Examining impact analysis for planning (IMPLAN) analysis of waterfowl hunting and the logging industry in Mississippi

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EXAMINING IMPACT ANALYSIS FOR PLANNING (IMPLAN) ANALYSIS OF WATERFOWL HUNTING AND THE LOGGING INDUSTRY IN MISSISSIPPI

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EXAMINING IMPACT ANALYSIS FOR PLANNING (IMPLAN) ANALYSIS OF

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Economic impact analyses were conducted on waterfowl hunting and the logging industry in Mississippi to determine the validity of the Impact Analysis for Planning (IMPLAN) input-output software model and associated 2007 databases. Detailed expenditure profiles were collected separately for the two studies through mail, electronic, and face-to-face surveys and analyzed with separate models using default data within IMPLAN itself. Additionally, for the logging industry, total economic impacts (i.e., direct, indirect, induced) were estimated within the IMPLAN model by removing the total employment for the relevant sector and calculating the impact on the state economy. This procedure was recommended by Minnesota IMPLAN Group, Incorporated (MIG, Inc.). Economic impact results derived from replicating this method were first compared to economic impact results derived with a population size of (N=2,471) loggers and second, with a sample size of (n=33) loggers. The top 20 output sectors in the state economy from both waterfowl hunting and logging expenditures were determined from model results. In turn, new data were acquired and used in each model that was more localized to the state, to replace one, two, three, and four of the top 20

sectors of importance for each industry, respectively. Multiple IMPLAN models were then reconstructed to determine economic outputs. The Mississippi default models and survey-based data default models, and survey-based data replacement models were compared, and differences in total economic outputs derived. Results using sector changes yielded different results for both industries in comparison to default values used within the model, making the case that the IMPLAN model has the potential to both understate and overstate economic impacts to Mississippi or any state economy for recreation and industry activity.

DEDICATION

To my family; thank you for giving me love, encouragement, and support while pursuing my childhood dream.

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encouragement; and to Roger, thank you for your undying love, encouragement, support, and dedication during the good and bad times.

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CHAPTER I

INTRODUCTION

Economic impact analysis traces the flow of spending associated with specific activities within a region to identify changes in sales, income, jobs, and revenues (Frectling 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 proposed stage, currently in existence, or to evaluate losses to an economy if they ceased to exist. There have been numerous studies describing the economic impact analysis of various survey and non-survey 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. 1990a; Loden et al. 2004; Cutshall et al. 2000; Bonn and Harrington 2008; Perez-Verdin et al. 2008; Grado 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, jobs) that are major determinants of total economic impacts. These studies involved either the use of expenditure data input in the model or through 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 includes on-site, food, travel, lodging, and equipment expenses collected along with the purchase location for each item (Loden et al. 2004).

The default IMPLAN software model has been used to perform a number of economic impact analyses covering a wide range of projects or activities. (Brucker et al. 1990; Charney and Leones 1997; MIG, Inc. 2000; Kronenberg 2009). For example, Tanjuakio et al. (1996) determined the economic contribution of agriculture in Delaware. Lazarus et al. (2002) analyzed the economic impacts of swine operations at the county and state level in Minnesota and determined how impacts were affected by the economic structure of the region. Hefner and Blackwell (2006) determined the economic impact of the recycling industry in South Carolina. Russell (2006) determined the economic significance of the aviation industry in Wisconsin to assist policymakers in evaluating airport operations and improvements. Capital Link (2007) along with the Health Federation of Philadelphia (HFP) determined the economic impact of community health centers in Philadelphia using the IMPLAN model while Crowly and Imhof (2011) examined the impact the commercial casino industry has on the Colorado economy.

The use of default IMPLAN model to perform economic impact analysis on recreational activities was numerous as well. For example, Stoll et al. (2002) determined the economic impact of charter and party boat operations in a five-state U.S. Gulf of Mexico study area while Daniels et al. (2004) determined methods for estimating income impacts of sport tourism events. Douglas and Harpman (1995) estimated recreation employment impacts for the Glen Canyon Dam Region as well as the economic implications of water-based recreational activities along the Colorado River.

Rezek and Grado (2008) determined recreational visitation patterns on lake impoundments in East-Central Mississippi from rural development projects. It has also been used for commercial activities. For example, Pomeroy et al. (1988) used IMPLAN to determine the economic impact of coastal and recreational tourism on South Carolina's economy. Bergstrom et al. (1990a) similarly used IMPLAN in a case study to determine the economic impacts of recreational spending on rural areas. Their study revealed that similar studies were severely lacking and thus, greatly needed. Cordell et al. (1992) addressed the local and statewide economic impacts of resident and nonresident visits to a state park in Kansas. Upneja et al. (2001) addressed economic benefits of sport fishing and angler wildlife watching in Pennsylvania.

From a forest and forest products perspective, Teeter et al. (1989) determined the interregional impacts of forest-based economic activity. Aruna et al. (1996) found that forestry and forest-based industries in the southeastern region of the United States have made significant contributions to the economies of each state in the region. Cox and Munn (2000) also used IMPLAN to examine forest industry contributions to regional economies of the South and Pacific Northwest Regions of the United States Tilley and Munn (2007) also derived economic impacts of the forest products industry in the Southern U.S. region with IMPLAN using economic multipliers. Perez-Verdin et al. (2008) also used IMPLAN to derive economic impacts of woody biomass utilization for bio-energy in Mississippi. Over the past decade, periodic studies have been completed to establish the economic impacts of Mississippi's forestry industry, which includes the four components of logging, pulpwood and paper, solid wood products and wood furniture (Aruna et al. 1996, Munn and Tilley 2005, Munn and Henderson 2008).

It is known that waterfowl recreational expenditures and logging expenditures contribute to the economy of Mississippi; however, these expenditures have not been quantified using localized data to replace default data contained within the IMPLAN software model. In the case of the former only one state-wide study exists at all (Grado et al. 2011). Results derived from these analyses were particularly useful for estimating impacts of economic changes (e.g., policy changes, natural disasters, employment, business activity, public service demands) and understanding interrelationships, economic linkages and trends of economies. Flick et al. (1980) and Radtke et al. (1985) conducted studies that focused on comparing the economic contribution various activities had on specific economies of interest. They outlined two different approaches: a unique comparison of the primary data versus secondary data found within the IMPLAN model. Primary data is data collected by the investigator conducting the research and secondary data is data collected by someone other than the user (e.g., censuses, prior surveys). It was these two issues, namely data collected by activity participants and the use of localized data that this research sought to address relative to a recreation activity and forestry-related activity.

Studies using the IMPLAN model, such as waterfowl hunting and logging in Mississippi are classic examples that will contribute significantly to efforts aimed at describing expenditures and their associated economic impacts. Additionally, and perhaps most importantly, agencies, the legislature, special interest groups, and the public will take more seriously results from these types of studies that have been criticized in the past for either over-stating or understating the value of natural resource-based projects and activities. The primary purpose of this study was to evaluate and improve the current methodology of deriving data sources and collecting data for use in IMPLAN to more accurately use, and be able to support inputs and outputs associated with economic impact models, specifically those generated by IMPLAN. Study objectives for waterfowl hunting were to: (1) identify how the statewide software model default estimates and statewide localized data level estimates differ from each other, (2) determine how the statewide software model default estimates and localized data level estimates affected

IMPLAN model outputs while quantifying the economic impacts of waterfowl hunting in Mississippi. Study objectives for the logging industry were to (1) determine the economic impact of the logging industry by using the total impacts (i.e., direct, indirect, and induced) and removing the total employment for the relevant sector (s) and calculating the impact on the state economy resulting from the total loss of industry production for the relevant sector (s), (2) identify how results from this methodology differs from using statewide expenditure data estimates collected through surveys; first, with an estimate of the population of loggers operating in Mississippi (N=2,471) and second, using a sample of survey loggers (n=33), and (3) determine how a change in IMPLAN sector estimates using the statewide localized data affected IMPLAN model outputs; first, with an estimate of the population of loggers operating in Mississippi (N=2,471) and second, using a sample of surveyed loggers (n=33).

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CHAPTER II

LITERATURE REVIEW

Input-Output Analysis and Models

Input-output analysis is an analytical framework originally developed 253 years ago by Francois Quesnay with the publication of the *Tableau Economique* (Miller and Blair 1985). More than a century after in 1874, Leon Walras expounded on Quesnay's work; however, it was not until the 20th century that Wassily Leontif simplified Walras's theoretical framework (Miller and Blair 1985). He later developed the concept of multipliers from input-output tables that earned him the 1973 Nobel Prize). Input-output analysis is a frequently used tool for estimating economic impact studies and examining relationships within an economy and capturing market transactions for consumption in a given time period (Miller and Blair 1985; Brucker et al. 1990; MIG, Inc. 2000; Bonn and Harrington 2008; Kronenberg 2009).

Input-output is best understood through the inter-industry transaction table/matrix (Miller and Blair 1985). This table graphically and numerically represents detailed accounting of inter-industry activity (i.e., relationships between sales and purchases of sectors of the economy) in a systematic way (Miller and Blair 1985; Table 1). The matrix rows describe the distribution of producer's output that a single sector provides to all other sectors throughout the economy and matrix columns describe the composition of inputs required by a particular industry sector to produce its output. In other words, each row of the input-output represents the value of an industry's outputs, and each column of the input-output matrix reports the monetary value of an industry's inputs (Miller and Blair 1985; MIG, Inc. 2000; Bonn and Harrington 2008).

The inter-industry exchanges of goods are represented in the shaded portion of Table 1. There are additional columns labeled final demand (i.e., consumer purchases, private investment purchases, government purchases, exports) represents sales by each sector to final markets for their production (Miller and Blair 1985; MIG, Inc. 2000, Bonn and Harrington 2008). The value added row (i.e., wages and salaries, profit-type income, interest, dividends, rents, royalties, capital consumption allowances, indirect business taxes) provides an estimate of the 'value' added to goods and services as a result of the economic activity (MIG, Inc. 2000).

In recent years, researchers, governmental agencies, and other organizations in the United States have become increasingly concerned about the extent of impacts various industries and businesses have had on the national economy and those of their respective states, counties, and parishes. Interest stemmed from the demand for regional models to expand traditional rural development programs in the United States Department of Agriculture (USDA), the loss of key industries (e.g., steel, textiles, general manufacturing) in many areas within the United States coupled with the need to attract new businesses to affected communities (Brucker et al. 1990; Taylor and Fletcher 1992). As a result, the three most widely used ready-made models: Regional Input-Output Modeling System (RIMS-II) produced by the U.S. Department of Commerce/Bureau of Economic Analysis (BEA); Regional Economic Modeling, Incorporated (REMI); and Impact Analysis for Planning (IMPLAN) produced by the USDA Forest Service and now maintained by a private company have been developed to help address these issues (Bergstrom et al. 1990a; Taylor and Fletcher 1992; Rickman and Schwer 1995). Apart from RIIMS, REMI, and IMPLAN, other models were developed (i.e., ADOTMATR by Lamphear et al. 1983; RSRI by Stevens et al. 1983; and SCHAFFER by Schaffer and Davidson 1985) (Brucker et al. 1987). These input-output models however, have not gained popularity and were not continuously improved in comparison to RIMS, REMI, and IMPLAN.

RIMS-II, a static input-output model, is designed to provide input-output type multipliers for any region composed of one or more counties and for any industry or group of industries. The model uses the location quotient (LQ) method to regionalize the national technical coefficients (Drake 1976; Rickman and Schwer 1995). In other words, it assumes that local demand is satisfied first, and the remainder of an industry's output is assumed to be exports (Rickman and Schwer 1995). It uses unsuppressed BEA national input-output tables at a 500 industry level of disaggregation using a series of spreadsheets. The RIMS-II method for estimating regional multipliers is viewed as a three-step process where the producer portion of the national input-output table was made region-specific by using four digit Standard Industrial Classification (SIC) location quotients, step two is a regionalization of household rows and column to adjust for regional consumption, savings and tax rates, and in step three the Leontief inversion approach is used that produced output, earnings, and employment multipliers (Brucker et al. 1990; Lynch 2000). Accessibility of the main data sources, level of industrial detail, and comparison of multipliers across areas of interest have contributed to the popularity of the RIMS-II model. It has been used mostly in the public sector to estimate regional impacts of military base closings and airport construction and expansion projects (Lynch 2000). RIMS-II uses only a series of spreadsheets for the user to conduct economic impact analysis in comparison to other models (i.e., REMI, IMPLAN) that use menu driven computer programs. In addition, RIMS-II is incapable of predicting economic growth (U.S.DC 1997).

Table 1 Input-Output Transactions Table

		PRODUCERS								FINAL DEMAND			
		Agriculture	Mining	Construction	Manufacturing	Trade	Transportation	Services	Other	Personal Consumption Expenditures	Gross Private Domestic Investment	Net Exports of Goods and Services	Government Purchases of Goods and Services
PRODUCERS	Agriculture												
	Mining												
	Construction												
	Manufacturing												
	Trade												
	Transportation												
	Services												
	Other												
VALUE	Employees	Employee Compensation								GROSS NATIONAL PRODUCT			
ADDED	Owners of Business and Capital	Profit type income and capital consumption allowance											
	Government	Indirect business tax											

Adapted from 'Input-Output Analysis: Foundations and Extensions,' by Miller, R.E. and Blair, P.D. 1985, 464p. Copyright 1985 by Prentice-Hall, Inc., New Jersey.

REMI is the most well known dynamic model used to estimate time paths of economic impacts and forecast economic growth over multiple year time frames (Rickman and Schwer 1995; Bonn and Harrington 2008). It is best described as an eclectic model that links an input-output model to an econometric model that allows users to manipulate input variables. The overall model structure can be summarized in five major blocks: - (1) Output; (2) Labor and Capital Demand; (3) Population and Labor Supply; (4) Wages, Prices, and Costs; and (5) Market Shares. Once the econometric specifications are suppressed, the model collapses into an input-output model (Rickman and Schwer 1995; Lynch 2000). National technical coefficients that are regionalized using the regional purchase coefficient (RPCs) technique acquired from the Bureau of Labor Statistics (BLS) are used along with a 493 sector scheme, however, with very limited industry detail. The model can be calibrated from national to local areas for policy analysis and forecasting with each calibrated area providing detailed economic and policy variables for testing the economy of interest (Lynch 2000). Due to the detailed nature of the model, an extensive amount of data is required, specifically, data on employment, income and output (Lynch, 2000). REMI uses three sources of employment and wage and salary data namely the BEA employment, wage, and personal income series, ES-202 establishment employment and salary data, and County Business Patterns (CBP) data acquired from the U.S. Census Bureau (Rickman and Schwer 1995; Lynch 2000; Bonn and Harrington 2008). REMI is comprised of many equations, whereby the exact number needed varies on the extent of industry, demographics, demands, and other details in the specific model being used (Rickman and Schwer 1990; Lynch 2000). REMI's greatest advantage is that it can be used extensively to measure proposed legislative and other program and policy economic impacts in both the public and private sectors (Bonn and Harrington 2008). The structure of the REMI model is based on complex formulas that are difficult for most people to understand and explain, therefore, questioning or calculating the assumptions behind the model remain difficult. In addition, although the model uses a wide range of variables (i.e., labor and capital demand, population and labor supply, wages, prices, and costs, market shares) to predict economic growth, it has a very limited industry sector detail in comparison to other models (i.e., IMPLAN software model) (Lynch 2000, MIG, Inc. 2000).

IMPLAN was originally designed by the USDA-Forest Service as a non-survey-based input-output model (Crihfield and Campbell, Jr. 1991; MIG, Inc. 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 BEA, U.S. Bureau of Labor, and U.S. Census (MIG, Inc. 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 3, 4, or 6 digit NAICS level codes. New datasets are released annually by a private company located in Minnesota and they include regional employment, income, value-added, household, and government consumption. Data found within the annual datasets have an exclusive national input-output structural matrix and trade flows model that can both be modified (MIG, Inc. 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, Jr. 1991; Lynch 2000). IMPLAN data is designed to be internally consistent so that county data sum to state totals, state data sum to region totals, and region data sum to national totals (Crihfield and Campbell, Jr. 1991).

Similar to REMI, IMPLAN assumes a uniform national production technology and uses the RPC approach to regionalize technical coefficients which show the value of total inputs purchased from all sectors in the economy irrespective of the geographic origin of the purchase (MIG, Inc. 2000; Karkacier and Goktolga 2005; Bonn and Harrington 2008). The IMPLAN software model has been used to analyze a variety of issues including, but not limited to recreational activities, military base closings, land and resource management planning, and economic base analysis (MIG, Inc. 2000).

Advantages and comparisons of using RIMS-II, REMI, and IMPLAN

A major strength of the RIMS-II model is that the user did not have to inflate or deflate data. RIMS-II multipliers were updated to reflect the most current year data within the spreadsheet. However, the user would be the one responsible for actually setting up and calculating multipliers (Lynch 2000). RIMS-II multipliers can be estimated for any region composed of one or more counties or parishes as well as any industries in the national input-output table (U.S.DC1997). The major strengths of REMI and IMPLAN are that they both provide detailed estimates of sectors at the county or parish level. Bonn and Harrington (2008) were of the opinion that REMI was better at providing finer data at this level than IMPLAN, however, at a vastly greater price. Most importantly, the REMI model uses theoretical structural restrictions instead of individual econometric estimates and is most powerful at predicting future economic growth. IMPLAN on the other hand, relies solely an I/O methodology with a one year static forecast (Bonn and Harrington 2008). The IMPLAN model, however, separates itself from the other two models by being the most user-friendly and economical. Although REMI is fairly easy to use, Lynch (2000) stated that entering required data within

IMPLAN seemed easier. Most importantly however, IMPLAN is the only model that allows internal customization of its databases and other facets of the model [e.g., Regional Purchase Coefficients (RPC's), production functions] (MIG, Inc. 2000; Bonn and Harrington 2008).

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, Inc. 2000; EDRG 2005). Users can also generate Type I and II or Social Account Matrix (SAM) multipliers based on their preferences, by choosing to internalize household, government, and/or investment activities (Bonn and Harrington 2008). IMPLAN is also the only model that provides a breakdown of its impacts into direct, indirect and induced impacts. Direct impacts refer to the portion of regional sales retained by regional businesses and allocated as final demands to the appropriate industrial sectors; it is the first impact to the economy. Indirect impacts are the changes in inter-industry purchases as they respond to the new demands of the directly affected industries. Induced impacts are the changes in spending from households as income increases or decreases due to changes in production. It is tied to direct and indirect sectors sales (MIG, Inc. 2000).

The IMPLAN model was chosen for this study because it is the most interactive, hands-on model with user friendly programming features (MIG, Inc. 2000). It has a detailed database with high sector specification, user calculated output, employment, and income impacts of changes in a region's industrial activity and a complete set of county level economic accounts, social accounting matrices. IMPLAN also has user specified sector aggregation for tables, and impact analysis software with support for deflation, margining, and structure for complex sets of expenditures (MIG, Inc. 2000). It also has a built-in structure for complex sets of expenditures, complete technical support to registered users covering all software, modeling, and project related issues, as well as the ability to construct and re-construct multiple and additional models with updated data that can be purchased annually. Most important however, IMPLAN provides the user with the option to change data within the model (i.e., internal customization) if better data is available (Lynch 2000; MIG, Inc. 2000; McKean and Spencer 2003; EDRG 2005; Bonn and Harrington 2008).

Shortcomings of the IMPLAN model

Although IMPLAN may outweigh the other two models described, it has its limitations. System bias occurs as a result of consistent over or under statement of parameters and variables in the IMPLAN model database. Maki et al. 1994 suggested that this was a result of a structural assumption in the model and database estimation. For example, IMPLAN does not take into account the effects of workers commuting across county boundaries or spatial variations in earnings per worker and output per worker with individual industries. Crihfield and Campbell, Jr. (1991) further suggested that IMPLAN goes to an opposite extreme assuming that all new jobs are filled by local residents. Another limitation of the IMPLAN model occurs with the aggregation of various industrial and commercial sectors in the model software. For example, there is only one harvesting sector and one processing sector that fall under the fishery sector (ESSRP 2006). As a result, this high aggregation of data in the fisheries sector would not account for changes that typically occur in fisheries management (i.e., changes in the harvest of certain species, and/or changes in the catch by certain types of vessels) (ESSRP 2006) and thus an economy. Another limitation of the model is the application of national technical coefficients to disaggregated regions that tend to ignore geographical differences in production processes and variations occurring between firms in an industry (Bergstrom et al. 1990b). Internal customization allows the user to replace and adjust data; however, national technical coefficients may change over time and are not readily updated by IMPLAN on a yearly basis (Bergstrom et al. 1990b).

IMPLAN also assumes that industries within the regional economy remain stable. This assumption is incorrect, when, for example, the loss of one major industry (e.g., closure of a particular industry) in a rural or small community may have serious implications on the rest of the economy (Bergstrom 1990b). IMPLAN accounts only for economic variables (i.e., production, spending, employment) and does not account for the labor force, population (e.g., migration, births, deaths), and loss of industries and thus, activities within a region (ESSRP 2006; Bonn and Harrington 2008).

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, Inc. 2000). Riggs et al. (2011) defined a sector as a group of firms engaged in the same general type of business. IMPLAN sectors 1-426 are all private sector producers of goods and services with the exception of sector 427 which contains both private post office activities as well as the quasi-public U.S. Postal Service (MIG, Inc. 2000). Public sector producers of goods and services range from 428-432 while IMPLAN sectors 433 to 440 are the government administrative sectors. For ease of reporting results, the 440 total sectors in the model were aggregated into nine categories according to the 2007 NAICS two digit code system. The nine categories were Agriculture, Forestry, and Fisheries (sectors 1-19) (NAICS code 11); Mining (sectors 20-22) (NAICS code 21); Construction (sectors 34-40) (NAICS code 23); Manufacturing (sectors 34-331)(NAICS codes 23 ,31, 32, 33, 42, 44, 45); Transportation, Telecommunication and Public Utilities (TCPU) (332-353)(NAICS code 48, 49, 51); Trade (sectors 354-356)(NAICS code 52); Finance, Insurance, and Real Estate (FIRE)(sector 357-366)(NAICS code 52, 53); Services (sectors 367-423) (NAICS code 54)(NAICS code 52); and Institutions (sectors 424-440) (NAICS code 81) (MIG, Inc. 2000).

Economic impact multipliers

Multipliers are used to describe how the economy reacts to a particular change in activity within the economy of interest. For example, they measure impacts such as a new investment, start up of a new business, and re-spending of new dollars within an economy (Riggs et al. 2011). Multiplier size was 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. Second, regions with large economies 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 which are 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 this economy indicating the need for more retail, wholesale, or producer enterprise-development in that particular area of interest (MIG, Inc. 2000).

Economic impact multiplier reports

Multipliers break the effects of stimuli on economic activity into three components namely, direct, indirect, and induced impacts (MIG, Inc. 2000). There are three different types of multipliers used in the IMPLAN software model: Type I, Type II, and Type Social Account Matrix (SAM). 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. In other words, it is a measure of the original impact expenditures as well as the indirect impacts of industries buying from each other (MIG, Inc. 2000).

$$\text{Type I} = (\text{Direct Impacts} + \text{Indirect Impacts}) / \text{Direct Impacts} \tag{1}$$

Type II multipliers

Type II multipliers are defined mathematically as the sum of direct, indirect, and induced impacts divided by direct impacts (Aruna et al. 1996).

$$\text{Type II} = (\text{Direct Impacts} + \text{Induced Impacts} + \text{Indirect Impacts}) / \text{Direct Impacts} \tag{2}$$

SAM multipliers

The 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, Inc. 2000). The SAM multiplier is considered a flexible analytical tool giving the user the option to include or exclude certain institutions. Including/internalizing certain or all institutions builds the activities of those institutions into the SAM multiplier. In other words, it was assumed that every dollar collected locally by the particular institution was re-spent for that local institution's operations and programs (MIG, Inc. 2000). It was further assumed that this would allow the capturing of all induced impacts and some of the leakages that would result in smaller multipliers.

The exclusion of certain institutions in the model construction option of IMPLAN was highly recommended (MIG, Inc. 2010). IMPLAN suggested that for the default Type SAM multiplier option, household consumption should be the only multiplier option included in model construction while the other institution categories (i.e., sales to government, gross private domestic investment, shipments in foreign trade) should be excluded. Theoretically, it was assumed that households earn income as a result of labor (i.e., employee compensation) and/or proprietor income. Employee compensation alone accounts for leakages (e.g., payment of monies to federal, state, and local governments, social insurance, domestic trade (i.e., commuters) that are not included in the multiplier formation (Miller and Blair 1985; MIG, Inc. 2010). Miller and Blair (1985) also suggested that household expenditures alone comprised one of the largest components of final demand in the U.S. economy and it was responsible for at least two-thirds of final demand. Other types of multipliers generated from model runs were classified as output, employment, income, and value-added. Output multipliers record the total change in output throughout all industries created by an additional dollar of final demand in any one industry (MIG, Inc. 2000). Employment multipliers measure the total impact on the state's employment when an industry changes its employment by only one job and value-added multipliers estimate the effects on value-added generated from the production output for final demand (Aruna et al. 1996, MIG, Inc. 2000). Income multipliers measure the total increase in income in the local economy as a result of a one dollar increase in income received by workers and value added multipliers provide an estimate of the value added to the product as a result of the economic activity. Income or any of the value added components are derived from the relationship between income and output (MIG, Inc. 2000). .

Type SAM = (Direct Impacts + Indirect Impacts+ Induced Impacts)/ Direct Impacts (3)

Social accounts

Social accounts are trade flows that specify the transfer of goods and services between a particular region and the rest of the world. It is necessary for social accounts to be constructed before economic multipliers can be calculated because social accounts show the flow of money between institutions (MIG, Inc. 2000). Regional purchase coefficients represent the proportion of local demand purchased from local producers. For example, an RPC of 0.25 for a given commodity means that for each $1 of local need, only 25% can be purchased from local producers (MIG, Inc. 2000). Supply/demand pooling assumes that everything that can be purchased locally will be. This approach tends to maximize multipliers since it assumes consumers will not buy imports unless local supply is unable to meet local demand (MIG, Inc. 2000). Location quotients measures an industry's concentration compared to a base area. In other words, it compares the ratios of local production to national production ratios. It assumes that the commodity will be purchased locally if production exists in the region (MIG, Inc. 2000).

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CHAPTER III

EFFECTS OF SECTOR CHANGES IN IMPACT ANALYSIS FOR PLANNING (IMPLAN) MODEL INDUSTRY SECTOR DATA ON WATERFOWL HUNTING IN MISSISSIPPI

Abstract

To better understand the economic contribution of waterfowl hunting in Mississippi, primary expenditure data were derived from an extensive mail survey conducted during the 2005-2006 Mississippi hunting season. Survey results were then analyzed using the latest Impact Analysis for Planning (IMPLAN) input-output software model and 2007 version of the state economy. The first state model was created using default data within IMPLAN itself. The top 20 output sectors in the state economy resulting from waterfowl hunting expenditures were determined from model results. In turn, new data more localized to the state were acquired from various sources and used in the model to replace four of the top 20 sectors of importance. A second IMPLAN model was then constructed to determine economic impacts. The Mississippi survey-based data default models and survey-based data replacement models were compared, and differences in total economic outputs were derived. It was found that the original model had overestimated the state economic impacts. Economic contributions generated from the survey-based default model was $158 million (2010 USD) and supported 1,981 full- and part-time jobs for the 2005-2006 waterfowl hunting season. Economic contributions using survey-based data replacement model was approximately $153 million (2010 USD)

and supported 1,517 full- and part-time jobs. Separate model runs using 1, 2, 3, and 4 sector changes yielded vastly different results, making the case for changing as many sectors as possible. In sum, when undertaking recreation-based activities, it is recommended that more localized data be used in the IMPLAN model when such data is available.

Introduction

Mississippi is rich with both forested and wetland areas that provide a multitude of habitats for an abundant number of wildlife species. Located in the southeast region of the United States, Mississippi forms the lower part of the Mississippi Flyway route for migratory birds attempting to fly south to warmer climates (Lindsay 1999). The presence and abundance of agricultural and forest lands and wetlands used as food and habitat for these birds, has led to a vast number of waterfowl species such as gadwalls (*Anas strepera*), mallards (*Anas platyrhynchos*), and canvasback ducks (*Aythya valisineria)* trafficking the state. Their presence has thus led to consumptive and non-consumptive recreational opportunities (i.e., hunting, observation, photography) that have attracted many visitors from across the country and beyond (Gan and Luzar 1993; Lindsay 1999). Waterfowl are economically important to the Mississippi economy since waterfowl-related activities are known to generate millions of dollars. These revenues in turn, benefit local hotels, restaurants, gas stations, and sporting goods stores (Grado et al. 2011)..

While studies have quantified state-wide economic impacts of hunting for game species such as northern bobwhite (*Colinus virginianus*, Burger et al. 1999), eastern wild turkey (*Meleagris gallopavo*, Grado et al.1997), and white-tailed deer (*Odocoileus* *virginianus,* Grado et al. 2008) only one previous study exists for waterfowl in Mississippi (Grado et al. 2011). Grado et al. (2011) assessed the economic impact of waterfowl hunting in Mississippi using the IMPLAN model and its default data and estimated an economic impact of $147 million (2007 dollars). with 1,898 full- and part-time jobs supported. With these findings, waterfowl managers in Mississippi were able to justify and allocate resources to manage waterfowl and create off-site accommodations and services for hunters, thus potentially enhancing economic impacts. This type of study provided a reliable database for management of the state's second most important game species after white-tailed deer (Grado et al. 2008) from an economic perspective (Grado et al. 2001). Since USFWS migratory bird surveys are implemented and reported on for the entire U.S. their purpose is to paint a broad overview for this activity. These studies also assist in pointing to aspects that can be enhanced through other localized studies.

The lack of literature available on the effects of changes on IMPLAN model industry sector data on waterfowl hunting economic impacts using survey data on a state-wide level led to the implementation of this project. This information would be useful because it quantifies the economic impact of waterfowl hunting which can be used in assessing and prioritizing resource-related decisions. The primary purpose of this study was to evaluate and improve the current methodology of deriving data sources and collecting data for use in IMPLAN to more accurately use, and be able to support inputs and outputs from economic impact models, specifically those generated by the IMPLAN software model. Specific objectives were to:

1. Refine and reanalyze IMPLAN database default values and surveyed data generated from waterfowl hunting expenditure profiles collected during the 2006 year.

2. Improve current data sources used in IMPLAN model itself by identifying top 20 output sectors for waterfowl hunting in Mississippi and replacing them with localized data.
3. Determine where the data for each sector in the IMPLAN model originates:
   (i) primary data source (directly from sector manufacturers), or
   (ii) secondary data source (relying on existing data source)
4. Determine how the statewide level estimates using the IMPLAN software model default data values differ from state-wide level estimates using localized data and comparing the economic impact analysis.

Methods

Economic Impact Analysis

For the economic impact analysis of waterfowl hunting in Mississippi, 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 resident and non-resident waterfowl hunters who purchased a duck stamp during the 2005-2006 waterfowl hunting season. The 2006 IMPLAN waterfowl hunting expenditure data were used in this study to obtain the economic impacts for both analysis approaches. The IMPLAN database and survey data generated from waterfowl hunting expenditure profiles during the year 2006 were collected, refined, and analyzed during this study.

The economic impact analysis of waterfowl hunting demonstrated the impact hunting activity expenditures (e.g., boats, guns, ATV’s, dogs) had on the state economy. It showed the set of expenditures applied, the inter-industry impacts of the input-output analysis, and the impact of household expenditures in the input-output analysis. Thus, the direct, indirect, and induced linkages of businesses and services gathered from the expenditure profiles were shown. Direct impacts referred to the portion of regional sales retained by regional businesses and allocated as final demands to the appropriate industrial sectors. It is the first impact to the economy. Indirect impacts were the income and employment resulting from inter-industry trade and commerce (industries supplying and servicing anything related to the products being sold) within a region that was generated by direct sales. The induced impacts were the income and employment resulting from household consumption generated by the employment tied to direct and indirect sales (MIG, Inc. 2000). Secondary results gathered, compared, and interpreted from the economic impact analysis of waterfowl hunting in Mississippi were the economic multipliers (i.e., Type I, Type SAM, value-added, employment).

Economic impact analysis of survey-data with IMPLAN model sector changes

At the completion of the economic analysis using the IMPLAN model, the top 20 output sectors (gathered from IMPLAN) that contributed to the economic impacts of waterfowl hunting were identified (e.g., food and beverage, retail stores-gasoline stations, other amusement and recreation industries). These relevant non-aggregated sectors were then ranked from highest to lowest according to the North American Industry Classification System (NAICS) and the Bureau of Economic Analysis (BEA) and were then ranked from highest to lowest by percent contribution to overall outputs.

The origin of the data for the top 20 output sectors were then identified to determine if the data originated directly from sector manufacturers (i.e., primary data source) or existing data (i.e., secondary data source). For existing data sources (i.e., primary and secondary data sources) key organizations involved in determining the original data (i.e., U.S. Census Bureau, Bureau of Labor Statistics (BLS), BEA, Mississippi Department of Revenue) were identified and contacted to assess data accuracy relative to the state. Four of the top 20 output sectors were used in this study because more improved data were either not available (e.g., boat building, travel trailer and camper manufacturing, fertilizer manufacturing) or compatible with the IMPLAN sectoring scheme (e.g. gasoline stations, imputed rental activity for owner-occupied dwelling).

Economic impact analysis of survey-data with sector changes study design

To conduct a new economic impact analysis, the top 20 output sectors in the Mississippi economy resulting from waterfowl hunting expenditures were examined to see if new data sources could be found; the intent being to use this new data in the model that was more localized to the state and thus replacing existing default data. For new data sources acquired from Mississippi Department of Revenue, it was necessary to convert the industry output gross sales to industry output gross margins. Localized data used in this study to replace default data were expressed in gross sales and not gross margins (D. Olson, pers. comm., 2011). A margin is defined as the total revenue remaining once costs of goods sold were subtracted (Southwick 1994). To derive gross margins, the estimated annual gross margin as a percentage of sales of U.S. retail firms by the kind of business was obtained from the U.S. Census Bureau and calculated for each of the four output sectors. For example, the gross margin/sales percentage relationship for the food and beverage sector, (sector 413) was 42%. All data elements for value-added (i.e., employee compensation, proprietor income, other property income, indirect business tax) along with output value (reported in millions) were lowered by 42% before it was entered into IMPLAN.

New calculated data elements for each sector were uploaded into the model to replace existing default data. The IMPLAN model was then reconstructed and run again individually for each of the four sectors, as well as with the two, three, and four sector combinations. For example, one sector runs were made with sectors 328, 329, 330, and 413; two sector combinations with 328 and 329, 328 and 330, 328 and 413, 329 and 330, 329 and 413, 330 and 413; three sector combinations with- 328, 329, and 330; 328, 329, and 413; 329, 330, and 413; and 329, 330, and 414; and a four sector combination with - 328, 329, 330, and 413. Eighteen separate economic impact analysis were derived. The Mississippi survey-based model using default data and using localized state data to replace default data were compared, and differences in total economic outputs were compared. Aggregated sectors were used to produce outputs such as direct impacts, secondary impacts, total impacts, employee income (compensation), value-added, and indirect business taxes, employment (full- and part-time job employment), and SAM multipliers.

Results

As per Grado et al. (2011) resident hunters made an estimated 83,386 waterfowl hunting trips during the 2005-2006 season with an average trip length of 2.5 days for 208,466 activity days (Table 2). Non-resident hunters made an estimated 18,927 waterfowl hunting trips during the 2005-2006 season with an average trip length of 3.1 days for a total of 58,672 activity days. Average trip-related expenditures of resident hunters in Mississippi were $107.69/waterfowl hunter/activity day and average trip related expenditures of non-resident hunters in Mississippi were $140.36/waterfowl hunter/activity day. Average expenditures for equipment and other long-term goods for resident hunters in Mississippi were $254.47/waterfowl hunter/activity day and average expenditures for equipment and other long-term goods for non-resident hunters in Mississippi were $89.03/waterfowl hunter/activity day (Tables 3-4).

Table 2 Total number of waterfowl hunting trips, average trip length, and total days of participation in Mississippi from September 1, 2005 to January 29, 2006 by residence location.

Resident Status	**Total Trips**	**Average Trip Length**	**Waterfowl Hunting Overall**
	#	**Activity Days**	**Activity Days**
MS resident N = 17,810	83,386	2.5	208,466
Non-resident N = 6,984	18,927	3.1	58,672
Total N = 24,794	**102,313**	**-----**	**267,138**

Table 3 Average expenditures incurred for goods and services for residents and non-residents per day by all waterfowl hunters in Mississippi during the 2005-2006 waterfowl hunting season.

Expenditure Item	**Residents $**	**Non-residents $**
Transportation		
Automobile gas/oil	24.56	21.05
Rental vehicle	0.09	0.99
Airfare or other travel	2.88	3.06
Lodging		
Lodging	8.19	17.30
Food and beverages		
Restaurant or take-out meals	10.42	12.80
Groceries, ice, and beverages	10.40	10.48
Other shopping, services, and entertainment		
Ammunition/hunting needs	19.78	38.25
Casinos	1.20	4.91
Daily use fees	0.85	1.23
Entertainment	0.56	0.91
Equipment rental	0.00	0.00
Game processing	1.84	0.43
Hunting guide fees	3.80	4.92
Heating/cooking fuel	0.28	0.29
Hunting lodges	5.80	8.78
Hunting package fees	2.95	7.48
Miscellaneous retail	3.01	1.06
Outfitters	4.43	0.90
Taxidermy	5.68	1.34
Other	0.97	4.21
Total	**107.69**	**140.36**

Table 4 Average expenditures incurred for durable items for resident and non-resident waterfowl hunters in Mississippi during the 2005-2006 hunting season.

Expenditure Item	Residents $	Non-residents $
Ammunition	10.56	3.62
Boats and accessories	89.71	0.77
Clothing (e.g., waders, coats)	13.88	1.97
Dog accessories	2.79	0.28
Dogs	3.59	0.39
Dog training	2.31	1.29
Equipment (e.g., decoys, calls)	10.73	0.67
Eye glasses, hearing protections, etc.	1.37	0.03
Food plot equipment	12.11	4.18
Food plot fertilizer, lime	8.17	1.83
Food plot seed	7.32	1.64
Groceries in bulk	4.70	3.42
Guns, knives, etc.	16.53	0.37
Herbicides and insecticides	6.73	0.32
Hunt club membership	11.95	39.68
Hunting lease	15.41	10.21
Hunting license, stamps	5.61	8.20
Misc. hunting gear (e.g., gun cases, etc.)	6.53	1.15
Standing crop from farmers	0.69	0.08
Trailer, ATV	21.11	7.92
Other	2.69	1.00
Total	**254.47**	**89.03**

Overall economic impacts in 2010 dollars were derived from waterfowl hunting expenditures from resident and non-resident expenditures and activity days collected from survey data. For the 2010 hunting season, the total unadjusted (i.e., use of default data) economic impacts were $158.810 million which supported 1,981 full- and part-time jobs (Table 5). The SAM multiplier was 1.58, indicating that for every dollar spent in-state on waterfowl hunting there was an economic impact return of $0.58. The largest sector generating economic impacts was manufacturing, with the next two largest sectors being services and trade (Table 5). Overall economic impacts in 2010 dollars derived from a one sector total output and value-added adjustment were relatively similar in value for three sectors (i.e., sectors 328-sporting goods, 330-miscellaneous retail, 413-food and beverage) with the exception of sector 329-general merchandise (Table 6). For changes in single sector values the economic impact values for sectors 328, 330, 413, and 329 were $151 million, $105 million, $115 million, and $151 million, respectively. The economic impact value of $151 million, derived by changing the general merchandise sector, was the economic impact value that was comparatively the closest in value to the total economic impacts of $158 million using the IMPLAN default values.

Table 5 Total estimated economic impacts of waterfowl hunting in Mississippi during the 2005-2006 waterfowl hunting season using the Impact Analysis for Planning (IMPLAN) model and default database along with the survey-based method for collecting hunter expenditures (2010 dollars).

Industry	Direct Impacts $	Indirect Impacts $	Induced Impacts $	Total Impacts $
Agriculture	156,674	399,840	360,504	917,018
Mining	20,306	1,812,535	947,391	2,780,233
Construction	49,625	527,301	254,800	831,726
Manufacturing	72,123,250	8,835,812	8,526,945	89,486,010
TCPU[1]	1,192,768	3,644,812	1,637,617	6,475,195
Trade	18,702	1,192,406	1,391,731	2,602,840
FIRE[2]	83,672	3,263,185	6,255,891	9,602,746
Services	27,534,739	5,670,503	9,092,911	42,298,151
Institutions	1,846,470	1,032,745	937,144	3,816,360
Total	**103,026,206**	**26,379,139**	**29,404,934**	**158,810,279**

[1] Transportation, Telecommunication, and Public Utilities
[2] Finance, Insurance, and Real Estate

The percentage difference value with a one sector value-added and total output value changes for three of the four sectors (i.e., 328-sporting goods, 330-miscelleneous retail, 413-food and beverage) ranged in value from -27.0-33.5% (Table 6). There was however, a smaller percentage difference with sector 329-general merchandise, which when calculated was approximately -4.3% (Table 6). The total economic impact in 2010 dollars derived from all possible two sector combinations had a similar trend as observed with the one sector combinations. Of the possible six combinations, sectors 329 and 330 and sectors 329 and 413 recorded the largest total economic impacts of $153 million and $150 million, respectively. Sectors 328 and 330, 328 and 413, and 330 and 413 each had a total economic impact of $105 million while sectors 328 and 330 had a total economic impact of $106 million (Table 6). The percentage difference (compared to the total economic output using default values) for the two sector value-added and total output value changes for three of the two sector combination (i.e., 328 and 413, 328 and 330, and 330 and 413) was 33.6% below the original model results. Sectors 329 and 330, 328 and 330, and 329 and 413 had a percentage difference of -3.1, -3.3, and -4.7%, respectively below the original model results. Similarly to the value-added and total output values changed for the one sector analysis, two sector combinations that specifically included sector 329 (general merchandise), recorded the highest values and smallest percentage differences when compared to the total economic output using default data only (Table 7). All three, three sector combinations (sectors 328, 329, 330; 328, 329, 413; 329, 330, 413) had total economic impacts of $154 million, $152 million, and $153 million, respectively (Table 8). These economic impacts were approximately $4-$6 million short of the total economic impact using default data only. The percentage difference for the three- three-sector combinations were -2.5, -4.2, and -3.5%, respectively. Combined sectors 328, 329, and 330 had the lowest percentage difference of all sector combinations with a percentage of 2.5 (Table 8). Total economic impacts for the four sector (i.e., 328, 329, 330, and 413) combination were 2.8% below the original model results. This value is approximately $4.45 million less than the total economic impact that used the default data only (Table 9).

Table 6 The sum of the estimated economic impacts of waterfowl hunting in Mississippi during the 2005-2006 waterfowl hunting season using the Impact Analysis for Planning (IMPLAN) model and database software with sector changes for 328[1], 329[2], and 330[3] and 413[4] along with the survey-based method for collecting hunter expenditures (2009 dollars).

1 Sector Output	**Total Impacts New Changes $**	**Percentage Difference %**
328	105,662,385	-33.5
329	151,841,840	-4.3
330	105,673,340	-33.4
413	115,870,661	-27.0

[1]Sporting Goods-IMPLAN Sector
[2]General Merchandise-IMPLAN Sector
[3]Miscellaneous Retail-IMPLAN Sector
[4]Food and Beverage-IMPLAN Sector

Table 7 The sum of the estimated economic impacts of waterfowl hunting in Mississippi during the 2005-2006 waterfowl hunting season using the Impact Analysis for Planning (IMPLAN) model and database software with sector changes for 328[1], 329[2], and 330[3] and 413[4] along with the survey-based method for collecting hunter expenditures (2010 dollars).

2 Sector Output	**Total Impacts New Changes $**	**Percentage Difference $**
328 and 413	105,479,831	-33.6
328 and 330	105,677,631	-33.5
328 and 329	106,834,842	-32.7
329 and 330	153,851,204	-3.1
329 and 413	151,393,379	-4.7
330 and 413	105,495,576	-33.6

[1]Sporting Goods-IMPLAN Sector
[2]General Merchandise-IMPLAN Sector
[3]Miscellaneous Retail-IMPLAN Sector
[4]Food and Beverage-IMPLAN Sector

Table 8 The sum of the estimated economic impacts of waterfowl hunting in Mississippi during the 2005-2006 waterfowl hunting season using the Impact Analysis for Planning (IMPLAN) model and database software with sector changes for 328[1], 329[2], and 330[3] and 413[4] along with the survey-based method for collecting hunter expenditures (2010 dollars).

3 Sector Output	Total Impacts New Changes $	Percentage Difference %
328, 329, 330	154,805,019	-2.5
328, 329, 413	152,349,465	-4.2
329, 330, 413	153,405,584	-3.5

[1]Sporting Goods-IMPLAN Sector
[2]General Merchandise-IMPLAN Sector
[3]Miscellaneous Retail-IMPLAN Sector
[4]Food and Beverage-IMPLAN Sector

Table 9 The sum of the estimated economic impacts of waterfowl hunting in Mississippi during the 2005-2006 waterfowl hunting season using the Impact Analysis for Planning (IMPLAN) model and database software with sector changes for 328[1], 329[2], and 330[3] and 413[4] along with the survey-based method for collecting hunter expenditures (2010 dollars).

4 Sector Output	Total Impacts New Changes $	Percentage Difference %
328, 329, 330, 413	154,355,258	-2.8

[1]Sporting Goods-IMPLAN Sector
[2]General Merchandise-IMPLAN Sector
[3]Miscellaneous Retail-IMPLAN Sector
[4]Food and Beverage-IMPLAN Sector

Discussion

Statewide estimates of the 2005-2006 waterfowl hunting expenditures, a recalculation of the economic impacts to the state economy by resident and non-resident waterfowl hunters who hunted in Mississippi, identification and replacement of four of the top 20 output sectors of importance to waterfowl hunting economic impacts based on this new information were provided in this study. Four of the top 20 output sectors were used in this study because more improved data were either not available (e.g., fertilizer manufacturing, pesticide and other agricultural chemical manufacturing, imputed rental activity for owner-occupied dwelling) or compatible with the IMPLAN sectoring scheme (e.g., gasoline service stations, wholesale trade businesses).

Past research has focused primarily on changing different components within the model. For example, McKean and Spencer's (2003) study 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 the RPCs. Both studies maintained the use of the IMPLAN default data. Bergstrom (1990b) addressed the highly aggregated sectors within the IMPLAN model. They suggested that the IMPLAN model could depict an inaccurate representation of local economies as it assumed that industries within a region remain economically stable which, in most cases, would not be accurate since the loss of one major industry would most likely have a much more serious impact on the economy than the model results would lead one to think.

The major constraint in the IMPLAN software model was its estimation of state-based data gathered from national data sources. This assumption has the potential to lead to either over or under estimations of impacts and multipliers because it does not capture a true representation of a state's industry and economy. Another corollary to the point mentioned above is how IMPLAN categorizes the value-added components (i.e., employee compensation, proprietor income, other property income, and indirect business tax). The model was designed in such a way that it is assumed that employee compensation and proprietor income are endogenous (i.e., remains within the local economy). It in effect, does not take into account that some proprietors providing services within the state, in this case Mississippi, may live outside the state. Similarly with employee compensation, it would not take into account that residents living in Alabama and Louisiana for example may be employed in Mississippi (MIG, Inc. 2000; McKean and Spencer 2003).

In this study, as opposed to McKean and Spencer's 2003 study, the output values were adjusted with state data, and in turn, all four value-added components were also adjusted for each of the four sectors that were changed in the IMPLAN model. This procedure was recommended by MIG, Inc. (D. Olson, pers. comm., 2011). Sector 329-general merchandise, had the largest gross margin value of the four sectors. This large value thus led to greater inter-industry interactions within the IMPLAN model. Inter-industry flow of goods and services occurring between sectors within the IMPLAN software model are known to be more effective if multiple changes in sectors are occurring thus, one sector change only would lead to a high gross margin value which was the case for sector 329. In addition, the general merchandise sector used in IMPLAN was highly aggregated and as a result, this highly aggregated data would not be suitable to estimate and capture all impacts related specifically to general merchandise. In addition, it may also include other components that would not be classified under general merchandise. As an end result, an increase in the number and combination of sectors led to the stabilization of the monetary values associated with the total economic impact. For instance, one and two sector total economic impacts ranged from $105 to $153 million however, three and four sector combinations total economic impacts ranged from $151 to $153 million (Tables 8-9). It is therefore important to change as many sectors within the model as it relates to the particular study of interest, even though there may be a need to conduct localized- or state-based survey to gather this type of information.

Unadjusted IMPLAN default values, as seen in this research, overestimated the true direct, indirect, induced, and total economic impact values because of the inappropriate use of national level production relationship estimates in regard to state industries. This estimation more than likely would not be an accurate depiction of regional, state, and county or parish technologies and industries. Therefore, it is highly recommended that researchers obtain primary data through surveys or use existing state or county data to combat this problem. The assumption is that researchers, who are unable to conduct surveys on their own, when conducting an economic impact analysis, confidently rely on the model's accuracy.

In this study, the SAM multipliers remained constant at 1.5 for both the IMPLAN model constructed with the use of default values and in all cases, the model that used localized data. Regional and state-level output multipliers particularly for recreation expenditures usually range between 1.5 to 2.7. SAM multipliers for turkey hunting, white tail deer hunting and waterfowl hunting in Mississippi, were 2.3, 1.5, and 1.5, respectively (Strauss et al. 1995; Grado et al. 1997; Grado et al. 2001; Grado et al. in press). The size of the multiplier is a good indicator of the level of business activity and development in an economy. Multiplier size is directly linked to the region's geographic extent, economic diversity, and the sectors studied (Grado et al. 1997; Grado et al. 2001). Regions that have a large geographic extent tend to have larger multipliers than smaller geographically extent areas because they do not require the imports and transportation costs of smaller geographically extent areas. Second, regions with large economies are capable of producing goods and services locally resulting in a higher local consumption.

Sectors chosen in an economic impact analysis can result in either a large- or small-sized multiplier; it is all dependent on a variety of inputs (e.g., labor) the availability of goods and services provided in the region, and the amount of leakage in the economy (Radtke et al. 1985). Despite the fact that sector values were replaced with localized data, the small multiplier size remained the same. The top 20 sectors of importance to waterfowl hunting for example did not include industries that produced goods and services within the state. As a result, this led to higher local consumption due to importation and transportation cost. Therefore, the multiplier size of 1.5 for waterfowl hunting was not unexpected.

Conclusions

This study examined the economic impacts of waterfowl hunting in the state of Mississippi using survey data to determine whether using default data within the IMPLAN model or by making a change in value-added and output components would yield a change in total outputs. Results showed that a change within a single or multiple sectors would create an increase in direct, indirect, induced, and total impacts as well as the number of jobs stimulating the state. In other words, in this study, the economic impacts of waterfowl hunting using default values within the IMPLAN model were consistently overstated. IMPLAN has been widely used in conducting impact analysis therefore users should be made aware of discrepancies in the model to prevent potential biases that may affect local, state, regional, and national spending decisions and policies. Second, users should also employ alternative methods and descriptions for calculating different components (e.g., multipliers, sectors, value-added components) within the model. Research on the impact of change with larger numbers of sectors and sector combination changes of value-added and output is needed to better assess the true economic impacts of survey and/or non-survey-based data for specific industries in Mississippi. It is important to identify and rank all sectors with the largest impacts to the specific economy of interest and replace all these sectors with localized data and run a single economic impact analysis. There is the concept of inter-industry flow of goods and services that occur between industries and sectors within the IMPLAN software model that most naturally, would be effective if all top ranked sectors are interacting with each other at the same time. Also, a corollary to the first suggestion would be the importance of determining the break-off point with the percentage of output of the ranked sectors. For future studies, data could be improved through extensive in-state surveys to collect a better set of data for specific sectors. Also, more research is necessary to assess the combined effect multiple sectors have on the economic impacts of selected economies of interest.

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CHAPTER IV

EFFECTS OF CHANGES IN IMPACT ANALYSIS FOR PLANNING (IMPLAN) MODEL INDUSTRY SECTOR DATA ON THE LOGGING INDUSTRY IN MISSISSIPPI

Abstract

This study examined the effects of changes on industry sector data on the logging industry to determine its importance and contribution to the Mississippi economy. It quantified, evaluated, and improved upon the current methodology of data and data collection for use in the Impact Analysis for Planning (IMPLAN) software model to more accurately reflect and support inputs and outputs from IMPLAN. Economic impact estimates derived from model default data found within the IMPLAN model were compared with estimates derived from survey-based expenditure data collected within the state. Also, the top 20 output sectors in the state economy resulting from logging expenditures were determined from model results. In turn, new data were acquired and used in the model to replace four of the top 20 sectors of importance and new economic impact estimates were derived. Economic impact assessment results on the model default data model showed that total economic impacts generated was \$2.309 billion and \$2.489 billion in industry output in 2006 and 2009 dollars, respectively. Total economic impact generated from survey-based data (N=2,471) was \$9.275 billion and \$9.856 billion in 2006 and 2009 dollars, respectively. Total economic impacts generated solely from a sample size of 33 loggers were \$129.310 million and \$131.747 million in 2006 and 2009 dollars, respectively. Total economic impacts generated by replacing four of the top 20 sectors of importance for the logging industry were $7.874 billion in 2009 dollars using survey data from Mississippi (N=2,471) and, for the 33 logger sample size, $109.978 million in 2009 dollars. While this latter aspect of the study was limited by small sample sizes, results indicated that limitations existing within the IMPLAN model further manifest themselves when implementing economic impact assessments. Indications were that more localized data need to be collected when doing studies of this type rather than just relying on the default IMPLAN model data.

Keywords: IMPLAN, logging, Mississippi, model default data- analysis, survey-based analysis, total economic impacts

Introduction

The forest products industry, consisting of four major groups (i.e., logging, wood furniture, pulp and paper, solid wood products), has been an important, historical component of the economic sustainability of Mississippi. For example, in 2001, total industry output has exceeded $13 billion with a total employment of 54,000; roughly 3% 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% of the direct jobs, while the solid wood products industry, pulp and paper, and logging and miscellaneous forest products contributed 27%, 13%, and 15%, respectively (Munn and Tilley 2005; Perez-Verdin 2008). Similar results were found by Greber et al. (1994) that showed timber-related industries (i.e., logging, sawmilling, plywood and veneer preparation, pulp and paper processing, manufacture of other wood products) wage and employment provided over 77,000 jobs of the 1,140,700 jobs in Oregon. This represented 6.8% of total wages and salary employment and 36.7% of manufacturing employment in the state. Within the non-metropolitan counties of Oregon, employment in the timber industry was 29.4% of total wage and salary employment.

The logging industry has continuously provided raw materials to the wood furniture and pulp and paper industry that has led to increased development and competitiveness of the forest products industry (Hailu and Veeman 2003; Munn and Tilley 2005; Rickenbach and Steele 2006; Tilley and Munn 2007; Perez-Verdin et al. 2008). Although it was obvious that loggers and logging firms within the logging industry have played an important role in the economic sustainability of the forest products industry, most economic research has focused on the wood furniture and pulp and paper industries (Sherif 1983; Bernstein 1989; Frank et al. 1990; Oum et al. 1991; Hsue and Buongiorno 1994; Hailu and Veeman 2003). Logging as an economic entity is commonly not considered or simply overlooked in many national, regional, or state economic analysis. A possible reason for the limited economic research with loggers and logging firms could be attributed to the fact that data required to conduct economic analysis (e.g., logger's box, financial reports) are very confidential and in most instances, logging contractors and logging firms are reluctant to cooperate in studies of their industry (Stutzman, Jr. 2003). Also, most logging firms are organized as small, family operated enterprises with few to no employees, thus making them hard to locate in the first place (Stutzman, Jr. 2003; Rickenbach and Steele 2006).

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, Inc. 2000; Spurlock 2004; Henderson et al 2006). 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 arising when using the IMPLAN model and the logging sector, is the definition of industrial sector 16-logging. For example, there is no definition of what logging (sector 16) in the IMPLAN model encompasses and logging, as seen from the logging contractors expenditure profiles (e.g., tires, fuel, contract trucking, insurance), is a lot more than just the value of the raw materials. Tanjuakio's et al. (1996) study also shared the similar issue when they were determining the economic impact of agriculture in Delaware. For example, their study showed that the word '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 study findings would enable economists to better understand and determine the economic role the logging sector plays in Mississippi, and most important, what logging encompasses.

The study objectives were to:

1. Replicate the method of determining economic impacts in IMPLAN by using the total impacts (i.e., direct, indirect, induced) estimated within the IMPLAN model by removing the total employment for the relevant sector and calculating the impact on the state economy while using the model's default data and comparing results to an economic impact model using survey data first, with a population size of 2,471 loggers, and second with a sample size of 33 loggers,
2. For the surveyed data, identify and break-down the logging cost components and then sort and determine appropriate IMPLAN sectors for each,
3. Determine where the data for each sector in the IMPLAN model originates:

(iii) primary data source (directly from sector manufacturers), or

(iv) secondary data source (relying on existing data source)

4. For primary and secondary data sources identify key individuals/organizations involved in determining the original data (i.e., U.S. Census Bureau, Bureau of Labor Statistics (BLS), and BEA,
5. Identify how the statewide software model default estimates and modified statewide localized data level estimates differ from each other while quantifying the economic impacts of logging in Mississippi using IMPLAN.

Methods

Methods used to perform economic impact analysis

The study area encompassed the state of Mississippi. The 2006 logging year was used because it was the most updated and completed dataset available at the start of the project. Data were collected from 33 loggers whose business varied in size and only included expenditures made within the state and categorized into three major groups (i.e., small, medium, large) based on average annual tonnage. Tonnage size ranged from 0 tons to 68,999 tons for small-sized loggers, 69,000 tons to 149,999 tons for medium-sized loggers and 150,000 tons to 430,000 tons for large-sized loggers. As a result, the small-sized logger group had 13 loggers, the medium-sized logger group 9 loggers, and the large-sized logger group 11 loggers. The percentage for each group relative to the total study population The percentage for each group relative to the total study populations was determined and then applied to the 2,471 loggers who registered through the Professional Logging Management Program (PLM) at Mississippi State University (MSU) administered through the Sustainable Forest Initiative (SFI) State Implementation

Committee (SIC) to approximate the specific number of loggers in each grouping. The small-sized group of loggers had 973 in their category, 674 loggers were in the medium-sized group, and 824 loggers in the large-sized group.

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 from logging contractor expenditure profiles during the year 2006. Direct impacts refer to the portion of regional sales retained by regional businesses and allocated as final demands to the appropriate industrial sectors; it is the first impact to the economy. Indirect impacts are the changes in inter-industry purchases as they respond to the new demands of the directly affected industries. 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 sectors sales (MIG, Inc. 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, employment).

Non-survey-based approach

Timber harvesting (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 U.S. Department of Labor). The IMPLAN industrial sectoring scheme allowed for a categorization according to the type of products or services produced (MIG, Inc. 2000). Following the method used by Spurlock (2004), a model was constructed in this study using the Construct Model from the Model Control Center menu bar in IMPLAN (MIG, Inc. 2000). The

Type SAM multipliers were selected along with the 18 institution 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, Inc. (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

The data used in this research is a subset of data from a long term study examining the long-term cost and productivity of the logging industry. 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 over 20 years from three primary sources. Logging contractors who attended the Mississippi Loggers Association (MLA) continuing logger education meetings at MSU in 2006, and owned a legitimate logging company were asked and encouraged to participate in the study (W. Stuart, pers. comm., 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. Stuart, pers. comm., 2010). Studies conducted from the collection of this data have focused primarily on long-term cost and productivity of logging contractors (Stuart et al. 2006; Stuart et al.

2007; Stuart et al. 2008). Using the same long-term cost and productivity dataset, the economic impacts of the logging industry was determined in this 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, Jr. 2003, W. Stuart, pers. comm., 2010). At this meeting logging contractors were informed of the specific types of information needed, methods of data collection, assurance of confidentiality for collected data, and how exactly their data would be used (Stutzman, Jr. 2003). They were also presented with published reports of similar data usage from previous years to show how their data would be as a contribution to this ongoing research. Logging contractors were under no pressure to participate and could at any time decide to withdraw from the study. A second interview/meeting was scheduled once the logging contractors agreed to participate. At this meeting, equipment spread, work force, market niche, and other business information were collected (Stutzman, Jr. 2003). Follow-up meetings were then scheduled on an annual basis to collect cost and production information for that particular year (e.g., 2006).

The investigator collected cost information from the logging contractors through electronic, hard copy, and face to face surveys from the participants and their accountants and bookkeepers (Stutzman, Jr. 2003). Annual interviews or questionnaires collected equipment spread by type; make; model number; and year; crew size; job assignment; 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 the business methods used (i.e., logger's books, tax filings, financial reports) (Stutzman, Jr. 2003). Logging contractors were also asked to provide detailed information on the method of getting stumpage to harvest (i.e., direct purchase, or through 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 they required the services of an accountant, and their personal opinions on the direction of the logging industry as well as problems they were facing in their business.

Each logging business had a different way of categorizing their expenses. Some contractors provided information in a year end format consisting of the six logging cost component categories (Table 10) while others provided more detailed financial statements (Stutzman, Jr. 2003). This information was then placed by the researchers into six categories: equipment, consumable supplies, labor expenses, insurance, administrative overhead, and contracted services (Stutzman, Jr. 2003). For the purposes of this study, each of these six categories were further broken down by this researcher into detailed expenditure profiles to accommodate an input-output analysis in IMPLAN based on logging business expenditures occurring within the state (Table 10).

Table 10 Major logging cost categories and components of logging contractor expenditure profiles collected in 2006 from loggers doing business in Mississippi (adapted from Stutzman, Jr. 2003).

Major cost categories	**Components of major cost categories**
Equipment	Note payments (i.e., principal and interest) Depreciation Taxes (i.e., highway use, 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, retirement)
Consumables	Tires Fuel Oil and lubricants Parts and maintenance Truck and equipment washing Non-depreciable 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)

Logging contractor category

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 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. Two different sets of group participant levels were run; first, with a population size of 2,471 loggers and second, 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, taxes) in Mississippi had on the state economy. It showed the set of expenditures applied and the inter-industry 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 9 categories according to the North American Industry Classification System 2007 (NAICS) two digit code system. The nine categories were Agriculture, Forestry, and Fisheries (sectors 1-19) (NAICS code 11); Mining(sectors 20-22) (NAICS code 21); Construction (sectors 34-40) (NAICS code 23); Manufacturing (sectors 34-331)(NAICS codes 23 ,31, 32, 33, 42, 44, 45); Transportation, Communication and Utilities (332-353)(NAICS code 48, 49, 51); Trade (sectors 354-356)(NAICS code 52); Finance, Insurance, and Real Estate (FIRE)(sector 357-366)(NAICS code 52, 53); Services (sectors 367-423) (NAICS code

54)(NAICS code 52); and Institutions (sectors 424-440) (NAICS code 81) (MIG, Inc. 2000).

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

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. Four of the top twenty 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 in this study because more improved data were either not available (e.g., extraction of oil and natural gas, petroleum refineries) or compatible with the IMPLAN sectoring scheme (e.g. transport trucking, wholesale trade businesses). In this study, the break-off point was 20. Percentages ranged from 14.1% being the highest ranked sector, to 1.0% being the 20th ranked sector. Percentages calculated after the 20th ranked sector were below 1%. Percentage values will vary depending on the economy of interest as well as the particular industry or activity understory.

New data were acquired from the Mississippi Department of Revenue to replace existing default data and used in the model because it was more localized to the state. Because localized data were expressed in gross sales it was necessary to convert the gross sales to gross margins. A margin is defined as the total revenue remaining once costs of goods sold were subtracted (Southwick 1994). To derive gross margins, estimated annual gross margin as a percentage of sales of U.S. retail firms by kinds of business was obtained from the U.S. 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%. All data elements for value-added (i.e., employee compensation, proprietor income, other property income, indirect business tax) along with output value (reported in millions) were lowered by 42%.

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-351, 413, 414, and 417 only. A previous (see Chapter III) showed that waterfowl hunting identifying, ranking, and replacing four sectors of interest with localized data produced effective estimates as opposed to one-, two-, and three-sector combinations. Economic impact analysis was then derived for this combination. The Mississippi survey-based model using default data and using localized state data to replace default data were compared to these new results, and differences in total economic outputs were reported. Aggregated sectors were used to produce outputs such as direct impacts, secondary impacts, total impacts, employee income (compensation), value-added, and indirect business taxes, employment (full- and part-time jobs), and (SAM multipliers.

Results

Non-survey based method economic impacts

Economic impacts were first determined by using methods developed by MIG, Inc. (2000). Total economic impacts for the logging industry for non-survey based data were $2.309 billion in 2006 dollars with a direct impact of $1.179 billion (Table 11).

Table 11 Estimated economic impacts of the logging industry using the Impact Analysis for Planning (IMPLAN) 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
TCPU[1]	0	18,535,968	40,104,192	58,640,160
Trade	0	3,008,619	24,875,504	27,884,122
FIRE[2]	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**

[1]Transportation, Telecommunication, and Public Utilities
[2]Finance, Insurance, and Real Estate

This value represented industries in Mississippi that produced goods and services for consumption from 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 a value of $327.141 million. In turn, the purchasing of available goods and services by employees of direct and indirect industries, known as the induced impact, had a value of $656.005 million. The industry output Type SAM multiplier for the logging industry was 1.83. This implied that for every $1.00 increase in output in the logging industry, other industries in the state generated an additional $0.83 in the economy. The employment multiplier was 2.41 which meant that for every one job increase in the logging industry, an additional 1.41 jobs were generated.

The total economic impact for the logging industry was $2.489 billion in 2009 dollars with direct impacts of $1.277 billion (Table 12). This value represented industries in Mississippi that produce goods and services for consumption from other producers. These other producers also contributed to the economy by purchasing these available goods and services, known as the indirect impact, which had a numeric value of $353.448 million. In turn, the purchasing of available goods and services by employees of direct and indirect industries, known as the induced impact, had a value of $700.842 million. The industry output Type SAM multiplier for the logging industry was 1.82. This implied that for every $1.00 increase in output in the logging industry, other industries in the state generated an additional $0.82 in the economy. The employment multiplier was 2.41 which meant that for every one job increase in the logging industry, an additional 1.41 jobs were generated.

Table 12 Estimated economic impacts of the logging industry using the Impact Analysis for Planning (IMPLAN) 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
TCPU[1]	0	19,775,610	42,120,332	61,895,944
Trade	0	3,211,120	26,188,592	29,399,712
FIRE[2]	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**

[1]Transportation, Telecommunication, and Public Utilities
[2]Finance, Insurance, and Real Estate

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, insurance). Ten of the top 100 average annual expenditures incurred for goods and services for the small, medium, and large logger groups were reported in 2006 dollars in tables 12-14. The highest value for the small-sized group of loggers was fuel with $160,428/year, followed by wages at $145,000/year, contract hauling at $125,499/year, insurance at $78,525, and equipment depreciation at $74,608/year (Table 13). The highest values for the medium-sized group of loggers were contract hauling with an average value of $379,515/year, followed by salaries at $334,866/year, depreciation at $206,496/year, fuel at $176,164/year, and insurance at $134,517/year (Table 14). The large group of loggers had similar results when compared to the medium loggers. Contract hauling for this group was $1.10 million/year, followed by salaries at $873,298/year, insurance at $509,349/year, fuel at $481,151/year, and contract labor at $442,648/year (Table 15).

Table 13 Ten of the top 100 average annual expenditures incurred for goods and services purchased by small-sized loggers[1] (n=13) doing business in Mississippi during 2006.

Expenditure item	**Item averages $**
Fuel	160,428
Wages	145,000
Contract hauling	125,499
Insurance	78,525
Depreciation	74,608
Loan/loan payable	49,082
Miscellaneous	47,066
Equipment repairs	43,476
Contract labor	34,342
Taxes	33,500

[1]Small-sized loggers were those whose tonnage size ranged from 0-68,999 tons

Table 14 Ten of the top 100 average annual expenditures incurred for goods and services purchased by medium-sized loggers[1] (n=9) doing business in Mississippi during 2006.

Expenditure item	Item averages $
Contract hauling	379,515
Wages	334,866
Depreciation	206,496
Fuel	176,164
Insurance	134,517
Contract labor	86,243
Taxes	67,472
Repairs and maintenance	64,018
Supplies and parts	43,908
Parts and maintenance	37,199
Auto/truck expense	30,228
Loans	23,464

[1]Medium-sized loggers were those whose tonnage ranged from 69,000-149,999 tons

Table 15 Ten of the top 100 average annual logging activity level related expenditures incurred for goods and services purchased in Mississippi by medium-sized loggers[1] (n=9) during 2006.

Expenditure item	Item averages $
Contract hauling	1,101,183
Wages	873,298
Insurance	509,349
Fuel	481,151
Contract labor	442,648
Depreciation	228,939
Repairs and maintenance	214,053
Equipment note/payment	152,008
Taxes	104,070
Parts	77,483
Office supplies	59,297
Tires	50,980

[1]Large-sized loggers were those whose tonnage ranged from 150,000-430,000 tons

Survey-based method economic impacts by group size and year

The survey-based data default model using the expenditures from the three logging groups (i.e., small, medium, large) had a combined total economic impact value of $9.275 billion for 2006. Total economic impacts for the small-sized group was $1.406 billion with a direct impact value of $794.716 million and an indirect and induced impact value of $210.810 million and $400.935 million, respectively (Table 16). The direct impact of the manufacturing industry had the highest value of $204.127 million followed by the services industry with a value of $168.814 million. Indirect and induced impacts for these two industries recorded the highest values within their respective categories as well (Table 16). The industry output Type SAM multiplier for the small group of loggers was 1.77. This implied that for every $1.00 increase in output in the logging industry, other industries in the state generated an additional $0.77 in the economy. The employment multiplier was 2.11 which meant that for every one job increase in the logging industry, an additional 1.11 jobs was generated.

Table 16 Estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for (N=973) small-sized loggers[1] and using a survey-based method for collecting logger expenditures (2006 dollars).

Industry	Direct Impacts $	Indirect Impacts $	Induced Impacts $	Total Impacts $
Agriculture	795,969	1,906,723	3,918,472	6,621,164
Mining	4,269,086	31,569,964	14,557,712	50,396,764
Construction	6,044,224	5,647,847	31,754,168	43,446,240
Manufacturing	204,127,600	56,956,984	94,328,664	355,413,248
TCPU[2]	129,184,032	29,346,622	20,138,670	178,669,328
Trade	51,045,348	13,054,792	13,502,911	77,603,056
FIRE[3]	92,771,520	24,800,802	58,705,780	176,278,112
Services	168,814,960	39,081,360	93,088,648	300,984,960
Institutions	137,663,448	8,445,233	70,940,576	217,049,264
Total	**794,716,186**	**210,810,327**	**400,935,601**	**1,406,462,136**

[1] Small-sized loggers were those whose tonnage size ranged from 0-68,999 tons
[2]Transportation, Telecommunication, and Public Utilities
[3]Finance, Insurance, and Real Estate

Total economic impacts for the medium-sized group of loggers were $1.808 billion in 2006 dollars (Table 17). Direct impacts were $1.009 billion and indirect and induced impacts were $281.729 million and $517.574 million, respectively. The direct impact of the transportation and telecommunication industry had the highest value of $265.505 million followed by institutions at $221.058 million. Indirect and induced impacts for these two industries recorded the highest values within their respective categories as well (Table 17). The Type SAM output multiplier for this group was 1.79 which meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.79 in the economy. The employment industry had a Type SAM multiplier of 1.97. This meant that every $1.00 increase in output generated an additional $0.97 in the economy.

Total economic impact for the large-sized group of loggers was $6.060 billion (Tables 18) with direct, indirect, and induced impact values of $3.318 billion, $983.436 million, and $1.758 billion, respectively (Table 18). Direct impact of the transportation and telecommunication industry for the large group of loggers, similar to the medium-sized group of loggers, had the highest value of $943.279 million followed by the manufacturing industry which had a value of $618.952 million. Indirect and induced impacts for these two industries recorded the highest values within their respective categories (Table 18). This particular group recorded the highest values in comparison to the other two groups, which was expected since most of the average expenditures were much higher in value for the large group of loggers. This was due in part to higher capital expenses in equipment contracts, and harvest tonnage. The Type SAM output multiplier for the large group of loggers was 1.83 while the employment multiplier was 2.11.

Table 17 Estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for (N=673) medium-sized loggers[1] and using a survey-based method for collecting logger expenditures (2006 dollars).

Industry	**Direct Impacts $**	**Indirect Impacts $**	**Induced Impacts $**	**Total Impacts $**
Agriculture	681,167	2,191,352	5,142,893	8,015,412
Mining	5,605,996	30,364,060	18,244,842	54,214,900
Construction	9,998,477	6,167,420	36,989,960	53,155,856
Manufacturing	197,600,992	77,861,168	122,322,904	397,785,056
TCPU[2]	265,505,792	47,791,784	26,202,804	339,500,384
Trade	4,361,304	12,573,660	17,866,190	34,801,156
FIRE[3]	129,918,880	37,736,084	78,101,448	245,756,416
Services	174,813,344	52,982,356	122,739,064	350,534,784
Institutions	221,058,360	14,061,271	89,964,400	325,084,016
Total	**1,009,544,312**	**281,729,155**	**517,574,505**	**1,808,847,980**

[1]Medium-sized loggers were those whose tonnage size ranged from 69,000-149,999 tons
[2]Transportation, Telecommunication, and Public Utilities
[3]Finance, Insurance, and Real Estate

Table 18 Estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for (N=823) large-sized loggers[1] and using a survey-based method for collecting logger expenditures (2006 dollars).

Industry	Direct Impacts $	Indirect Impacts $	Induced Impacts $	Total Impacts $
Agriculture	2,536,001	6,778,079	17,410,210	26,724,290
Mining	16,065,378	101,565,160	62,807,208	180,437,744
Construction	14,054,947	20,382,522	130,194,048	164,631,520
Manufacturing	618,952,320	258,304,304	415,885,568	1,293,142,272
TCPU[2]	943,279,296	163,389,232	88,895,360	1,195,563,904
Trade	142,114,512	54,292,888	60,333,776	256,741,168
FIRE[3]	556,370,816	141,095,712	263,394,832	960,861,376
Services	519,371,904	189,456,688	414,890,752	1,123,719,296
Institutions	505,614,824	48,172,008	30,499,6576	858,783,424
Total	**3,318,359,998**	**983,436,593**	**1,758,808,330**	**6,060,604,994**

[1]Large-sized loggers were those whose tonnage size ranged from 150,000-430,000 tons
[2]Transportiaton, Telecommunication, and Public Utilities
[3] Finance, Insurance, and Real Estate

The three logging groups (i.e., small, medium, large) had a combined economic impact of $9.867 billion for 2009. Total economic impacts derived from the small-sized group of loggers were $1.489 billion (Tables 19). Direct impacts were $843.565 million. Indirect and induced impact values were $220.861 million and $425.107 million, respectively (Table 19). Again, manufacturing and services industries were highest in value at $218.455 million and $174.439 million, respectively. The industry output Type SAM multiplier for the small group of loggers was 1.76. This implies that for every $1.00 increase in output in the logging industry, other industries in the state generated an additional $0.76 in the economy. The employment multiplier was 2.11 which meant that for every one job increase in the logging industry, an additional 1.11 jobs was generated.

Table 19 Estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for (N=973) small-sized loggers[1] and using a survey-based method for collecting logger expenditures (2009 dollars).

Industry	Direct Impacts $	Indirect Impacts $	Induced Impacts $	Total Impacts $
Agriculture	789,691	1,903,395	4,073,113	6,766,200
Mining	4,485,068	30,086,492	15,067,122	49,638,684
Construction	6,239,946	5,830,734	32,782,424	44,853,100
Manufacturing	218,455,712	60,907,132	103,054,896	382,417,728
TCPU[2]	144,608,176	31,282,740	21,423,728	197,314,640
Trade	55,391,996	14,132,282	14,615,254	84,139,536
FIRE[3]	90,935,008	25,550,730	62,508,464	178,994,208
Services	174,439,376	42,154,228	100,490,328	317,083,936
Institutions	148,220,376	9,013,515	71,091,704	228,325,592
Total	**843,565,349**	**220,861,248**	**425,107,033**	**1,489,533,624**

[1]Small-sized loggers were those whose tonnage size ranged from 0-68,999 tons
[2]Transportation, Telecommunication, and Public Utilities
[3]Finance, Insurance, and Real Estate

The medium-sized group of loggers had a total economic impact of $1.928 billion. Direct impacts were $1.082 billion, and indirect and induced impacts were $297.154 million and $549.134 million, respectively (Table 20). Again, the transportation and telecommunication industry at $297.531 million followed by institutions at $237.869 million were highest in value (Table 20). The Type SAM output multiplier for the medium-sized group of loggers was 1.78 which meant that every $1.00 increase in output results in other industries in the state generating an additional $0.78 economy. The employment industry had a Type SAM multiplier of 1.97 which meant that every one job increase in the logging industry generated an additional 0.97 jobs.

Table 20	Estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for (N=673) medium-sized loggers[1] and using a survey-based method for collecting logger expenditures (2009 dollars).

Industry	Direct Impacts $	Indirect Impacts $	Induced Impacts $	Total Impacts $
Agriculture	718,659	2,235,470	5,350,933	8,305,062
Mining	5,901,080	29,114,648	18,857,894	53,873,624
Construction	10,322,244	6,367,131	38,187,756	54,877,132
Manufacturing	214,553,024	83,263,488	133,691,688	431,508,192
TCPU[2]	297,531,712	51,401,588	27,865,810	376,799,072
Trade	4,719,109	13,618,821	19,337,892	37,675,824
FIRE[3]	129,195,008	38,953,392	83,170,024	251,318,432
Services	181,797,712	57,250,220	132,519,800	371,567,744
Institutions	237,869,672	14,949,296	90,152,912	342,971,872
Total	**1,082,608,219**	**297,154,054**	**549,134,709**	**1,928,896,954**

[1]Medium-sized loggers were those whose tonnage ranged from 69,000-149,999 tons
[2]Transportation, Telecommunication, and Public Utilities
[3]Finance, Insurance, and Real Estate

The large-sized group of loggers had a total economic impact value of $6.448 billion, the largest value recorded for the entire survey-based model (Table 21). Total direct impacts derived from the logging industry were $3.545 billion, with indirect and induced impacts at $1.037 billion and $1.866 billion, respectively. Again, the transportation and telecommunication industry at $1.056 billion followed by manufacturing and finance, insurance and real estate (FIRE) at $664.962 million and $554.171 million, respectively, were highest in value (Table 21). A type SAM output multiplier of 1.82 for the large-sized group of loggers meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.82 within the economy. The employment multiplier of 2.10 meant that every one job increase in the logging industry generated an additional 1.10 jobs.

Table 21 Estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for (N=823) large-sized loggers[1] and using a survey-based method for collecting logger expenditures (2009 dollars).

Industry	Direct Impacts $	Indirect Impacts $	Induced Impacts $	Total Impacts $
Agriculture	2,675,581	7,021,154	18,109,226	27,805,960
Mining	16,842,632	97,287,648	64,952,624	179,082,896
Construction	14,510,070	21,042,544	134,409,952	169,962,560
Manufacturing	664,962,624	275,945,536	454,489,696	1,395,397,888
TCPU[2]	1,056,934,912	175,723,152	94,548,032	1,327,206,144
Trade	154,187,232	58,782,360	65,303,764	278,273,344
FIRE[3]	554,171,584	145,267,168	280,480,000	979,918,784
Services	537,875,648	204,801,568	447,932,544	1,190,609,792
Institutions	543,632,328	51,207,908	305,804,224	900,644,480
Total	**3,545,792,611**	**1,037,079,038**	**1,866,030,062**	**6,448,901,848**

[1]Large-sized loggers were those whose tonnage ranged from 150,000-430,000 tons
[2]Transportation, Telecommunication, and Public Utilities
[3]Finance, Insurance, and Real Estate

Total economic impacts in 2009 dollars derived from using the survey-based data default model were $9.867 billion for all loggers which was an almost $7 billion difference in comparison to the original total economic impacts of $2.489 billion using the model default data. The percentage difference value (compared to the total economic output using default values) for the small-, medium-, and large-sized logger groups were -40.1%, -22.5% and 61.3%, respectively (Table 22).

Table 22 Percentage differences of estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for small-[1] (N=973), medium-[2] (N=673) and large-sized [3]loggers (N=823) using and comparing a survey-based method for collecting logger expenditures to a non-survey based model using default values (2009 dollars).

Logging Contractors	**Total Output New Changes $**	**Percentage Difference %**
Small	1,489,533,624	-40.1
Medium	1,928,896,954	-22.5
Large	6,448,901,848	61.3

[1]Small-sized loggers were those whose tonnage size ranged from 0-68,999 tons
[2]Medium-sized loggers were those whose tonnage ranged from 69,000-149,999 tons
[3]Large-sized loggers were those whose tonnage ranged from 150,000-430,000 tons

The total economic impact for the small-, medium-, and large-sized groups of 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 and $131.747 million in 2006 and 2009 dollars, respectively. Taken alone these loggers represented 1.3% of the total economic impacts generated by the 2,471 estimated logging contractors (both full- and part-time) previously reported. The Type SAM output multiplier for small-, medium-, and large-sized loggers for the 2006 logging year was 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-sized group of loggers in 2009 dollars was $19.901 million, $25.756 million, and $86.089 million, respectively. The Type SAM output multiplier for small, medium and large-sized loggers for the 2009 logging year was 1.82, 1.78, and 1.77, respectively. This 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

The total combined overall logging economic impact in 2009 dollars derived from the survey-based data replacement model [i.e., small-, medium-, and large-sized loggers with values changes in a four sector combination (i.e., sectors 351 telecommunication, 413-food and beverage, 414-auto parts, tires and accessories, 417-commercial and industrial machine and equipment)] was $7.874 billion.

Total economic impacts in 2009 dollars for the small logger group of loggers with value changes in the four sector combinations were $1.196 billion. The Type SAM output multiplier for this group was 1.40 which meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.40 in the economy. The employment industry had a Type SAM multiplier of 1.45. This meant that every $1.00 increase in output generated an additional $0.45 in the economy.

Total economic impacts in 2009 dollars for the medium group of loggers with value changes in the four sector combination were $1.551 billion. The Type SAM output multiplier for this group was 1.41 which meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.41 in the economy. The employment industry had a Type SAM multiplier of 1.39. This meant that every $1.00 increase in output generated an additional $0.39 in the economy.

Total economic impacts in 2009 dollars for the large group of loggers with value changes in the four sector combination were $5.125 billion. The Type SAM output multiplier for this group was 1.43 which meant that every $1.00 increase in output resulted in other industries in the state generating an additional $0.43 in the economy. The employment industry had a Type SAM multiplier of 1.45. This meant that every $1.00 increase in output generated an additional $0.45 in the economy. The new total combined economic impact value of $7.874 billion in 2009 dollars with the changed sector values was almost $5 billion larger in value in comparison to the original total economic impact of $2.489 billion (2009 dollars) when the default data were used in the model. The percentage difference value (compared to the total economic output using default values) calculated with the four sector combination (sectors 351, 413, 414, and 417) value-added and total output value change for the small-, medium-, and large-sized logger groups were -51.9%, -37.6%, and -51.4%, respectively (Table 23).

Table 23 Percentage differences of estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for small-[1] (N=973), medium-[2] (N=673) and large-sized [3]loggers (N=823) using and comparing a survey-based method for collecting logger expenditures based on value changes in sectors 351[4], 413[5], 414[6] and 417[7] sector changed to a non-survey based model using default values for Mississippi (2009 dollars).

Logging Contractors	**Total Output New Changes $**	**Percentage Difference %**
Small	1,196,663,346	-51.9
Medium	1,551,825,396	-37.6
Large	5,125,727,542	51.4

[1]Small-sized loggers were those whose tonnage size ranged from 0-68,999 tons
[2]Medium-sized loggers were those whose tonnage ranged from 69,000-149,999 tons
[3]Large-sized loggers were those whose tonnage ranged from 150,000-430,000 tons
[4]Telecommunication-IMPLAN Sector
[5]Food Services and Drinking Places- IMPLAN Sector
[6]Automotive Repair and Maintenance- IMPLAN Sector
[7]Commercial and Industrial Machine and Equipment - IMPLAN Sector

Total overall economic impact for the actual study participants (i.e., small-sized logger-13, medium-sized logger-9, and large-sized logger-11) using the four sector combination value change was 109.594 million in 2009 dollars. Total economic impacts of the small logger group with the four sector combination were $16.422 million. The Type SAM output multiplier for this group was 1.44 which meant that 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. This meant that every $1.00 increase in output generated an additional $0.52 in the economy. Total economic impact of the large group of logger 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. This meant that every $1.00 increase in output generated an additional $0.60 in the economy. The percentage difference value (compared to the total economic output using default values) calculated with the four sector combination (i.e., sectors 351, 413, 414, 417) value-added and total output value change for the small-, medium-, and large sized logger groups were 21.1%, 19.2%, and 20.2%, respectively (Table 24).

Table 24 Percentage differences of estimated economic impacts of the logging industry in Mississippi using the Impact Analysis for Planning (IMPLAN) model and database software for small-[1] (n=13), medium-[2](n=9) and large-sized [3]loggers (n=11) using and comparing a survey-based method for collecting logger expenditures based on value changes in sectors 351[4], 413[5], 414[6] and 417[7] sector changed to a non-survey based model using default values for Mississippi (2009 dollars).

Logging Contractors	**Total Output New Changes $**	**Percentage Difference %**
Small	16,422,426	-21.1
Medium	21,603,959	-19.2
Large	71,568,008	-20.2

[1]Small-sized loggers were those whose tonnage size ranged from 0-68,999 tons
[2]Medium-sized loggers were those whose tonnage ranged from 69,000-149,999 tons
[3]Large-sized loggers were those whose tonnage ranged from 150,000-430,000 tons
[4]Telecommunication-IMPLAN Sector
[5]Food Services and Drinking Places- IMPLAN Sector
[6]Automotive Repair and Maintenance- IMPLAN Sector
[7]Commercial and Industrial Machine and Equipment - IMPLAN Sector

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, Inc. 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 (MIG, Inc., 2000; Crihfield and Campbell, Jr. 2001; Kronenberg 2009). With the use of non-survey data, it is necessary for the national level data to be adjusted to supply the regional level with data, and thus, IMPLAN uses a supply-demand approach (Radtke et al. 1985; MIG, Inc. 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, Inc. 2000). It also assumes that there are no constraints to the supply of commodity (i.e., imports will be the same across all industries) and full employment is the norm (Lazarus et al. 2002; Bonn 2008). Radtke et al. (1985) stated that this assumption and approach is inaccurate, and thus leads 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).

Thus, differences between total and net imports, which are not differentiated or present with the use of default data in the IMPLAN model, is 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 non-stochastic in nature; in other words, meaningful statistical confidence intervals and analysis cannot be generated (Radtke et al. 1985).

Survey data in this 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). There has been no economic impact study of logging done in Mississippi with the use of survey data. It should be noted that this type of information was 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, uncertainty on how the data will be used) (W. Stuart, pers. comm., 2010). In addition, loggers track expenses in different ways, and using different named categories, thus, presenting 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. A constraint in the survey-based data was its low sample size of 33 loggers. It was very important that enough surveys were gathered so that the sample size was an accurate representation of the entire population being surveyed (McNamara, 1994; Meyer, 2002). 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 to perform this economic impact analysis to be 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 very confidential and in most instances, logging contractors and logging firms were reluctant to cooperate in studies of this nature (Stutzman, Jr. 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 for the past 20 years 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 (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 selecting from all elements of the population) and thus allow for a lower variance in the sample data (Salant and Dillman 1994). Of note, the dissertation objectives were to estimate the effects of industry sector changes using the IMPLAN default software model and compare those results to 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, the researcher 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 these two sets of surveyed data were chosen; however, use of the extrapolation of logger numbers based on data from the 33 loggers has given us an indication that previously used methods of determining the economic impacts of loggers in Mississippi are being underestimated.

In terms of the sample sizes used, other researchers have also had low sample sizes when gathering and conducting research of this nature. For example, LeBel and Stuart (1998) conducted research in the eastern U.S. (e.g., Michigan, Virginia, Georgia) comparing the technical efficiency of converted inputs (i.e., dollars of capital, consumables, and labor output per tons/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 U.S. as well (e.g., Michigan, Virginia, Georgia) location when trying to demonstrate how logging costs have steadily risen at a faster rate than logging contracts received.

For this study, it was determined that, the majority of expenses made by loggers occurred in state, with the exception of fuel for transporting wood. Legal requirements regarding fuel taxes may result in having 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. Stuart, pers. comm., 2010). Logging contractors tend to employ locals for convenience and mobility reasons and contract for services (i.e., trucking, road building) from local firms as well. Also, insurance is purchased in state (in Mississippi) to avoid legal complications. In addition, out-of-state loggers are purchasing items in Mississippi mainly because logging supplies were bulky, heavy, and expensive to transport (W. Stuart, pers. comm., 2010). The three groups of loggers all shared similar expenses (i.e., contract hauling, contract trucking, fuel, salaries, insurances, taxes, equipment purchasing).

Data collected and interpreted in this study allowed a number of observations to be made 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 his 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 related labor expenses were 30% of all ranching expenses while for the other four, labor expenses were only 10%. Lazarus et al. (2002) compared primary data based RPC estimates with econometrically-derived default RPCs in the IMPLAN model. Results for this 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, Jr. (1992) found that IMPLAN underestimated total employment for ten of 11 sectors in a particular county in Illinois. For this research study, impacts estimated by the IMPLAN using survey-based data default model values and survey-based data replacement model, were of a higher value than those estimated using the model default data while at the same time results using the survey-based data replacement model were of a lower value in comparison to survey-based data default model.

A constraint in the survey-based models was its low sample size. As previously noted, the model default data total economic impact for the logging industry was $2.309 billion in comparison to the combined total economic impact value of the small-, medium-, and large-sized loggers of $9.275 billion. The total economic value for the large-sized group of loggers (Table 18) was almost three times larger than the entire economic impact of the non-surveyed model (Table 11). Despite a small sample size, this study pointed to potential inaccuracies of using default data computed within the model when compared to actual surveyed data input into the model. Direct impacts for the model default data were $1.179 billion with all other categories under the direct impacts having a zero value. The highest value noted for the small-sized loggers direct impact was in manufacturing ($204.127 million). The highest direct impact value for the medium-sized loggers was transportation and telecommunication ($265.505 million). This in turn would require more contract trucking, in comparison to the small-sized group of loggers. The large group of loggers harvested the greatest tonnage (i.e., 150,000-430,000 tons) and, therefore, required more contract trucking and services to transport logs to mills and/or other consumers. They, in turn, needed more fuel for their trucks, and insurance which explains why the other industries under the direct impact as well as the indirect impacts had large values. In summary, there is a good indication that previously reported numbers have been underestimated (see Chapter III). When undertaking these types of studies, it is recommended that localized input data be acquired where possible, to improve on the model outputs.

Model default data within the IMPLAN model compared to the survey-based data replacement model also resulted in large differences in values. For example, model default data values had a total economic impact value of $2.489 billion while survey-based data replacement model had an overall total economic impact of $7.874 billion (2009 dollars). Similarly, the 2006 survey-based data replacement model using the actual number of logging contractors (n=33) had a combined total economic impact value of $131.747 million using the default values in the IMPLAN model. This number was reduced to $109.593 million (2009 dollars) when four sectors were changed in the state model.

The survey-based data default model total economic impacts (i.e., $9.487 billion) as well as the survey-based data replacement model total economic impacts (i.e., $7.874 billion) had a numeric value difference of $1.613 billion. These results were anticipated because data collected from the logging contractors by Mississippi State University researchers came directly from the logging contractors accounting books and the data from the Mississippi Tax Commission came directly from sales tax by industry groups operating in Mississippi. Therefore, the survey-data collected by Mississippi State

University researchers and the data collected by the Mississippi Tax Commission were relatively consistent in comparison to the estimated default values found within the model.

The methodology and results derived from this study were the first of its kind. Bergstrom et al. (1990b) did, however, recommend comparing county level estimates of final demand, final payment, gross output and employment with local databases (i.e., state government labor statistics) because economic activity within a region constantly changes over time. From a modeling standpoint, past research has focused primarily on changing different components within the model. For example, McKean and Spencer's (2003) study 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) in their study focused primarily on changing the production function and RPCs. Both studies maintained the use of the IMPLAN default data. This 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 under estimation of multipliers because it does not capture a true representation of a state's industries and their impact on the economy. In this study, as opposed to McKean and Spencer's 2003 study, output values were adjusted with localized data, and in turn, all four value-added components (i.e., employee compensation, proprietor income, other property income, indirect business tax) also were adjusted.

Study Limitations

A certain type of expertise and persistence is needed to gather survey data used in this 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 people into the logging profession due mostly to a prolonged economic recession that hit this industry long before it hit the U.S. economy as a whole. Also, there has been difficulty in recovering from natural disasters (e.g., hurricanes), 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, 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 that was available at the start of this project. In addition, considerable effort had to be made in this study preparing this information for use in IMPLAN as well.

The makeup and components of sectors used and described by the IMPLAN model were at times not clearly labeled which at times proved challenging when comparing them to Mississippi Tax Commission data, and vice versa. It was evident that the IMPLAN sectors were too highly aggregated as described in past studies (ESSRP 2006). For example, sector 326 is defined as retail-gasoline stations in IMPLAN and 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 mini shopping 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, extraction of oil and natural gas) and 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 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 U.S. 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 bring about awareness about the validity of the model and 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. As a result, IMPLAN users should be made aware of these discrepancies in the model and try using alternative methods (e.g., surveys, 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 data within the model when feasible. Last, all economic impact analysis conducted using the IMPLAN model should provide information on institution inclusion when model construction is being accomplished, and a detailed description of data/impact analysis and multiplier calculation to further support the results. 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 with the percentage of output of the ranked sectors.

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