Regional Science Perspectives

ESTIMATING REGIONAL INFORMATION SYSTEMS WITH APPLICATION
TO COMMUNITY SERVICE PLANNING*

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Decision-making at the local and multi-county jurisdictional level has
been described as programmatic in nature, involving the efficient and
equitable distribution of public services and financing burdens [9]. Planning
for the efficient provision of community services is one of the most important
means available to local decision-makers for influencing growth and develop-
ment. Local initiative and enthusiasm as expressed through providing adequate
services at least cost is important in providing the climate conducive to
business investment.

Regional information systems should be policy oriented and designed to
facilitate decision-making [10]. Local planners frequently lack adequate
information systems on which to base decisions. What information is available
usually lacks an analytical construct which relates different segments of the
local economies. Drawing upon constructs described in other sources [21, 10],
an information system that interrelates area activity in business, households,
and governments for a multi-county region in Oklahoma has been estimated and
is reported here. Application of the information system to planning community
services is given by means of estimating the regional requirements for solid
waste disposal services. Other applications are suggested as determining rates
of return to communities and regional planning authorities from subsidizing
industry location. Finally, descriptions of the estimation procedures are
dispersed throughout the paper with a final section on research staff personnel
requirements in man-month units.

Interdependence in a Regional Information System

Direct contributions of a manufacturing plant and its high-skilled labor
force are welcome to tax revenue coffers of local jurisdictional governments.
But the public service requirements and the local contributions to government
revenues which are indirectly associated with plant location may tend to add
a total net negative contribution to community well-being when measured against
the "before plant location" community fiscal balance [8]. This emphasizes the

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importance of a total interdependence model.[1]

The primary problem in using a total interdependence model is one of cost. Maki has estimated that a comprehensive one-county study may cost fifty thousand dollars or more while a single state-level study may cost five times as much [14]. Even leaving out the extra costs associated with publishing slick-covered multi-colored reports, a multi-area or state-level input-output study can easily exceed one million dollars in total cost.

A second problem is one of analytical complexity. The total interdependence model should be within the analytical ability of the local planners; or at least within the analytical ability of the multi-county economic planner. Of the eleven planning regions in Oklahoma, only one, which is also an Economic Development District, has the staff and the planner to operationalize an interdependence model of the traditional input-output type.

Related to this problem Leven [13], Tiebout [24], and Perloff and Leven [21] have devised and illustrated a method "from-to analysis," for extending the economic base concept to include intermediate markets and, hence, interindustry flows. An area economy is divided into industry groups by aggregating similar firms which describe structural features of the local economy. Market demand sources are delineated; first, by broad market categories of export and local. Additional detail delineates types of local and export markets.

Important features of the from-to analysis are its conceptual simplicity and its ease in obtaining primary data for its estimation.[2] Business firms, especially in rural areas, are very cognizant of who their customers are. Estimates of the distribution of their gross receipts by market source appear to be easily ascertained. The question to be asked is merely one of "who are your customers and what per cent of your total gross receipts does each account for." When weighted by gross sales (or other variables such as employment or value added), individual firm distributions may be summed to arrive at an industry distribution.

Conceptually, the local planner only needs to realize that as the demand by market source changes, those firms and industry categories serving these markets will be affected. Some markets (i.e., exports and Federal government) change because they are influenced by exogenous factors. Other markets may be assumed endogenously determined. Interbusiness transactions are assumed proportional to sector output. Consumption and local government market source demand may be assumed proportional to total level of area activity. All of

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[1]Perloff and Leven [21] in their system of integrated regional accounts contains an interindustry matrix. Hirsch, in his recent publication on selecting regional information for government planning and decision-making, has included an information account on interindustry sales and purchases [10, p. 72].

[2]For a comparison of input-output and from-to analysis, see Leven [13].

the above concepts can be explained to local planners verbally, by flow diagrams, or equationally.

Kalter [11] has used mail questionnaires to further expedite data collection for a from-to analysis. His questionnaire is similar to one suggested by Tiebout [24] and used in both personal and mail questionnaire interviews.

Estimating Area Economic Interaction as Part of a Regional Information System (RIS) for South Central Oklahoma

The study area covers eight counties in South Central Oklahoma, designated as Planning Region Nine in a state delineation scheme. It is also geographically synonymous with the Economic Development District called Association of South Central Oklahoma Governments (ASCOG). Table 1 includes characteristics of the population for the years 1960 and 1970 and employment characteristics for 1970. Overall area structure has been influenced by five major industries: agriculture, mining of crude petroleum, military operations at Fort Sill, large oil field equipment manufacturing, and horse trailer and mobile home manufacturing. Agriculture and mining have followed state and national trends in providing decreasing employment opportunities. Civilian employment at Fort Sill increased considerably over the past decade [20]. However, it appears that for the region Federal civilian employment is on the decline. Manufacturing shows the greatest growth potential of any of the basic sectors. National and international demand for oil field equipment will influence the number of job opportunities in this sector for the planning region. Chickasha in Grady County is known as the horse trailer capital of the world and, together with mobile home plants in other parts of the planning region, a skilled labor force is being developed for this type of manufacturing.

Interbusiness and Final Market Source Employment Transaction Flows

The questionnaire was designed in a manner to distribute individual business firm gross receipts on a percentage basis to thirty-three other businesses and seventeen final market sources. Employment control totals were estimated using various sources including Oklahoma Employment Security Commission [19], U. S. Censuses, and County Business Patterns. Various allocators were devised to distribute employment to those sectors covered up for disclosure purposes in the official statistics. County control totals for self-employed persons have been allocated to sectors based on state ratios of number of proprietors and partners in partnerships available in the Statistics of Income [28]. Employment in all cases has been classified on a job location basis. Corrections for in-commuters and out-commuters in final market distributions to consumption, government, and investment have not been made.

Individual firm distributions were weighted by annual average employment levels and summed for counties. County distributions were weighted by control totals to arrive at planning region totals. Table 2 contains the employment transaction flows for the following aggregations: interbusiness; consumption; public and private investment; state and local government; Federal government;

TABLE 1: Employment and Population Characteristics of Planning Region Nine, South Central Oklahoma

County	Population[a] 1970	Population[a] 1960	Total Civilian Labor Force	Agriculture	Domestic Serv. Self Employed Unpaid Family Workers	Wage and Salary Private	Wage and Salary Government	Average Monthly Unemployment Number	Average Monthly Unemployment Rate
Total	243,346	230,621	72,800	11,370	8,399	34,926	14,493	3,612	4.9
Caddo	28,931	28,621	8,260	2,340	630	3,370	1,450	470	5.7
Comanche	108,144	90,803	26,500	975	3,025	12,775	8,300	1,425	5.4
Cotton	6,832	8,031	2,750[c]	975	297	1,018	328	132	4.8
Grady	29,354	29,590	9,750	2,050	900	4,640	1,690	470	4.8
Jefferson	7,125	8,192	2,220	690	320	760	330	120	5.4
McClain	14,157	12,740	3,540	1,020	440	1,350	550	180	5.1
Stephens	35,902	37,990	13,970[c]	1,480	1,977	8,893	1,155	465	3.3
Tillman	12,901	14,654	5,810	1,840	810	2,120	690	350	6.0

Header spanning employment columns: Average Monthly Employment, 1970[b]

[a] United States Department of Commerce, Bureau of the Census, Census of Populaton, 1970 Preliminary.
[b] Oklahoma Employment Security Commission, Research and Planning Division.
[c] Average of four months for Stephens and Cotton Counties.

TABLE 2. Employment Transaction Flows by Aggregated Sectors for Oklahoma Planning Region Nine, 1970

Sector	Inter-business	Consumption	State Local Gov't.	Federal Gov't.[b]	Public and Private Investment	Exports	Total
(1) Farms & Ranches	3,810	632	4	519	--	6,406	11,371
(2) Agricultural Services[a]	523	224	2	79	34	366	1,228
(3) Mining	1,316	13	6	6	12	939	2,292
(4) Contract Construction	296	559	42	13	625	1,054	2,589
(5) Transp. & Storage	965	174	14	226	--	393	1,772
(6) Finance, Ins. & Real Estate	910	1,417	120	343	11	393	3,194
(7) Communication & Util.	479	645	50	370	--	13	1,557
(8) Food Processing	467	61	38	57	--	308	931
(9) Textile & Apparel Mfg.	259	--	--	4	--	1,328	1,591
(10) Wood & Paper Products	41	4	--	--	--	182	227
(11) Printing & Publishing	318	64	22	60	16	37	517
(12) Petroleum Refining	175	5	4	34	--	446	664
(13) Rubber, Plastic & Leather	11	--	--	--	--	71	82
(14) Concrete Products	265	94	24	23	--	66	472
(15) Metal & Machinery Mfg.	322	9	6	1	78	3,521	3,937
(16) Building Material	132	322	46	36	13	10	558
(17) General Merchandise	75	1,255	65	289	24	38	1,746
(18) Food Stores	33	1,449	16	56	--	38	1,592
(19) Gas Service Stations	225	445	37	19	--	73	799
(20) Automobile Dealers	148	799	36	245	55	50	1,333
(21) Clothing Stores	8	713	1	1	--	45	768
(22) Furniture Stores	11	383	4	146	6	17	567
(23) Eating & Drinking Estab.	22	1,665	--	665	--	268	2,620
(24) Miscellaneous Retail	114	880	43	81	34	67	1,219
(25) Lodging	86	49	7	24	--	361	527
(26) Personal Services	118	895	7	735	--	31	1,786
(27) Business Services	931	118	8	34	--	157	1,248
(28) Professional Services	313	1,490	15	73	15	159	2,065
(29) Auto Repair Services	158	171	15	105	--	10	459
(30) Recreation	8	229	1	96	--	3	337
(31) Miscellaneous Repair Serv.	38	205	2	1	--	38	285
(32) Medical Services	10	2,104	50	30	1	148	2,342
(33) Wholesale Trade	1,412	103	76	85	141	211	2,028
Total	13,999	17,175	761	4,456	1,065	17,247	54,703

[a]Includes farm equipment dealers, farm product materials, and farm and garden supply stores.

[b]Includes off-base consumption of military personnel.

and exports. Interbusiness transfers accounted for approximately twenty-five per cent of total private employment flows, not indicating a highly developed interdependent business matrix.[3] Major export sectors of agriculture, mining, and metal and machinery manufacturing confirm the earlier significance placed on these sectors for the region. Importance of recent developments in the textile and apparel manufacturing sector is noted by the employment flow to exports.

Short-run direct and indirect production employment multipliers for the thirty-three endogenous sectors are given in Table 3. The largest employment multipliers are in the processing sectors of food products (sector eight) and petroleum refining (sector twelve).[4]

Interaction in the Oklahoma study and in most small regional studies does not occur as much through interbusiness transactions as through households and area business relationships. Consumption employment flows accounted for over 31 per cent of total private regional employment. In the short-run, consumption and local government employment flows may be considered endogenously determined. In the long-run, it may also be expected that investment flows reflect changes in levels of area activity. Exports and Federal government final market sources then remain as the only primary movers of the economy under these assumptions. Additional market sector multipliers can be constructed where the above assumptions have been made [24, 11, 22].

Inter-County and Extra-Regional Employment Transaction Flows

Few studies have tried to quantify interregional dependence, specifically for purposes of community service planning.[5] Firms in South Central Oklahoma, in addition to being asked who their customers were (sector distribution), were also asked where their customers came from (intercounty business patterns). In order to construct a complete interregional from-to table for Planning Region Nine, it is necessary to assume that the distribution of the types of customers a business firm has is the same whether his sales are within his own county or in other counties of the planning region.

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[3]By contrast, Kalter's New York study showed interbusiness employment transactions of about twenty-eight per cent of essentially total covered employment [11]. The New York study included a population base approximately three times as large as the Oklahoma region.

[4]No adjustments have been made for excess capacities found in rural economies, both in primary material production and in service sectors [22]. For projection purposes simulation may be used to adjust for excess capacity, changing labor productivities, and enterprise substitutions [3, 15].

[5]Kalter [11] estimated intercounty distributions of gross receipts by business firms. He did not formally relate county business patterns by an interdependent model nor did he apply to community service planning.

TABLE 3. Short-run Direct and Indirect Production Employment
Multipliers for Oklahoma Planning Region Nine, 1970

Sector	Short-run Production Multiplier	Sector	Short-run Production Multiplier	Sector	Short-run Production Multiplier
(1)	1.488	(12)	3.170	(23)	1.196
(2)	1.723	(13)	1.234	(24)	1.154
(3)	1.752	(14)	1.074	(25)	1.415
(4)	1.333	(15)	1.076	(26)	1.067
(5)	1.112	(16)	1.379	(27)	1.100
(6)	1.190	(17)	1.159	(28)	1.046
(7)	1.149	(18)	1.956	(29)	1.304
(8)	3.077	(19)	1.978	(30)	1.207
(9)	1.108	(20)	1.333	(31)	1.301
(10)	1.062	(21)	1.122	(32)	1.164
(11)	1.084	(22)	1.774	(33)	1.000

Table 4 gives the intercounty employment transaction flow data for Planning Region Nine and county distribution to final market source. Consumption employment flow data have been adjusted to exclude off-base consumption by military personnel. The latter consumption flows have been allocated to the Federal government market source. This will more realistically permit assuming private consumption to be determined endogenously as a function of the level of regional activity. It should be noted that employment flows in Table 4 to final market sources of private consumption, state and local government, and public and private investment are regionally defined. Each market source represents an eight by eight matrix with the row county delivering to itself and each of the other seven counties in proportions indicated through the county business pattern response of the aggregated individual firms. For convenience the matrices have been collapsed into regional sectors.

Table 5 assumes Federal government purchases, exports, and direct government employment as the only long-run exogenous market sources with private consumption, state and local government expenditures, and public and private investment endogenously determined. Employment transaction flows in Table 5 can take on a special meaning. For instance in Caddo County in order to have a total private and public employment of 7,790 it requires 2,801 jobs within the county to service interbusiness transfers, consumption, state and local government expenditures, and public and private investment needs. In addition it requires 224 jobs in Grady, 23 in McClain, 172 in Comanche, and 42 in Stephens to service the same needs. Out of the total 7,790 jobs in Caddo, 2,830 deliver directly to the final market sources of Federal government purchases and regional exports. Table 6 assumes proportional amounts of employment requirements in order to have county total employment. That is, each column entry in Table 5 was divided by total employment for that county and recorded in Table 6. Hence, for Caddo County, out of each job a proportion equal to 0.35956 served nonbasic requirements within the county. The intercounty ratio between Grady and Caddo of 0.02876 means that for each person employed in Caddo County it requires three-hundredths of a person in Grady County to directly service his needs. Other coefficients have similar meanings.

Direct, indirect, and induced county and intercounty requirements for deliveries to Federal government purchases, regional exports, and direct government employment are contained in Table 7. Interpretation of these interdependence coefficients means that for a change in basic employment of a county, a multiple of employment requirements is needed from within the county and from other counties according to the corresponding column of coefficients in Table 7. As an example, if basic employment changes by 100 jobs in Caddo County, an additional 57 jobs are created in the same county, 8 jobs in Grady, 6 in Comanche, 2 in Stephens plus smaller additions in the remaining counties. The total number of jobs created in Planning Region Nine including the original 100 jobs in Caddo is 174 which is the sum of the column of interdependence coefficients times 100.

Table 8 presents four sets of county and intercounty employment multipliers for comparative purposes. Each set assumes an additional induced or endogenously determined market source. The level of the additional induced market may be determined from Table 4.

TABLE 4: Intercounty and Final Market Source Distribution of Employment Transactions, Oklahoma Planning Region Nine, 1970

County	Intercounty Interbusiness Employment Transaction Flows								Final Market Source, Planning Region Nine					
	Caddo	Grady	McClain	Comanche	Stephens	Tillman	Cotton	Jefferson	Private[a] Consumption	State and Local Gov't.	Public and Private Invest.	Regional Exports and Federal Gov't. Purchases[b]	Direct Gov't. Employment	Total
Caddo	1,549	126	34	118	32	24	32	26	1,473	71	25	2,830	1,450	7,790
Grady	93	1,738	31	35	35	---	6	2	2,419	167	153	2,911	1,690	9,280
McClain	8	10	587	1	1	---	---	---	1,101	25	23	1,053	550	3,360
Comanche	76	35	1	4,284	80	33	51	16	5,166	292	295	6,446	8,300	25,075
Stephens	16	43	27	108	2,468	8	48	81	4,022	101	483	4,943	1,155	13,505
Tillman	---	---	---	11	1	1,061	46	9	1,646	45	73	1,879	690	5,460
Cotton	---	2	---	17	33	9	544	12	526	22	8	1,118	328	2,618
Jefferson	---	---	---	1	19	---	9	430	587	39	8	678	330	2,100

[a]Excludes off-base consumption by military personnel.
[b]Includes what is excluded by footnote a.

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TABLE 5: Intercounty Distribution of Employment Transactions Assuming Endogenous Consumption, State and Local Government, Public and Private Investment; Oklahoma Planning Region Nine, 1970

County	Intercounty Employment Transaction Flows (Interbusiness, Consumption, State and Local Government, and Public and Private Investment)								Final Market Source		Total
	Caddo	Grady	McClain	Comanche	Stephens	Tillman	Cotton	Jefferson	Regional Exports & Fed. Govt. Purchases	Direct Govt. Purchases	
Caddo	2,801	228	61	213	58	43	58	47	2,830	1,450	7,790
Grady	224	4,192	75	84	84	--	14	5	2,911	1,690	9,280
McClain	23	29	1,698	3	3	--	--	--	1,053	550	3,360
Comanche	172	79	2	9,670	181	74	115	36	6,446	8,300	25,075
Stephens	42	114	71	286	6,529	21	127	214	4,943	1,155	13,505
Tillman	--	--	--	28	3	2,720	118	23	1,879	690	5,460
Cotton	--	4	--	32	63	17	1,034	23	1,118	328	2,618
Jefferson	--	--	--	2	45	--	21	1,024	678	330	2,100

TABLE 6: Direct County and Intercounty Employment Requirements Per Job Assuming Endogenous Consumption, State and Local Government Purchases, and Public and Private Investment, Oklahoma Planning Region Nine, 1970

Direct Employment Coefficients

County	Caddo	Grady	McClain	Comanche	Stephens	Tillman	Cotton	Jefferson
Caddo	.35956	.02457	.01816	.00850	.00430	.00788	.02215	.02238
Grady	.02876	.45172	.02232	.00335	.00622	--	.00535	.00238
McClain	.00295	.00312	.50536	.00012	.00022	--	--	--
Comanche	.02208	.00851	.00060	.38564	.01340	.01355	.04393	.01714
Stephens	.00539	.01228	.02113	.01141	.48345	.00385	.04851	.10191
Tillman	--	--	--	.00112	.00022	.49817	.04507	.01095
Cotton	--	.00043	--	.00128	.00466	.00311	.39496	.01095
Jefferson	--	--	--	.00008	.00333	--	.00802	.48762

TABLE 7: Direct, Indirect, and Induced County and Intercounty Requirements for Deliveries to Final Market Sources, Oklahoma Planning Region Nine, 1970

Interdependence Coefficients

County	Caddo	Grady	McClain	Comanche	Stephens	Tillman	Cotton	Jefferson
Caddo	1.56583	0.07126	0.06138	0.02253	0.01556	0.02570	0.06375	0.07449
Grady	0.08311	1.82884	0.08659	0.01162	0.02337	0.00194	0.02230	0.01768
McClain	0.00990	0.01201	2.02261	0.00062	0.00112	0.00018	0.00063	0.00075
Comanche	0.05791	0.02905	0.00731	1.62987	0.04475	0.04607	0.12865	0.06983
Stephens	0.02007	0.04560	0.08579	0.03702	1.94168	0.01722	0.16599	0.39241
Tillman	0.00017	0.00025	0.00013	0.00399	0.00262	1.99376	0.14965	0.04648
Cotton	0.00034	0.00172	0.00075	0.00376	0.01533	0.01050	1.65560	0.03881
Jefferson	0.00014	0.00033	0.00057	0.00055	0.01287	0.00028	0.02702	1.95484
Total	1.73746	1.98905	2.26513	1.70997	2.05729	2.09565	2.21359	2.59529

TABLE 8: County and Intercounty Employment Multipliers for Deliveries to Final Market Source, Oklahoma Planning Region Nine, 1970

County	Direct & Indirect County & Intercounty Employment Multipliers	Employment Multipliers with Induced Consumption	Employment Multipliers with Induced (1) Consumption, and (2) State and Local Government Expenditures	Employment Multipliers with Induced (1) Consumption, (2) State and Local Government Expenditures, and (3) Public and Private Investment
Caddo	1.287	1.692	1.720	1.737
Grady	1.267	1.869	1.928	1.989
McClain	1.254	2.179	2.219	2.265
Comanche	1.224	1.635	1.674	1.710
Stephens	1.247	1.905	1.934	2.057
Tillman	1.262	2.006	2.041	2.096
Cotton	1.379	2.121	2.167	2.214
Jefferson	1.368	2.417	2.519	2.595

Intercounty dependence and subsidized industry.[6] Intercounty dependence coefficients are a significant quantitative tool that further relates production, consumption, and government activities within a planning region. As an example, the effects of an additional one-hundred jobs in the export base of Jefferson County have been traced in Figure 1 (dashed lines). An additional ninety-five jobs were created within the county from the added one-hundred export base jobs. Using local income or employment multipliers Moes [18] has determined the annual rate of return a community may expect from subsidizing firm location. The annual rate of return for Jefferson County would be limited by the size of the local multiplier which is 1.95. However, the annual rate of return for Planning Region Nine would be somewhat larger since the direct and indirect county and intercounty multiplier is greater by the amount 0.64. This would mean that the regional planning authority could beneficially subsidize Jefferson County in attracting industry.

Central place theory and intercounty dependence. Economic geographers have long discussed the availability of essentially private services using central place theory. Under this theory, cities are ordered according to the number of services or goods that they provide. Places of higher order offer more goods, have more establishments and business types, larger populations, tributary areas and tributary populations, do greater volumes of business, and are more widely spaced than lower order places [1]. Centers of each higher order group perform all the functions of lower order centers plus a group of central functions that differentiates them from and sets them above the lower order. Berry and Pred [1] give as businessmen's motives for a hierarchical order of places, the differences in conditions of entry and available economies of scale, with implications for required number of customers. For rural areas, the lowest order of central place may be identified as a village and of size proportional to the rural population within its trade area. Successively higher orders offer more services and have larger markets; the two being mutually interdependent.

Central place theory, however, has been more concerned with identification of the minimum thresholds of various hierarchical orders than with quantifying the extent of the interdependencies of hinterlands, villages, cities and other orders.[7] Interregional from-to analysis permits to some degree, the quanti-

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[7]This has led to difficulties in making central place theory dynamic. As an example Marshall [17, pp. 172-173] in the summary and conclusion of a recent Canadian publication has indicated that one of the two main directions static central place theory needs to take is that of introducing the time dimension. "What is required is not merely the reconstruction of central place networks as they existed in the past, but comparative cross-sectional studies of the same area at several different points in time. Coupled with existing central place theory, which is by nature static, such studies should lead to a deeper understanding of the evolution of central place patterns, and perhaps ultimately to the formulation of a much needed dynamic central place theory."

fication of these interdependencies. Again using the data in Table 7, the total dependence of each county on Comanche County, and presumably the regional trade center of Lawton, is shown in Figure 1 (solid lines) on the basis of 100 additional jobs in the export base of the corresponding county. As an example, for each one-hundred jobs producing for the export sector in Caddo County, six jobs are required directly and indirectly in Comanche County servicing regional firms, households and local governments. Part of this employment is due to services or functions that are not available in lower order centers in Caddo County itself. Identification of lower central place orders may be hypothesized when viewing the employment requirements for Jefferson County (see Figure 1). This is the only county in the planning region without a center of at least 2,500 population. It may be considered a primary production region (agriculture) with Duncan and Lawton serving as its trade centers. Duncan is the primary trade center since it is the closest town over 10,000, but significant direct trade also occurs with Lawton, a higher order central place.

Intercounty flows, even for such a small rural region as Planning Region Nine, are not limited only to unilateral trade in the direction of larger centers. Centers specializing in certain production or distribution functions serve the whole region whether the trading partner is of a higher or lower order central place. However, a major part of intercounty flows occur as trade between primary resource regions and trade centers. It may be hypothesized that trade coefficients based on the conditions of central place theory are more stable than the more traditional interregional trade coefficients assumed in input-output analysis.

Using RIS to Plan Solid Waste Disposal Services

The 1965 Solid Waste Disposal Act of Congress authorizes research and technical assistance to state and local governments [2, forward]. The Oklahoma Solid Waste Management Act of 1970 provides enabling legislation for municipal and county solid waste management systems and makes illegal dumping a misdemeanor. The 1968 Clean Air Act administered by the Oklahoma State Health Department regulates use of the atmosphere for waste disposal. One state regulation prohibits open burning in Air Quality Control regions and in all other urban areas of more than 10,000 population.

Professional planners have prepared materials concerning disposal of solid wastes in municipalities [4, 12]. The Duncan City Planners recommended two or more cities study the feasibility of sharing a common facility, and the Association of South Central Oklahoma Governments (ASCOG) supports a seven-county waste disposal system. The above accounts indicate a need for comprehensive planning of waste management systems. A discussion of demand for solid waste disposal, data for development of solid waste multipliers and application to comprehensive planning of area wide solid waste disposal services is a relevant application of RIS to regional problems.

The present discussion centers only on the estimation of needs for solid waste disposal services and applied to Oklahoma Planning Region Nine. Vari-
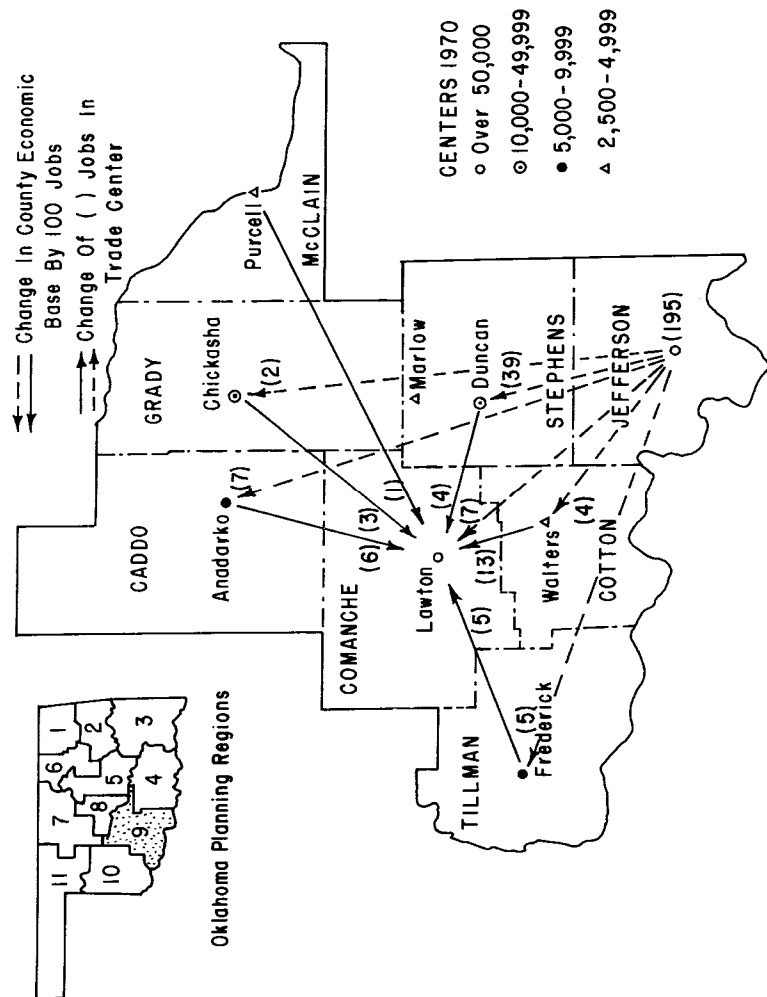
FIGURE 1. INTERCOUNTY EMPLOYMENT DEPENDENCE FROM A CHANGE IN EXPORT BASE EMPLOYMENT

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ations in the needs for solid waste disposal services are conducive to estimation through coefficients of industry, household and institution generation of waste material. Using data from [2, 26] and adjusting for industry mix and other characteristics unique to Planning Region Nine, a set of solid waste coefficients have been estimated and are given in Table 9, column three. As an example, Oklahoma RIS Sector eight (food processing) generates 9.48 thousands of pounds a year per employee (kpye) of solid waste material for disposal. Residential solid waste material has been estimated on a basis of average waste material per employee of the resident work force. No waste coefficients were estimated for agriculture and mining since the type of disposal service required for these sectors is sufficiently different from the other sectors to warrant separate study. An estimated total of 787,063 thousand pounds of solid waste material was generated in Planning Region Nine for disposal in 1970.

For planning future waste disposal requirements a set of direct and indirect solid waste coefficients were computed. Direct and indirect interdependence employment coefficients from the from-to analysis were multiplied by the solid waste coefficients to arrive at the total disposal coefficients in the last column of Table 9. As an example of the interpretation of the total (direct and indirect) solid waste coefficients, Oklahoma RIS Sector eight shows that for each man year of employment used in deliveries to final demand a total of 14.672 thousand pounds of solid waste is generated in the producing sectors of the region and must be disposed. Residential waste generated may also be estimated by multiplying the employment multiplier for sector eight by the household solid waste coefficient. Hence, for each man year employed in food processing for delivery to final demand markets, a total of approximately 10.5 tons of solid waste is generated for disposal. By relating solid waste coefficients to direct and indirect employment requirements, specific industry and location factors for solid waste generation are identified for the planning region.

The Oklahoma Experience in Estimating RIS

A primary objective in selecting the appropriate methods for estimating RIS was that of keeping costs within budget constraints of multi-county planning groups. The development of RIS for Planning Region Nine has extended only through the estimation of the interdependent, intercounty economic base. It may, however, serve a purpose to estimate the quantity and type of research staff resources used to date in the estimating procedures. Adding additional information segments to RIS will depend on the type of problems requiring attention in the planning region.

Various information sources were used in compiling the population of business firms in the planning region including yellow pages of telephone directories, the Oklahoma Directory of Manufacturers and various other registers. Sampling rules were used to determine sample size for mail-out questionnaires

TABLE 9: Estimation of the Total Demand for Solid Waste Disposal and Related Information, Oklahoma Planning Region Nine, 1970

Okla. RIS Code	SIC Code	Solid Waste[a] Coefficient Kpye	Employment 1970	Waste in Thousands of Pounds per Year	Direct and Indirect Solid Waste Disposal Coefficients in Kpye
(1)	01, 08, 09	---	11370	---	1.771
(2)	07, 505, 596	7.620	1228	9357	12.848
(3)	10-14	---	2280	---	2.604
(4)	15-17	82.504	2589	213603	89.651
(5)	40-47	7.620	1772	13503	8.487
(6)	60-67	7.620	3194	24338	8.921
(7)	48-49	7.620	1557	11864	9.941
(8)	20-21	9.479	931	8825	14.672
(9)	22-23	1.348	1591	2145	2.149
(10)	24-26	26.459	227	6006	26.902
(11)	27	16.500	517	8531	17.148
(12)	28-29	19.394[b]	664	12878	26.098
(13)	30-31	15.006	82	1230	16.772
(14)	32	5.280	471	2487	5.864
(15)	33-39	2.937	3936	11560	3.625
(16)	52 except 5252	7.620	558	4252	11.837
(17)	53	7.620	1747	13312	9.373
(18)	54	35.700	1592	56834	42.172
(19)	5541	7.620	800	6096	15.703
(20)	55 except 5541	7.620	1333	10157	10.291
(21)	56	7.620	767	5845	8.934
(22)	57	7.620	567	4321	11.559
(23)	58	7.620	2620	19964	9.249
(24)	59 except 596	7.620	1218	9281	9.084
(25)	70	7.620	527	4016	11.240
(26)	72	7.620	1786	13609	8.277
(27)	73	7.620	1248	9510	8.462
(28)	81, 82, 86, 89	7.620	2064	15728	8.126
(29)	75	7.620	461	3513	10.197
(30)	78, 79, 84	7.620	338	2576	9.486
(31)	76	7.620	286	2179	10.149
(32)	80	7.620	2342	17846	9.368
(33)	50 except 505	7.620	2032	15484	7.620
	Government[c]	7.620	10849	82669	
	Households	2.089[e]	69188	144534	
	Off base Military[d]	2.089	9100	19010	
	Total			787063	

[a]Data adapted from [2] and [26].
[b]Refining wastes excluded.
[c]Excludes Federal Civilian employees at Fort Sill.
[d]Military personnel with off base residence.
[e]Average residential waste per employee of the labor force.

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assuming response rates by sector from the New York study [11].[8]

Table 10 attempts to recall estimates of man months spent on constructing the interbusiness type economic base model for Planning Region Nine. In one respect it is a liberal estimate since considerable wheel-spinning took place as a first attempt by the present research staff. Familiarity with the technique and procedures should reduce the allotted time for repeated studies.

Summary and Conclusions

Before planning of community services can be brought about, information systems need to be estimated which relate the changing economic base to jobs, population, and community service requirements not only in the framework of regional industry sectors, but also in intraregional locations.

Part of the problem in establishing appropriate information systems for rural regions is one of cost. Most metropolitan areas have planning staffs available to perform economic base studies and some have elaborate information systems including industry interdependence models. Most rural planning regions in Oklahoma have neither the planning staff nor the budget to estimate and maintain information systems with interdependence models of the traditional input-output type. The present study uses mail questionnaire and personal interview data to estimate a from-to interdependence model. The model is then related to planning of solid waste disposal services for an eight county planning region in South Central Oklahoma.

The information system thus far developed for Planning Region Nine in Oklahoma should still be considered a research tool at this time. Considerable interchange needs to take place with planning groups to determine feasibility of implementation. But, at least it is a start in designing research techniques with application to direct problem solving in regional planning.

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[8]Francis McCamely developed the sampling rules. A research bulletin is in process which presents estimates of variances of multipliers derived from sample data.

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TABLE 10: Estimates of Man Months Required to Construct a Regional Interbusiness Economic Base Model[a]

Job	Staff	Time Estimate (months)
Compilation of population	Research Staff[b]	1.0
Keypunch population	Clerical	3.0
SIC coding, programming, and sample selections	Research Staff	2.0
Community contacts	Research Staff	1.0
Mail out	Clerical	0.5
Personal interviews	Research Staff: Graduate Assistants	5.0
Editing questionnaires	Research Staff: Graduate Assistants	3.0
Tabulation and aggregation	Clerical	2.5
Total		18.0

[a]Does not include research staff time for analysis and presentation of results.

[b]Research staff includes personnel from the Agricultural Experiment Station, Cooperative Extension and Graduate Students.

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