total employment change due to a one unit increase in employment servicing final demand for the sector named at the head of the column. The sector multipliers are employment multipliers because the transactions and direct requirements matrices were calculated in terms of employment. A large sector multiplier indicates stronger backward linkages in the regional economy. For an equal change in final demand for any regional endogenous sector the larger the sector multiplier the greater the impact on regional employment. For example, food and apparel manufacturing have sector multiplier values of 3.08 and 1.11 respectively. Increasing direct employment by 100 employees in food processing results in an additional regional endogenous change of 208 employees. Apparel manufacturing's increase in final demand sales requiring 100 direct employees results in 11 additional employees in the endogenous sectors. Comparisons of this type should be made with caution since the capital requirements per job may be significantly different causing an equal investment in apparel manufacturing to stimulate more indirect endogenous employment than in food manufacturing. A brief analysis of the distribution table revealed low amounts of trade among regional endogenous sectors and the bulk of regional endogenous employment servicing final demand. Employment flows servicing final demand are the foundation of regional trade

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[2]See Chapter II for the mathematical equations.

TABLE IV

TOTAL REQUIREMENTS, (DIRECT AND INDIRECT), PER UNIT OF EMPLOYMENT SERVING FINAL DEMAND, PLANNING REGION NINE, 1970

SECTOR[a/]	Farms Ranches (1)	Ag Services (2)	Mining (3)	Const. (4)	Transport. (5)	Finance R.E. (6)	Utilities (7)	Food Mfg. (8)	Apparel Mfg. (9)	Wood Paper (10)	Printing Publishing (11)	Petroleum Refining (12)	Leather Plastic Rubber (13)	Concrete (14)	Metal Mfg. (15)	Const. Materials (16)	General Sales (17)
Farms Ranches (1)	1.283883	0.013733	0.002927	0.020449	0.007610	0.053311	0.007296	1.531765	0.011569	0.006754	0.010711	0.008654	0.031119	0.012039	0.000818	0.008574	0.005951
Agricultural Services (2)	0.047770	1.046562	0.000307	0.001076	0.001294	0.002004	0.000503	0.057168	0.039400	0.000258	0.000406	0.000881	0.001221	0.000464	0.000102	0.001670	0.000360
Mining (3)	0.006788	0.077438	1.373679	0.003632	0.009116	0.000941	0.002575	0.012157	0.003032	0.001724	0.000733	1.291175	0.016497	0.000422	0.000718	0.019074	0.000650
Construction (4)	0.002907	0.004602	0.003704	1.062804	0.000747	0.002681	0.015028	0.013329	0.000900	0.000257	0.000822	0.005626	0.001290	0.001181	0.001355	0.016513	0.003918
Transportation (5)	0.020995	0.370600	0.084534	0.005948	1.004679	0.002093	0.003564	0.041867	0.016273	0.001450	0.003452	0.433144	0.006349	0.000496	0.007294	0.111190	0.001793
Finance-Real Estate (6)	0.048636	0.050254	0.014992	0.014278	0.009000	1.015514	0.032043	0.074471	0.004500	0.008222	0.025911	0.022594	0.012836	0.018757	0.004667	0.032206	0.024457
Utilities (7)	0.007308	0.017989	0.057071	0.004137	0.004027	0.022420	1.010058	0.021446	0.010022	0.002581	0.006152	0.111620	0.055350	0.006513	0.002333	0.014509	0.010403
Food Manufacturing (8)	0.001068	0.001814	0.000907	0.000912	0.001002	0.000559	0.001424	0.012889	0.000334	0.000674	0.001577	0.002928	0.002762	0.000736	0.000241	0.002318	0.001007
Apparel Manufacturing (9)	0.000080	0.000102	0.000845	0.000313	0.000008	0.000035	0.000050	0.000112	1.000006	0.000003	0.000003	0.000802	0.001063	0.000262	0.000266	0.000100	0.000107
Wood-Paper (10)	0.000049	0.000068	0.000074	0.012778	0.000011	0.000104	0.000191	0.000589	0.000018	1.000009	0.000013	0.000100	0.000049	0.000024	0.000025	0.003808	0.000053
Printing-Publishing (11)	0.001612	0.008587	0.003194	0.003354	0.000741	0.006187	0.011698	0.003949	0.002316	0.000283	1.003188	0.015260	0.018345	0.003378	0.003340	0.014296	0.032975
Petroleum Refining (12)	0.002258	0.003742	0.002638	0.002769	0.007041	0.000607	0.001980	0.005852	0.000228	0.001329	0.000546	1.007500	0.012796	0.000300	0.000554	0.014790	0.000486
Leather-Plastic-Rubber (13)	0.000007	0.000031	0.000303	0.000005	0.000004	0.000001	0.000005	0.000018	0.000003	0.000001	0.000002	0.000297	1.000033	0.000003	0.002405	0.000010	0.000326
Concrete Products (14)	0.001286	0.001715	0.000891	0.086926	0.000473	0.000386	0.001953	0.002627	0.000200	0.000172	0.000152	0.002413	0.000634	1.000963	0.002679	0.023494	0.000883
Metal Manufacturing (15)	0.001697	0.011802	0.126976	0.001435	0.001038	0.000266	0.001444	0.005217	0.000493	0.000190	0.000204	0.123197	0.013540	0.000331	1.008146	0.003484	0.000139
Construction Materials (16)	0.002576	0.002155	0.001021	0.029346	0.000156	0.003109	0.002136	0.003899	0.001993	0.001418	0.000226	0.002046	0.000294	0.000339	0.000313	1.021630	0.000449
General Sales (17)	0.001694	0.000325	0.000744	0.001102	0.000211	0.000264	0.000184	0.002710	0.003778	0.001999	0.000257	0.002171	0.000255	0.000089	0.005121	0.001511	1.001391
Food Sales (18)	0.000683	0.000078	0.000133	0.000022	0.000009	0.000049	0.000517	0.000831	0.000026	0.000007	0.000018	0.000179	0.000050	0.000012	0.000248	0.000022	0.000012
Gasoline Service (19)	0.011266	0.011524	0.002787	0.006349	0.016696	0.001497	0.006242	0.030436	0.000677	0.007307	0.002855	0.011943	0.001067	0.001549	0.001207	0.016923	0.001067
Auto Sales (20)	0.005812	0.006100	0.001219	0.003252	0.003232	0.001703	0.003598	0.010156	0.000653	0.000223	0.002557	0.005502	0.000546	0.004890	0.001898	0.004095	0.000826
Clothing (21)	0.000212	0.000013	0.000015	0.000083	0.000004	0.000068	0.000007	0.000258	0.000003	0.000002	0.000006	0.000019	0.000008	0.000007	0.000094	0.000008	0.000003
Furniture (22)	0.000172	0.000177	0.001891	0.000699	0.000017	0.000077	0.000111	0.000243	0.000011	0.000008	0.000007	0.001796	0.002379	0.000587	0.000593	0.000223	0.000240
Eating (23)	0.000385	0.001648	0.000316	0.000049	0.000057	0.000443	0.004433	0.000540	0.002896	0.000022	0.001761	0.004606	0.000343	0.000050	0.000363	0.000166	0.000114
Miscellaneous Retail (24)	0.005335	0.004685	0.002144	0.003983	0.000775	0.002474	0.002734	0.009175	0.000578	0.000739	0.002027	0.003551	0.001380	0.003546	0.000649	0.002401	0.001564
Lodging (25)	0.000511	0.006638	0.000793	0.001902	0.005449	0.000164	0.000777	0.005020	0.002471	0.013536	0.006013	0.007455	0.037589	0.006603	0.001105	0.007017	0.002131
Personal Services (26)	0.000237	0.001691	0.000163	0.000316	0.001000	0.000098	0.000343	0.000969	0.000414	0.002046	0.000970	0.001336	0.005686	0.001060	0.000222	0.001149	0.000332
Business Services (27)	0.004643	0.012871	0.004239	0.006436	0.001699	0.056049	0.029793	0.008977	0.001396	0.001847	0.003371	0.014600	0.005256	0.002233	0.001259	0.012106	0.054445
Professional Services (28)	0.008562	0.009078	0.018920	0.010353	0.002971	0.011418	0.000887	0.021822	0.000567	0.002094	0.001028	0.020998	0.001885	0.001826	0.000416	0.010880	0.004238
Automobile Repair (29)	0.006144	0.026397	0.000808	0.002863	0.002856	0.002722	0.001940	0.007971	0.001082	0.000265	0.002270	0.005116	0.000430	0.002598	0.002985	0.003083	0.000304
Recreation (30)	0.000053	0.000185	0.000038	0.000108	0.000094	0.000317	0.000332	0.000227	0.000129	0.000025	0.000021	0.000142	0.000070	0.000020	0.000009	0.001363	0.000388
Miscellaneous Repair (31)	0.000270	0.000495	0.000266	0.000439	0.000504	0.000782	0.000502	0.000520	0.000099	0.000355	0.001107	0.000232	0.000205	0.000351	0.000185	0.001371	0.005248
Medical (32)	0.000216	0.001358	0.000337	0.000620	0.000021	0.000117	0.000282	0.000877	0.000058	0.000102	0.000354	0.000589	0.000039	0.000470	0.000153	0.000453	0.000091
Wholesale (33)	0.012675	0.028776	0.043055	0.044598	0.029322	0.001818	0.004317	0.189147	0.001808	0.005830	0.004911	0.053658	0.002632	0.001439	0.025540	0.028245	0.002279
Total	1.487778	1.723219	1.751919	1.332511	1.111855	1.190269	1.148938	3.077220	1.107921	1.061723	1.083615	3.170115	1.233987	1.073528	1.076395	1.378678	1.158621

[a/] See Table XI for complete sector descriptions.

TABLE IV (Continued)

		Food Sales (18)	Gasoline Services (19)	Auto Sales (20)	Clothing (21)	Furniture (22)	Eating (23)	Misc. Retail (24)	Lodging (25)	Personal Services (26)	Business Services (27)	Professional Services (28)	Automobile Repair (29)	Recreation (30)	Miscellaneous Repair (31)	Medical (32)	Wholesale (33)
Farms Ranches	(1)	0.360897	0.037862	0.006289	0.006258	0.013837	0.021367	0.010908	0.026943	0.002418	0.002765	0.002271	0.004930	0.025841	0.003595	0.003725	0.0000000
Agricultural Services	(2)	0.013618	0.001855	0.000575	0.000832	0.018352	0.000885	0.000597	0.001024	0.000095	0.000108	0.000091	0.000204	0.000969	0.000162	0.000146	0.0000000
Mining	(3)	0.003300	0.230289	0.002427	0.000327	0.005174	0.000315	0.000744	0.002110	0.002432	0.007029	0.000237	0.002163	0.001076	0.002483	0.000838	0.0000000
Construction	(4)	0.012514	0.007889	0.002549	0.003401	0.004026	0.001880	0.004098	0.007909	0.002009	0.001176	0.001724	0.003341	0.004450	0.003248	0.006714	0.0000000
Transportation	(5)	0.010455	0,079072	0.018385	0.002917	0.011540	0.000703	0.000878	0.001999	0.001017	0.002619	0.000626	0.004170	0.001158	0.005407	0.000995	0.0000000
Finance-Real Estate	(6)	0.033918	0.032504	0.019898	0.016660	0.039805	0.006437	0.017130	0.026248	0.008730	0.002170	0.007590	0.029575	0.008543	0.025329	0.010045	0.0000000
Utilities	(7)	0.018784	0.034924	0.007071	0.011283	0.020125	0.005500	0.008652	0.035673	0.010627	0.002733	0.004802	0.012039	0.007797	0.017643	0.003401	0.0000000
Food Manufacturing	(8)	0.235720	0.021537	0.001396	0.001349	0.002848	0.011438	0.004622	0.016594	0.000815	0.001086	0.000814	0.002043	0.016620	0.001262	0.001256	0.0000000
Apparel Manufacturing	(9)	0.000039	0.000166	0.000034	0.007703	0.447084	0.000004	0.000026	0.000087	0.000004	0.000016	0.000021	0.000009	0.000006	0.000238	0.000048	0.0000000
Wood-Paper	(10)	0.000255	0.000117	0.000035	0.000047	0.013144	0.000029	0.000055	0.000110	0.000026	0.000016	0.000026	0.000044	0.000063	0.000051	0.000084	0.0000000
Printing-Publishing	(11)	0.043319	0.004742	0.019646	0.025805	0.045769	0.001594	0.008337	0.006498	0.001920	0.000267	0.002663	0.006097	0.014217	0.004210	0.001096	0.0000000
Petroleum Refining	(12)	0.001711	0.179589	0.001860	0.000208	0.003039	0.000190	0.000544	0.001582	0.001892	0.005478	0.000179	0.001675	0.000778	0.001928	0.000645	0.0000000
Leather-Plastic-Rubber	(13)	0.000018	0.000066	0.000494	0.000095	0.000007	0.000001	0.000041	0.000003	0.000006	0.000002	0.000002	0.000016	0.000022	0.000009	0.000002	0.0000000
Concrete Products	(14)	0.002692	0.003154	0.002099	0.001756	0.000621	0.000620	0.000612	0.007612	0.001420	0.000574	0.000463	0.003560	0.003213	0.005188	0.001489	0.0000000
Metal Manufacturing	(15)	0.001388	0.023003	0.040831	0.000149	0.001000	0.000134	0.004313	0.000514	0.000495	0.000835	0.000212	0.002162	0.000228	0.001732	0.000701	0.0000000
Construction Materials	(16)	0.002244	0.002142	0.000595	0.001214	0.003954	0.000513	0.000720	0.001506	0.000356	0.000281	0.001272	0.000423	0.000738	0.001070	0.000488	0.0000000
General Sales	(17)	0.001118	0.009639	0.005956	0.001732	0.003382	0.001737	0.001592	0.002758	0.000393	0.000611	0.000376	0.000400	0.000127	0.000425	0.000659	0.0000000
Food Sales	(18)	1.006901	0.000061	0.000026	0.000017	0.000046	0.004447	0.000199	0.000055	0.000010	0.000008	0.000710	0.000018	0.000019	0.000020	0.000528	0.0000000
Gasoline Service	(19)	0.008134	1.012845	0.007847	0.000544	0.015180	0.000742	0.002631	0.005251	0.000706	0.001295	0.000830	0.008436	0.001192	0.007597	0.000430	0.0000000
Auto Sales	(20)	0.003319	0.019805	1.012107	0.002028	0.007040	0.000690	0.001465	0.001512	0.000740	0.000603	0.004073	0.026481	0.000857	0.011746	0.000384	0.0000000
Clothing	(21)	0.000064	0.000025	0.000694	1.000004	0.000010	0.000005	0.000005	0.000023	0.000104	0.000001	0.000004	0.000025	0.000006	0.000012	0.001666	0.0000000
Furniture	(22)	0.000086	0.000371	0.000064	0.000039	1.000838	0.000008	0.000059	0.000195	0.000008	0.000036	0.000048	0.000020	0.000014	0.000532	0.000078	0.0000000
Eating	(23)	0.000267	0.000927	0.001104	0.000125	0.001473	1.000036	0.000065	0.000189	0.000061	0.000037	0.000033	0.000107	0.000071	0.000113	0.000024	0.0000000
Miscellaneous Retail	(24)	0.003363	0.001743	0.001332	0.001419	0.010507	0.000615	1.005105	0.001917	0.000677	0.000295	0.003003	0.001402	0.001093	0.002862	0.002074	0.0000000
Lodging	(25)	0.003015	0.004621	0.002834	0.004493	0.007597	0.001337	0.013518	1.000327	0.000072	0.000077	0.002209	0.000243	0.000220	0.000238	0.000097	0.0000000
Personal Services	(26)	0.007573	0.001389	0.000785	0.004089	0.002452	0.004500	0.002103	0.150696	1.000017	0.000015	0.000423	0.024847	0.000041	0.000402	0.000538	0.0000000
Business Services	(27)	0.024771	0.029003	0.072377	0.013363	0.048477	0.006215	0.010160	0.063302	0.005710	1.062057	0.001911	0.016542	0.109812	0.108218	0.110115	0.0000000
Professional Services	(28)	0.008195	0.006640	0.006388	0.010850	0.028326	0.002180	0.014763	0.031263	0.004903	0.005793	1.006422	0.010950	0.001114	0.010991	0.009797	0.0000000
Automobile Repair	(29)	0.002220	0.027777	0.014334	0.000261	0.007915	0.000232	0.002572	0.000533	0.000112	0.000095	0.000254	1.024623	0.000250	0.014860	0.000357	0.0000000
Recreation	(30)	0.000109	0.000428	0.000521	0.000402	0.001424	0.000120	0.000054	0.001163	0.000039	0.000358	0.000106	0.000095	1.001119	0.000062	0.000275	0.0000000
Miscellaneous Repair	(31)	0.000771	0.003359	0.007935	0.000313	0.001550	0.000121	0.000238	0.001047	0.000153	0.000076	0.000916	0.001064	0.000602	1.000269	0.000052	0.0000000
Medical	(32)	0.000414	0.000606	0.000213	0.000167	0.000083	0.000125	0.000259	0.000050	0.000010	0.000008	0.000305	0.000761	0.000028	0.001034	1.000178	0.0000000
Wholesale	(33)	0.144323	0.199575	0.074460	0.001704	0.007193	0.121114	0.036724	0.017912	0.018629	0.001788	0.001323	0.116017	0.004857	0.067607	0.005196	1.0000000
Total		1.955507	1.977718	1.333153	1.121543	1.773811	1.195830	1.153785	1.414601	1.066604	1.100306	1.045937	1.304479	1.207140	1.300543	1.164117	1.0000000

relationships. Regional multipliers help illustrate the relationships between endogenous and final demand sectors.

Regional Multipliers

Regional multipliers estimate total change in area employment due to additional deliveries to final demand by any endogenous sector. One approach determines regional multipliers by multiplying direct requirements of a selected final demand column times the inverse matrix, and the second gives regional multipliers endogenously using simultaneous equations. The results are equivalent with respect to regional multipliers. Both methods also estimate strength of backward linkages in the regional economy.

The values recorded in the final demand columns in the transactions table represent direct requirements in terms of employment by sector for the exogenous sector named at the head of each column. Multiplication of each final demand column of the transactions table by the inverse matrix one at a time yields total employment associated with the respective final demand category. The difference between total employment and direct employment in each endogenous sector is the indirect employment of that sector serving final demand. The results are recorded in Table V.

Table V also contributes knowledge concerning backward linkages in the regional economy. The products of all firms are either delivered directly to final demand customers, or sold indirectly as inputs for other regional firms to produce products for final demand. Therefore, in terms of employment the final demand categories in Table V sum to regional sector control totals. Backward linkages refer to the

TABLE V

DIRECT AND INDIRECT EMPLOYMENT ASSOCIATED WITH FINAL DEMAND PURCHASES AND PERCENTAGES OF DIRECT TO TOTAL EMPLOYMENT, PLANNING REGION NINE, 1970

	Consumption				State and Local Government				Public and Private Investment			
Sector	Direct	Indirect	Total	Direct Percent	Direct	Indirect	Total	Direct Percent	Direct	Indirect	Total	Direct Percent
(1)	632.2	1003.5	1635.7	38.65	3.8	77.4	81.2	4.68	—	15.3	15.3	0
(2)	224.3	80.7	305.0	73.54	2.3	3.4	5.7	40.35	33.9	2.4	36.3	93.39
(3)	13.2	167.0	180.2	7.33	6.4	18.1	24.5	26.12	12.4	10.2	22.6	54.87
(4)	559.4	118.5	677.9	82.52	42.3	6.7	49.0	86.33	625.0	40.3	665.3	93.94
(5)	174.0	230.0	404.0	43.07	13.8	14.8	28.6	48.25	.2	20.6	20.8	.96
(6)	1417.0	330.1	1747.1	81.11	120.1	16.4	136.5	87.99	11.1	14.8	25.9	42.86
(7)	645.0	185.7	830.7	77.65	49.5	9.9	59.4	83.33	—	5.8	5.8	0
(8)	61.0	393.9	454.9	13.41	38.3	6.1	44.4	86.26	.1	1.0	1.1	9.09
(9)	--	177.8	177.8	0	--	2.0	2.0	0	—	3.0	3.0	0
(10)	3.7	14.7	18.4	20.11	.4	.8	1.2	33.33	.4	8.1	8.5	4.71
(11)	63.9	208.2	272.1	23.48	21.6	7.1	28.7	75.26	16.5	5.4	21.9	75.34
(12)	5.4	104.0	109.4	4.94	3.5	8.4	11.9	29.41	--	2.4	2.4	0
(13)	--	1.0	1.0	0	--	.1	.1	0	—	.2	.2	0
(14)	94.5	78.7	173.2	54.56	23.5	5.6	29.1	80.76	—	55.1	55.1	0
(15)	8.7	62.6	71.3	12.20	5.6	4.5	10.1	55.45	78.0	6.0	84.0	92.86
(16)	321.6	44.5	366.1	87.84	46.1	3.2	49.3	93.51	12.7	18.9	31.6	40.19
(17)	1255.5	24.9	1280.4	98.06	65.2	1.1	66.3	98.34	24.2	1.6	25.8	93.80
(18)	1449.3	20.8	1470.1	98.59	16.1	.2	16.3	98.77	—	.1	.1	0
(19)	445.5	71.4	516.9	86.19	37.4	4.5	41.9	89.26	.4	5.4	5.8	6.90
(20)	799.4	60.5	859.9	92.96	35.8	3.3	39.1	91.56	54.6	3.4	58.0	94.14
(21)	712.6	4.6	717.2	99.36	.8	.2	1.0	80.00	—	.1	.1	0
(22)	383.4	2.4	385.8	99.38	4.3	.1	4.4	97.73	6.2	.5	6.7	92.54
(23)	1664.9	7.2	1672.1	99.57	.1	.5	.6	16.67	—	.2	.2	0
(24)	880.3	43.8	924.1	95.26	42.7	1.9	44.6	95.74	33.6	3.2	36.8	91.30
(25)	48.8	43.1	91.9	53.10	6.7	2.1	8.8	76.14	—	1.9	1.9	0
(26)	895.4	41.1	936.5	95.61	7.4	2.0	9.4	78.72	—	.5	.5	0
(27)	117.9	636.0	753.9	15.64	8.3	25.0	33.3	24.92	—	11.5	11.5	0
(28)	1490.0	137.6	1627.6	91.55	14.7	6.2	20.9	70.33	14.8	8.5	23.3	63.52
(29)	171.2	60.9	232.1	73.76	15.2	3.4	18.6	81.72	.3	3.9	4.2	7.14
(30)	229.1	4.7	233.8	97.99	1.2	.3	1.5	80.00	.1	.2	.3	33.33
(31)	205.4	21.5	226.9	90.52	2.0	1.1	3.1	64.52	1.1	.9	2.0	55.00
(32)	2103.8	4.4	2108.2	99.79	50.0	.2	50.2	99.60	.1	--	.1	100.00
(33)	102.9	735.9	838.8	12.27	76.1	28.8	104.9	72.55	141.2	37.5	178.7	79.02
Total for 33 Sectors	17179.3	5121.7	22301.0	77.03	761.2	265.4	1026.6	74.15	1066.9	288.9	1355.8	78.69
State & Local Government	8097.0		8097.0									
Federal Government												
Regional Total			30398.0									

[a]Rows of final demand categories may not equal total regional employment due to rounding.

TABLE V (Continued)

Sector	Federal Government				Exports				Sector Totals			
	Direct	Indirect	Total	Direct Percent	Direct	Indirect	Total	Direct Percent	Direct	Indirect	Total	Direct Percent
(1)	518.9	307.0	825.9	62.83	6405.6	2405.6	8811.2	72.70	7560.5	3809.5	11370.0	66.50
(2)	79.3	37.7	117.0	67.78	365.6	398.3	763.9	47.86	705.3	522.7	1228.0	57.43
(3)	6.4	70.2	76.6	8.36	938.6	1037.6	1976.2	47.50	977.0	1303.0	2280.0	42.85
(4)	13.1	18.6	31.7	41.32	1053.6	111.4	1165.0	90.44	2293.4	295.6	2589.0	88.58
(5)	226.4	76.3	302.7	74.79	392.8	623.0	1015.8	38.67	807.1	964.9	1772.0	45.55
(6)	343.3	94.8	438.1	78.36	392.5	453.4	845.9	46.40	2284.1	909.9	3194.0	71.51
(7)	370.2	49.1	419.3	88.29	13.1	227.6	240.7	5.44	1077.8	479.2	1557.0	69.22
(8)	56.8	28.2	85.0	66.82	307.9	37.8	345.7	89.07	464.0	467.0	931.0	49.84
(9)	3.9	65.4	69.3	5.63	1327.9	10.9	1338.8	99.19	1331.8	259.2	1591.0	83.71
(10)	--	2.5	2.5	0	181.7	14.6	196.3	92.56	186.2	40.8	227.0	82.03
(11)	60.1	38.8	98.9	60.77	37.3	58.0	95.3	39.14	199.3	317.7	517.0	38.55
(12)	34.5	11.8	46.3	74.51	445.9	48.1	494.0	90.26	489.3	174.7	664.0	73.69
(13)	--	.3	.3	0	71.4	9.0	80.4	88.81	71.4	10.6	82.0	87.07
(14)	22.8	7.5	30.3	75.25	65.5	117.8	183.3	35.73	206.3	264.7	471.0	43.80
(15)	1.0	20.0	21.0	4.76	3521.0	228.0	3749.0	93.92	3614.2	321.8	3936.0	91.82
(16)	35.6	6.8	42.4	83.96	10.2	58.4	68.6	14.87	426.2	131.8	558.0	76.38
(17)	289.0	5.8	294.8	98.03	38.1	41.3	79.4	47.98	1672.0	75.0	1747.0	95.71
(18)	55.8	4.1	59.9	93.16	38.3	7.5	45.8	83.62	1559.4	32.6	1592.0	97.95
(19)	18.9	24.0	42.9	44.06	72.9	119.6	192.5	37.87	575.1	224.9	800.0	71.89
(20)	244.8	16.5	261.3	93.69	50.0	64.5	114.5	43.67	1184.6	148.4	1333.0	88.87
(21)	1.0	.4	1.4	71.43	45.1	2.2	47.3	95.35	759.5	7.5	767.0	99.02
(22)	145.9	.5	146.4	99.66	16.6	7.1	23.7	70.04	556.3	10.7	567.0	98.11
(23)	665.0	3.1	668.1	99.54	267.9	11.4	279.3	95.92	2597.9	22.1	2620.0	99.16
(24)	80.6	10.6	91.2	88.38	67.1	54.2	121.3	55.32	1104.2	113.8	1218.0	90.66
(25)	24.3	8.6	32.9	73.86	361.0	30.5	391.5	92.21	440.8	86.2	527.0	83.64
(26)	734.6	11.4	746.0	98.47	30.5	63.1	93.6	32.59	1667.9	118.1	1786.0	93.39
(27)	33.9	107.1	141.0	24.04	156.7	151.4	308.1	50.86	316.8	931.2	1248.0	25.38
(28)	72.5	29.6	102.1	71.00	59.3	230.8	290.1	20.44	1751.3	312.7	2064.0	84.85
(29)	105.4	17.0	122.4	86.11	10.5	73.2	83.7	12.54	302.5	158.5	461.0	65.62
(30)	96.5	1.1	97.6	98.87	3.1	1.8	4.9	63.27	330.0	8.0	338.0	97.63
(31)	.8	5.5	6.3	12.70	38.3	9.4	47.9	80.29	247.5	38.5	286.0	86.54
(32)	30.4	.9	31.3	97.12	147.5	4.4	151.9	97.10	2331.9	10.1	2342.0	99.57
(33)	84.8	175.0	259.8	32.64	210.9	438.8	649.7	32.46	616.0	1416.0	2032.0	30.31
Total for 33 Sectors	4456.5	1256.2	5712.7	78.01	17144.4	7150.7	24295.1	70.57	40707.6	13987.4	54695.0	74.43
State & Local Government									8097.0		8097.0	
Federal Government	6396.0		6396.0						6396.0		6396.0	
Regional Total			12108.7								69188.0	

amount of regional employment serving final demand categories indirectly by contributing to production processes of regional endogenous firms. Lower percentage values of direct to total employment therefore indicate stronger backward linkages. Extending this analysis to the final demand categories themselves, 74 percent of regional employment or 40,708 man years of employment serves final demand categories directly. The lowest percentage of direct employment to total employment, 71 percent, of any final demand category is found in exports where 17,144 man years of employment is direct and only 7,151 indirect. The percentages direct to total employment by endogenous sector are less than the total regional percentage of 74 percent in only 13 sectors: (1) farms and ranches, (2) agricultural services, (3) mining, (5) transportation, (6) banking, finance and real estate, (7) utilities and communications, (8) food manufacturing, (11) printing and publishing, (12) petroleum refining, (14) concrete products, (19) gasoline service, (27) business services, (29) automotive repair services, and (33) wholesaling.

Direct and indirect, induced, and final demand impact are three types of multipliers calculated from information in Table V. Induced multipliers are multiplied times endogenous sector multipliers to estimate total regional employment change due to a one employee increase in any endogenous sector servicing final demand. Induced multipliers are based on the assumption that changes in household consumption and requirements for state and local government services occur instantaneously due to increases in employment.

In Chapter II the regional induced consumption multiplier is derived, $\frac{1}{1-c}$, where the proportion of total employment in household

consumption is $c = \frac{C}{E_r}$. Solution of this equation yields a regional induced household multiplier equal to 1.78, Table VI. A portion of regional employment depends on state and local government purchases. The proportion of regional employment in state and local government is $s = \frac{LG}{E_r}$. The equation $\frac{1}{1-c-s}$ gives the induced households and state and local government employment multiplier 1.83 recorded in Table VI. The regional induced household and state and local government multiplier 1.83 means .83 additional job is required to serve household and state and local government markets for each new employee serving final demand. Multiplication of the induced households plus state and local government multiplier times endogenous sector multipliers furnishes estimates of regional multipliers. A regional multiplier computed for food manufacturing is 3.08 x 1.83 = 5.64. A 100 employee increase in food processing due to increased deliveries to final demand results in 464 other jobs, 208 and 256 servicing endogenous sectors and household and state and local governments respectively.

Direct and indirect multipliers are also found by a procedure outlined in Chapter II. The equation $FG = FG^d(1+g)$ contains the direct and indirect multiplier for federal government purchases, (1+g), in which g is the proportion of indirect to direct government employment, $g = \frac{FG^{id}}{FG^d}$. Table V supplies information to calculate indirect to direct employment ratios for exports, private and public investment, and federal government purchases. Values of these multipliers appear in Table VI. A fourth category, federal government employment, represents additional direct employment in federal government rather than employment in firms serving this market. No indirect employment is reported and the ratio of indirect to direct employment is zero and a value of

TABLE VI

FINAL DEMAND MULTIPLIERS, PLANNING REGION NINE, 1970

Induced	
(1)	(2)
Households	Households plus State and Local Government
1.78	1.83

Direct and Indirect Final Demand Multipliers			
(3)	(4)	(5)	(6)
Exports	Federal Government Purchases	Public and Private Investment	Federal Government Employment
1.42	1.28	1.27	1.00

Final Demand Impact Multipliers (Induced Households and State and Local Government)			
(7)	(8)	(9)	(10)
Exports	Federal Government Purchases	Public and Private Investment	Federal Government Employment
2.60	2.34	2.32	1.83

one is recorded in Table VI. The export direct and indirect multiplier indicates an expected employment change per additional endogenous worker serving the export market. A 100 employee increase in direct export employment results in 42 additional jobs in endogenous sectors. A similar interpretation applies to federal government purchases and public and private investment.

Final demand impact multipliers, Table VI, result from multiplication of induced multipliers times direct and indirect final demand multipliers. Final demand impact multipliers estimate the total effect of an additional employee serving final demand without considering what endogenous sector the increase in direct employment occurs. This multiplication indicates a greater than one employee direct and indirect effect must occur before an induced effect can occur. A final demand impact multiplier of 2.60 for exports, shows a 100 employee increase in direct employment deliveries to final demand results in 260 jobs, 160 of which service requirements of additional inputs for endogenous firms and additional induced household consumption and state and local government services.

An alternative method for calculating regional multipliers includes household consumption and state and local governments in a simultaneous equation approach previously utilized for 33 endogenous sectors. The resulting computations furnish regional multipliers equivalent to those obtained by multiplication of endogenous sector multipliers times the regional induced household consumption plus state and local government multiplier. The mathematical equations for this method are discussed in Chapter II.

Table VII lists the direct coefficients required for household consumption and state and local governments endogenous. A 34th column of direct coefficients for consumption is obtained by dividing each entry in the consumption column of the transactions table by total regional employment including government employment. These coefficients indicate direct employment serving consumption for each employee in the region. A 35th column of direct coefficients for state and local government endogenous results from dividing each entry in the state and local government column of the transactions table by total state and local government employment. These coefficients show direct employment serving state and local government requirements. The table also contains row entries for direct coefficients. A value of one for household consumption endogenous is the labor-output coefficient and is recorded for all entries of row 34 except the 34th column for which a value of zero is entered since households are not assumed to produce output for final demand. All entries in row 35 are zero except for the 34th column, which is the ratio of state and local government to total regional employment. This ratio indicates the number of employees in state and local government endogenous serving household consumption per unit of regional employment. Entries of zero in the 35th row (except for column 34) are the result of a lack of information on the distribution of state and local government public services to producing sectors or other final demand sectors.

Inversion of the 35 x 35 matrix provides Table VIII of direct, indirect, and induced requirements. The induced household consumption and state and local government requirements are included along with total requirements direct and indirect. Larger elements at the junction

TABLE VII

DIRECT COEFFICIENTS, HOUSEHOLD CONSUMPTION AND STATE AND LOCAL GOVERNMENT ENDOGENOUS, PLANNING REGION NINE, 1970

Sector	Household Consumption Requirements (34th column)	State and Local Gov't Requirements (35th column)	Household Employment (34th row)	State and Local Gov't Distribution of Public Services (35th row)
(1)	.00914	.00046	1.00000	--
(2)	.00324	.00029	1.00000	--
(3)	.00019	.00079	1.00000	--
(4)	.00808	.00523	1.00000	--
(5)	.00251	.00171	1.00000	--
(6)	.02048	.01484	1.00000	--
(7)	.00932	.00612	1.00000	--
(8)	.00088	.00474	1.00000	--
(9)	--	--	1.00000	--
(10)	.00005	.00005	1.00000	--
(11)	.00092	.00267	1.00000	--
(12)	.00008	.00043	1.00000	--
(13)	--	--	1.00000	--
(14)	.00137	.00290	1.00000	--
(15)	.00013	.00069	1.00000	--
(16)	.00465	.00570	1.00000	--
(17)	.01815	.00805	1.00000	--
(18)	.02095	.00198	1.00000	--
(19)	.00644	.00461	1.00000	--
(20)	.01155	.00443	1.00000	--
(21)	.01030	.00010	1.00000	--
(22)	.00554	.00053	1.00000	--
(23)	.02406	.00002	1.00000	--
(24)	.01272	.00527	1.00000	--
(25)	.00071	.00083	1.00000	--
(26)	.01294	.00092	1.00000	--
(27)	.00170	.00102	1.00000	--
(28)	.02153	.00181	1.00000	--
(29)	.00248	.00187	1.00000	--
(30)	.00331	.00015	1.00000	--
(31)	.00297	.00024	1.00000	--
(32)	.03041	.00618	1.00000	--
(33)	.00149	.00940	1.00000	--
(34)	.00000	1.00000	--	.11703
(35)	.11703	--	1.00000	--

TABLE VIII

TOTAL REQUIREMENTS, (DIRECT, INDIRECT, INDUCED), OF EMPLOYMENT SERVING FINAL DEMAND, PLANNING REGION NINE, 1970

SECTOR[a]	Farms Ranches (1)	Ag Services (2)	Mining (3)	Const. (4)	Transport. (5)	Finance R.E. (6)	Utilities (7)	Food Mfg. (8)	Apparel Mfg. (9)	Wood Paper (10)	Printing Publishing (11)	Petroleum Refining (12)	Leather Plastic Rubber (13)	Concrete (14)	Metal Mfg. (15)	Const. Materials (16)	General Sales (17)	Food Sales (18)
Farms Ranches (1)	1.351521	0.092074	0.082573	0.081028	0.058157	0.107423	0.059259	1.671660	0.061938	0.055022	0.059974	0.152774	0.087219	0.060844	0.049753	0.071251	0.058624	0.449797
Agricultural Services (2)	0.060011	1.060740	0.014722	0.012040	0.010442	0.011797	0.009957	0.082487	0.048516	0.008994	0.009322	0.026965	0.011374	0.009296	0.008959	0.013013	0.009893	0.029707
Mining (3)	0.014852	0.086778	1.383175	0.010855	0.015143	0.007392	0.008803	0.028836	0.009037	0.007479	0.006606	1.308358	0.023185	0.006240	0.006552	0.026546	0.006930	0.013899
Construction (4)	0.031544	0.037772	0.037426	1.088453	0.022149	0.025592	0.037143	0.072560	0.022225	0.020693	0.021680	0.066645	0.025042	0.021845	0.022074	0.043050	0.026219	0.050154
Transportation (5)	0.038039	0.390342	0.104604	0.021214	1.017416	0.015729	0.016727	0.077120	0.028966	0.013613	0.015866	0.469462	0.020486	0.012795	0.019625	0.126984	0.015067	0.032858
Finance-Real Estate (6)	0.122845	0.136207	0.102375	0.080742	0.064458	1.074883	0.089351	0.227959	0.059762	0.061179	0.079961	0.180715	0.074386	0.072303	0.058356	0.100973	0.082248	0.131456
Utilities (7)	0.042373	0.058603	0.098360	0.035542	0.030232	0.050473	1.037137	0.093970	0.036133	0.027604	0.031691	0.186334	0.084432	0.031814	0.027701	0.047002	0.037709	0.064871
Food Manufacturing (8)	0.020737	0.024594	0.024067	0.018527	0.015700	0.016294	0.016613	1.053569	0.014980	0.014710	0.015902	0.044836	0.019075	0.014928	0.014471	0.020544	0.016324	0.261571
Apparel Manufacturing (9)	0.007164	0.008308	0.009187	0.006658	0.005302	0.005703	0.005521	0.014765	1.005282	0.005059	0.005163	0.015897	0.006939	0.005374	0.005391	0.006665	0.005624	0.009351
Wood-Paper (10)	0.000823	0.000965	0.000985	0.013472	0.000589	0.000723	0.000788	0.002190	0.000595	1.000561	0.000577	0.001750	0.000691	0.000583	0.000585	0.004525	0.000656	0.001273
Printing-Publishing (11)	0.013461	0.022312	0.017147	0.013967	0.009597	0.015667	0.020849	0.028458	0.011140	0.008739	1.011818	0.040509	0.028173	0.011928	0.011913	0.025277	0.042203	0.058894
Petroleum Refining (12)	0.007037	0.009278	0.008265	0.007049	0.010613	0.004430	0.005671	0.015736	0.003787	0.004739	0.004027	1.017683	0.016760	0.003748	0.004012	0.019219	0.004208	0.007992
Leather-Plastic-Rubber (13)	0.000051	0.000081	0.000355	0.000044	0.000036	0.000036	0.000039	0.000108	0.000035	0.000032	0.000033	0.000389	1.000069	0.000034	0.002436	0.000051	0.000360	0.000075
Concrete Products (14)	0.009256	0.010946	0.010277	0.094064	0.006430	0.006762	0.008108	0.019112	0.006135	0.005860	0.005957	0.019395	0.007245	1.006714	0.008445	0.030880	0.007090	0.013168
Metal Manufacturing (15)	0.004901	0.015514	0.130750	0.004305	0.003433	0.002830	0.003919	0.011845	0.002880	0.002477	0.002538	0.130025	0.016198	0.002643	1.010464	0.006454	0.002635	0.005600
Construction Materials (16)	0.018940	0.021109	0.020291	0.044003	0.012386	0.016202	0.014774	0.037746	0.014180	0.013096	0.012145	0.036915	0.013867	0.012147	0.012152	1.036794	0.013193	0.023753
General Sales (17)	0.054750	0.061778	0.063219	0.048621	0.039862	0.042711	0.041157	0.112448	0.043288	0.039862	0.038900	0.115221	0.044261	0.038372	0.043507	0.050677	1.042709	0.070854
Food Sales (18)	0.059239	0.067900	0.069085	0.052466	0.043769	0.046896	0.045737	0.121943	0.043631	0.041794	0.042666	0.124948	0.048617	0.042264	0.042613	0.054284	0.045613	1.083865
Gasoline Service (19)	0.033279	0.037021	0.028708	0.026065	0.033147	0.019108	0.023242	0.075966	0.017070	0.023016	0.018888	0.058848	0.019325	0.017433	0.017133	0.037322	0.018210	0.037067
Auto Sales (20)	0.041232	0.047126	0.042928	0.034976	0.029703	0.030040	0.030952	0.083417	0.027030	0.025501	0.028355	0.080974	0.029924	0.030448	0.027525	0.036918	0.028410	0.049875
Clothing (21)	0.028505	0.032783	0.033331	0.025423	0.021148	0.022703	0.021856	0.058777	0.021072	0.020193	0.020613	0.060305	0.023475	0.020422	0.020563	0.026226	0.022037	0.037252
Furniture (22)	0.015544	0.017981	0.019992	0.014467	0.011505	0.012375	0.011982	0.032037	0.011458	0.010977	0.011203	0.034549	0.015129	0.011678	0.011715	0.014468	0.012211	0.020290
Eating (23)	0.066283	0.077975	0.077914	0.059071	0.049305	0.053164	0.055323	0.136840	0.051969	0.047049	0.049758	0.145020	0.055000	0.047600	0.048040	0.061232	0.051433	0.086883
Miscellaneous Retail (24)	0.043500	0.048889	0.047084	0.038164	0.029297	0.033007	0.032207	0.088112	0.028998	0.027974	0.029824	0.084870	0.033034	0.031084	0.028261	0.037767	0.031285	0.053525
Lodging (25)	0.004480	0.011235	0.005466	0.004646	0.008415	0.003339	0.003842	0.013229	0.005427	0.016369	0.008904	0.015912	0.040881	0.009467	0.003976	0.010695	0.005222	0.008231
Personal Services (26)	0.037504	0.044855	0.044046	0.033693	0.028850	0.029912	0.029122	0.078048	0.028166	0.028641	0.028113	0.080742	0.036595	0.027950	0.027184	0.035683	0.029353	0.056555
Business Services (27)	0.035658	0.048794	0.040760	0.034215	0.024878	0.080862	0.053744	0.073126	0.024493	0.023981	0.025961	0.080686	0.030980	0.024613	0.023698	0.040847	0.078598	0.065537
Professional Services (28)	0.073504	0.084298	0.095392	0.068518	0.051505	0.063374	0.051039	0.156145	0.048928	0.048439	0.048328	0.159376	0.055749	0.048686	0.047401	0.071060	0.054812	0.093554
Automobile Repair (29)	0.016021	0.037836	0.012438	0.011709	0.010237	0.010624	0.009567	0.028399	0.008436	0.007313	0.009464	0.026160	0.008621	0.009724	0.009230	0.012235	0.007995	0.015201
Recreation (30)	0.009320	0.010919	0.010951	0.008409	0.007020	0.007732	0.007489	0.019396	0.007031	0.006638	0.006771	0.019889	0.007757	0.006707	0.006714	0.009951	0.007605	0.012290
Miscellaneous Repair (31)	0.009331	0.010990	0.010936	0.008555	0.007276	0.008032	0.007500	0.019262	0.006847	0.006821	0.007706	0.027539	0.007721	0.006889	0.006741	0.009768	0.012304	0.012681
Medical (32)	0.085248	0.099847	0.100465	0.076778	0.063568	0.068145	0.065948	0.176750	0.063380	0.060783	0.062286	0.181772	0.070566	0.061826	0.061673	0.079249	0.066311	0.112178
Wholesale (33)	0.049856	0.071840	0.086837	0.077898	0.057108	0.031563	0.033030	0.266048	0.029495	0.032363	0.031992	0.132881	0.033470	0.028267	0.052440	0.062699	0.031234	0.193192
Households[b] (34)	2.725809	3.157168	3.209746	2.441344	2.037071	2.180735	2.105013	5.637855	2.029862	1.945221	1.985333	5.808054	2.260829	1.966847	1.972098	2.525915	2.122749	3.582731
State-Local Government (35)	0.318999	0.369480	0.375633	0.285708	0.238396	0.255209	0.246347	0.659792	0.237553	0.227647	0.232341	0.679710	0.264582	0.230178	0.230793	0.295605	0.248423	0.419283

[a] See Table XI for detailed sector classification.

[b] Direct, indirect, and induced multipliers are read from row 34.

TABLE VIII (Continued)

		Gasoline Services (19)	Auto Sales (20)	Clothing (21)	Furniture (22)	Eating (23)	Misc. Retail (24)	Lodging (25)	Personal Services (26)	Business Services (27)	Professional Services (28)	Automobile Repair (29)	Recreation (30)	Miscellaneous Repair (31)	Medical (32)	Wholesale (33)	Households (34)	State Local Government (35)
Farms-Ranches	(1)	0.127773	0.066897	0.057245	0.094478	0.075732	0.063362	0.091254	0.050908	0.052787	0.049821	0.064234	0.080720	0.062720	0.056648	0.045462	0.045462	0.061253
Agricultural Services	(2)	0.018128	0.011544	0.010060	0.032947	0.010724	0.010090	0.012663	0.008871	0.009162	0.008697	0.010937	0.010901	0.010862	0.009724	0.008228	0.008228	0.009974
Mining	(3)	0.241009	0.009652	0.006406	0.014788	0.006797	0.006997	0.009778	0.008213	0.012993	0.005906	0.009234	0.007619	0.009532	0.007147	0.005420	0.005420	0.009127
Construction	(4)	0.045956	0.028210	0.024988	0.038168	0.024898	0.026306	0.035137	0.022539	0.022355	0.021857	0.028450	0.027685	0.028281	0.029121	0.019248	0.019248	0.027739
Transportation	(5)	0.101730	0.033658	0.015765	0.031861	0.014403	0.014096	0.018205	0.013236	0.015225	0.012609	0.019115	0.014987	0.020307	0.014331	0.011456	0.011456	0.016440
Finance-Real Estate	(6)	0.131150	0.086394	0.072601	0.128280	0.066084	0.074680	0.096806	0.061931	0.057052	0.059760	0.094640	0.068753	0.090198	0.068109	0.049878	0.049878	0.073062
Utilities	(7)	0.081535	0.038491	0.037716	0.061930	0.033683	0.035845	0.069012	0.035765	0.028665	0.029452	0.042784	0.036247	0.048294	0.030837	0.023568	0.023568	0.033890
Food Manufacturing	(8)	0.047682	0.019020	0.016176	0.026297	0.027246	0.019875	0.035295	0.014915	0.015632	0.014641	0.019287	0.032578	0.018455	0.016645	0.013220	0.013220	0.020377
Apparel Manufacturing	(9)	0.009583	0.006382	0.013043	0.455530	0.005698	0.005520	0.006823	0.005083	0.005256	0.005002	0.006221	0.005754	0.006431	0.005591	0.004762	0.004762	0.005609
Wood-Paper	(10)	0.001146	0.000729	0.000630	0.014067	0.000651	0.000655	0.000846	0.000581	0.000589	0.000571	0.000723	0.000691	0.000728	0.000690	0.000520	0.000520	0.000736
Printing-Publishing	(11)	0.020494	0.030264	0.034737	0.059896	0.011118	0.017527	0.017765	0.010416	0.009030	0.010993	0.016487	0.023832	0.014568	0.010368	0.007965	0.007965	0.012520
Petroleum Refining	(12)	0.185942	0.006142	0.003810	0.008737	0.004032	0.004250	0.006126	0.005318	0.009012	0.003539	0.005865	0.004656	0.006105	0.004384	0.003212	0.003212	0.005088
Leather-Plastic-Rubber	(13)	0.000124	0.000533	0.000128	0.000058	0.000036	0.000074	0.000045	0.000037	0.000035	0.000033	0.000054	0.000057	0.000047	0.000036	0.000029	0.000029	0.000041
Concrete Products	(14)	0.013749	0.009241	0.007764	0.010124	0.007026	0.006793	0.015190	0.007134	0.006469	0.006066	0.010548	0.009680	0.012155	0.007725	0.005357	0.005357	0.009634
Metal Manufacturing	(15)	0.027263	0.043703	0.002565	0.004821	0.002710	0.006799	0.003561	0.002793	0.003205	0.002465	0.004972	0.002828	0.004534	0.003209	0.002154	0.002154	0.003671
Construction Materials	(16)	0.023896	0.015259	0.013550	0.023464	0.013666	0.013410	0.017066	0.012088	0.012384	0.012776	0.014771	0.014016	0.015375	0.013293	0.010999	0.010999	0.018486
General Sales	(17)	0.080167	0.053498	0.041727	0.066639	0.044382	0.042738	0.053204	0.038430	0.039849	0.037675	0.046919	0.043175	0.046804	0.042173	0.035661	0.035661	0.048373
Food Sales	(18)	0.077900	0.052496	0.044159	0.069859	0.051512	0.045609	0.055730	0.041989	0.043313	0.041875	0.051359	0.047529	0.051206	0.046344	0.039357	0.039357	0.046358
Gasoline Service	(19)	1.042107	0.027572	0.017138	0.041425	0.018435	0.019702	0.026182	0.016488	0.017575	0.016306	0.027737	0.019053	0.026840	0.017654	0.014796	0.014796	0.021846
Auto Sales	(20)	0.066889	1.043846	0.028730	0.049270	0.029160	0.028933	0.035190	0.026134	0.026798	0.028974	0.057537	0.029596	0.042708	0.028099	0.023807	0.023807	0.031658
Clothing	(21)	0.037635	0.026046	1.021332	0.033742	0.022746	0.021946	0.026924	0.020387	0.020925	0.019895	0.024832	0.022961	0.024744	0.023804	0.019017	0.019017	0.021549
Furniture	(22)	0.020805	0.013838	0.011627	1.019165	0.012363	0.011980	0.014811	0.011028	0.011405	0.010854	0.013498	0.012486	0.013970	0.012106	0.010332	0.010332	0.012185
Eating	(23)	0.088527	0.060154	0.049802	0.080040	1.053003	0.051170	0.062846	0.047304	0.048772	0.046361	0.057886	0.053539	0.057718	0.051586	0.044293	0.044293	0.049984
Miscellaneous Retail	(24)	0.052475	0.035530	0.030189	0.056008	0.031290	1.034702	0.038204	0.028037	0.028520	0.029833	0.034864	0.032059	0.036223	0.031935	0.025652	0.025652	0.034417
Lodging	(25)	0.009897	0.006390	0.007485	0.012329	0.004527	0.016596	1.004100	0.002918	0.003012	0.005000	0.003723	0.003441	0.003707	0.003202	0.002668	0.002668	0.004099
Personal Services	(26)	0.050927	0.034178	0.032182	0.046883	0.034453	0.031003	0.186129	1.026733	0.027576	0.026621	0.057522	0.030278	0.032978	0.029697	0.025048	0.025048	0.029384
Business Services	(27)	0.070231	0.100168	0.036743	0.085455	0.031144	0.034213	0.092791	0.027945	1.084994	0.023715	0.043735	0.134977	0.135330	0.134383	0.020846	0.020846	0.027605
Professional Services	(28)	0.092969	0.064581	0.059806	0.105754	0.054379	0.065127	0.093011	0.051460	0.053822	1.052078	0.067891	0.053806	0.067760	0.060611	0.043650	0.043650	0.051769
Automobile Repair	(29)	0.040905	0.023183	0.007706	0.019690	0.008170	0.010231	0.009924	0.007192	0.007399	0.007198	1.033282	0.008263	0.023493	0.008084	0.006638	0.006638	0.009779
Recreation	(30)	0.012747	0.008825	0.007388	0.012473	0.007569	0.007241	0.009975	0.006683	0.007212	0.006621	0.008221	1.008638	0.008163	0.007526	0.006229	0.006229	0.007200
Miscellaneous Repair	(31)	0.015404	0.016054	0.007144	0.012354	0.007404	0.007265	0.009662	0.006649	0.006777	0.007287	0.009008	0.007954	1.008190	0.007142	0.006090	0.006090	0.007244
Medical	(32)	0.113639	0.076407	0.064268	0.101462	0.068471	0.066202	0.080899	0.060970	0.062895	0.060084	0.075316	0.069020	0.075365	1.066710	0.057153	0.057153	0.070606
Wholesale	(33)	0.248999	0.107776	0.029732	0.051521	0.150998	0.065558	0.053264	0.045284	0.029285	0.027461	0.148616	0.035024	0.100108	0.034287	1.024990	0.024990	0.041116
Households	(34)	3.623427	2.442505	2.054813	3.249842	2.190910	2.113880	2.591726	1.954152	2.015895	1.916285	2.389964	2.211627	2.382751	2.132801	1.832118	1.832118	2.064410
State-Local Government	(35)	0.424046	0.285844	0.240473	0.380326	0.256400	0.247385	0.303307	0.228692	0.235918	0.224261	0.279695	0.258824	0.278851	0.249599	0.214411	0.214411	1.241596

of rows and columns identify those sectors with stronger backward linkages, as do larger multipliers. Row 34 contains estimates of the regional multipliers. A comparison of the regional multipliers in Table VIII with those previously calculated from Tables IV and VI shows that they are approximately equal. As an additional check multiplication of each inverse matrix times final demand categories in the transaction table sums to regional employment.

Limitations of the Data

A brief critique of the data examines the form of questionnaire, assignment of firms into sectors, response bias, control totals, problems of in-commuters and out-commuters, treatment of military consumption, and failure to consider transactions in terms other than employment. Questionnaires were too long and complicated for mail-out techniques and were awkward for personal interviewing when completely evaluated. Perhaps a shorter questionnaire for each sector or similar sectors would be more appropriate.

Classification of firms into sectors affects the analysis. Firms at one location often performed several functions each of which could be classified in a different regional endogenous sector. Multi-function firms were allocated to appropriate sectors on the basis of the activity from which it earned the major percentage of its gross receipts. Variation in firm functions contributes to response bias.

Response bias occurs due to variation of firm functions within a sector, in markets served by individual firms, in firm size, and in follow-up procedures. For future studies sub-samples of each sector at a three digit SIC code level and a weighting procedure for

aggregation of questionnaire results by size of firm are recommended. The follow-up interviews rather than selecting a sample from part of the population which had not been interviewed concentrated on partially completed questionnaires.

Application of County Business Pattern [35] state employment figures were required for sector distribution when county CBP data lacked sufficient detail. State data about proprietors and partnerships from Statistics of Income [37] were used to distribute self-employed persons among the endogenous sectors. Dependence on state rather than county data directly influences estimates of county control totals and the values of multipliers obtained from interindustry analysis.

An accounting problem arises in connection with in-commuters and out-commuters because employment is by place of work. Projections from the model pertaining to requirements for public services overestimate needs for public services under conditions of net in-commuting and underestimate them for situations of net out-commuting from the region. The treatment of military consumption is consistent with the assumed exogenous impact of Fort Sill. Projections for public services require consideration of military personnel and dependents living off base as out-commuters.

A final criticism of the empirical analysis lies in its failure to consider transactions in terms other than employment such as value added. But, requirements for community services are frequently estimated in terms of population served. Employment offers a direct approach to service requirements, since the value of some sectors' output such as farms and ranches and mining may increase while the number of employees in these sectors remains constant or declines.

CHAPTER IV

APPLICATION OF INTERINDUSTRY ANALYSIS TO SOLID WASTE MANAGEMENT

Legislation and growth in amounts of solid waste generated have encouraged local jurisdictions to develop improved storage, collection, transfer, and disposal facilities. A review of legislation encouraging improved solid waste disposal systems, application of a planning framework to solid waste management, and use and limitations of the solid waste coefficients indicates a role for interindustry analysis in planning and implementing solid waste management systems.

Legislation Affecting Solid Waste Management

State and federal legislation have a direct impact on local jurisdiction's solid waste disposal practices. Briefly, state legislation sets and administers standards to be met by communities for solid waste disposal and fixes penalties for failures in compliance. State and federal legislation provide measures of assistance to local jurisdiction's efforts to upgrade current solid waste management practices.

Federal legislation reflecting national awareness of solid waste problems authorizes technical and financial assistance to local jurisdictions, individuals, private agencies and institutions. The 1965 Solid Waste Disposal Act [30] as amended by the Resource Recovery Act of 1970 [27] outlines a coordinated program of grants for training,

research, planning, and construction in resource recovery and solid waste disposal. Some research areas include determination of ill effects of materials in solid wastes; reductions in solid wastes and unsalvageable items; development of new collection, disposal, and recycling systems; identification of recoverable materials and energy from solid waste; public policies affecting resource recovery; and market impact of recycled materials.

Planning grants for state, interstate, and local planning provide up to 75 percent of costs for survey of disposal practices and problems, development of solid waste disposal plans and facilities, and planning for automobile salvage. Grants for demonstration resource recovery systems and improved solid waste disposal facilities in different sized communities under varying geographic conditions are authorized to state, municipal, and interstate agencies. Some criteria judged in awarding these grants are: benefits, potential economic success of the project, applicability of the project to waste disposal problems, and the applicant's use of sub-state or regional planning. Only in the case of resource recovery systems may the federal share exceed 75 percent of costs. Training grants are available to eligible recipients for development of expertise in management, design, operation, and maintenance of solid waste disposal and resource recovery systems and equipment. The Environmental Protection Agency administers federal solid waste programs.[1]

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[1]Current regulations governing the award and administration of grants are reported in the Federal Register [5]. Information about research and development in solid waste management and procedures for applying for grants may be obtained by writing the Environmental Protection Agency, 1626 K Street N.W., Washington, D. C. 20460.

The Oklahoma Solid Waste Management Act of 1970 [24] gave the greatest impetus to local jurisdiction's interest in storage, collection, transfer, and disposal of solid wastes. Under the act, the State Board of Health sets and enforces rules and regulations for collection and disposal of solid wastes and sets minimum standards for landfill operations. Regulations of immediate interest to local jurisdictions required landfills or alternative acceptable methods for ultimate disposal of solid wastes to be instituted on or before July 1, 1971, for cities of greater than 10,000 population. The following time schedule applies to cities and towns of lesser population or adjacent to them: 5,000 - 10,000, July 1, 1972; 3,000 - 5,000, July 1, 1973; and less than 3,000 by July 1, 1974. Other regulations prohibit operation of disposal sites below the water table or close enough to streams or lakes such that waste materials enter the water, burning of wastes in disposal sites serving populations of more than 10,000 persons, and operation of a disposal site without a department permit. No permit will be issued a disposal site which fails to meet department standards. The act bans illegal "wild cat" dumps, and can restrain violations with injunctions, and levy a fine of $200 and 30 days imprisonment for each day or part of a day a violation occurs.

A positive side of the Solid Waste Management Act is revealed in other responsibilities of the State Health Department. The department assists in planning and implementation of solid waste management systems at the local, state, and national level. The department is authorized to respond to the Federal Solid Waste Disposal Act, to handle outside funds for planning, operation, and constructing solid waste disposal facilities, and examine and approve local jurisdiction's

plans. The state act also provides enabling legislation permitting municipalities, counties, and multi-county areas to establish, jointly if they wish, solid waste management systems.

The Oklahoma Clean Air Act of 1967 [17] is administered by the State Health Department. The department is empowered to plan and cooperate with other agencies, governments, and industry for air quality management. It may also obtain injunctions against violations of regulations.

An Air Pollution Council conducts hearings and recommends rules and regulations to the State Board of Health concerning the use of the atmosphere for waste disposal. Regulation No. 1 [23] prohibits and establishes admissible conditions for open burning of wastes. Curtailment of burning in solid waste disposal areas by operators of disposal facilities has been set up according to the following schedule [22]: Populations greater than 10,000, January 1, 1971; 5,000 - 10,000, July 1, 1972; 3,000 - 5,000, July 1, 1973; and less than 3,000, July 1, 1974.

Enforcement of the Air Quality Act and Oklahoma Solid Waste Management Act implies amounts of solid wastes entering licensed sanitary landfills will increase. Even with a cessation of illegal dumping and burning it is not clear that 100 percent of wastes generated will be disposed of in public facilities. A San Francisco Bay Regional Study [8, First Report, p. 40] compared amounts of waste generated with amounts entering disposal systems and found only 34 percent of wastes generated are disposed of (excluding agricultural wastes). Potential increases in amounts of wastes entering waste management systems and the volume to be disposed of by methods other than burning extend

required waste management systems beyond current costs, sizes, and complexities. The next section considers solid waste management planning.

Application of Sub-State Planning Framework to Solid Waste Management

Examination of solid waste disposal within the framework for sub-state planning developed in Chapter II requires addition of models describing waste generation, spatial location, and collection-transfer-disposal. Figure 3 depicts a solid waste management planning framework on a sub-state level.

Ideally, a waste generator furnishes a sub-state region with information about the weight and composition of solid waste produced by the regional economy's producing and consuming sectors. A California study [8, First Report, p. 56] proposed a regression analysis which could test the statistical significance of independent variables thought to affect the magnitude of a sector's solid waste generation. However, only average waste coefficients by sector were calculated from survey data [8, Second Report, p. 21].

Impact of several variables in a waste generator model are inferred by quickly analyzing data about the composition of solid wastes and quantities of waste associated with economic activities. A 1952 Berkeley, California record of weight and composition of wastes entering landfills was repeated in 1967 [8, Second Report, pp. 30-38]. Comparison of the first load from seven routes, six of which were residential (the seventh included some light commercial), indicated an increase in weight of wastes entering landfills. Percentage reductions

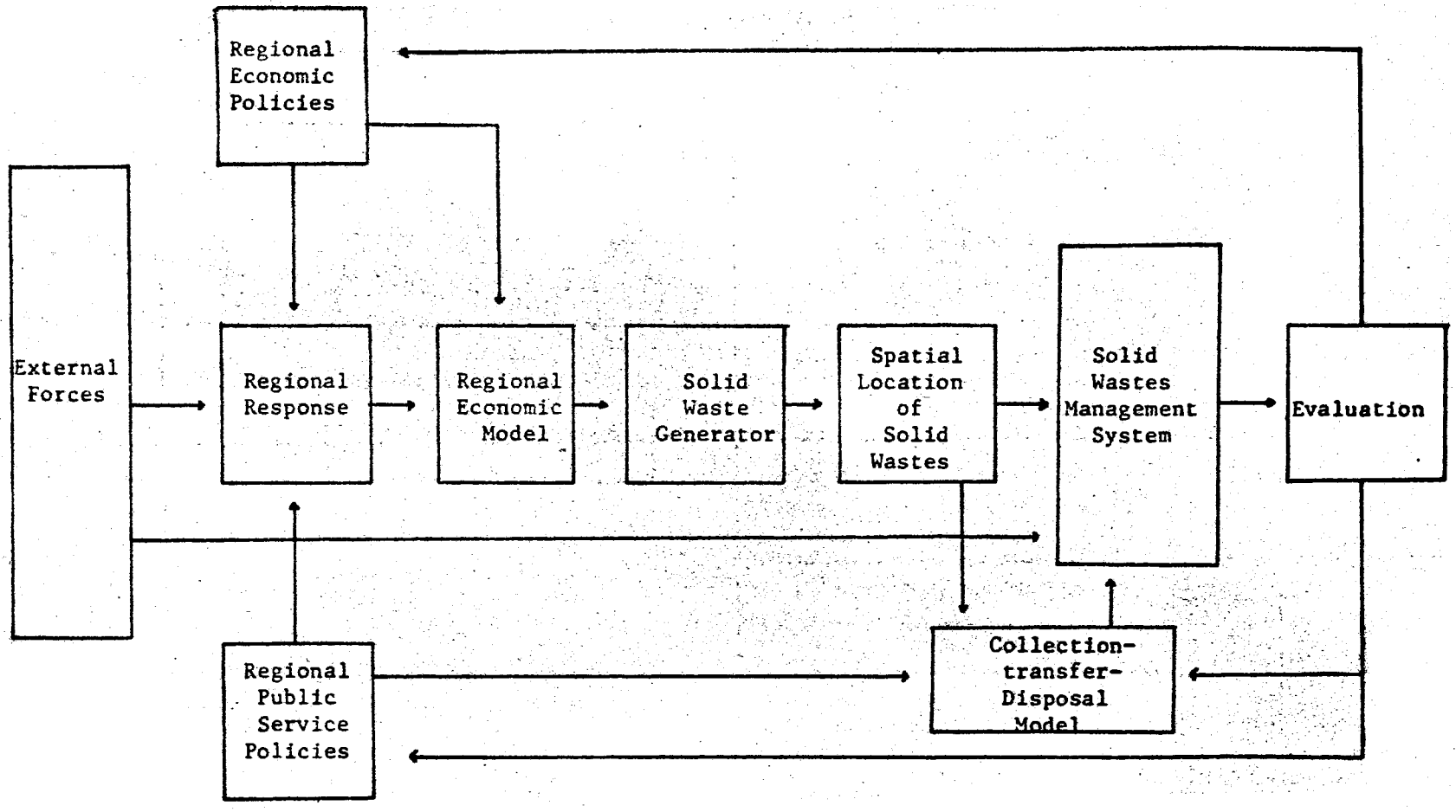

Figure 3. Solid Waste Management Planning Framework on a Sub-State Level

in tin cans, glass, rags, metals, and wastes of no value were reported. Increased percentages were recorded in plastics, shoes, and compostable materials. The greatest increase occurred in plastics from merely a trace in 1952 to 1.9 percent in 1967 and tin cans decreased from 10 percent to 8.4 percent. The garbage fraction of compostable wastes decreased, possibly due to the advent of garbage disposals and convenience foods, but offsetting increases in waste paper occurred. The data imply the composition of wastes by the mentioned categories has changed very little.

The level and kinds of economic activity within a region influence the solid waste generation because different industries produce different amounts of solid waste. Food processing generates 9,479 pounds of solid waste per employee per year [2, Vol. II, p. 4], agriculture 152,770 pounds, and construction 82,504 pounds [8, Second Report, pp. 23, 24]. Changes in the level and kinds of economic activity and population apparently have the greatest immediate impact upon generation of solid wastes at the sub-regional level. Population increases are assumed to be associated with additions to wastes while other variables may change the composition, but very slowly.

Solid wastes generation within a sub-state planning region can be estimated by treating solid waste production as if it were a primary resource requirement [16, pp. 14, 15]. The interindustry analysis explained in Chapter II describes a method of determining sector output, X, in terms of employment when final demand in employment, Y, is specified. The equation $X = (I - A)^{-1}(Y)$ expresses this relationship. If a relation exists between solid waste generation and regional output, total solid waste generation can be calculated given values of final

demand. Generation of waste type k, W_k, is a function of output of all sectors. A waste coefficient for wastes of type k in sector j is the ratio of solid waste generated by sector j to the output of sector j:

$$w_{kj} = \frac{W_{kj}}{X_j}$$

and $W_{kj} = w_{kj}X_j$ expresses the total solid waste generation of type k associated with the output of sector j.

All solid wastes of type k generated can be expressed algebraically as:

$$W_k = \sum_{j=1}^{n} W_{kj} = \sum_{j=1}^{n} w_{kj} X_j$$

and in matrix form:

$$W_k = w_k X$$

where w_k is a row vector of solid waste coefficients. The total generation of solid wastes of type k associated with final demand is:

$$W_k = w_k X = w_k(I - A)^{-1}Y.$$

Multiplication of the vector of solid waste coefficients w_k times the interdependence coefficients $(I - A)^{-1}$ gives the direct and indirect amount of solid waste generated per employee for sales generated to final demand.

Induced amounts of solid waste generated for disposal assumes households and state and local government endogenous as explained in the model described in Chapter II. Residential waste is incorporated in the model through use of an average residential waste per employee coefficient.

The spatial location of solid wastes may be expressed as a function of service area output. For a county service area solid waste coefficients per unit of employment for each sector are multiplied by corresponding employment estimates and summed. Two additional methods for determining spatial location of wastes are computer mapping and a proxy method. Solid waste coefficients could be associated with corresponding economic activities at their location utilizing a grid system in which coordinates of each economic unit and employment serve as input data. The resulting regional map indicating solid waste densities would greatly facilitate planning of collection, transfer and disposal systems. However, the mapping system is expensive and has only been carried out for Standard Metropolitan Statistical Areas. A more common technique to determine spatial location of wastes is simply to use household and commercial densities as proxies for waste densities.

The total amount and spatial location of solid wastes could also be estimated with a value added approach. The important element in the analysis is the tying of solid waste generation to area economic activity such that a regional interindustry analysis can be used for projection purposes [8, First Report, pp. 50-52].

A collection-transfer-disposal model serves as an aid in planning and implementing changes in a solid waste management system. A common denominator of the elements in a system is cost. An elaborate model may be expected to assist in the selection of the most efficient least cost mix of equipment and employees; the optimum locations of waste pickups, routes, transfer stations, disposal sites, and most economical frequency of collection and type of ultimate disposal. The model would

also help analyze required excess capacity and need for additional equipment and facilities; investigate feasibility of resource recovery and the impact of cost reducing technology; and estimate rate schedules appropriate to different users of the service.

Some 80 percent of solid waste management costs have been associated with collection [14, p. 362] and most investigations have focused on methods to isolate variables affecting costs, shape of a collection cost curve, and methods for minimizing costs of solid waste collection. Schultze [29, pp. 291-307] develops a mathematical approach for determining cost functions for facilities, processing, and collection; and procedures for estimating optimum location of transfer stations and the timing and size for additional facilities. A St. Louis study [9, pp. 88-91] indicated collection frequency and pickup location to be statistically significant variables affecting collection costs. The study failed to find evidence of economies of scale in collection of solid wastes. However, some economies probably could be realized through centralization of the administrative functions of waste management, which is an implicit assumption of the Schultze study [29, p. 288]. Marks and Liebman [15] apply operations research to develop models of facility location and routing. Also, an application is made to the Baltimore, Maryland solid waste collection system in which feasibility of transfer sites, rail haul, and increased collection frequency are examined. Additional consideration of the supply side of the model is omitted here since this study deals primarily with generation of solid wastes.

The results obtained from a solid waste management model are subject to constraints of regional public service policies and

external forces. Public service policy dictates whether or not administrators will implement changes in the waste management system. The collection-transfer-disposal model may also assist in formulating regional public service policies and economic policies and conditioning regional response to external forces since cost reduction may be substantial enough to insure policy changes. Public service policy dictates the method of financing waste management systems and appropriation of revenues from the system. Policies may reflect tastes and preferences of a community, possibly resulting in some diseconomies. Regional economic policies may also be applied to solid waste management. Communities may discourage expansion or location of waste intensive industries through zoning, ordinances, or withholding of incentives.

External forces affect the generation of solid wastes, requirements for its disposal, and offer some assistance in meeting the needs for solid waste management. Private sector decisions, and state and federal government spending can affect solid waste generation as indicated in the discussion of the impact on level and kinds of economic activity. State and federal legislation affecting requirements for solid waste management and assistance have already been discussed.

The solid waste management system in Figure 3 should include a complete account of operating costs, amounts of waste processed, and employee and equipment efficiency. Also, a record should be kept about operating problems and their solutions. With this type of information an evaluation of the level of service can be made and needed adjustments in regional public service policies, regional economic policies and responses to external forces can be made so that cost reducing or

quality improvements can be made in the solid waste management system.

Solid Wastes Generation in South Central Oklahoma and Limitations of the Coefficients

Solid waste coefficients and an interindustry model comprise a waste generator for Planning Region Nine. Table IX presents solid waste coefficients by sectors, employment, wastes in thousands of pounds per year and a set of direct, indirect, and induced waste coefficients in thousands of pounds of waste per year per employee (kpye).

Solid waste coefficients in kpye are presented in column two of Table IX. Manufacturing sectors are well represented as are households, construction, and food retailing. Types of solid waste for disposal in agriculture and mining were thought to be sufficiently different from the other sectors to warrant exclusion from this analysis. The waste coefficient for petroleum refining represents only employment in asphalts and paint production. Other sectors are represented by an average estimate for commercial and institutional wastes. The highest waste coefficient, 82.504 kpye is associated with construction and the lowest, 1.348 kpye with apparel manufacturing.

Multiplication of solid waste coefficients times 1970 estimated employment furnishes an estimate of wastes in thousands of pounds per year associated with regional endogenous sectors including state and local government and household consumption. The problem of in-commuters and out-commuters is partially dealt with by assuming Fort Sill solid wastes associated with federal civilian employment and military personnel and their dependents having on base residence to

TABLE IX

DIRECT, INDIRECT, AND INDUCED SOLID WASTE COEFFICIENTS AND SOLID WASTE GENERATION, PLANNING REGION NINE, 1970

Sector	Solid Waste[a] Coefficient, Kpye	Employment 1970	Waste in Thousands of Pounds Per Year	Direct, Indirect, and Induced Solid Waste Coefficients, Kype
(1)	--	11,370	--	20.246
(2)	7.620	1,128	9,357	34.246
(3)	--	2,280	--	24.358
(4)	82.504	2,589	213,603	106.197
(5)	7.620	1,772	13,503	22.293
(6)	7.620	3,194	24,338	23.702
(7)	7.620	1,557	11,864	24.209
(8)	9.479	931	8,825	52.884
(9)	1.348	1,591	2,145	15.906
(10)	26.459	227	6,006	40.086
(11)	16.500[b]	517	8,531	30.604
(12)	19.394[b]	664	12,878	65.463
(13)	15.006	82	1,230	32.096
(14)	5.280	471	2,487	19.195
(15)	2.937	3,936	11,560	16.991
(16)	7.620	558	4,252	28.957
(17)	7.620	1,747	13,312	23.760
(18)	35.700	1,592	56,834	66.454
(19)	7.620	800	6,096	40.261
(20)	7.620	1,333	10,157	26.845
(21)	7.620	767	5,845	22.861
(22)	7.620	567	4,321	33.586
(23)	7.620	2,620	19,964	24.098
(24)	7.620	1,218	9,281	23.411
(25)	7.620	527	4,016	28.806
(26)	7.620	1,786	13,609	21.522
(27)	7.620	1,248	9,510	22.125
(28)	7.620	2,064	15,728	21.113
(29)	7.620	461	3,513	26.395
(30)	7.620	338	2,576	24.476
(31)	7.620	286	2,179	26.299
(32)	7.620	2,342	17,846	23.823
(33)	7.620	2,032	15,484	20.037
Households	2.089[c]	69,188	144,534	12.417
State and Local Gov't	7.620	8,097	61,699	23.034
Federal Employees[d]	7.620	2,752	20,970	
Off Base Military[e]	2.089	9,100	19,010	
Total			787,063	

[a] Sectors 8-15 and 18 calculated from: Combustion Engineering, Inc., Technical-Economic Study of Solid Waste Disposal Needs and Practices, Bureau of Solid Waste Management, 1969. Remaining sectors derived from: Golueke, C. G. and P. H. McGauhey, Comprehensive Studies of Solid Waste Management, First and Second Annual Reports, Bureau of Solid Waste Management, 1970.

[b] Refining wastes excluded.

[c] Average residential waste per employee of the labor force.

[d] Excludes federal civilian employment at Fort Sill.

[e] Military personnel with off base residence, Appendix B.

be generated outside of the system. Members of the armed forces and their dependents with residences outside a military reservation produce 19,010 kpye in household wastes. Federal employees other than those employed on a military reservation generate an estimated 20,970 kpye. These values when added to the regional endogenous wastes generated furnish an estimated regional waste generation of 787,063,000 pounds during 1970, or 9.7 pounds per day per person in Planning Region Nine.[2]

A set of direct, indirect and induced solid waste coefficients furnish projection parameters of amounts of solid waste in kpye generated by each sector's additional delivery to final demand requiring one additional employment unit. Multiplication of each column of the inverse matrix developed in Chapter III, households and state and local government endogenous, by the solid waste coefficients furnishes direct, indirect and induced solid waste coefficients. These coefficients, recorded in the last column of Table IX, have a range of 12 to 106 kpye.

The direct effect of an additional employee is equal to the solid waste coefficients in column two. The sum of the repercussions in generation of solid waste in other economic sectors due to an employment increase in a sector for delivery to final demand is the indirect effect. The induced effect accounts for additional employment required to service household consumption and purchases of state and local government. The strength of the interindustry model for projection purposes lies in this ability to capture the indirect and induced effects of solid waste generation throughout the entire economy. The direct

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[2]No attempt is made to analyze solid waste types.

amount of solid waste produced by a specified change in regional employment can be estimated at a single source, but the indirect and induced effect, revealed to be two or three times larger than the direct effect, is distributed throughout the region.

The direct, indirect and induced solid waste coefficients are subject to limitations of the theoretical model, empirical data, and direct solid waste coefficients. Limitations of the model and data have been discussed at the end of Chapters II and III. Additionally the direct solid waste coefficients are averages; fail to reflect composition, volume, and waste generated for disposal; and contain a limitation originating in the in-commuter and out-commuter problem.

Average coefficients are a result imposed by the selection of secondary data to estimate solid waste generated per employee. The manufacturing sectors, construction, food retailing and households are well represented in Table IX, but the rest of the sectors' coefficients are only an approximation of wastes determined from total wastes generated by employment in broad firm groupings [8, Second Report, pp. 23-25, 34-36]. For sectors with the coefficient 7.620, and construction a detailed Standard Industrial Classification code organizing firms into sectors was not made. Application of any solid waste coefficients to a specific firm should not be made due to the aggregate nature of these coefficients. A complete analysis of wastes generated in Planning Region Nine should contain primary data on solid waste generation for each sector.

A second limitation is failure to describe solid waste volume and composition, and solid waste generated for disposal. In one study only an estimated 34 percent of wastes generated entered disposal

sites [8, Second Report, p. 40]. Solid wastes for disposal might be estimated in the waste generator with firm data, or in the collection-transfer-disposal model using data about the amounts of solid waste handled by the waste management system. Information about the composition and volume of solid wastes would be useful in planning a collection-transfer-disposal model with respect to system capacity and feasibility of resource recovery.

The in-commuting, out-commuting has been touched on previously, but in analysis of service areas the problem becomes more critical. Regional employment is by place of work. For generation of solid waste by firms this assumption is appropriate, but the assumption is not as realistic for examination of household wastes because persons may not reside in the same service area as their place of employment. For example, Fort Sill is assumed to be a service area separate from Planning Region Nine, therefore persons employed at Fort Sill, including military personnel, having residence in the planning region were assumed to contribute to the regional waste flow.

The model of regional solid waste generation demonstrates an application of regional interindustry analysis within a public service framework to estimate the need for public services associated with regional output in terms of employment. Legislation pertaining to solid waste management may encourage local jurisdictions to move rapidly in development of solid waste management systems. A public service framework offers an approach to organizing information and evaluating the planning process and its results. Part of the planning process involves association of public services with economic activities. Since waste production can be associated with employment, much

as a primary resource requirement, regional waste generation can be estimated given levels of final demand. Variability in direct coefficients and direct, indirect and induced coefficients implies that the planning process should allow for different sized additions to commercial and residential wastes due to employment in areas in endogenous sectors.

CHAPTER V

SUMMARY AND FINAL COMMENT

Summary

A public service planning framework facilitates collection and organization of information pertinent to local decision making. Inter-industry analysis expresses the relationships between resource inputs and sales of regional firms to final markets. The programmatic nature of local jurisdiction's decision making in administering public services lends itself very well to establishment of a public service planning framework. External forces (federal expenditures and legislation, state expenditures and legislation, and private sector decisions) operate on regional economic and public service policies, at times even modifying them beyond what local communities desire in terms of public services. Regional policy goals may be to furnish an ideal level of public services and reduce the cost of a given mix of public services, or improve quality for a given expenditure. The impact of changes in regional markets upon requirements for public services is also considered. Local jurisdictions formulate estimates of required service levels and plan, administer, and evaluate systems furnishing public services. A framework for rural planning depicted in Figure 1, Chapter I, serves as a guide to isolate policy tools, outside influences, and activity of local economic units so that their effect on requirements for public services, and planning can be more readily evaluated.

Public services furnished by a community are a function of the distribution of population and the level and kinds of economic activity. An interindustry model can aid in estimating need for public services by capturing indirect and induced effects in addition to the direct effect associated with additional deliveries to final demand. An interindustry from-to analysis model for 33 endogenous sectors and five final demand sectors was constructed for eight counties in Planning Region Nine in South Central Oklahoma. Questionnaire data concerning the distribution of gross receipts of firms in each endogenous sector were aggregated to a regional distribution table. The distribution table shows the percentage of each endogenous sector's sales in terms of employment to other endogenous sectors and final demand. Most producing sectors sell more than 50 percent of their output to final demand markets.

Additional tables presented for the interindustry model include transactions, total requirements (direct and indirect), percentage direct to total employment associated with final demand, and total requirements (direct, indirect and induced). The transactions table describes the regional employment flows from each endogenous sector to other firms and final demand, and is a step in calculation of a direct requirements matrix indicating regional sales to each endogenous sector per employee.

The total requirements (direct and indirect) are the core of the interindustry model and estimate employment requirements per unit of additional employment in endogenous sectors serving final demand. The total changes in sector output necessary to serve increased direct employment serving final demand are recorded in the columns of Table IV.

The sum of each column is a sector multiplier indicating the regional employment change in that sector associated with its increased deliveries to final demand requiring one unit of employment. The total requirements permit analysis of the indirect effect which is often neglected in planning community services. The highest sector multipliers, 3.08 and 3.17, were found in food manufacturing and petroleum refining respectively.

Calculation of percentage direct to total employment serving final demand, Table V, indicated 74 percent of regional employment serves final demand categories directly. The lower the direct to total employment for any endogenous sector serving final demand the stronger backward linkages in the regional economy or, a greater amount of indirect employment producing inputs for regional firms serving final demand. Table V also furnished information for calculation of an induced households and state and local government final demand multiplier, 1.83. Multiplication of the induced households and local government multiplier times the sector multipliers in the total requirements table furnishes regional multipliers estimating total employment requirements (direct, indirect, and induced) associated with increased deliveries to final demand in terms of one unit of employment. The total requirements (direct, indirect, and induced) were calculated alternatively with household consumption and state and local government endogenous, and the regional multipliers are read from row 34, Table VIII.

Application of the interindustry analysis within the framework developed in Chapter II to estimate solid waste generation in Planning Region Nine is a step toward solution of the problems of determining

need for public services and organization and collection of data for public service planning. Additional sub-models are suggested in the framework for analysis of solid waste management: collection, transfer, and disposal; waste generator; and model of spatial location. Some state and federal legislation encouraging local jurisdictions to improve solid waste management systems and furnishing them with technical and financial assistance and to do so was also discussed: Oklahoma Solid Waste Management Act, Oklahoma Clean Air Act, Solid Waste Disposal Act of Congress, and Resource Recovery Act of 1970.

The total requirements matrix of interindustry analysis and direct solid waste coefficients constitute a waste generator for Planning Region Nine. Direct waste coefficients in thousands of pounds of waste per employee per year (kpye) are associated with employment in each producing sector. Since multiplication of the total requirements matrix by final demand yields regional employment required by sector to produce final demand output, the sector employment multiplied times the direct waste coefficients furnishes an estimate of solid waste generation associated with sales of producing sectors to final demand.

Multiplication of waste coefficients times regional employment resulted in an estimated 787,063,000 pounds of solid waste generated in Planning Region Nine in 1970, excluding petroleum refining, mining, and agricultural wastes. The total (direct, indirect, and induced) solid waste coefficients obtained by multiplying direct solid waste coefficients times each column in the total (direct, indirect, and induced) requirements matrix estimates expansion in regional waste generation due to addition of one unit of employment in any endogenous sector serving final demand. Some examples of direct, indirect, and induced

solid waste coefficients include 52.884 kpye for food manufacturing and 16.991 kpye for metal manufacturing. The change in regional waste generation for an additional employee in any sector is greater than the direct effect measured at his place of employment.

Final Comment

Primary data have been assembled into an interindustry model of South Central Oklahoma. The model and framework for public service planning have immediate application to planning and other analysis utilizing interindustry analysis. The study is not without its weaknesses. Constructive criticism of the data and procedure can only improve the methodology of similar research efforts in the future.

A number of opportunities exist for additional research and application of economic theory to public service planning. Several suggestions for additional research are brought out in the limitations of the theoretical model, interindustry analysis, and solid waste coefficients. Development of a sub-state simulation model to estimate regional economic activity and tie it to public services would permit relaxation of the basic assumptions of the static interindustry model: stable trade-production coefficients and full employment. Primary data about waste generated for disposal by waste type and development of a comprehensive model of spatial location of wastes would be an important addition to analysis of need for solid waste management.

Other research efforts might concentrate on projections of solid waste generation over time and a comprehensive model of supply of public services. Given the supply side of the model, studies concerning the effect on average unit costs of public services through

combining service areas could be undertaken. Finally, the framework developed for solid waste management systems should be applicable to planning and administering other public services.

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APPENDIX A

SOURCES OF INTERINDUSTRY ANALYSIS DATA FOR PLANNING REGION NINE

Construction of an interindustry model for Planning Region Nine required identification of regional firms by endogenous sector, data collection, and a method of expanding the data to represent regional economic activities.

The population of firms in Planning Region Nine came from area telephone directories, Table X, and the Oklahoma Directory of Manufacturing, 1970 [21]. The Standard Industrial Classification Manual, 1967 [6], facilitated classification of economic units into sectors. A list of endogenous sectors by SIC code and the number of firms in each is recorded in Table XI. A sampling rule[1] based on standard deviations estimated from data in another study [11] indicated the number of observations required to furnish an estimate of the distribution of sales of each endogenous sector. Also, the sampling rule provided an estimate of the number of questionnaires to mail out to each sector to insure the required sector response.

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[1]Professor Francis McCamley, University of Missouri, developed the sampling rule and authored computer programs for sample selection. He is co-author of a forthcoming article "A Method for Estimating the Sampling Variances of Multipliers Derived from a From-To Model."

TABLE X

TELEPHONE EXCHANGES, PLANNING REGION NINE, 1969[a/]

1.	Lawton/Cache, Indiahoma[b/]
2.	Duncan
3.	Blanchard, Dibble, Newcastle, Bradley
4.	Tuttle
5.	Cyril, Elgin, Fletcher, Gracemont, (Union City), Verden/Sterling
6.	Chickasha, Alex, Cement, Minco, Rush Springs/Amber, Ninnikah, Norge, Tabler
7.	Velma, Alma, (Pike City, Ratliff City)/Sante Fe, County Line
8.	Healdton, Ringling, (Wilson)
9.	(Pauls Valley), Byars
10.	Purcell, Washington, Wayne/(Lexington)
11.	Waurika, Ryan
12.	Walters
13.	Hastings, Comanche, Loco, Temple/Addington
14.	Apache
15.	Anadarko, Binger, Ft. Cobb
16.	Chattanooga, Davidson, Frederick, Grandfield, Manitou, Tipton/ Loveland, Hollister, Faxon
17.	Terral
18.	Devol, Randlett, (Several Texas Towns)
19.	Hydro
20.	Marlow
21.	(Paoli), Rosedale
22.	Carnegie
23.	Hinton, Lookeba, Eakly/Bridgeport, Cedar Lake, Colony, Sickles

Source: Area Telephone Directories.

[a/] Area telephone directories.

[b/] Main towns/other towns.

TABLE XI

NUMBER AND CLASSIFICATION OF FIRMS INTO SECTORS, PLANNING REGION NINE, 1969

Economic Sector	Standard Industrial Classification Code	Number of Firms, 1969
(1)	01, 08, 09	--[a]
(2)	07, 505, 596, 5252	248
(3)	10-14	139
(4)	15-17	251
(5)	40-47	162
(6)	60-67	525
(7)	48-49	65
(8)	20-21	71
(9)	22-23	8
(10)	24-26	16
(11)	27	56
(12)	28-29	11
(13)	30-31	5
(14)	32	43
(15)	19, 33-39	66
(16)	52 except 5252	134
(17)	53	127
(18)	54	310
(19)	5541	428
(20)	55 except 5541	250
(21)	56	130
(22)	57	184
(23)	58	444
(24)	59 except 596	434
(25)	70	100
(26)	72	591
(27)	73	99
(28)	81, 82, 86, 89	185
(29)	75	224
(30)	78, 79, 84	80
(31)	76	161
(32)	80	251
(33)	50 except 505	281
Total		6,079

Source: The Standard Industrial Classification Manual, 1967, Bureau of the Budget, Area telephone directories, and the Oklahoma Directory of Manufacturing, 1970, Oklahoma Industrial Development and Parks Department.

[a] Farms and ranches estimated with secondary data.

Various techniques were used to insure adequate response to the mail-out questionnaire.[2] Meetings were held with community leaders in each county to explain the procedure and objectives of the project. Representatives of civic organizations and local government officials provided advice and assistance in conducting the survey and increasing the response rate. A few weeks after the initial mail-out a second mail-out was made to non-response firms. The gross rate of return for the eight county area was over 20 percent. About one-third of the 840 completed questionnaires were obtained from mail-outs with no further corrections or follow-ups necessary. Additional personal interviews were made to non-respondents and those whose questionnaire forms were incomplete. This effort was necessary to round out the projected number of interviews needed to adequately estimate the population. The total number of completed mail-out questionnaires and personal interviews equaled 14 percent of the population of firms and accounted for approximately 29 percent of the endogenous sector employment, excluding farms and ranches.

Processing the data required tabulation of questionnaires and development of employment control totals. Each individual questionnaire was tabulated to add to 100 percent of a firm's output in terms of sales. Average firm employment was also calculated from employment estimates in each questionnaire. Application of firm employment to tabulated data aggregated firms into appropriate sectors within each county. Aggregation of sample data to a regional estimate of distribution of regional gross receipts required control totals estimating

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[2] A sample questionnaire appears in Figure 4.

DATA INFORMATION SYSTEM FOR PLANNING REGION 9

(ROUGH ESTIMATES ARE ACCEPTABLE FOR ALL QUESTIONS)

NOTE: This questionnaire applies only to gross receipts of the establishment of your firm located in Grady County, Oklahoma.

PLEASE ANSWER ONLY THOSE QUESTIONS WHICH PERTAIN TO YOUR FIRM

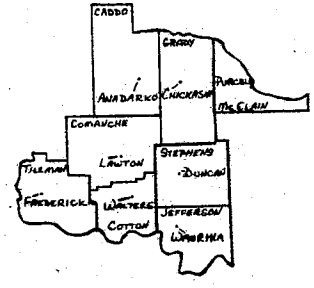
DEFINITIONS:

Firms describe any business or professional activity which provide a good or service to be consumed by other firms (i.e., farm firms, manufacturing firms, retail establishments, repair services, legal counsel, medical consultation) or final consumers such as households or governmental and educational units.

Gross Receipts is total receipts of your firm from sales of products and/or services.

IN THE FOLLOWING QUESTIONS, IF YOU SELL TO WHOLESALERS, PLEASE DISREGARD THIS FACT AND ESTIMATE WHERE YOUR WHOLESALER SELLS YOUR PRODUCT.

1. To give us an idea of business patterns between counties within Planning Region 9, please estimate the percentage of your firm's 1969 gross receipts derived from customers in:



County	Percentages
Caddo.....	_____%
Grady.....	_____%
McClain.....	_____%
Comanche.....	_____%
Stephens.....	_____%
Tillman.....	_____%
Cotton.....	_____%
Jefferson.....	_____%
Outside Planning Region 9.....	_____%
	Total 100%

2. Consider your gross receipts in 1969 as coming from three types of consumers. Estimate the source of these gross receipts from among the following: (the total of the three blanks should sum to 100%)

(2a) Percentage from Firms (Note definition)..... _____%

(2b) Percentage from Governmental and Educational units..... _____%

(2c) Percentage directly from Individuals or Households ..... _____%

Total 100%

3. Taking a typical dollar of gross receipts from sales to firms (estimated in 2a), how would you distribute this dollar of sales among the following two sources? (If 0% in 2a, go to question 5.)

(3a) Sales to firms as capital goods..... _____%
(Capital goods include plant, machinery, and equipment, with a life of more than one year, used to produce other products or services by purchasing firms.)

(3b) Sales to firms as non-capital goods and services..... _____%
(Non-capital goods include all products and services purchased by firms except capital goods.) Total 100%

4. Taking a typical dollar of gross receipts from sales of non-capital goods and services to firms (estimated in 3b), how would you estimate its source from the following regional economic sectors or industries? (If 0% in 3b, go to question 5.)

(4a) Farms, ranches and foresty firms..... _____%

(4b) Agricultural suppliers and service firms (farm equipment dealers, feed and fertilizer dealers, elevators, veterinary, consulting, etc.) ..... _____%

(4c) Mining, crude petroleum and natural gas firms..... _____%

(4d) Construction firms..... _____%

(4e) Transportation, storage and warehousing firms..... _____%

(4f) Banking and other finance, insurance and real estate firms..... _____%

(4g) Utilities, both private and public, and communications firms (electricity, gas, telephone, telegraph, radio and TV)..... _____%

(4h) Manufacturing firms..... _____%

(1) Food and similar products (i.e., meat, dairy and bakery products, canning and beverage industries, prepared animal feeds)..... _____%

(2) Apparel and related products..... _____%

(3) Wood and paper products..... _____%

(4) Printing and publishing (i.e., newspapers, periodicals and other printing)..... _____%

(5) Petroleum refining and paving and roofing materials ..... _____%

(6) Leather, plastic and rubber products..... _____%

(7) Stone, clay, and concrete products..... _____%

(8) Metal products, machinery, transportation equipment, instruments and related products..... _____%

Subtotal _____%

Figure 4. Questionnaire "Data Information System for Planning Region 9"

(4i) Retail firms (other than agricultural supplies)..... _____%

(1) Building materials and hardware..... _____%

(2) General merchandise stores (i.e., department stores, limited price variety stores and general stores)..... _____%

(3) Food stores (i.e., grocery stores, bakeries, candy stores)..... _____%

(4) Gasoline service stations..... _____%

(5) Automotive dealers and trailer sales (cars, boats, trailers, and supplies)..... _____%

(6) Apparel and accessory stores..... _____%

(7) Furniture, home furnishings, appliances and equipment..... _____%

(8) Eating and drinking establishments..... _____%

(9) Drug, liquor, sporting goods, antiques, book, garden supply, jewelry, florists, gift and camera stores, other misc. retail stores..... _____%

Subtotal _____%

(4j) Service firms (other than agricultural services)..... _____%

(1) Hotels, motels, tourist courts, camps and other lodging..... _____%

(2) Personal services (i.e., laundries, dry cleaners, photographic studios, barber and beauty shops, shoe repair, funeral service, tailors)..... _____%

(3) Business services (i.e., advertising, employment agencies, business and management consulting, credit reporting)..... _____%

(4) Professional services (i.e., legal, accounting, auditing and bookkeeping, engineering and technical consulting, churches and religious organizations)..... _____%

(5) Automotive repair services, rental and parking garages..... _____%

(6) Amusement and recreation businesses..... _____%

(7) Miscellaneous repair services (i.e., electrical, radio, TV, jewelry, watch, upholstery, furniture, lawnmower, typewriter)..... _____%

(8) Medical and other health services (i.e., medical doctor, dentist, and other medical professionals, hospitals, clinics, laboratories, nursing homes)..... _____%

Subtotal _____%

Total 100%

5. Taking a typical dollar of gross receipts from sales to governmental and educational units (estimated in 2b), how would you distribute this dollar of sales among the following two sources? (If 0% in 2b, go to question 7.)

(5a) Sales to governmental and educational units as capital goods..... _____%
(Capital goods include plants [buildings], structure [roads, bridges, etc.], machinery and equipment, with a life of more than one year.)

(5b) Sales to governmental and educational units as non-capital goods and services..... _____%
(Non-capital goods include all products and services purchased by such units except capital goods.) Total 100%

6. Taking a typical dollar of gross receipts from sale of non-capital goods and services to governmental and educational units (estimated in 5b), how would you estimate its source from the following units? (If 0% in 5b, go to question 7.)

(6a) Federal governmental units..... _____%

(6b) State governmental units (other than educational)..... _____%

(6c) School districts (private and public)..... _____%

(6d) Colleges, universities, and other institutions of special learning..... _____%

(6e) City governmental units (excluding public utilities included in 4g and public health services included in 4j)..... _____%

(6f) County governmental units (excluding public utilities included in 4g and public health services included in 4j)..... _____%

(6g) Other governmental units (specify _____)..... _____%

Total 100%

7. Taking a typical dollar of gross receipts from sales to individuals or households (estimated in 2c), how would you distribute this dollar of sales among the following two sources? (If 0% in 2c, go to question 8.)

(7a) Sales to individuals or households as consumer durable goods..... _____%
(Consumer durable goods include houses [and other construction], major appliances, automobiles, boats, and other consumer goods purchased on an infrequent basis.)

(7b) Sales to individuals or households as nondurable goods..... _____%
(Nondurable goods include all products and services purchased by individuals or households except consumer durable goods.) Total 100%

8. In order to give us some idea of the size of the firm covered by this questionnaire would you please indicate the number of people (including yourself) that were employed (in full time equivalents) during:

the last month _____ the 1969 high month _____ the 1969 low month _____

Area - SIC No. _____

Figure 4. (Continued)

total employment by sector in each county. The control totals in Table XII sum to Oklahoma Employment Security Commission average annual 1970 county employment [18, 19, 20] and are allocated to the appropriate sectors using as weights appropriate sub-grouping allocations of County Business Patterns [35] and the Oklahoma Directory of Manufacturing [21]. The OESC estimates also contain government employment which is allocated to state and local and federal government [33, 36]. County control totals include self-employed which were allocated on the basis of state sector ratios of proprietors and partnerships from Statistics of Income [37]. Employment estimates are for place of employment and follow the definitions of the Oklahoma Employment Security Commission.

TABLE XII

EMPLOYMENT CONTROL TOTALS BY SECTOR BY COUNTY, PLANNING REGION NINE, 1970

Sector	Caddo	Grady	McClain	Comanche	Stephens	Tillman	Cotton	Jefferson	Total
(1)	2,340	2,050	1,020	975	1,480	1,840	975	690	11,370
(2)	354	187	37	310	105	189	27	19	1,228
(3)	148	171	79	112	1,483	138	66	83	2,280
(4)	202	405	124	1,008	612	195	5	38	2,589
(5)	322	259	97	499	338	104	108	45	1,772
(6)	229	324	188	1,349	603	228	72	201	3,194
(7)	210	166	58	666	257	111	63	26	1,557
(8)	36	212	--	627	54	1	1	--	931
(9)	675	--	70	74	319	150	303	--	1,591
(10)	100	63	--	56	1	--	7	--	227
(11)	64	93	13	242	81	10	12	2	517
(12)	244	61	--	15	344	--	--	--	664
(13)	--	11	--	--	--	71	--	--	82
(14)	73	14	4	202	156	20	2	--	471
(15)	2	909	52	513	2,389	45	15	11	3,936
(16)	72	112	20	182	75	73	13	11	558
(17)	89	202	52	853	393	72	47	39	1,747
(18)	139	187	112	518	463	89	44	40	1,592
(19)	114	99	59	280	98	76	32	42	800
(20)	112	206	38	547	254	86	38	52	1,333
(21)	27	107	36	348	134	73	24	18	767
(22)	45	69	18	288	85	39	13	10	567
(23)	185	287	193	1,478	264	98	46	69	2,620
(24)	101	184	55	482	208	89	60	39	1,218
(25)	11	42	14	346	35	55	15	9	527
(26)	68	137	48	1,043	296	123	45	26	1,786
(27)	22	44	28	873	127	109	29	16	1,248
(28)	47	331	64	875	327	316	69	35	2,064
(29)	12	54	18	190	94	67	20	6	461
(30)	10	42	13	170	31	52	13	7	338
(31)	11	43	14	49	90	56	15	8	286
(32)	215	217	255	458	801	102	74	220	2,342
(33)	61	302	31	1,147	353	93	37	8	2,032
State and local government	1,052	1,483	493	2,831	1,050	617	283	288	8,097
Non-military federal civilians	398	207	57	1,825	105	73	45	42	2,752
Civilian Military	--	--	--	3,644[a]	--	--	--	--	3,644
Total[b]	7,790	9,280	3,360	25,075	13,505[c]	5,460	2,618[d]	2,100	69,188

[a] Annual Report of Federal Civilian Employment by Geographic Area, December 31, 1969, U. S. Civil Service Commission

[b] "1970 Annual Average Labor Force Data for Selected Counties in Planning Region IX." Oklahoma Employment Security Commission, Research and Planning Division.

[c] "Duncan area labor force." Oklahoma Employment Security Commission, Research and and Planning Division.

[d] "Walters area labor force." Oklahoma Employment Security Commission, Research and and Planning Division.

APPENDIX B

ALLOCATION OF MILITARY PERSONNEL AND DEPENDENTS' CONSUMPTION TO FEDERAL GOVERNMENT

Allocation of military personnel and dependents' household consumption to federal government seemed desirable because members of the armed forces are not accounted for in employment control totals and their household consumption is better described as a regional export. Deleting this "exported consumption" from household consumption makes possible the endogenous determination of household consumption flows since remaining consumption is associated with estimated regional employment. The transfer was accomplished using county business pattern data, estimates of military and civilian population, and a preliminary distribution table.

County business patterns, question one, Figure 4, describe the percentage distribution of a firm's gross receipts from customers in planning region counties and outside the region. Regional sales to individuals and households in each county times county business patterns distribution of sales from regional counties to Comanche County times 1970 employment control totals gives a gross Comanche County consumption function. The function estimates each endogenous sector's sales in employment flows to household consumption in Comanche County. Subtraction of this function from total regional household consumption in a preliminary distribution table yields a consumption vector for the remaining counties in Planning Region Nine.

Census data from Table I reveals the 1970 population of the planning region excluding Comanche County to be 135,202. This figure is divided into each value of the regional consumption vector to get a seven county per capita consumption vector.[1] Multiplication of the Comanche County population, 58,717, net of military personnel and dependents found in Table XIII results in a non-military Comanche County consumption function. The difference between the Comanche County gross consumption function and non-military consumption function was allocated to the final demand category federal government. Negative values were assumed to be zero.

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[1]Gross Comanche County consumption of agricultural services was allocated to federal and household consumption on a per capita basis excluding residents of military group barracks.

TABLE XIII

MILITARY PERSONNEL AND DEPENDENTS IN COMANCHE COUNTY, 1970

	Fort Sill Group Quarters	Fort Sill Family Quarters	Off Post	Total
Dependents	--	4,730	19,110	23,840
Service Members	15,119	1,368	9,100	25,587
Total	15,119	6,098	28,210	49,427

Source: Lawton Metropolitan Area Planning Commission.

VITA

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Master of Science

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