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CONSTRUCTING A SOCIAL ACCOUNTING MATRIX TO ADDRESS DISTRIBUTIVE ECONOMIC IMPACTS OF FOREST MANAGEMENT

David W. Marcouiller, Dean F. Schreiner, and David K. Lewis*

Introduction

Importance of Distributive Economic Impacts

A major regional shift is underway in the source of U.S. timber supply. This is due primarily to highly productive lands in the south and to restrictions in western public supply. Haynes and Adams (1992) report that the southern region of the United States will expand as a major source of domestic timber supplies throughout the next century. Alig and Wear (1992) conclude that the South will experience large increases in timber production, particularly on privately owned lands. Market price and favorable government policies toward long-term investments will provide the motivation for increased timber production on private southern timberlands.

How will these changes in the rural South impact regional economic development? Do all income groups benefit from intensive timber production, or are the main beneficiaries only the timber resource owners? What economic groups are the principal gainers from forest product industry development? Are there significant financial outflows from forest industry regions? Answers to these questions are needed for objective public policy formation.

Natural resource policy analysis is hampered by a lack of working tools to determine impacts on income distribution from alternative resource allocation decisions (Rose, Stevens, and Davis, 1988). Aggregate measures of benefit-cost analysis provide economic efficiency criteria. These measures, however, generally fail to address distributive criteria important for decision-making by land managers, policy makers, interest groups, and private enterprise. Distributive economic impact analysis is an increasingly important component of forest management decision-making.

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* Respectively, the authors are Assistant Professor, Department of Urban and Regional Planning, University of Wisconsin—Madison; Professor, Department of Agricultural Economics, Oklahoma State University; and Associate Professor, Department of Forestry; Oklahoma State University. The authors extend appreciation to Michael Woods, Gerald Doeksen, Michael Wiseman, Steve Deller, and the reviewers of *Regional Science Perspectives* for comments with the caveat that any remaining errors are the responsibility of the authors.

The distribution of returns resulting from timber production is dependent upon the ownership of resources as well as linkages within the regional economy. These resources include land, labor, capital, and management. Differences exist between industrial and nonindustrial private ownership of timber resources and economic integration within a region. For example, returns to resources used in timber production from nonindustrial private forest lands generally are more regionally integrated compared to industrial private forest lands.

Objective of This Paper

The objective of this paper is to outline the construction of a social accounting matrix (SAM) that allows assessment of distributional impacts brought by changes in natural resource productivities. The paper is organized into three broad categories:

- Justification and presentation of the SAM framework;
- Data sources used in construction; and
- General uses of a SAM.

The emphasis in this paper is the empirical estimation procedures used in constructing a regional SAM focused on forest management. Assessment of how natural resource productivities impact income distributions (analysis using the estimated SAM) is available in other studies (Marcouiller, Schreiner, and Lewis, 1993b and 1993c).

Previous Studies

Social accounting analysis provides a framework that fully accounts for the flow of production to factor income, institutional income, commodity demand, and savings to further production and investment. The SAM generally is expressed in value terms with row accounts mapping sources of revenue (receipts) and column accounts specifying expenditures (outflows). Each individual account describes a different portion of the economic structure. Initial work on social accounts focused at the national level (Pyatt and Round, 1985). Applications, however, have extended to regions, villages, and producer groups. Rose, Stevens, and Davis (1988) develop data and procedures to analyze distributive effects of natural resource policy using social accounting methods for subnational regions. Their analysis, however, does not assess distributive impacts resulting from changes in timber resource productivity.

The USDA, Forest Service is interested in how the management of forest resources impacts regional economies. Since the late 1970s the Forest Service's input-output model generator known as IMPLAN (Impact Analysis for Planning) has aided in this endeavor. Primarily developed to generate impact analysis to county resolution for 528 sectors, the IMPLAN system has significant potential for assessing

regional economies. Its current database and software[1] is for the base year 1991. Operational aspects of IMPLAN are found in the current technical software manual (Minnesota IMPLAN Group, 1992).

The IMPLAN system incorporated a SAM in an earlier (1982) database (Alward, 1985). This IMPLAN SAM, however, has inconsistencies[2] and does not allow the user to disaggregate the production sector or specify an institutional disaggregation that is critical to addressing the previously discussed questions of distributive impacts.

The IMPLAN system provides a foundation for generating components of a SAM. These components include interindustry transactions, vectors of final demand, and value added for a regional sector aggregation. The completion of a SAM requires specific estimated values that fully describe the distribution of factor payments among regional institutions. It is this full description of the regional economy that provides answers to questions of distributional economic impacts.

Specification of a Timber Production SAM

Specification of a SAM is determined by the problem being addressed.[3] The SAM developed in this paper was based upon the schematic of Figure 1. The flow designation follows the accounting convention of rows showing regional receipts and columns showing regional expenditures.

The factor account specifies resource inputs of land, labor, and capital. Those sectors comprised by the forestry complex (from growing trees through wood processing) are of primary institutional importance. Institutions are disaggregated by forestry complex and nonforestry complex. The forestry complex is further disaggregated into timber production and timber processing. Timber production is disaggregated further into three different land ownership classes: nonindustrial private forest (NIPF) owners, industrial private forest (IPF) owners, and public forest owners.

Income flows through this regional accounting structure in a systematic manner. The SAM is set up to identify how different household income levels accrue income. The operative unit of analysis is the household. Household income is derived from institutions and transfers.

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[1] The current version of IMPLAN is MI 91-F with a regional 1991 database. It is available from the Minnesota IMPLAN Group, 1940 Greeley Street, Stillwater, MN 55082.

[2] An IMPLAN SAM was run for the 1982 McCurtain County, Oklahoma region which resulted in unequal row - column totals for inventory and capital accumulation. Balance between rows and columns is an important SAM characteristic.

[3] A rudimentary understanding of social accounting matrices is found in Taylor (1990; Chapter 1).

Institutional income is derived from factors of production and transfers. Factor income is generated from productive activities. In this manner, income flows through the region and ends in households.

Constructing the SAM

Empirical estimation of a SAM for a region in which forest management and wood processing play significant economic roles illustrate a SAM's usefulness in addressing the distributional issues of timber production. McCurtain County, in southeastern Oklahoma, is predominantly rural and forested. Roughly one-fourth of its industrial output is tied directly to the forestry complex.[4] McCurtain County is an example of the current economic structure in the rural south and indicative of structure throughout the rural Gulf-Coastal Plains region of east Texas, Louisiana, southern Arkansas, Mississippi, and Alabama. McCurtain County, Oklahoma is, arguably, a good example of the timber-producing regions of the southern United States. What is true about the connection between timber production and income in McCurtain County is likely to be true elsewhere. In any event, the technique of empirically estimating the SAM presented in this paper can be replicated for other regions of the United States.

Developing a Hybrid IMPLAN Model

IMPLAN is used to develop the interindustry transactions matrix, vectors of final demand, and components of value added. The 1985[5] IMPLAN database is edited to reflect timber production in McCurtain County, Oklahoma more accurately. Development of a hybrid model uses standard conventions as outlined in the Micro-IMPLAN Users Manual (Minnesota IMPLAN Group, 1992; section 4). This hybrid model is constructed using unaggregated sectors according to IMPLAN industries established in the manual (Minnesota IMPLAN Group, 1992, Appendix N). Regional purchase coefficients are adjusted according to defined standards (Engineering-Economics Associates, 1985a, 1985b, 1985c, 1985d; Minnesota IMPLAN Group, 1992).

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[4] The forestry complex comprises timber production and primary and secondary wood processing. Data can be referenced by the author's model MCCURT1, built using IMPLAN version MI 91-09.

[5] Version 91-F and the 1990 database were released in January 1993. This paper uses version 91-09 and the 1985 data because the more recent version was unavailable at the time of analysis. IMPLAN procedures, however, are fundamentally the same between the two versions.

Adjustment of Timber Production Sector Value Added

Values for timber production output (particularly industrial timber production) often are included with nontimber production sectors in which industrial firms are vertically integrated. An example is a forest products firm engaged in the production of lumber, paper, or plywood relying upon its own forest land for raw material supplies. Employment and output values found in higher levels of vertical integration (manufacturing sectors) typically account for employment and output of lower levels (timber production). Timber production sector value added is adjusted using the Southern Forest Inventory and Analysis database (USDA Forest Service, 1992a) using standard procedures (USDA Forest Service, 1992b). McCurtain County volumes for hardwood and softwood removals for 1985 are provided in Table 1.

Value of the timber production is calculated using reported prices for southeastern Oklahoma (Region 1, Oklahoma) found in Timber-Mart South (Norris, 1985). Table 2 contains estimated values of timber stumpage for 1985 by ownership and type of product. These values are totaled for industry output of timber production.[6]

Industrial sectors are aggregated to focus on the specific problem. The hybrid model is allowed to generate components of regional receipts and expenditures. Total regional commodity demand is calculated as the row sum of interindustry transactions, personal consumption expenditures, government expenditures, capital formation, and commodity exports. Total regional production sector expenditures is calculated as the column sum of interindustry transactions, factor payments, indirect business taxes, and imported inputs.

Establishing Factor Shares

Components of the regional SAM include two primary submatrices (referred to as the *institutional income distribution matrix* and the *household income distribution matrix*) and numerous secondary submatrices. Prior to constructing these submatrices, however, factor income totals derived from IMPLAN are reordered to reflect factor shares for resources of land, labor, and capital.

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[6] The hybrid IMPLAN model was created to account more closely for timber production output. Annual stumpage value of removals is used as a measure of timber production output and represents total gross receipts to landowners. Interindustry inputs and components of value added for timber production are estimated using national coefficients. Value of timber output assumes vertical integration and is shifted from the wood processing sector to the timber production sector, and appropriate adjustments are made for intermediate inputs and value added (total combined value added and total combined industrial output of the wood processing and timber production sectors remain constant) using standard procedures within the interactive capabilities of IMPLAN (pp. 4-17-4-26).

Factor Income Distribution

IMPLAN classifies value added following the standard national income accounting framework. This limits the applicability of results and does not allow identification of factor payments by resource use. IMPLAN classifies value added by four primary components:

- Employee compensation;
- Proprietary income;
- Other property income; and
- Indirect business taxes.

These, in aggregate, equal total factor returns plus indirect business taxes. This classification does not distinguish returns to the factor inputs of land, labor, and capital. For example, the IMPLAN category employee compensation uses *County Business Patterns* and other data sources to identify wages paid to individuals. This category does not include returns to entrepreneurial (or self-employed) labor. Entrepreneurial labor is captured in the IMPLAN category of proprietary income which includes capital rents and profits. Information from other studies and databases are used to supplement IMPLAN data to allow a reclassification of factor income.

Timber Production Factor Shares

Timber production factor shares are calculated (Marcouiller, Lewis, and Schreiner, 1993a) using a proportion of land value as land rent, returns to labor using USDL wage and employment data, and a proportion of residual growing stock liquidation value as a proxy for capital rent. This procedure is used to calculate timber production factor shares which equal 0.419 for land, 0.341 for labor, and 0.240 for capital across all land ownership categories.

Factor Shares for Other Industries

Agriculture factor shares for McCurtain County are assumed similar to the other crops category in Robinson, Kilkenny, and Hanson (1991). These factor shares are 0.427 for land, 0.323 for labor, and 0.251 for capital.

Factor shares for manufacturing, food/fiber processing, timber and wood processing, and services and government are adapted from the original IMPLAN value-added categories. Labor returns initially are calculated following the procedure outlined in Koh (1991, pp. 84-87). Namely, employee compensation and proprietary income are added together to form labor returns. Other property income is used as a proxy for returns to capital. Koh's procedure is modified for two reasons. First, his method appears to overestimate returns to labor and underestimate returns to capital because proprietary income is defined as income from

self employment including some proportion to labor and some proportion to capital. Koh (1991, p. 87), however, deals with the State of Oklahoma and notes that proprietary income accounts for less than 5 percent of total value added. In McCurtain County, proprietary income of these sectors accounts for 11.1 percent of total value added and 21.1 percent of total employee compensation. More importantly, proprietary income of these sectors is 41.7 percent of total other property income. Allocating all proprietary income to labor overestimates labor returns and underestimates capital returns.

The proportion of proprietary income accruing to labor and capital is derived by balancing the household income distribution matrix control totals which were based upon data from the personal income by major source (Bureau of Economic Analysis, 1992) for McCurtain County, Oklahoma during 1985. For this analysis, 6.4 percent of proprietary income accrues to labor and 93.6 percent accrues to capital for all sectors except agriculture and timber production.

Using these procedures, returns to factors of production for each production sector are calculated based upon value-added control totals net of indirect business taxes generated from IMPLAN.

Disaggregating Labor Returns

Labor is disaggregated further to assess impacts accruing to various labor skill levels. This is important between production sectors such as timber production and wood processing where technological substitution in labor inputs by skill level occurs. Disaggregation of labor into skill categories by sector for the United States is completed following Rose, Stevens, and Davis (1988). Labor categories and occupations included within each category for this study follow their classifications.

Institutions

The ability to focus on distributional impacts of timber production is related directly to how regional income is associated with regional institutions. Institutions in this SAM are categorized into forestry and nonforestry complex activities. Forestry complex activities are disaggregated into four categories. These include timber production activities corresponding to land ownership classes:

- Nonindustrial private forest (NIPF);
- Industrial private forest (IPF); and
- Public forest

and a single nontimber management forestry activity category of:

- Timber and wood processing which includes logging, log transport, primary wood-based manufacturing, and secondary wood-based manufacturing.

Nonforestry complex activities are disaggregated into two categories:

- Agricultural production; and
- Nonagricultural/nonforestry activities (including all other manufacturing and service and government enterprises).

Similar to the production sectors, this scheme accounts for all economic activities within the region.

Institutional Income Distribution

The institutional income distribution matrix reflects factor expenditures for firm-level production activities. This matrix is similar to the matrix of value added in many respects. The exception is that it is net of both indirect business taxes as well as factor taxes such as Social Security.

Institutional Factor Shares

The same hybrid IMPLAN model (MCCURT1) is used to produce a control total for each institutional account. Total returns to factors of production are allocated to land, labor, and capital following the same procedures as discussed above with the exception that factor shares are identified by institution instead of by production sector. Factor shares for timber production forestry complex institutions are determined based upon the extent of ownership within McCurtain County as identified in the McCurtain County forest inventory.

Factor share analysis for these timber production forestry complex institutions are thought of as implying a representative enterprise budget for current timber management intensities in 1985. Generalizations regarding these timber management enterprise budgets are made from the McCurtain County forest inventory (USDA Forest Service, 1992). Industrial private forest (IPF) timber production is typified by short (30 years) rotation even-aged loblolly pine management with at least one intermediate commercial thinning. Active timber management is evident in the McCurtain County forest inventory for IPF lands. Nonindustrial private forest (NIPF) management is typified by a less intensive management regime which includes a combination of even and uneven-aged management of both hardwoods and softwoods. Little active timber management is evident in the forest inventory for NIPF lands. Public timber management occurs in a mixture of intensities, with emphasis on multiple use concepts incorporating other resources such as recreation, water, and wildlife management.

Annual institutional income from timber production is categorized with respect to each factor input. The timber production factor shares estimation technique (Marcouiller, Lewis, and Schreiner, 1993) is applied to forest land ownerships. Factor shares for nonindustrial pri-

vate forest landowners are 0.407 for land, 0.290 for labor, and 0.302 for capital. Factor shares for industrial private forest landowners are 0.494 for land, 0.327 for labor, and 0.180 for capital. Factor shares for public forests are - 0.210 for land, 1.218 for labor, and -0.008 for capital.

Factor Taxes

A portion of income from factor inputs accrues to government sectors as direct taxes. Taxes can be accounted for in the factor account or in the institution account. Accounting for taxes in the factor account allows identification of net returns to factors of production. Factor taxes include Social Security payments, taxes specific to capital returns, and land taxes. Factor taxes exclude indirect taxes that are found elsewhere in the SAM. This convention agrees with reporting procedures and use of personal income data from the BEA (1992) which excludes personal contributions for Social Security from personal income.

Personal contributions for Social Security specific to McCurtain County are obtained from BEA data files (1992). In this data file, personal contributions are 6.3 percent of total earnings by place of work. Under the assumption that employer contributions match personal contributions, a rate of 12.6 percent is applied to total returns to labor found in the institutional income matrix. The procedure used in deriving this rate is the same as the procedure used by Koh (1991; pp. 89-91) and matches closely with the 14.1 percent Social Security tax rate used in the national USDA ERS study by Robinson, Kilkenny, and Hanson (1991; p. 67).

A tax rate specific to factor returns to capital in Oklahoma is calculated based upon the Koh (1991) study and equals 14.25 percent. This rate, taken as a proportion of factor capital tax to total institutional capital, is calculated from Koh's SAM (1991, p. 104). This compares favorably to the USDA ERS summed enterprise tax rate and enterprise savings rate of 13.3 percent (Robinson, Kilkenny, and Hanson, 1991, p. 67)

All land is taxed at a rate of 15.98 percent in the Koh (1991) study. This estimate appears high, and the procedures used to derive this rate are unclear. The citation used by Koh (1991, p. 91) to derive a tax rate for land is specific to real estate in agricultural production. Agricultural production land typically is taxed at a higher rate than the classification of forest land, which comprises the bulk of land taxed in McCurtain County. In McCurtain County, forest land is taxed at the agricultural land: wasteland and forest land category rate. For this analysis, forest land is taxed at a rate of 10 percent[7] regardless of institutional owner-

[7] A specific published tax rate for this land category is not directly available. Information obtained through personal communication with the McCurtain County Tax Assessor's office provided 10 percent as an

ship. Factor taxes are subtracted from factor returns and placed in the government account.

Transfers to Institutions

Transfers to institutions are important in nonindustrial private forest timber production as well as in agricultural production. County level data on federal forestry cost-share programs, agricultural price supports, and other government programs are contained in USDA documents. The Forestry Incentives Program (FIP) accounts for $35,230 accruing to nonindustrial private landowners in McCurtain County for 1985 (Oklahoma Department of Agriculture, Forestry Service, 1992). Total crop payments and price support payments are $1,574,322 (USDA, Agricultural Stabilization and Conservation Service, 1987). While timber production is the dominant land use in McCurtain County, federal and state assistance to forest landowners is relatively insignificant (roughly 2 percent of total institutional transfer payments) compared to assistance given to agricultural landowners.

Institutional Savings

Depreciation on capital assets and retained earnings are accounted for in the institutional capital/savings account. Koh (1991) refers to the USDA ERS study which uses the rate of 38.5 percent of total factor return to capital. That rate is used in this study but is applied only to industries with large capital investments in equipment. Specifically, this rate is applied to wood processing, industrial timber production, and nonforestry/nonagricultural institutions. Because of the nonintensive nature of management and the manner in which capital returns are dealt with in nonindustrial and public timber production, depreciation and retained earnings are assumed to be zero. Institutional savings are computed as a residual for agriculture. Most agricultural resource ownership resides with producers in the county and thus rest-of-world transfers are assumed to be zero. These assumptions allow institutional savings from agriculture to be computed as a residual.

Institutional Rest-of-World Transfers

Factor payment outflows are made to owners of land, labor, and capital who reside outside McCurtain County. These payments are significant for some institutional categories. Statistics on absentee nonindustrial private forest landowners are contained in Donovan (1987). In this study, 22.8 percent of landowners in McCurtain County are absentee landowners. There are few data on other sectors to indicate actual

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appropriate rate. The McCurtain County Tax Assessor's office telephone number is 405/286-5272.

rest-of-world flows. All IPF and public forest landowners are assumed to be absentee landowners; thus, all returns to capital and land for these institutional categories are allocated as transfers to the rest-of-world account. Rest-of-world transfers for wood processing and non-forestry/nonagriculture are calculated as residuals after all other allocations are made in the institutional columns. The empirical results are found in the institutional rest-of-world account in the SAM.

Households

The household income distribution matrix maps institutional factor payments for the base year. Households are classified into low (annual incomes less than $15,000), medium ($15,000 to $40,000), and high (greater than $40,000) income categories. This classification follows national standards for 1985. Total household income is derived from factor payments by institutional grouping (i.e., nonindustrial private forest production, industrial private forest production, public forest production, wood processing, agriculture, nonag/nonforestry), government transfers, and unearned income. Household income in the SAM is net of FICA payments (accounted for as a factor tax).

Aggregate Income by Income Class

This analysis uses the BEA REIS data on personal income by source for McCurtain County for 1985 (BEA, 1992) as the control total from which the household income distribution must balance. The analysis assumes that this data is correct and, when summed with respective values for other counties, adds to total state personal income. Evidence from other sources, however, tends to indicate that these values could be underestimations of actual personal incomes for McCurtain County. Taking state totals for personal income as correct, however, does not preclude the possibility that individual counties could be in error. This argument aside, household income is held to the control total for McCurtain County throughout the analysis.

Total personal income reported by the BEA is $281,350,000 for McCurtain County in 1985 (BEA, 1992). The distribution of income by household income size is accomplished through use of Summary Tape File Number 3 from the 1990 Census (U.S. Bureau of the Census, 1991) with data specific to McCurtain County. The assumption is that the distribution of income in McCurtain County is the same (when adjusted for inflation using the Consumer Price Index(CPI)) in 1989 as in 1985. The calculations used to determine distribution of total personal income for McCurtain County in 1985 are in Table 3. The 1989 household income ranges are deflated to 1985 household income ranges using the CPI. The number of households identified in the Summary Tape File (U.S. Bureau of the Census, 1991) is multiplied by the deflated household income to estimate aggregate income.

Unearned Household Income

The BEA reports unearned income (dividends, interest, and capital consumption adjustment for rental income) for McCurtain County in 1985 as $34,414,000 (1992). This value does not include transfer income. This value is used as a control total for unearned income and is distributed among household income groups using data from Rose, Stevens, and Davis (1988; Table 6.5, p. 66). The calculations used to distribute unearned income among household income groups are presented in Table 4. The assumption is that the distribution of dividends among household income groups in McCurtain County for 1985 did not differ from that of the U.S. in 1982 (adjusted for inflation using the CPI).

Household Transfer Income

Transfer payments are taken from BEA (1992) and equal $76,520,000 for McCurtain County in 1985. These payments include retirement, disability and health insurance, medical, income maintenance, and unemployment insurance. Only payments made to individuals (not transfer payments made to nonprofit institutions or businesses) are used in identifying components of household income. Total government payments to individuals in McCurtain County for 1985 are $72,365,000 (BEA, 1992).

Total transfer payments are distributed among household income groups using data from Peterson (1991; Tables 2-6, p. 46). The assumption is that distribution of transfer payments in McCurtain County for 1985 did not differ from the national distribution in 1983 (after adjustments are made for inflation using the CPI). Peterson (1991) differentiates between distribution of Social Security payments, which are not means dependent, and public assistance payments, which are means dependent. Distribution of transfer income to household income groups for McCurtain County is detailed in Table 5.

Row Totals: Household Income Distribution

Once transfer payments to individuals and unearned income are accounted for, the sum of these income sources are subtracted from total household income to arrive at earned household income from institutions. This value matches the BEA data (1992) accounting for farm and nonfarm earnings by place of residence. These row totals are identified as total household income by income class size and used as column totals.

Household Income Distribution

This section allocates institutional income by institutional category to household income class size. First, data are reviewed showing the correspondence between IMPLAN and BEA aggregate income. Next,

data sources and methods are identified to show disaggregation of institutional household income by income class size. The correspondence between IMPLAN and BEA aggregate income used for the study is the following:

IMPLAN ($1,000)

Value Added	
Labor Share	$188,313
Capital Share (gross)	124,764
Land Share	14,453
Total Factor Income	327,530
Indirect Taxes	14,479
Total Value Added	342,009
Institutional Income	
Factor Income	327,530
minus: Factor Taxes	43,575
plus: Institutional Transfer Income	1,609
Total Institutional Income	285,564
Personal Income	
Institutional Income	285,564
minus: Institutional Depreciation and Retained Earnings	58,891
Rest-of-World Transfers	52,102
Wages, Salaries, Other Labor Income, and Proprietary Income	174,571
plus: Government Transfers	72,365
Unearned Income	34,414
Total Household Income	281,350

BEA ($1,000)

Personal Income	
Wages, Salaries, Other Labor Income, and Proprietary Income	174,571
Government Transfers	72,365
Unearned Income	34,414
Total Household Income	281,350

This correspondence between IMPLAN value added and BEA personal income is approximate because it depends upon several crude estimates. For example, factor taxes and institutional depreciation and retained earnings are estimated based on rates from other studies. Rest-of-world transfers from institutional income is derived as a residual so that payroll and proprietary income from institutions agree with that from BEA.

Household income distribution by income class is derived through the use of the total income distribution matrix for the United States

found in Rose, Stevens, and Davis (1988; Table 7.6, p. 77). It assumes that the distribution of income in McCurtain County for 1985 did not differ from the distribution by institutional category for the United States in 1982 after adjusting for inflation.[8] Initial use of the coefficients of the total income distribution matrix (Table 6), applied to the control totals[9] results in a distribution that does not agree with the row totals by income group. The row control totals (computed above) for low, medium, and high income households are $15,485,830, $97,604,470, and $61,480,730, respectively. Using the above coefficients for low, medium, and high income households results in the distribution $25,132,010, $83,874,830, and $65,564,200, respectively. Discrepancies are allocated proportionally throughout the household income distribution matrix to ensure that row and column totals match. Results of this procedure are included in the household income distribution matrix of the SAM.

Household Taxes

These taxes include personal income tax and sales tax. Household taxes are calculated as a constant ratio of aggregate income by household grouping. This study uses the household tax rates published in the USDA ERS study by Robinson, Kilkenny, and Hanson (1991; p. 67). Earned income is taxed at the rate of 12.6 percent. Unearned income (interest and dividends) is taxed at the rate of 35 percent. Tax on earned income is added to tax on unearned income by household income group to derive the total household tax found in the SAM.

Household Savings

Household savings are calculated for low, medium, and high income household levels. The marginal propensities to save from earned and unearned income are taken from Robinson, Kilkenny, and Hanson (1991; p. 67). These marginal propensities are 6.2 percent of earned income and 17.4 percent of unearned income. These rates are applied to the distribution of household earned income from institutions and the distribution of household unearned income and then summed for total savings by income group.

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[8] This is the same database used to distribute total household income found in the U.S. Department of Commerce's *Summary Tape File 3*, STF 3A, 1990 CPH-L-81, Table 3, McCurtain County, Oklahoma (Bureau of the Census, 1991).

[9] Control totals are derived by proportionally allocating the $15,747,001 discrepancy between row total ($174,571,000) and column total ($190,318,001) to the institutional savings account.

Government Expenditure

Government expenditures comprise government demand for regionally produced commodities, transfers to institutions, transfers to households, and local government demand for commodities produced by the rest of the world. Data on government demand for regionally produced commodities (IMPLAN, 1991), transfers to institutions (Oklahoma Department of Agriculture, Forestry Services, 1992, USDA Agricultural Stabilization and Conservation Service, 1987), transfers to households (BEA, 1992), and local government demand for commodity imports (IMPLAN, 1991) provide total government expenditure equal to $151,358,000 for McCurtain County in 1985.

Government Revenue

Total government revenue is made up of indirect business taxes, factor taxes, and household taxes. For McCurtain County, total government revenue generated for 1985 is equal to $92,095,400. The difference between government revenue and government expenditure for McCurtain County is allocated to rest-of-world government transfer.

Rest-of-World Government Transfer

The SAM reflects the ability of the regional government account to be in surplus or deficit. The government account is aggregated to include federal, state, and local/county government. Thus, the government account shows inflows and outflows of funds. Government rest-of-world transfers of $59,262,600 are required for government expenditures to equal government revenues for McCurtain County. This implies a significant government transfer to McCurtain County in 1985.

Financial Markets: Regional Capital Flows

This account represents net capital flow for the region during 1985. No data source for this flow at the county level exists. This flow, however, can be inferred from the SAM (Hughes, 1991). Inference of capital flow is based upon examination of the rest-of-world account.

The SAM explicitly accounts for both a trade balance and a financial balance. It is assumed that trade imbalances of the region are offset by financial flows. These net capital flows are represented as the difference between current account outflows and inflows. Furthermore, the current account is composed of the trade account which may or may not balance. Imbalance implies an offsetting capital flow such that the sum of trade and financial accounts balances between inflows and outflows.

Current account trade outflows include competitive and noncompetitive imports to intermediate demand, household imports, government imports, imports for capital formation, and net factor

payments as established for institutions. Current account trade inflows consist of production exports, household unearned income, and net government transfers. The rest-of-world account for McCurtain County indicates a net financial outflow of roughly $33 million in 1985 to obtain rest-of-world account balance[10] (Table 7).

Balance Within the Social Accounting Matrix

The SAM balances. This means that factor expenditure equals factor income, institutional expenditure equals institutional income, household expenditure equals household income, government expenditure equals government revenue (including government transfer), total investment equals total savings (including regional capital flow), and total financial inflow equals total financial outflow. This allows the SAM to be contained within a finite boundary and completely specified. Given control totals, all respective components are internally consistent. Following the above procedure, the constructed SAM balances.

The Social Accounting Matrix for McCurtain County

General Discussion

The McCurtain County SAM for base year 1985 is presented in Table 8. The SAM is used to identify phenomenon that characterize the McCurtain County economic structure.

Activities related to production and processing of timber account for a significant portion of the McCurtain County economy. Over 23 percent of regional sector output is directly attributable to these activities. Roughly 90 percent of this percentage consists of wood processing, while timber production accounts for 10 percent of this percentage. Roughly 20 percent of regional factor income is generated in timber production and wood processing. Roughly 13.7 percent of this factor income is from timber production and 86.3 percent from wood processing.

These activities are defined realistically as being *primary* in nature, contributing to McCurtain County's export base and generating rest-of-world transfers. From the commodity exports account, roughly 31.5 percent of McCurtain County exports are from timber and processed wood products. Imported inputs into the production of these commodities, however, accounts for 20.2 percent of total production imports.

Roughly $175 million (see household income distribution account of Table 8), or 62 percent of total household income, is factor income accruing to households through the use of wage and self-employed resources. These resources are used by institutions to produce institu-

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[10] This is the result of a net commodity trade deficit (outflow) of $8,506,000 and a net current financial inflow of $41,575,000.

tional income. Approximately 1.4 percent of this total McCurtain County earned household income is derived from producing timber and 18.4 percent from wood processing (forestry complex institutions). The remainder is derived from nonforestry complex institutions.

In assessing the distribution of household institutional income resulting from forestry complex activities, it is apparent that low income households are impacted positively by wood processing. Roughly 14 percent of total household institutional income from wood processing is distributed to low income households, 58 percent to medium income households, and 28 percent to high income households. Timber production, on the other hand, has no effect[11] in its impact on low income households. Most of the impact that timber production has on households is found in the medium income levels (roughly 71 percent) and high income levels (roughly 30 percent). To more fully understand this distribution and the implications that more intensive timber management have on regional economic development, further analysis is required.

Government revenues and government expenditures in McCurtain County do not balance without large transfers from outside the region (government row and rest-of-world column, Table 8). About 39 percent of total government revenue (balanced with expenditure) is transferred to the county. The category for government account includes local, county, state, and federal units. Governmental interaction in the regional economy through expenditure for goods and services (regionally produced and imported) accounts for about 51 percent of total government revenues/expenditures. The remaining 49 percent, or about $74 million, are transfer payments.

About 51 percent of McCurtain County households are categorized as low income in 1985 (less than $15,000 annual income, see Table 3). Furthermore, 67 percent of income of the low income groups is derived from government transfer payments ($12 million from Social Security and $26 million from public assistance). Of the total $72 million in government transfer payments to individuals in McCurtain County, about 55 percent is Social Security and 45 percent is public assistance.

About 16 percent of government revenue generated within McCurtain County (excluding ROW transfers) is derived through indirect business taxes, 47 percent through factor taxes, and 37 percent through household taxes. Factor taxes consist of roughly 54 percent

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[11] Values are slightly negative. This accounts for roughly 1 percent of total earned resource compensation from timber production. From a statistical sense, this number is small enough to be concealed in an error term. Rose, Stevens, and Davis (1988, p. 72) identify these negative payments as resulting from net capital usage losses rather than profits in agriculture, forestry, and mining activities. Potential underaccounting for home consumption of commodities produced could be considerable.

generated from labor, 42 percent from capital, and 4 percent from land. About 9 percent of household taxes are collected from low income households, 45 percent from medium income households, and 46 percent from high income households.

The combined institutional aggregations expended about $286 million during 1985. Forestry complex institutions account for about 19 percent of this expenditure. Roughly 62 percent of the total forestry complex expenditures accrue to households. This compares with 61 percent from nonforestry complex institutions. The remaining institutional expenditure not accruing to households either is put into depreciated assets or flows out of the region. Roughly 22 percent of institutional depreciation and retained earnings comes from forestry complex institutions. Roughly 15 percent of total institutional rest-of-world transfers is made from forestry complex activities. Combined, this indicates that relatively more forestry complex institutional expenditures are attributable to depreciation and retained earnings as compared to nonforestry complex institutional expenditures.

Results of the SAM indicate that McCurtain County had a net resource outflow of roughly $33 million in 1985. This is estimated indirectly from the trade and current account balance. More payments are coming in for exports and through government transfers than are flowing out as payments for imports and factor returns. These financial inflows are offset with a net capital outflow. Capital outflow represents about 43.7 percent of total investment and savings and 6.3 percent of total financial flow or rest-of-world account. The reasons for this are not evident from this analysis. It can be speculated, however, that this trend results partly because current outflows are returns to earlier investments in timber production and wood processing. These earlier investments are responsible for establishing plantations and associated capital costs with processing facilities.

Further Analysis of the SAM

Once the SAM has been constructed, certain accounts such as production, factors, institutions, and households may be endogenized for purposes of multiplier analysis. Fixed price SAM multiplier analysis is outlined in Pyatt and Round (1985, Chapter 9). The SAM also may form the basis of commodity and factor market analysis, including that of a computable general equilibrium analysis (Koh, 1991; Robinson, Kilkenny, and Hansen, 1991). Total direct, indirect, and induced distributional economic impact analysis is completed for McCurtain County through shocking the endogenized base year SAM with timber production potentials. For the sake of manuscript length, however, these results are contained elsewhere (Marcouiller, Schreiner, and Lewis, 1993b, 1993c).

Summary and Conclusions

This paper justifies the construction and use of a SAM to address regional economic development issues related to natural resource management. A method for construction of such a SAM is presented and applied to a region with significant timber resources.

Current policies targeting private forest management throughout the United States are criticized as generally reactive versus proactive. The general shift in sources of U.S. domestic timber supplies are real and, to a large extent, an inevitable consequence of current public sentiment. The southern U.S. will experience an increase in timber production on private lands during the twenty-first century. What will be the distributional effects of increased timber production in the south, and will the form of timber resource ownership influence this distribution? Are there policies that can be used to manage distributional outcomes more conducive to regional development goals? Establishment of a SAM similar to that proposed in this paper should allow analysis of such distributional effects.

Generalizations of this SAM for other forested regions in the Southern United States can be made. More important, however, is the fact that the construction procedures outlined in this paper are easily replicable for other regions of the United States. Such replications can provide a perspective of implications for income distribution of producing and processing timber resources.

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Table 1—Timber Removals From McCurtain County by Ownership During 1985[1]

Forest Ownership	Removals Volume			
	Softwood		Hardwood	
	Sawtimber[2]	Pulpwood[3]	Sawtimber[2]	Pulpwood[3]
Industrial	103.68	6.840	23.120	3.131
Nonindustrial	2.86	0.596	8.384	0.413
Public	3.50	0.078	0.000	0.000
Total[4]	110.04	7.513	31.504	3.545

[1]McCurtain County forest inventory data were obtained from the USDA Forest Service. Specific batch file available from author

[2]Sawtimber volume is in million board feet International 1/4 Log Rule

[3]Pulpwood volume is in million cubic feet

[4]May not sum to total due to rounding

Table 2—Total Value of Timber Removals by Ownership During 1985, McCurtain County, Oklahoma

Ownership	Removals Value (1985 $)					
	Softwood		Hardwood			
	Sawtimber	Pulpwood	Sawtimber	Pulpwood	Total	Percentage of Total
Industrial	14,002,352	992,912	1,519,848	117,412	16,632,524	92.39
Non-Industrial	386,813	86,535	551,125	15,505	1,039,978	5.78
Public	323,973	6,557	0	0	330,530	1.84
Total	14,713,138	1,086,004	2,070,973	132,917	18,003,031	100.01[1]

[1]Does not sum to 100.00 due to rounding

Table 3—Income Distribution for McCurtain County, 1985

Income Range 1989[1]($)	Income Range 1985[2]($)	Number of Households[3]	Percentage of Households by 1985 Range	Accumulated Income Bill[4] 1985 ($)
5,000	4,339	1,709	0.14	
10,000	8,677	2,388	0.19	
15,000	13,016	1,573	0.13	
	15,000	594	0.05	56,550,692
25,000	21,693	2,005	0.16	
35,000	30,370	1,645	0.13	
	40,000	976	0.08	130,238,400
50,000	43,386	343	0.03	
75,000	65,078	768	0.06	
100,000	86,771	162	0.01	
150,000	130,157	82	0.01	
200,000	173,542	38	0.00	94,560,934
Total		12,283	1.00	281,350,020

[1]Value is upper bound of range

[2]Upper bound adjusted by CPI (.89771 1989 range = 1985 range)

[3]Number of households listed in *Summary Tape File No. 3* 1990 (27)

[4]Number of households multiplied by .983 upper bound 1985 range. This value is determined by adjusting range to allocate a known total household income for 1985

Table 4—Dividend Income Distributed By Income Class Size, McCurtain County, 1985[1]

1982 Range[2] ($)	1985 Range[3] ($)	Accumulated Distribution[4]	Dividend Income, 1985[5] ($)
5,000	5,574		
10,000	11,147		
	15,000	0.0915	3,149,000
15,000	16,721		
20,000	22,295		
25,000	27,868		
35,000	39,015		
	40,000	0.2434	8,376,000
50,000	55,736		
75,000	83,604		
100,000	111,473		
2000,00	222,945	0.6651	22,889,000
		1.0000	$34,414,000

[1]From Rose, Stevens, and Davis (Table 6.5, p. 66)

[2]Upper bound

[3]Upper bound adjusted for CPI (1.114725389 1982 Range = 1985 Range)

[4]Arbitrarily sets lower bound at $10,000 and accumulates to low, medium, and high household income ranges

[5]In 1985 dollars distributing a known total of $34,414,000

Table 5—Distribution of Transfer Payments to McCurtain County (1985)

Class	Upper Bound of 1983 Income Range[2] ($)	Upper Bound of 1985 Income Range[1] ($)	Social Security			Public Assistance		
			% of Payments[2]	Payments Distributed[3] (million $)	Accum. Payments[3] (million $)	% of Payments[2]	Payments Distributed[3] (million $)	Accum. Payments[3] (million $)
Poor	10,000	10,800	0.158	6.252		0.688	22.564	
Near Poor	12,500	13,500	0.109	4.313		0.090	2.952	
		15,000	0.039	1.555	12.119	0.009	0.281	25.797
Working Class	30,000	32,401	0.456	18.032		0.100	3.261	
		40,000	0.060	2.380	20.412	0.018	0.585	3.846
Middle Class	50,000	54,002	0.111	4.386				
Upper Mid Class	75,000	81,002	0.051	2.018		0.096	3.154	
Affluent	200,000	216,006	0.016	0.633	7.037			3.154
Total			1.000	39.568	39.568	1.000	32.797	32.797

[1]Originally in 1983 dollars. Converted to 1985 dollars using the CPI.(1.08003 1983 range = 1985 range)

[2]From Peterson (Table 2-6, p. 46)

[3]In millions of 1985 dollars

Table 6—Total Income Distribution Coefficients[1]

Household Income Range (in 1985$)	Institution			
	Timber[2] Production	Agricultural[3] Production	Wood[4] Processing	Nonag[5] Nonforestry
Less than 15,000	.043165	.042683	.195469	.151496
15,000-40,000	.628199	.628355	.500102	.443579
more than 40,000	.328636	.328962	.304428	.404925

[1]Adapted from Rose, Stevens, and Davis (Table 7.6, p. 77) by aggregating sectors, weighting by total sector group income, adjusting 1982 income ranges to 1985 income ranges (using the appropriate CPI), linearly interpolating and accumulating to above listed low, medium, and high income ranges

[2]Includes forestry products and agricultural services

[3]Includes livestock products and other agricultural products

[4]Includes lumber and wood products, wood containers, household furniture, other furniture, paper and allied products, and paper containers and boxes

[5]Includes all other sectors

Table 7—Rest of World Account, McCurtain County, Oklahoma, 1985 ($1,000)

Receipts (Outflows)		Expenditures (Inflows)	
Imports		Exports	
Production Sectors	279,157	Production Sectors	433,960
Households	129,245		
Government	30,598		
Capital formation	3,466		
Subtotal	442,466	Subtotal	433,960
Factor Payments		Regional Transfers	
Institutions	52,102	Households	34,414
		Government	59,263
Subtotal	52,102	Subtotal	93,677
Regional Capital Flow	33,069		
Total	527,637	Total	527,637

Table 8 - Social Accounting Matrix for McCurtain County, Oklahoma (in thousands of 1985 dollars)

	Agriculture Production	Timber Production	Manufacturing	Food/fiber Process	Wood Processing	Services Government	Mgmt/Prof	Tech Sales	Serv	Farm Forest Fish	Prod Crafts	Capital	Land
PRODUCTION SECTORS													
1. Agriculture Prod	12227	2240	238	30965	264	361							
2. Timber Prod and Serv	228	547	0	47	7502	0							
3. Manufacturing	282	698	243	331	897	5531							
4. Food/fiber process	3	13	4	2877	16	159							
5. Wood processing	19	1	1009	157	31660	78							
6. Services and gov't	7161	692	5098	3412	12630	20681							
FACTOR ACCOUNTS													
1. Labor													
a. Mgmt/Professional	1532	559	3410	3167	6412	39649							
b. Tech/Sales/Admin Supp	614	224	2294	2855	5360	35719							
c. Service	148	54	141	389	524	12213							
d. Farm/Forest/Fish	5143	1878	4	7	627	205							
e. Prod/Crafts/Repair	705	257	8592	12078	25918	17633							
2. Capital	6347	2088	12399	5622	16153	82156							
3. Land	10797	3656											
INSTITUTIONS													
a. Forestry Complex													
1. NIPF							24	10	2	81	11	131	185
2. IPF							433	173	42	1453	199	1241	3578
3. Public							32	13	3	108	15	-18	-13
4. Wood processing							5604	4685	458	548	22652	13851	
b. Non-Forestry Complex													
1. Agriculture							1339	536	130	4495	616	5442	9071
2. Non-Agriculture							40101	34308	10127	174	36214	85901	
HOUSEHOLDS													
1. Low													
2. Medium													
3. High													
GOVERNMENT													
Government Revenue Sources	1324	432	312	244	1393	10774	7197	7340	2708	1006	5476	18216	1632
CAPITAL													
Savings													
REST OF WORLD		4992	28442	75335	51473	51958							
TOTAL	113487	18332	62186	137486	160829	277117	54730	47065	13471	7864	65183	124764	14453

Table 8 - Social Accounting Matrix for McCurtain County, Oklahoma (in thousands of 1985 dollars) (Continued)

	NIPF	IPF	Public	Wood Proc	Agric	Non-Agric	Low	Medium	High	Government	Capital	Rest of World	TOTAL
PRODUCTION SECTORS													
1 Agricultural Prod							670	624	295	419	343	64842	113487
2 Timber Prod and Serv							80	54	16	0	0	9857	18332
3 Manufacturing							117	101	38	8408	34714	10826	62186
4 Food/fiber process							1921	2051	1106	36	558	128742	137486
5 Wood processing							44	37	14	123	765	126921	160829
6 Services and govt							43057	36190	14838	37799	2787	92772	277117
FACTOR ACCOUNTS													
1 Labor (total)													
a Mgmt/Professional													54730
b Tech/Sales/Admin Supp													47065
c Service													13471
d Farm/Forest/Fish													7864
e Prod/Crafts/Repair													65183
2 Capital													124764
3 Land													14453
TOTAL													
INSTITUTIONS													
a Forestry Complex													
1 NIPF										35			478
2 IPF										0			7119
3 Public										0			140
4 Wood processing										.0			47798
b Non-Forestry Complex													
1 Agriculture										1574			23204
2 Non-Agriculture										0			206825
HOUSEHOLDS													
1 Low	-5	-23	-2	4494	-284	11306				37916		3149	56551
2 Medium	267	1343	109	18548	15987	61350				24258		8376	130238
3 High	115	580	47	9007	6910	44822				10191		22889	94561
GOVERNMENT													
Government Revenue Sources							3053	15230	15758			59263	151358
CAPITAL													
Savings	0	731	0	12339	592	45229	1508	7509	7795				75702
REST OF WORLD	100	4488	-15	3411	0	44118	6101	68442	54702	30598	36538		527636
TOTAL	478	7119	140	47798	23204	206826	56551	130238	94561	151358	75702	527636	

	Production Sectors						Factors	Institutions	Households			Government	Capital/ Savings	Rest of World	TOTAL
	Ag Prod	Timber Prod.	Mfgr	Food Fiber Proc	Wood Proc	Services and Gov't	1a 1b 1c 1d 1e 2 3	a1 a2 a3 a4 b1 b2	Low	Medium	High				
Production Sectors Ag Production Timber Prod & Serv Manufacturing Food/Fiber Proc Wood Processing Services & Govt	Interindustry Transactions								Consumption Demand From In-Region Sources			Government Demand From In-Region Sources	Investment Demand From In-Region Sources	Commodity Exports From In-Region Sources	Commodity Demand From In-Region Sources
Factors 1 Labor a. Mgmt/Prof. b. Tech/Sales/Support c. Services d. Farm/Forest/Fish e. Prod/Crafts/Repair 2. Capital 3 Land	Payments to Factors of Production														Factor Income
Institutions a Forestry Complex 1. NIPF 2. IPF 3. Public 4. Wood Proc b. NonForestry Complex 1. Agric Prod 2. NonAg							Institutional Income Distribution					Transfers to Institutions			Institutional Income
Households Low Medium High								Household Income Distribution				Transfers to Households		Unearned Income	Household Income
Government	Indirect Business Taxes						Factor Taxes	Corporate Income Tax	Household Taxes					Government Transfer	Gov't Revenue
Capital/Savings								Institutional Depreciation	Household Savings						Total Savings
Rest of World	Imports of Production Inputs							Institutional Transfer	Imports to Consumption			Gov't Imports	Cap.Form. Imports		Outflows
TOTAL	Total Industry Outlays						Factor Expenditure	Institutional Expenditure	Household Expenditure			Gov't Expenditure	Total Investment	Inflows	

Figure 1. Schematic Social Accounting Matrix Which Focuses on Timber Production