Effects of Changes in Impact Analysis for Planning Model Industry Sector Data on the Economic Impacts of the Logging Industry in Mississippi

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Abstract

Effects of changes on industry sector data for the Mississippi logging industry were examined to determine importance to and economic impact in that state's economy. Quantification, evaluation, and improvements upon current methodology of data and data collection for use in the Impact Analysis for Planning (IMPLAN) software model to more accurately reflect and support IMPLAN inputs and outputs were also determined. Economic impact estimates derived from model default data were compared with estimates derived from survey-based expenditure data collected within the state. The top 20 output sectors in the state economy resulting from logging expenditures were determined. In turn, new data were acquired to replace 4 of the top 20 sectors and new economic impact estimates derived. Economic impact assessment results on the model default data showed total economic impacts of $2.309 billion and $2.489 billion in industry output in 2006 and 2009 dollars, respectively. Total economic impacts generated using survey-based data from a sample of 33 loggers were $129.310 million and $131.747 million in 2006 and 2009 dollars, respectively. Total economic impacts generated by replacing 4 of the top 20 sectors from 33 loggers were $109.979 million in 2009 dollars. While this study was limited by a small sample size in regard to making statewide estimates, results indicated that limitations within the IMPLAN model further manifest themselves when implementing economic impact assessments. Rather than just relying on the default model data, more localized data should be collected when doing studies of this type.

The forest products industry, consisting of four major groups (i.e., logging, wood furniture, pulp and paper, and solid wood products), has been an important, historical component of the social and economic sustainability of the United States. For example, Deckard and Skurla (2011) showed Minnesota's forest industry contributed $17.1 billion to the economy and supported approximately 87,000 jobs. The North Carolina Forestry Association (2003) also reported, using 2002 data, that the forest products industry has contributed $29.7 billion to the state's economy and has supported more than 300,000 jobs when applying an economic multiplier. In Mississippi, the total forest industry output for 2001 exceeded $13 billion, with a total employment of 54,000—roughly 3 percent of the state's total employment, with an average annual income per worker of $34,656 (Munn and Tilley 2005, Henderson et al. 2008). Wood furniture contributed 44 percent of the direct jobs, while the solid wood products industry, pulp and paper, and logging and miscellaneous forest products contributed 27, 13, and 15 percent, respectively (Munn and Tilley 2005, Perez-Verdin et al. 2008).

The logging industry has continuously provided raw materials to the forest products industry (e.g., for wood furniture, saw timber, and pulp and paper) that has led to increased development and competitiveness within the forest products industry (Munn and Tilley 2005, Rickenbach and Steele 2006, Tilley and Munn 2007, Perez-Verdin et al.

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2008). Although loggers and logging firms within the logging industry obviously have played an important role in the economic sustainability of the forest products industry, most economic research has focused on the wood furniture, sawtimber, and pulp and paper industries (Sherif 1983, Bernstein 1989, Frank et al. 1990, Oum et al. 1991, Hsue and Buongiorno 1994). Logging, as an economic entity, commonly is not considered, or is simply overlooked, in many national, regional, or state economic analyses. A possible reason for the limited economic research with loggers and logging firms could be that data required to conduct economic analysis (e.g., logger's books, tax filings, and financial reports) are kept confidential and, in most instances, logging contractors and logging firms are reluctant to cooperate in studies of their industry (Stutzman 2003). Also, most logging firms are organized as small, family operated enterprises with few or no employees, thus making them hard to locate in the first place (Stutzman 2003, Rickenbach and Steele 2006). There is also continual ingress and a good deal of egress from the industry, making it hard to focus on a stable population base.

The Impact Analysis for Planning Model

The Impact Analysis for Planning (IMPLAN) software model was originally designed by the US Department of Agriculture (USDA) Forest Service as a non–survey-based, input–output model (Crihfield and Campbell 1991, Minnesota IMPLAN Group, Inc. [MIG] 2000). It was originally designed to derive economic impacts of USDA Forest Service forest management plans. IMPLAN data are gathered from numerous federal data sources, including the Bureau of Economic Analysis (BEA), Bureau of Labor, and Census Bureau (MIG 2000). IMPLAN makes use of the BEA benchmark input–output tables derived from the North American Industry Classification System (NAICS) data, including disaggregated industries sorted by a three-, four-, or six-digit NAICS level code. New data sets are released annually by a private company located in Minnesota and include regional employment, income, value added, household, and government consumption. Data found within the annual data sets have an exclusive national input–output structural matrix and trade flows model, both of which can be modified (MIG 2000). IMPLAN's database is built from top to bottom with national accounts constructed first, followed by regional, state, and county or parish accounts (Crihfield and Campbell 1991, Lynch 2000). IMPLAN data are designed to be internally consistent so that county data sum to state totals, state data sum to regional totals, and regional data sum to national totals (Crihfield and Campbell 1991). A key feature in the IMPLAN modeling software system is the ability to change data, internal to the database, to more accurately reflect county or parish, state, regional, or national conditions in the economy. Users have the ability to select and define appropriate inputs with a sufficient understanding of both the subject area to be modeled and interpretation of applicable IMPLAN parameters (Lynch 2000, MIG 2000). Users can also generate Type I and II and Type Social Accounting Matrix (SAM) multipliers based on their preferences, by choosing to internalize household, government, and/or investment activities (Bonn and Harrington 2008). Type I multipliers are defined mathematically as the sum of the direct impact (as a result of change in final demand) and indirect impacts divided by the direct impacts. Type I = (Direct Impacts + Indirect Impacts)/Direct Impacts. Type II multipliers are defined mathematically as the sum of direct, indirect, and induced impacts divided by direct impacts (Aruna et al. 1996). Type II = (Direct Impacts + Induced Impacts + Indirect Impacts)/Direct Impacts. Type SAM multipliers are the total impacts (i.e., direct, indirect, induced) where the induced impact is based on information derived from the social account matrix. It shows the flow of money between institutions. This relationship accounts for social security and income tax leakage, institutional savings, and commuting (MIG 2000).

Economic impact analysis traces the flow of spending associated with specific activities within a region to identify changes in sales, income, jobs, and revenues (Frechtling 1994). Since the early 1980s, the IMPLAN model and software has had empirical success explaining various economic impacts tied to specific activities or commercial enterprises, whether they are in the proposal stage, currently in existence, or have ceased to exist (i.e., to evaluate losses to an economy). Numerous studies have described the economic impact analysis of various survey- and non–survey-based, industry-related projects and recreational activities using the IMPLAN software model within the last 20 years (Flick et al. 1980, Radtke et al. 1985, Bergstrom et al. 1990, Cutshall et al. 2000, Loden et al. 2004, Bonn and Harrington 2008, Grado et al. 2008, Perez-Verdin et al. 2008). Studies using this analysis tool have derived direct, indirect, and induced impacts for a number of variables (e.g., value added, employee compensation, indirect business taxes, and jobs) that are major determinants of total economic impacts. These studies involved either the use of expenditure data input in the model or the use of default data within the model to determine the economic impacts on a particular economy of interest (Radtke et al. 1985, Douglas and Harpman 1995, Charney and Leones 1997, Lazarus et al. 2002). Expenditure data generally include on-site, food, travel, lodging, and equipment expenses along with the purchase location for each item (Loden et al. 2004).

IMPLAN sectoring scheme

The IMPLAN industrial sectoring scheme classifies data within the model and allows categorization according to the type of products or services being produced (MIG 2000). Riggs et al. (2011) defined a sector as a group of firms engaged in the same general type of business. IMPLAN Sectors 1 to 426 are all private sector producers of goods and services; Sector 427 contains both private post office activities as well as the quasi-public US Postal Service (MIG 2000). Public sector producers of goods and services range from Sectors 428 to 432, while IMPLAN Sectors 433 to 440 are the government administrative sectors. The Type SAM multiplier includes information about local economic interaction in terms of the flow of dollars from purchaser to producers (inter-institutional transfers) within the region (MIG 2000). The Type SAM multiplier allows the user the option to include or exclude certain institutions (e.g., employee compensation, proprietory income, other property income, indirect business tax). Including/internalizing certain or all institutions builds the activities of those institutions into the SAM multiplier. The user also has the option of selecting sectors to correspond with the included/excluded institutions. For example, employee compensation is under Sector 5001, other proprietary income under Sector

6001, other property income under Sector 7001, and indirect business taxes under Sector 8001 (MIG 2000).

Economic impact multipliers

Multipliers are used to describe how the economy of interest reacts to a particular change in activity. For example, they measure impacts such as a new investment, startup of a new business, and respending of new dollars within an economy (Riggs et al. 2011). Multiplier size is a good indicator of the level of business activity and development in an economy. It is also directly linked to the geographic extent of the region, its economic diversity, and the sectors being studied (Grado et al. 2001). Regions that have a large geographic extent, which in all likelihood includes more development, tend to have larger multipliers than smaller areas, because they generally do not require extensive product imports and transportation costs. Regions with large economies also are capable of producing goods and services locally, resulting in a higher local consumption and production. Sectors chosen in an economic impact analysis can result in either a large- or small-sized multiplier, dependent on a variety of inputs (e.g., labor), availability of goods and services provided in the economy of interest, and amount of leakage in the economy (Radtke et al. 1985). Leakages represent the portion of retail or wholesale sales lost by an area of interest to a competitive market outside the economy in question, indicating the need for more retail, wholesale, or producer/enterprise development in that particular area of interest (MIG 2000).

Economic impact studies have been conducted in the past in Mississippi using a non–survey-based methodology in conjunction with the IMPLAN software model (MIG 2000, Spurlock 2004). To our knowledge, quantifying the economic contribution of the logging industry on the Mississippi economy using survey data (i.e., logging contractor expenditure profiles) within the IMPLAN model has not yet been attempted. One issue that arises when using the IMPLAN model and the logging sector is the definition of Sector 16 (logging). For example, there is no definition of what logging (Sector 16) in the IMPLAN model encompasses, and as seen from logging contractors' expenditure profiles (e.g., tires, fuel, contract trucking, and insurance), logging is a lot more than just the value of the raw materials. The study by Tanjuakio et al. (1996) also shared a similar issue when those authors were determining the economic impact of agriculture in Delaware. For example, their study showed that agriculture in the IMPLAN model ranged from basic production agriculture to more encompassing definitions that included agribusiness industries, food processing, and natural resource–based industries (Tanjuakio et al. 1996).

The purpose of the present study was to conduct economic impact analyses on the logging industry in Mississippi to identify how the statewide software model default estimates and modified statewide localized data level estimates obtained from the Mississippi Department of Revenue differ from each other while quantifying the economic impacts of logging in Mississippi and, most important, what logging encompasses.

Methods

Both MIG (2000) and Spurlock (2004) determined economic impacts in IMPLAN by using total economic impacts (i.e., direct, indirect, and induced) estimated within the IMPLAN model, using default model data, by removing the total employment for the relevant sector and calculating the impact on the state economy. Consequently, this method was replicated to derive economic impact results of the logging industry in Mississippi. The top 20 output sectors in the state economy for logging expenditures were determined from model results. For the survey data, logging cost components were then identified from a long-term study examining long-term cost and productivity of the logging industry, deaggregated to highlight all expenses and activities generated by 33 logging contractors who conducted business in Mississippi, and then sorted within appropriate IMPLAN sectors. The origin of data for each appropriate sector in the IMPLAN model was determined from primary data sources (i.e., directly from sector manufacturers) or secondary data sources (i.e., relying on existing data source).

For primary and secondary data sources, key individuals/organizations involved in determining the original data were identified (i.e., Census Bureau, Bureau of Labor Statistics [BLS], and BEA). New data were acquired from the Mississippi Department of Revenue that were similar to sector descriptions used by IMPLAN (e.g., tires would fall under Sector 208 [plastics and rubber industry machinery manufacturing], fuel under Sector 115 [petroleum refineries], depreciation under Sector 7001 [other property income], and contract hauling under Sector 335 [truck transportation]) but more localized to the state to replace 4 of the top 20 sectors of importance for each industry, respectively. Economic impact analyses were derived using separate models by replacing default model data used in IMPLAN with survey-based replacement model data acquired from the Mississippi Department of Revenue. Economic impact results derived from the default model data were compared with the economic impact results derived from the survey-based replacement data to determine and identify how statewide software model default estimates and modified statewide localized data level estimates differed from each other while quantifying the economic impacts of logging in Mississippi using IMPLAN.

Expenditure data

The study area encompassed the state of Mississippi. The 2006 logging year was used because it was the most updated and complete data set available within the state at the start of the project. For the purposes of the present study, expenditure data information only included those expenditures made within the state. Data were collected by researchers at Mississippi State University (MSU) from 33 loggers willing to cooperate in this effort. This process has been ongoing for 20 years.

Logging businesses varied in size and were thus categorized into three major groups (i.e., small, medium, or large) based on average annual tonnage. Tonnage size ranged from 0 to 68,999 tons for small loggers, 69,000 to 149,999 tons for medium loggers, and 150,000 to 430,000 tons for large loggers. As a result, the small group had 13 loggers, the medium group 9 loggers, and the large group 11 loggers. These loggers are part of a group of 2,471 loggers who registered through the Professional Logging Management Program at MSU administered through the Sustainable Forest Initiative State Implementation Committee.

Economic impact analysis

The most current data on the Mississippi economy (2007) was used to construct an IMPLAN model of the state to generate direct and secondary impacts resulting from logging contractor expenditures incurred during 2006. Direct impacts refer to the portion of regional sales retained by regional businesses, industries, and services and allocated as final demands to the appropriate ''industrial'' sectors; it is the first impact to the economy. Indirect impacts are the changes in interindustry purchases in response to the new demands of the directly affected businesses, industries, and services. Induced impacts are the changes in spending from households as income increases or decreases due to changes in production and are tied to direct and indirect sector sales (MIG 2000). Secondary information gathered from the economic impact analysis of the logging industry in Mississippi included economic multipliers (e.g., Type I, Type SAM, value added, and employment).

Non–survey-based approach

For the non–survey-based approach, timber harvesting (i.e., logging) data were obtained from within the IMPLAN model database, which used expenditures obtained in the modeled economy on behalf of an investment or an activity (currently 440 sectors as described by the US Department of Labor). The IMPLAN industrial sectoring scheme allowed for a categorization according to the type of products or services produced (MIG 2000). Following the method used by Spurlock (2004), a model was constructed in the present study using Construct Model from the Model Control Center menu bar in IMPLAN (MIG 2000). The Type SAM multipliers were selected along with the 18 institutional categories (i.e., those within household income, federal government, state/local government, and social accounts matrix). After model construction, the appropriate industries for analysis were selected following methods used by MIG (2000) and Spurlock (2004). In this case, for the logging industry sector, it was Sector 16. Multipliers derived from the economic impact analysis were used to compare the impacts of growth from various sectors of the economy.

Survey-based data approach

In the alternative survey-based approach, data used are a subset of data from an extended study examining the long-term cost and productivity of the logging industry in Mississippi. Researchers at MSU have been collecting expenditure data for the logging industry, one of the four major forest products–related industries in the state, for more than 20 years from three primary sources. Logging contractors who attended the Mississippi Loggers Association continuing logger education meetings at MSU in 2006 and owned a legitimate logging company were asked and encouraged to participate in the study (W.B.S., personal communication, 2010). Second, loggers who were in the logging business also recommended other loggers known to them and who might participate in the study as well. Third, firms and companies within the forest products industry were approached and asked for a referral of the loggers/contractors from whom they primarily purchased wood. These business owners were chosen for the study because they had a good business reputation with a long-term chance of business survival and good organizational skills (W.B.S., personal communication, 2010). Previously, studies conducted from this data collection have focused primarily on long-term cost and productivity of logging contractors (Stuart et al. 2006, 2007, 2008). Using the same long-term cost and productivity data set, the economic impacts of the logging industry was determined in the present study.

Participating contractors

Logging contractors who had agreed to participate were then contacted and asked to meet with faculty or graduate students from MSU at a location of their choice (Stutzman 2003; W.B.S., personal communication, 2010). At this meeting, logging contractors were informed of the specific types of information needed and methods of data collection, assured of confidentiality for collected data, and told how exactly their data would be used (Stutzman 2003). They were also presented with published reports of similar data usage from previous years to show how their data would contribute to this ongoing research. Logging contractors were under no pressure to participate and could decide to withdraw from the study at any time. A second interview/meeting was scheduled once the logging contractors agreed to participate. At this meeting, equipment spread, workforce, market niche, and other business information were collected (Stutzman 2003). Follow-up meetings were then scheduled on an annual basis to collect cost and production information for that particular year (e.g., 2006).

Researchers (W.B.S. and L.A.G.) collected cost information from the logging contractors through electronic, hard copy, and face-to-face surveys from participants and their accountants and bookkeepers (Stutzman 2003). Annual interviews or questionnaires collected equipment spread by type, make, model number, and year; crew size, job assignments, and years with the operation; and demographic information (i.e., the principal's age, education level, and years in the business). Loggers were asked to provide detailed cost information dependent on business methods used (i.e., logger's books, tax filings, and financial reports; Stutzman 2003). Logging contractors were also asked to provide detailed information on the method of getting stumpage to harvest (i.e., direct purchase, contracts with a wood dealer, from company lands, or other), the percentage of hardwoods and softwoods harvested and usual product mix, years in business, business organization (i.e., sole proprietorship, partnership, limited partnership, limited liability company, sub-S corporation, or full corporation), worker's compensation insurance paid, crew size, labor turnover, method of payment for equipment, current equipment spread, ownership or rental of a shop, computer use, type of business forms used, whether the business required the services of an accountant, and personal opinions on the direction of the logging industry as well as problems faced.

Each logging business had a different way of categorizing expenses. Some contractors provided information in a year-end format consisting of the six logging cost component categories (Table 1), while others provided more detailed financial statements (Stutzman 2003). This information was then placed by researchers into six categories: equipment, consumables, labor, insurance, administrative overhead, and contracted services (Stutzman 2003). For the purposes of the present study, each of these six categories were further broken down by this researcher (X.T.S.) into detailed expenditure profiles to accommodate an input–output analysis in IMPLAN based on logging business expenditures occurring within the state (Table 1). In this study, detailed expenditure profiles for each logger in their respective grouping based on tonnage per year harvested were carefully reviewed, catalogued, and combined with other logger expenditure profiles in that group to obtain an overall weighted average annual expenditure profile for each grouping. All expenditure items were then entered into the events section of the IMPLAN model where appropriate industry sectors were assigned. The analysis was then run with the sample size of 33 loggers.

Economic impact analysis of the logging industry for each group demonstrated the impact logging activity expenditures (e.g., fuel, insurance, equipment purchases, and taxes) in Mississippi had on the state economy. It showed the set of expenditures applied and the interindustry and household expenditure impacts derived from the input–output analysis. Thus, the direct, indirect, and induced linkages of businesses and services gathered from the expenditure profiles were shown for this industry.

Model outputs would take the form of economic impacts per sector. For ease of results reporting, the 440 total sectors in the model were aggregated into nine categories according to the NAICS 2007 two-digit code system. The nine categories were agriculture, forestry, and fisheries (Sectors 1 to 19; NAICS Code 11); mining (Sectors 20 to 22; NAICS Code 21); construction (Sectors 34 to 40; NAICS Code 23); manufacturing (Sectors 34 to 331; NAICS Codes 23, 31, 32, 33, 42, 44, and 45); transportation, communication, and utilities (Sectors 332 to 353; NAICS Codes 48, 49, and 51); trade (Sectors 354 to 356; NAICS Code 52); finance, insurance, and real estate (Sectors 357 to 366; NAICS Code 52 and 53); services (Sectors 367 to 423; NAICS Codes 54 and 52); and institutions (Sectors 424 to 440; NAICS Code 81; MIG 2000).

An aggregated template for sectors was used in the present study to produce direct, secondary, and total impacts: employee income (i.e., compensation); value added; indirect business taxes; employment (full- and part-time jobs); output; and Type SAM and Type I multipliers in both 2006 and 2009 dollars. The state industry multipliers were created using Construct Model from the Model Control Center menu bar in IMPLAN (MIG 2000). The Type SAM multipliers were selected along with only the default household income category in IMPLAN. The household category was considered to be the most common circumstance for building the Type SAM multiplier, comprised the largest component of final demand in the US economy, and captured the induced impact and accommodated for leakages.

Table 1.—Major logging cost categories and components of logging contractor expenditure profiles collected in 2006 from loggers doing business in Mississippi.[a]

Major cost categories	Components of major cost categories
Equipment	Note payments (i.e., principal and interest)
	Depreciation
	Taxes (i.e., highway use and property tax)
Labor	Payroll (wages and interest)
	Payroll taxes (Federal Unemployment Tax Act [FUTA], Federal Insurance Contribution Act [FICA], and Medicare)
	Workers Compensation Insurance (WCI)
	Fringe benefits (i.e., vacation, uniforms, and retirement)
Consumables	Tires
	Fuel
	Oil and lubricants
	Parts and maintenance
	Truck and equipment washing
	Nondepreciable tools
	Gravel
	Mats
	Wrecker service
Administrative overhead	Secretary wages
	Bookkeeping or accounting fees
	Office expenses
	Licenses
	Fines
	Legal and professional fees
	Travel expenses
	Phone and CB radio expenses
	Medical expenses
	Miscellaneous dues and contributions
Insurance	General liability
	Equipment (for fire, theft, vandalism)
	Umbrella policy
Contract services (labor)	Contract trucking
	Excavating
	Road building
	Best Management Practices (BMPs)

[a] Adapted from Stutzman (2003).

Economic impact analysis of survey data with IMPLAN model sector changes

To conduct a new economic impact analysis, the top 20 output sectors in the Mississippi economy resulting from logging contractor expenditure profiles were determined from the baseline analysis using the default model data. Four of the top 20 sectors (i.e., Sectors 351 [telecommunication], 413 [food and beverage], 414 [auto parts, tires, and accessories], and 417 [commercial and industrial machine and equipment]) were chosen based on their contribution to total outputs and the ability to find replacement data. These sectors were used because more improved data either were not available (e.g., extraction of oil and natural gas as well as petroleum refineries) or were compatible with the IMPLAN sectoring scheme (e.g., transport trucking and wholesale trade businesses). In the present study, the break-off point was 20, because the percent contributions tailed off even before the top 20 sectors were identified in the results. Percentages ranged from 14.1 percent being the highest-ranked sector to 1.0 percent being the 20th-ranked sector. Percentages calculated after the 20th-ranked sector were all below 1.0 percent.

New data were acquired from the Mississippi Department of Revenue to replace existing default data and were used in the model because the data were more localized to the state (Mississippi State Tax Commission 2007). Because localized data were expressed in gross sales, it was necessary to convert gross sales to gross margins. A margin is defined as the total revenue remaining once costs of goods sold have been subtracted (Southwick 1994). To derive gross margins, estimated annual gross margin as a percentage of sales of US retail firms by kinds of business was obtained from the Census Bureau and calculated for each of the four output sectors chosen. For example, the gross margin/sales percentage relationship for the food and beverage sector (Sector 413) was 42 percent. All data elements for value added (i.e., employee compensation, proprietor income, other property income, and indirect business tax) along with output value (reported in millions) were subsequently lowered by 42 percent.

New calculated data elements for each sector were uploaded into the model of the state economy. A second model was then reconstructed and run again with the four-sector combinations (Sectors 351, 413, 414, and 417) only. Economic impact analysis was then derived for the combination of all four changed sectors. The Mississippi survey-based model using default data and using localized state data to replace default data were compared with these new results, and differences in total economic outputs were reported. Aggregated sectors were used to report on outputs such as direct impacts, secondary impacts, total impacts, employee income (compensation), value added, indirect business taxes, employment (full- and part-time jobs), and the Type SAM multiplier.

Results

Non–survey-based method economic impacts

Economic impacts were first determined using methods developed by MIG (2000) and Spurlock (2004). Total economic impacts for the logging industry for non–survey-based data in 2006 and 2009 dollars were $2.309 billion and $2.489 billion, respectively. Direct impacts in 2006 and 2009 dollars were $1.179 billion and $1.277 billion, respectively (Tables 2 and 3). These direct impact values represented industries in Mississippi that produced goods and services for consumption by other producers. These other producers also contributed to the economy by purchasing available goods and services needed to supply the direct businesses (indirect impact), which had values of $327.141 million and $353.448 million in 2006 and 2009 dollars, respectively. In turn, the purchasing of available goods and services by employees of direct and indirect industries, known as the induced impact, had values of $656.005 million and $4700.842 million in 2006 and 2009 dollars, respectively. The industry output Type SAM multipliers for the logging industry were 1.83 and 1.82 in 2006 and 2009, respectively. This implied that for every $1.00 increase in output in the logging industry, other industries in the state generated an additional $0.83 and $0.82 in the economy in 2006 and 2009, respectively. The employment multiplier was 2.41 in both 2006 and 2009, which meant that for every one job increase in the logging industry, an additional 1.41 jobs were generated.

Survey-based method logging expenditures

All three groups had similar expenditure profiles capturing nearly the same expenses in each group (e.g., contract hauling, contract labor, fuel, equipment depreciation, and insurance). Ten of the top 100 average annual expenditures incurred for goods and services for the small, medium, and large logger groups are reported in 2006 dollars in Tables 4 through 6. The highest value for the small loggers was fuel, with $160,428/y, followed by wages at $145,000/y, contract hauling at $125,499/y, insurance at $78,525/y, and equipment depreciation at $74,608/y (Table 4). The highest values for the medium loggers were contract hauling, with an average value of $379,515/y, followed by salaries at $334,866/y, depreciation at $206,496/y, fuel at $176,164/y, and insurance at $134,517/y (Table 5). The large loggers had similar results to the medium loggers.

Table 2.—Estimated economic impacts of the logging industry using the Impact Analysis for Planning model default data for Mississippi in 2006 dollars.

Industry	Direct impacts ($)	Indirect impacts ($)	Induced impacts ($)	Total impacts ($)
Agriculture	1,179,563,520	239,168,752	7,036,084	1,425,768,320
Mining	0	2,217,856	31,148,852	33,366,706
Construction	0	566,299	85,168,416	85,734,712
Manufacturing	0	37,170,172	188,934,080	226,104,256
Transportation, telecommunications, and public utilities	0	18,535,968	40,104,192	58,640,160
Trade	0	3,008,619	24,875,504	27,884,122
Finance, insurance, and real estate	0	5,635,792	105,041,392	110,677,184
Services	0	20,838,458	173,697,152	194,535,616
Institution	0	1,110,480	145,587,248	146,697,728
Total	1,179,563,520	328,252,396	801,592,920	2,309,408,804

Table 3.—Estimated economic impacts of the logging industry using the Impact Analysis for Planning model default data for Mississippi in 2009 dollars.

Industry	Direct impacts ($)	Indirect impacts ($)	Induced impacts ($)	Total impacts ($)
Agriculture	1,277,820,416	259,214,800	7,542,157	1,544,577,408
Mining	0	2,490,731	33,088,468	35,579,200
Construction	0	620,878	94,014,128	94,635,008
Manufacturing	0	39,176,304	199,434,784	238,611,088
Transportation, telecommunications, and public utilities	0	19,775,610	42,120,332	61,895,944
Trade	0	3,211,120	26,188,592	29,399,712
Finance, insurance, and real estate	0	6,188,735	109,228,360	115,417,096
Services	0	22,770,322	189,225,728	211,996,048
Institution	0	1,140,083	155,971,232	157,111,328
Total	1,277,820,416	354,588,582	856,813,781	2,489,222,832

Table 4.—Ten of the top 100 average annual expenditures incurred for goods and services purchased by small loggers doing business in Mississippi during 2006.[a]

IMPLAN sector scheme			
No.	Description	Expenditure item	Item average ($)
115	Petroleum refineries	Fuel	160,428
5001	Employee compensation	Wages	145,000
335	Truck transportation	Contract hauling	125,499
358	Insurance agencies, brokerages, and related activities	Insurance	78,525
7001	Other property income	Depreciation	74,608
354	Monetary authorities and depository credit intermediation	Loan/loan payable	49,082
330	Retail miscellaneous	Miscellaneous	47,066
417	Commercial and industrial machinery and equipment repair and maintenance	Equipment repairs	43,476
5001	Employee compensation	Contract labor	34,342
437	Employment and payroll for state and local government noneducation	Taxes	33,500

[a] Small loggers ($n = 13$) were those whose tonnage size ranged from 0 to 68,999 tons. IMPLAN = Impact Analysis for Planning.

Table 5.—Ten of the top 100 average annual expenditures incurred for goods and services purchased by medium loggers doing business in Mississippi during 2006.[a]

IMPLAN sector scheme			
No.	Description	Expenditure item	Item average ($)
335	Truck transportation	Contract hauling	379,515
5001	Employee compensation	Wages	334,866
7001	Other property income	Depreciation	206,496
115	Petroleum refineries	Fuel	176,164
358	Insurance agencies, brokerages, and related activities	Insurance	134,517
5001	Employee compensation	Contract labor	86,243
437	Employment and payroll for state and local government noneducation	Taxes	67,472
414	Automotive repair and maintenance, except car washes	Repairs and maintenance	64,018
414	Automotive repair and maintenance, except car washes	Supplies and parts	43,908
414	Automotive repair and maintenance, except car washes	Parts and maintenance	37,199

[a] Medium loggers ($n = 9$) were those whose tonnage ranged from 69,000 to 149,999 tons. IMPLAN = Impact Analysis for Planning.

Contract hauling for this group was $1.10 million/y, followed by salaries at $873,298/y, insurance at $509,349/y, fuel at $481,151/y, and contract labor at $442,648/y (Table 6).

The total economic impact for the small, medium, and large loggers ($n = 33$) in 2006 dollars were $18.280 million, $26.246 million, and $84.783 million, respectively. Total combined economic impacts for the 33 loggers in the state of Mississippi were $120.310 million and $131.747 million in 2006 and 2009 dollars, respectively. Taken alone, these loggers represented 1.3 percent of the total economic impacts generated by the 2,471 estimated logging contractors (both full- and part-time) in the state of Mississippi. The Type SAM output multipliers for small, medium, and large loggers for the 2006 logging year were 1.77, 1.79, and 1.83, respectively. This meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.77, $0.79, and $0.83, respectively. Total economic impact for the small, medium, and large loggers in 2009 dollars was $19.901 million, $25.756 million, and $86.089 million, respectively. The Type SAM output

Table 6.—Ten of the top 100 average annual logging activity level related expenditures incurred for goods and services purchased by large loggers doing business in Mississippi during 2006.[a]

IMPLAN sector scheme			
No.	Description	Expenditure item	Item average ($)
335	Truck transportation	Contract hauling	1,101,183
5001	Employee compensation	Wages	873,298
358	Insurance agencies, brokerages, and related activities	Insurance	509,349
115	Petroleum refineries	Fuel	481,151
5001	Employee compensation	Contract labor	442,648
7001	Other property income	Depreciation	228,939
414	Automotive repair and maintenance	Repairs and maintenance	214,053
354	Monetary authorities and depository credit intermediation	Equipment note/payment	152,008
437	Employment and payroll for state and local government noneducation	Taxes	104,070
414	Automotive repair and maintenance, except car washes	Parts	77,483

[a] Large loggers ($n = 11$) were those whose tonnage ranged from 150,000 to 430,000 tons. IMPLAN = Impact Analysis for Planning.

multiplier for small, medium, and large loggers for the 2009 logging year was 1.82, 1.78, and 1.77, respectively, which meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.82, $0.78, and $0.77, respectively.

Survey-based data with sector changes

Total overall economic impact for the actual study participants (i.e., 13 small loggers, 9 medium loggers, and 11 large loggers) using the four-sector combination value change was $109.979 million in 2009 dollars (Table 7). Total economic impact of the small logger group with the four-sector combination was $16.422 million. The Type SAM output multiplier for this group was 1.44; therefore, every $1.00 increase in output resulted in other industries in the state generating an additional $0.44 in the economy. The employment industry had a Type SAM multiplier of 1.55. This meant that every $1.00 increase in output generated an additional $0.55 in the economy. Total economic impact of the medium group of loggers was $21.603 million. The Type SAM output multiplier for this group was 1.47, which meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.47 in the economy. The employment industry had a Type SAM multiplier of 1.52, so every $1.00 increase in output generated an additional $0.52 in the economy. Total economic impact of the large group of loggers was $71.568 million. The Type SAM output multiplier for this group was 1.50, which meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.50 in the economy. The employment industry had a Type SAM multiplier of 1.60, meaning that every $1.00 increase in output generated an additional $0.60 in the economy. The percent difference value (compared with the total economic output using default values) calculated with the four-sector combination (i.e., Sectors 351, 413, 414, and 417) value added and total output value changes for the small, medium, and large logger groups were −21.1, −19.2, and −20.2 percent, respectively (Table 8).

Discussion

The IMPLAN database consists of both the national-level technology matrix and regional estimates of final demand, final payments, and gross output (Radtke et al. 1985, MIG 2000). Regional input–output analyses are usually constructed from non-survey data in an effort to save time and money (Kronenberg 2009). The application of input–output information to generate economic impacts for a region, while available, is hindered by the fact that companies and agencies provide data at the national level only (Crihfield and Campbell 1991, MIG 2000, Kronenberg 2009). With the use of non-survey data, it is necessary for the national-level data to be adjusted to supply the state level with data; thus, IMPLAN uses a supply–demand approach (Radtke et al. 1985, MIG 2000). In other words, the model assumes that local demand will be supplied by local firms until local supply and demand is exhausted (Radtke et al. 1985, MIG 2000). It also assumes no constraints on the supply of commodity (i.e., imports will be the same across all industries) and full employment as the norm (Lazarus et al. 2002, Bonn and Harrington 2008). Radtke et al. (1985) stated that these assumptions are inaccurate and, thus, lead to an underestimation of interregional trade and leakages. The size of the economic impact, while dependent on the geographic extent and economic diversity of the region, is more importantly determined by leakages (i.e., net imports) in the economy of interest (Radtke et al. 1985).

Table 8.—Percent differences of estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for small, medium, and large loggers using and comparing a survey-based method for collecting logger expenditures based on value changes in Sectors 351, 413, 414, and 417 with a non–survey-based model using default values (2009 dollars).[a]

Logging contractors	Total output new changes ($)	Percent difference (%)
Small ($n = 13$)	16,422,426	−21.1
Medium ($n = 9$)	21,603,959	−19.2
Large ($n = 11$)	71,568,008	−20.2

[a] Small loggers were those whose tonnage size ranged from 0 to 68,999 tons. Medium loggers were those whose tonnage ranged from 69,000 to 149,999 tons. Large loggers were those whose tonnage ranged from 150,000 to 430,000 tons. IMPLAN sectors refer to telecommunication (Sector 351), food services and drinking places (Sector 413), automotive repair and maintenance (Sector 414), and commercial and industrial machine and equipment (Sector 417).

Table 7.—Estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for small, medium, and large loggers using a survey-based method for collecting expenditures based on value changes in Sectors 351, 413, 414, and 417 (2009 dollars).[a]

Industry	Direct impacts ($)	Indirect impacts ($)	Induced impacts ($)	Total impacts ($)
Agriculture	57,152	143,836	208,780	409,768
Mining	282,290	2,078,058	545,729	2,906,076
Construction	9,357	442,727	143,682	595,766
Manufacturing	14,606,268	5,418,917	4,873,017	24,898,202
Transportation, telecommunication, and public utilities	20,010,882	3,456,804	944,898	24,412,582
Trade	2,864,752	1,180,230	798,843	4,843,824
Finance, insurance, and real estate	10,388,906	2,800,717	3,618,404	16,808,026
Services	11,604,423	3,639,694	4,656,697	19,900,813
Institutions	13,629,921	1,008,576	566,065	15,204,560
Total	73,453,949	20,169,556	16,356,112	109,979,617

[a] Small loggers ($n = 13$) were those whose tonnage size ranged from 0 to 68,999 tons. Medium loggers ($n = 9$) were those whose tonnage ranged from 69,000 to 149,999 tons. Large loggers ($n = 11$) were those whose tonnage ranged from 150,000 to 430,000 tons. IMPLAN sectors refer to telecommunication (Sector 351), food services and drinking places (Sector 413), automotive repair and maintenance (Sector 414), and commercial and industrial machine and equipment (Sector 417).

Thus, differences between total and net imports to an economy, which are not differentiated or present with the use of default data in the IMPLAN model, are developed and present with the use of primary data (i.e., survey data) input into the model. Primary data used with the IMPLAN model employs the use of a technological coefficient matrix that has been developed from surveys of local industries; therefore, estimates of total interregional trades would be generated. IMPLAN and other input–output models are nonstochastic in nature; in other words, meaningful statistical confidence intervals and analysis cannot be generated (Radtke et al. 1985).

Survey data in the present study included detailed information collected from 33 licensed loggers who spent money in Mississippi. Research conducted on loggers in the past has focused primarily on increases in productivity, reduction in logging operation costs, and operation efficiency (LeBel and Stuart 1998, Stuart et al. 2007, Drolet and LeBel 2010). To our knowledge, no economic impact study of logging has been done in Mississippi with the use of survey data. It should be noted that this type of information is difficult to generate, as uncovered during the information gathering stage, for a variety of reasons (i.e., confidentiality, inability to produce the needed data, unwillingness to participate in a research project, and uncertainty regarding how the data would be used; W.B.S., personal communication, 2010). In addition, loggers track expenses in different ways and using different named categories, thus making it a challenge in any study of this type to align like expenses under the proper sectors to be included in IMPLAN. Another constraint that is applicable to all types of analysis of loggers is the continuing reduction of this workforce due to economic constraints. This has an effect of making estimates of logger numbers somewhat problematic.

For the present study, it was determined that the majority of expenses for loggers occurred in-state, with the exception of fuel for transporting wood. Legal requirements regarding fuel taxes may result in fuel being purchased in other states through which wood is transported. In almost all instances, equipment, office overhead, utilities, labor, supplies, accountancy, and professional services were purchased in-state. Financing options for loans made to the equipment company may eventually leave the state, but the first transaction was done locally in Mississippi. Loggers who harvested or delivered wood in Mississippi and along other state borders purchased fuel, labor, and supplies from local firms in Mississippi (W.B.S., personal communication, 2010). Logging contractors tend to employ locals for convenience and mobility reasons and to contract for services (i.e., trucking and road building) from local firms as well. Also, insurance is purchased in-state to avoid legal complications. In addition, out-of-state loggers either passing through Mississippi or providing contract services in the state are purchasing items locally mainly because logging supplies are bulky, heavy, and expensive to transport (W.B.S., personal communication, 2010). The three groups of loggers all shared similar expenses (i.e., contract hauling, contract trucking, fuel, salaries, insurances, taxes, and equipment purchasing).

A constraint in the present study using survey-based data was its low sample size of 33 loggers. While it is important that enough surveys are gathered so that the sample size is an accurate representation of the entire population being surveyed (McNamara 1994, Meyer 2002), this is the best available data set for Mississippi. An appropriate calculated sampling size based on the 2,471 registered logging contractors in Mississippi was 332 (McNamara 1994, Meyer 2002). In other words, 332 logging contractors were needed in this economic impact analysis for a representative sample of the Mississippi population (McNamara 1994, Meyer 2002). The detailed level of data required (e.g., logger's financial reports), however, were considered to be very confidential, and in most instances, logging contractors and logging firms were reluctant to cooperate in studies of this nature (Stutzman 2003). As a result, several biases were present. For example, the survey relied particularly on convenience and volunteer samples drawn from logging contractors who had willingly provided financial information. As a result, sampling error (i.e., surveying only some, and not all, randomly selected elements of the survey population) and volunteer bias (i.e., sample members are self-selected volunteers) were evident in this study (Salant and Dillman 1994).

Increasing sample size of logging contractors in future studies would reduce sampling error (i.e., surveying only some, and not all, randomly selected elements of the population) and allow a lower variance in the sample data (Salant and Dillman 1994). Of note, the primary study objectives were to estimate the effects of industry sector changes within the IMPLAN default software model and compare those results with a survey-based replacement model. As a result, a wide range of accurate and reliable survey data could have been used to fulfill the study objectives. Due to time constraints and the relative importance of specific economic sectors to the industry, the researcher (X.T.S.) was unable to conduct independent surveys and, as a result, relied on previously collected logging contractor expenditure profiles to illustrate the effects of the replacement model. It was for this reason that surveyed data were chosen; however, the use of an extrapolation of logger numbers based on data from the 33 loggers has given us an indication that using previous methods, the economic impacts of loggers in Mississippi are being underestimated.

In terms of the sample sizes used, other researchers have also had small sample sizes when gathering and conducting research of this nature. For example, LeBel and Stuart (1998) conducted research in the eastern United States (e.g., Michigan, Virginia, and Georgia) comparing the technical efficiency of converted inputs (i.e., dollars of capital, consumables, and labor output per ton of wood) by only being able to sample a total of 23 logging contractors, while Cutshall et al. (2000) only sampled 19 logging contractors in the eastern United States (e.g., Michigan, Virginia, and Georgia) location when trying to demonstrate how logging costs have steadily risen at a faster rate than logging contracts received.

Data collected and interpreted in the present study allowed a number of observations regarding the validity of the IMPLAN model as seen in other studies. For example, Radtke et al. (1985) concluded that impacts estimated by the IMPLAN model were higher than those estimated by primary data in their models in four of five cases. Results showed that in the fifth case, where the IMPLAN estimates were lower, greater inter-industry purchases were observed for the particular area and that related labor expenses were 30 percent of all ranching expenses, while for the other four, labor expenses were only 10 percent. Lazarus et al. (2002)

compared primary data based on Regional Purchase Coefficient (RPC) estimates with econometrically derived default RPCs in the IMPLAN model. Results of their study indicated that the primary data estimates were higher than the IMPLAN default values while, at the same time, the primary data RPCs were smaller than default model estimates. Lazarus et al. (2002) suggested that the IMPLAN default data were probably underestimating the local supply and/or suppliers may have been acting as wholesale distributors of inputs, while IMPLAN data represented the manufacturing of the inputs. Similarly, Crihfield and Campbell (1991) found that IMPLAN underestimated total employment for 10 of 11 sectors in a particular county in Illinois. For the present research study, impacts estimated by IMPLAN using model default data values were of a higher value than those estimated using the survey-based data replacement model.

From a modeling standpoint, past research has focused primarily on changing different components within the model. For example, the study by McKean and Spencer (2003) focused on IMPLAN treatment of final payments (i.e., proprietor and other property income) by creating and focusing primarily on the Type II multipliers for the study region. Lazarus et al. (2002) focused primarily on changing the production function and RPCs. Both studies maintained the use of the IMPLAN default data. The present study, in part, focused on the default data within the model itself.

The major constraint with the IMPLAN software model is the estimation of state-based data gathered from regional or national data. This assumption could lead to an over- or underestimation of multipliers, because it does not capture a true representation of a state's industries and their impact on the economy. In the present study, as opposed to McKean and Spencer (2003), output values for key economic sectors were adjusted with localized data, and in turn, all four value-added components (i.e., employee compensation, proprietor income, other property income, and indirect business tax) also were adjusted.

A certain type of expertise and persistence is needed to gather survey data used in the present study for the logging industry and was achieved by researchers at MSU with over 20 years of experience. During this period, there has been a continuous decline in recruiting young and new loggers into the profession, most recently due to a prolonged economic recession that hit this industry long before it affected the US economy as a whole. Also, there has been difficulty in recovering from natural disasters (e.g., hurricanes and ice storms), a lack of interest from upcoming generations, and a dearth of required financing necessary to start, manage, and maintain a new business. Due to the type of information required from logging contractors (i.e., business and financial records), it was very difficult to gather data of this nature, and hence the reason for only 33 logging contractor expenditure profiles. The 2006 logging year was used, and not a more current logging year, because this was the most current data available at the start of this project. In addition, considerable effort had to be made in preparing this information for use in IMPLAN as well.

The makeup and components of sectors used and described by the IMPLAN model were not always clearly labeled, which at times proved challenging when comparing them with Mississippi Tax Commission data and vice versa. It was evident that the IMPLAN sectors were too highly aggregated. For example, Sector 326 is defined as retail gasoline stations in IMPLAN and as gasoline service stations with the Mississippi Tax Commission data. It was challenging to decipher whether retail gasoline stations in IMPLAN included other services, such as shopping mini-marts found at gas stations, or vice versa with the Mississippi Tax Commission data. For many of the top 20 ranked output sectors, more improved data were not available (e.g., travel trailer and camper manufacturing, fertilizer manufacturing, petroleum refineries, and extraction of oil and natural gas); thus, the default data had to be used. For future studies, data could be improved through extensive in-state surveys to collect a better set of data for specific business, industrial, and service sectors.

Conclusions

The IMPLAN software model has been used primarily for determining economic impact analysis; however, IMPLAN's adjustment of national data gathered from both the Census Bureau and the BLS has affected economic impact analysis results at state and county or parish levels. Although study results only examined one logging operation year and 33 logging contractors, these research findings will increase awareness about the validity of the model and the need for more localized data. In this analysis, based on research findings, there were indications that the IMPLAN model may be underestimating the true value of the logging industry on the state economy of an individual state. The case could be made that if 33 loggers (of an estimated 2,471 full- and part-time logging contractors and firms) are providing \$131.747 million in 2009 dollars in economic impacts to the state, and with all else being equal (e.g., expenditures profiles by operation size), there is a strong indication that this may be true. As a result, IMPLAN users should be made aware of these discrepancies in the model and try using alternative methods (e.g., surveys and focus groups) to input data into the model rather than relying solely on the data within the model. In addition, efforts should be made to improve the model data when feasible. For future studies, data could be improved through extensive in-state surveys to collect a better set of data for specific sectors. In addition, it is important to determine the break-off point by taking into consideration the percentage of output of the ranked sectors. Last, all economic impact analysis conducted using the IMPLAN model should provide information on institution categories when model construction is being accomplished and a detailed description of data/impact analysis and multiplier calculations to further support results.

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