ESTIMATING INTERCOUNTY EMPLOYMENT LINKAGES IN A MULTI–COUNTY DEVELOPMENT DISTRICT*

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Association of costs and benefits from rural development is becoming more important as we become more knowledgeable about the actual processes of economic growth. Measuring the geographic distribution or multiple-level benefits is hypothesized as being important for the purpose of creating incentives for further development and growth. This may be necessary, in part, because certain jurisdictional groups are unaware of the benefits and hence do not show initiative in investing (i.e., bearing the costs) in rural development.

An example may be used to clarify this point. A local community is considering subsidizing the location of a private industrial firm. Negotiations have reached a point where the subsidy cost is greater than the breakeven point for local community benefits.[1] However, because of hierarchical[2] trading patterns or labor commuting patterns, a nearby community or the larger development authority of an Economic Development District stands to gain additional benefits from the location of the industrial plant. If the neighboring community or the larger authority bears part of the subsidy cost, the local community may be able to stay above the breakeven point and invite the firm to locate.

A major problem has been that of developing methodology and estimation procedures to measure intercommunity economic linkages and hence establish a basis for determining the distribution of benefits from rural development programs. The same procedures may also serve to assess cost penalties associated with certain development programs or to plan the provision of area wide public services.

The objectives of this paper are to (1) delineate some of the intercommunity linkages in an economic accounting model, (2) describe a procedure for their estimation, and (3) analyze the results of estimated intercounty employment linkages for a multi-county planning region in South Central Oklahoma.

A RURAL DEVELOPMENT ACCOUNTING MODEL

People frequently reside in one community but commute to jobs in another community. Trading patterns of households tend to follow a hierarchical system of trade centers which are distinguished by differences in availability of goods and services. Production firms may also follow a hierarchical system of trade centers for purchases of some inputs. Local government financing of community services is usually determined by political jurisdictions and referendums rather than locational demand for the services.

Allocation of benefits and costs of economic development programs is greatly facilitated through economic accounting models that capture in-and-out commuting of labor, consumer trading patterns, and local government financing procedures. A two community accounting model is specified here that is similar to the interregional input-output model. The following equations are specified:

[1] For methods of computing rates of return on subsidies see Moes [3] or for determining breakeven points see Shaffer and Tweeten [5]. Shaffer and Tweeten compute a net community gain for the location of a plant as the difference in annual total benefits and annual total costs for the sum of the private, municipal government, and school district sectors. Secondary benefits and costs for each sector due to plant location are included. The breakeven subsidy is equal to community net gains.

[2] Hierarchical refers to an ordering of trade centers, usually according to the number of different public and private services available at any center. A higher order trade center offers more services than a lower order trade center.

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$$
(1)\quad
\begin{aligned}
X^1 &= A^{11}X^1 + A^{12}X^2 + D^{11}C^1 + D^{12}C^2 && + Y^{1x}\\
X^2 &= A^{21}X^1 \quad A^{22}X^2 \quad D^{21}C^1 \quad D^{22}C^2 && + Y^{2x}\\
C^1 &= + H^1L^1 && + C^{1c}\\
C^2 &= + H^2L^2 && + C^{2c}\\
L^1 &= P^1S^{11}X^1 + P^2S^{12}X^2 && + L^{1f}\\
L^2 &= P^1X^{21}X^1 + P^2S^{22}X^2 && + L^{2f}
\end{aligned}
$$

where the following variables and coefficients are defined:

X^r = total output of all firms and businesses located in the rth region (transaction dollars),[3]

C^r = consumption in the rth region of those goods and services produced only in region one or two (dollars),

L^r = total labor force residing in the rth region (number),

A^{rt} = technical production coefficients indicating the amount of output coming from the rth region and used in the tth region,[4]

D^{rt} = consumption coefficients showing the proportion of C^t coming from the rth region,

P^r = employment-output ratio in the rth region,[5]

H^r = local (two community) consumption to labor force ratio in the rth region,[6]

S^{rt} = proportion of the labor force of firms located in the rth region and residing in the tth region. For $r \neq t$, the corresponding coefficients refer to in-commuting for columns and out-commuting for rows,

Y^{rx} = delivery of output of the producing firms to final markets of exports, federal government, and capital formation in the production sectors (dollars),

C^{rc} = consumption in the rth region by institutional, retired, and other persons not associated with the labor force (dollars),

L^{rf} = federal employment plus unemployed persons in the labor force (number).

The set of simultaneous equations in (1) may be expressed in terms of the exogenous factors of regional final demand, institutional consumption, and federal and unemployed labor force. The solution of system (1) may be expressed as the following:

$$
(2)\quad
\begin{aligned}
X^1 &= B^{xx}_{11}Y^{1x} + B^{xx}_{12}Y^{2x} + B^{xc}_{11}\ C^{1c} + B^{xc}_{12}\ C^{2c} + B^{xf}_{11}L^{1f} + B^{xf}_{12}L^{2f}\\
X^2 &= B^{xx}_{21}Y^{1x} + B^{xx}_{22}Y^{2x} + B^{xc}_{21}\ C^{1c} + B^{xc}_{22}\ C^{2c} + B^{xf}_{21}L^{1f} + B^{xf}_{22}L^{2f}\\
C^1 &= B^{cx}_{11}Y^{1x} + B^{cx}_{12}Y^{2x} + B^{cc}_{11}\ C^{1c} + B^{cc}_{12}\ C^{2c} + B^{cf}_{11}L^{1f} + B^{cf}_{12}L^{2f}\\
C^2 &= B^{cx}_{21}Y^{1x} + B^{cx}_{22}Y^{2x} + B^{cc}_{21}\ C^{1c} + B^{cc}_{22}\ C^{2c} + B^{cf}_{21}L^{1f} + B^{cf}_{22}L^{2f}\\
L^1 &= B^{1x}_{11}Y^{1x} + B^{1x}_{12}Y^{2x} + B^{1c}_{11}\ C^{1c} + B^{1c}_{12}\ C^{2c} + B^{1f}_{11}L^{1f} + B^{1f}_{12}L^{2f}\\
L^2 &= B^{1x}_{21}Y^{1f} + B^{1x}_{22}Y^{2x} + B^{1c}_{21}\ C^{1c} + B^{1c}_{22}\ C^{2c} + B^{1f}_{21}L^{1f} + B^{1f}_{22}L^{2f}
\end{aligned}
$$

[3] Application of the model in a later section is limited to employment linkages. However, the accounting model here is expressed in the more general input-output terms of dollar transactions.

[4] If output is defined for a set of industries, the A^{rt} becomes matrices representing regional and interregional interindustry coefficients.

[5] When output is measured by persons employed, the P^r ratios are equal to one.

[6] When output of the producing firms is measured by the number of persons employed, the assumption of a fixed ratio between employment in the local consumer market to total employment is similar to the assumptions usually found in economic base studies [6].

The general interpretaion of any B_{ij} is that it represents the total (direct and indirect) change in the variable to the left of the equality per unit change in the exogenous variable or that variable represented by a column. When a change in any exogenous variable is expressed in units of persons employed to serve that market, the B_{ij}'s in the L^1 and L^2 equations represent employment multipliers.[7] As an example, B_{11}^{1x} is an employment multiplier in region one for deliveries to the final demand markets of exports, federal government, and capital formation in region one. Similarly, B_{21}^{1x} is the employment multiplier in region two for deliveries to final demand markets in region one.

B_{11}^{1f} is the employment multiplier in region one for each additional person added to federal employment in region one, whereas B_{21}^{1f} is the employment multiplier in region two for the same addition in federal employment in region one.

The assumptions of the model include those of fixed input-output and consumption coefficients, constant trading patterns and constant labor commuting routes. For short-run planning purposes, the assumptions of fixed production and consumption coefficients are fairly realistic for a fully employed regional economy. The problem exists that many rural regions exhibit underutilization of resources. To the extent that this occurs, the assumption of fixed coefficients for additions to output is invalidated. Trading patterns change relatively slowly and are highly dependent upon the rate of growth or decline of a region. Labor commuting routes will depend upon preferred residential patterns, size of region, and supply of labor. Changes in commuting routes can easily be incorporated for output expansions in specific regions.

ESTIMATING EMPLOYMENT LINKAGES

Primary data were collected by means of mail and personal interview questionnaires from a sample of firms and businesses in South Central Oklahoma.[8] The questionnaire[9] was designed in a manner to distribute individual firm gross receipts on a percentage basis to other businesses and final market sources.[10] Business firms, especially in rural areas, are very cognizant of who their customers are. Rough estimates of the distribution of gross receipts by market source are easily ascertained. The question asked is, "Who are your customers, and what percent of your total gross receipts does each account for?"

Firms were then aggregated using employment as weights. Gross receipts is a better weighting device but it was felt that firms are more willing to divulge information on number of persons employed. Weighted questionnaire data were then applied to county employment control totals to give an employment transaction flow table. Other variables could be used, such as value added, if the distribution of gross receipts adequately reflects the distribution of the variable of interest. Because of availability, county employment data were initially applied.

Firms in South Central Oklahoma, in addition to being asked who their customers are (industry and final market distribution), were also asked where their customers came from (intercounty business patterns). In order to construct a complete interregional employment transaction flow table, it was necessary to assume that the distribution of the types of customers a business firm has is the same whether sales are within the county or in other counties within the planning region.

Corrections in the accounting model for net commuting effects were not made at this time. Hence the in and out-commuting coefficients were assumed zero. For a new plant to be added in any one of the counties with a known commuting pattern for its labor force, a comparative static analysis for the region can be performed on the basis of before and after plant location where the in-commuting coefficients are included for the latter case. Local government purchases and direct local government employment were allocated to the consumption vectors in the accounting model. Lack of information on the distribution of government services prevents any further allocation.

INTERCOUNTY DEPENDENCE RESULTS

Table 1 contains the intercounty multipliers for additions in employment to the final markets of regional exports, federal government and capital formation. Viewing the column coefficients for Caddo County, if employment serving the export

[7] This assumes full employment of the labor force or that the additions in employment can not come from the presently unemployed pool.

[8] The study area includes the eight counties of Caddo, Grady, McClain, Comanche, Stephens, Tillman, Cotton, and Jefferson. It corresponds to Planning Region Nine in the state delineation of multi-county planning regions.

[9] The questionnaire was patterned after those of Kalter [2] and Tiebout [6].

[10] An expanded version of the model is contained in Schreiner and Muncrief [4] where thirty-three business sectors were defined and five final markets.

base for that county increases by 100 jobs, total employment in Caddo County is expected to increase by 198 jobs. In addition, employment in Grady County is expected to increase by 14 jobs due to trading relationships directly and indirectly with Caddo County.

Similarly, employment in Comanche County will increase directly and indirectly by 9 jobs and in Stephens County by 3 jobs. The employment multiplier for the total planning region equals 2.25 of which 88 percent (1.98/2.25) of the employment benefits accrue within the county where the increase in export activity employment occurred and 12 percent of the benefits accrue in other counties of the region.

By looking at each row of coefficients it is possible to identify the importance of certain trade centers and to measure the impact a change in the export activity within the trading region has on the center. Figure 1 identifies the two sub-regional trade centers of Chickasha in Grady County and Duncan in Stephens County. It also identifies the regional trade center of Lawton in Comanche County. As an example, employment in Duncan is expected to increase (decrease) by 55 for an increase (decrease) of 100 in the export base of Jefferson County, by 21 for a comparable increase (decrease) in Cotton County, by 5 for Comanche County, by 6 for Grady County, and by 13 for McClain County.

Federal civilian employment totaled 6,396 for Planning Region Nine in 1970 with a major proportion associated with Fort Sill in Lawton. Table 2 shows the employment multipliers associated with federally employed persons. The regional employment multiplier for federal employees located in Comanche County is estimated at 1.69 with about 96 percent of the employment benefits accruing in Comanche County itself. These results indicate that almost the total employment benefit in Planning Region Nine accruing from Fort Sill occurs within Comanche County.

Table 1.– EMPLOYMENT MULTIPLIERS BY COUNTY FOR CHANGES IN FINAL MARKETS OF REGIONAL EXPORTS, FEDERAL GOVERNMENT AND CAPITAL FORMATION, SOUTH CENTRAL OKLAHOMA, 1970[a]

County	Caddo	Grady	McClain	Comanche	Stephens	Tillman	Cotton	Jefferson
Caddo	1.98	0.12	0.11	0.03	0.02	0.04	0.10	0.13
Grady	0.14	2.49	0.16	0.02	0.03	---	0.04	0.03
McClain	0.02	0.02	2.82	---	---	---	---	---
Comanche	0.09	0.05	0.01	1.95	0.06	0.07	0.18	0.11
Stephens	0.03	0.06	0.13	0.05	2.13	0.02	0.21	0.55
Tillman	---	---	---	0.01	---	2.49	0.22	0.08
Cotton	---	---	---	0.01	0.02	0.02	2.01	0.06
Jefferson	---	---	---	---	0.02	---	0.04	2.64
Total[b]	2.25	2.75	3.24	2.07	2.29	2.65	2.81	3.61

[a]Each coefficient represents the change in total number of persons employed in the county to the left for each additional person employed in producing final market output within industries located in the county at the top.

[b]Total direct, indirect and induced employment multiplier for Planning Region Nine.

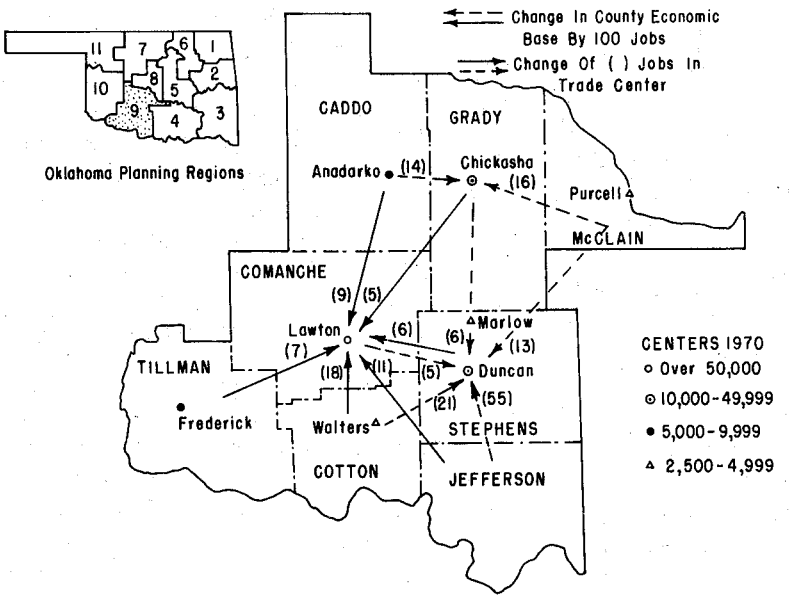

FIGURE 1. INTERCOUNTY EMPLOYMENT DEPENDENCE FROM A CHANGE IN EXPORT BASE EMPLOYMENT

Table 2. – EMPLOYMENT MULTIPLIERS BY COUNTY FOR CHANGES IN FEDERAL EMPLOYMENT, SOUTH CENTRAL OKLAHOMA, 1970[a]

County	Caddo	Grady	McClain	Comanche	Stephens	Tillman	Cotton	Jefferson
Caddo	1.58	0.08	0.07	0.02	0.01	0.02	0.05	0.08
Grady	0.08	2.02	0.11	0.01	0.02	---	0.02	0.02
McClain	0.01	0.02	2.33	---	---	---	---	---
Comanche	0.05	0.03	0.01	1.62	0.03	0.04	0.10	0.07
Stephens	0.02	0.04	0.09	0.03	1.74	0.01	0.12	0.35
Tillman	---	---	---	---	---	2.01	0.13	0.05
Cotton	---	---	---	---	0.01	0.01	1.59	0.04
Jefferson	---	---	---	---	0.01	---	0.03	2.10
Total[b]	1.74	2.18	2.60	1.69	1.84	2.10	2.05	2.71

[a]Each coefficient represents the change in total number of persons employed in the county to the left for each additional federally employed person in the county at the top. Diagonal coefficients include the additional federal employee.

[b]Total employment multiplier for Planning Region Nine.

EVALUATION OF RESULTS

The multipliers in Tables 1 and 2 represent static conditions and full capacity use of all resources. If local economies in rural areas tend to have excess capacity in some of the service sectors, the multipliers will overinflate expected secondary employment benefits generated from the additions to employment in those sectors serving the export base. In a similar manner, if labor productivity increases such as through larger class sizes in local schools (perhaps through school consolidations), size of the multipliers will also be biased upwards. On the other hand, as the economic base of a region expands and certain major trade centers in the region grow in population, internal markets become sufficiently large to substitute domestic production for previous imports. This tendency causes a downward bias in estimation of secondary employment benefits.

For long-run planning purposes more dynamic models can be constructed to recognize changes in relative labor productivities, capacity utilization rates, or other changes that more fully reflect growth or decline in regional economies [1].

The model as applied in this paper concentrates only on the regional employment variable. One of the objectives of the paper was to quantify intercommunity linkages. This has been done with questionnaire data and readily available employment control data. Intercommunity linkages as represented through wage and salary income payments or through supplying and financing local public services are further applications to give additional insights into the processes of promoting rural growth and development. Because of differences in sector wage and salary payments, different conclusions may be drawn when using an income variable to measure effects of intercommunity linkages.

SUMMARY AND CONCLUSIONS

A tendency exists for communities to feel that unless new firms locate in their community rather than a neighboring town no benefits will accrue to them. This may be true if the community is not a higher order trade center or if the firm does not provide jobs to their labor force. It may also be true if more of the costs of community services are passed on to them due to the plant location than they receive in community benefits. An economic accounting model was constructed and estimated for a South Central Oklahoma planning region. The model estimated county and intercounty employment multipliers based only on trade relationships. For several counties, expansion or decline of the economic base significantly affects the employment benefits in other counties.

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