

10-1-2013

Economic Contribution of the Agricultural Sector to the Arkansas Economy in 2011

Leah English

University of Arkansas, Fayetteville


Jennie Popp

University of Arkansas, Fayetteville

Wayne Miller

University of Arkansas at Little Rock

Follow this and additional works at: <https://scholarworks.uark.edu/aaesrb>

 Part of the [Agricultural Economics Commons](#), [Agronomy and Crop Sciences Commons](#), [Animal Studies Commons](#), [Forest Management Commons](#), and the [Other Animal Sciences Commons](#)

Recommended Citation

English, Leah; Popp, Jennie; and Miller, Wayne, "Economic Contribution of the Agricultural Sector to the Arkansas Economy in 2011" (2013). *Research Reports and Research Bulletins*. 7.
<https://scholarworks.uark.edu/aaesrb/7>

This Report is brought to you for free and open access by the Arkansas Agricultural Experiment Station at ScholarWorks@UARK. It has been accepted for inclusion in Research Reports and Research Bulletins by an authorized administrator of ScholarWorks@UARK. For more information, please contact scholar@uark.edu, ccmiddle@uark.edu.

Economic Contribution of the Agricultural Sector to the Arkansas Economy in 2011



Leah English, Jennie Popp, and Wayne Miller

UofA

DIVISION OF AGRICULTURE

RESEARCH & EXTENSION

University of Arkansas System

ARKANSAS AGRICULTURAL EXPERIMENT STATION

October 2013

Research Report 992

Technical editing and cover design by Gail Halleck.

Arkansas Agricultural Experiment Station, University of Arkansas System Division of Agriculture, Fayetteville. Mark J. Cochran, Vice President for Agriculture; Clarence E. Watson, Associate Vice-President for Agriculture–Research and Director, AAES. WWW/InddCS6.

The University of Arkansas System Division of Agriculture follows a nondiscriminatory policy in programs and employment. ISSN: 1539-5944 CODEN: AKABA7

Economic Contribution of the Agricultural Sector to the Arkansas Economy in 2011

Leah English*
Jennie Popp
Wayne Miller

**Arkansas Agricultural Experiment Station
University of Arkansas System
Division of Agriculture
Fayetteville, Arkansas 72701**

* Leah English is a Program Associate in the Department of Agricultural Economics and Agribusiness in Fayetteville; Jennie Popp is a Professor in the Department of Agricultural Economics and Agribusiness in Fayetteville; and Wayne Miller is a Professor of Economic and Community Development with the University of Arkansas System Division of Agriculture, Cooperative Extension Service in Little Rock, Ark.

CONTENTS

List of Tables, Boxes, and Figures.....	3
Acknowledgements	3
Executive Summary	4
Definitions and Styles	6
Agricultural Sectors.....	6
Economic Contribution.....	6
Style Notes	7
1: Direct, Indirect, and Induced Contributions of the Aggregate Agriculture Sector.....	8
1.1: Introduction.....	8
1.2: Methods.....	8
1.2.1: General Procedures.....	9
1.2.2: Analysis by Parts.....	10
1.2.3: Measures of Economic Contribution	10
1.3: The Aggregate Agriculture Sector	11
1.3.1: The Crops Sector	13
1.3.2: The Animal Agriculture Sector	14
1.3.3: The Forestry Sector	14
1.4: Summary of the Contribution of Agriculture in 2011	16
End Notes	17
Literature Cited.....	17
Appendix A: Description of IMPLAN Sectors and Aggregation Schemes.....	19
Appendix B: Agriculture-Generated Activity by Sector.....	22
Appendix C: IMPLAN Analysis by Parts, Technical Details.....	32

TABLES

1.	The Aggregate Agriculture Sector's Contribution to Arkansas' Economy, 2011	12
2.	The Contribution of Major Agricultural Sectors to Agricultural Production and Processing, 2011.....	13
3.	The Crops Sector's Direct Contribution to Arkansas' Economy, 2011.....	13
4.	The Animal Agriculture Sector's Direct Contribution to Arkansas' Economy, 2011.....	14
5.	The Forestry Sector's Direct Contribution to Arkansas' Economy, 2011.....	15

BOXES

B1.	Total Contribution of Arkansas Agriculture, 2011	11
B2.	Employment Generated by Agriculture, 2011 - Top Five NAICS Industries.....	11
B3.	Value Added Generated by Agriculture, 2011 - Top Five NAICS Industries.....	12
B4.	Labor Income Generated by Agriculture, 2011 - Top Five NAICS Industries.....	12
B5.	Direct Contribution of the Crops Sector, 2011	14
B6.	Direct Contribution of the Rice Industry (<i>Rice Farming and Rice Milling</i>).....	14
B7.	Direct Contribution of the Animal Agriculture Sector, 2011	14
B8.	Direct Contribution of the Poultry Industry (<i>Poultry and Egg Production and Poultry Processing</i>).....	15
B9.	Direct Contribution of the Forestry Sector, 2011	15
B10.	Direct Contribution of the Top Five Forestry Industries: <i>Paper Mills, Sawmills and Wood Preservation, Veneer and Plywood Manufacturing, Sanitary Paper Product Manufacturing, and Paperboard Container Manufacturing</i>	15

ACKNOWLEDGEMENTS

We, the authors, would like to thank the Arkansas Division of Agriculture for funding this initiative. We also extend our appreciation to several individuals in the University of Arkansas, Fayetteville, Departments of Horticulture and Poultry Science; the Arkansas Forestry Commission; and the University of Arkansas Monticello School of Forest Resources, who offered their expertise for data collection and interpretation. We would like to thank our reviewers for their insightful input and suggestions. Finally, we sincerely appreciate Judy Howard's and Gail Halleck's publishing skills and attention to detail.

Executive Summary

Agriculture and associated agricultural activities are major contributors to the Arkansas economy. Agriculture is defined as the sum of agricultural production and processing activities, unless otherwise specified, and includes crop and animal production and processing, agricultural support industries, forestry and forest products, and textile goods. Agriculture contributes to the economy through direct agricultural production and value-added processing, and also leads to economic activity in other parts of the economy.

This report¹ is the eighth in a series of reports examining agriculture's economic contribution on the Arkansas economy. Utilizing data from the United States Bureau of Economic Analysis (BEA), USDA Economic Research Service (ERS), USDA National Agricultural Statistics Service (NASS), and Minnesota IMPLAN Group, Inc. (MIG), the economic contribution of agriculture on the Arkansas economy was estimated for the most recent year available, 2011. The total economic contribution of agriculture (direct, indirect, and induced effects) to value added, employment, and labor income was estimated using the Impact Analysis for Planning System (IMPLAN). The economic contributions of agricultural production and processing were estimated for agriculture as a whole and also separately for the Crops Sector, the Animal Agriculture Sector, and the Forestry Sector. Key findings of the IMPLAN analysis are as follows:

- Aggregate Agriculture contributed \$17.0B in total value added to the state economy; this is almost \$0.17 of every \$1 in value generated in the state.
- Aggregate Agriculture accounted for 259,243 jobs, which is almost 17% of all jobs in the state. Over one-half of these (150,419), or 10.3% of all state employment, are in the agriculture production, processing and agriculture-related industries.
- *Poultry and Egg Production* and *Poultry Processing* alone provided over one in four of the state's agricultural jobs, as in previous years.
- Aggregate Agriculture generated \$10.1B in labor income, or 15% of the state's total labor income, including agriculture payrolls, which totaled \$7.9B, or 15% of total state wages.
- Aggregate Agriculture generates value added, employment, and income in all 20 of the 2-digit NAICS aggregated industries in the state. Almost half of agriculture's contribution to value added occurs in industries closely tied to agriculture but not defined as part of the agriculture sector, such as *Real Estate and Rental*, *Wholesale Trade*, and *Transportation and Warehousing*.
- The direct contribution of the Crops Sector included \$3.1B in value added, 62,918 jobs and over \$1.6B in labor income. *Rice Farming* and *Rice Milling* accounted for 13% of jobs, 17% of labor income, and 18% of value added in the Crops Sector.
- In direct contributions, the Animal Agriculture Sector generated \$2.9B in value added, 52,000 jobs and \$1.7B in labor income. *Poultry and Egg Production* and *Poultry Processing* provided 74% of jobs, 82% of income, and 79% of value added in the Animal Agriculture Sector.
- The direct contribution of the Forestry Sector included \$2.9B in value added, 26,234 jobs, and \$1.9B in income. Within the Forestry Sector, *Paper Mills, Sawmills and Wood Preservation*, *Veneer and Plywood Manufacturing*, *Sanitary Paper Product Manufacturing*, and *Paperboard Container Manufacturing* contributed 52% of forestry jobs, almost two-thirds of forestry income, and 69% of value added.

Including direct, indirect and induced effects, agriculture generates over one in six jobs and almost 17% of value added in the state. The diversity of the state's agriculture helps mitigate the effects of low world market prices or trade embargoes on commodities. Crops, animal agriculture, and forestry production and processing are all major contributors to agriculture and to the state's economy. The large and diverse natural resource base of the state provides the opportunity for agriculture to change and develop new value added and bio-energy industries. The size and diversity of the state's agriculture contribute greatly to the well-being of Arkansans and to the stability of the state's economy.

Note: In some cases, numbers reported in this research report may differ from numbers reported in its companion documents, the pocket guide *Economic Contribution of Arkansas Agriculture* (McGraw, Popp and Miller 2013), due to rounding.

Definitions and Styles

Agricultural Sectors

Aggregate Agriculture consists of the Crops, Animal Agriculture, and Forestry Sectors' production and processing industries, plus the Agriculture-Related Sector. See Appendix A, Tables 1-4 for a complete listing of the sectors included.

Crops Sector comprises those industries directly involved in crop production and processing. See Appendix A, Table 1 for a complete listing of the industries included.

Animal Agriculture Sector comprises those industries directly involved in livestock production and processing. See Appendix A, Table 2 for a complete listing of the industries included.

Forestry Sector comprises those industries directly involved in forestry production and processing. See Appendix A Table 3, for a complete listing of the industries included.

Agriculture-Related Sector comprises those industries that support the Crops, Animal Agriculture, and Forestry Sectors. See Appendix A, Table 4 for a complete listing of the industries included.

Note: No input providers (fertilizer, pesticide and equipment manufacturers) or retail locations (restaurants, grocery stores, lawn and garden centers, etc.) are considered as direct contributors to the Aggregate Agriculture Sector in the contribution analysis. However, much or some of the economic activity in these firms is picked up as indirect and induced effects and reported as part of the total economic contribution.

Economic Contribution

The **total economic contribution** of the Aggregate Agriculture Sector includes three components of wealth and job generation:

1. **Direct Contributions** are the sum of the contributions of farm production and processing of farm and forestry products. Only direct contributions are reported in the Crops, Animal Agriculture and Forestry Sector discussions.
2. **Indirect Contributions** result when agricultural firms purchase raw materials and services from other Arkansas businesses to produce their products.
3. **Induced Contributions** result when employees of agricultural firms and employees of the raw material and service firms spend a portion of their income on local purchases.

These contributions are reported in terms of **Employment**, **Labor Income**, and **Value Added**:

1. **Employment** includes all wage and salary employees, as well as self-employed workers (owner-operators) in a given sector.
2. **Labor Income** consists of two parts: proprietary income and wages. Proprietary income includes all income received by self-employed individuals, such as private business owners, doctors, lawyers or other professionals. Wages include all worker salaries, payments, and fringe benefits paid by employers.
3. **Value Added** includes labor income plus indirect taxes and other property-type income such as payments for rents, royalties, and dividends. Value added and Gross Domestic Product (GDP) are equivalent measures in theory but are estimated using different methods and data sources.

Style Notes

Agricultural Sectors. These comprise the areas of focus in our study. The report refers to the four areas of analysis: Crops Sector, Animal Agriculture Sector, Forestry Sector, and Aggregate Agriculture Sector. The Agriculture-Related Sector is included in the analysis of the Aggregate Agriculture Sector, but is not presented individually. These terms are capitalized and underlined throughout the text.

NAICS Sectors. The North American Industry Classification Scheme (NAICS) is “...the standard for use by Federal statistical agencies in classifying business establishments for the collection, tabulation, presentation, and analysis of statistical data describing the U.S. economy....For statistical purposes, a business establishment is assigned one NAICS code, based on its primary business activity” (USCB, 2013). This report uses the 2007 NAICS sectoring scheme (USCB, 2006). Agricultural activities are classified under, or can impact, multiple sectors. Throughout the document, capitalization of sectors is used when referring to NAICS sectors. Examples include Food Manufacturing, Paper Manufacturing, and Wood Product Manufacturing.

Industries. These are defined as individual IMPLAN industries that are defined by aggregating NAICS sectors into the larger IMPLAN industries used in our analysis. These industries are capitalized and italicized. Examples include *Poultry and Egg Production* and *Paperboard Mills*.

General Descriptive Terms. These are terms used to describe agriculture throughout the text that are not related to established industry classification schemes or specific agricultural sector titles used in this analysis. These terms are presented in lowercase. Examples include agricultural production and agricultural processing.

1: Direct, Indirect, and Induced Contributions of the Aggregate Agriculture Sector

1.1: Introduction

The total economic contribution of Arkansas' Aggregate Agriculture Sector is much more than the direct contribution of agricultural production and processing. To measure agriculture's total economic contribution, the indirect and induced contributions of agriculture must also be taken into consideration. Indirect contributions occur when the Aggregate Agriculture Sector purchases goods and services from local businesses. The production of fertilizers and certain farm machinery and equipment, for example, are indirect contributions of agricultural production. Agriculture's induced contributions are measured by increases in economic activity due to personal consumption by employees of the Aggregate Agriculture Sector and by employees of firms that provide inputs to the Aggregate Agriculture Sector. The sum of direct, indirect, and induced agricultural effects provides a measure for the total economic contribution of agriculture. The report discusses the overall economic contribution of agriculture to Arkansas' economy, considering the direct, indirect, and induced effects of the Aggregate Agriculture Sector in 2011.

1.2: Methods

This report builds upon Part II of previous reports (Goodwin et al., 2002; Popp, Vickery and Miller, 2005; Popp, Kemper and Miller, 2007; Kemper, Popp and Miller, 2009; Popp et al., 2010; McGraw, Popp and Miller, 2011) and utilizes data for 2011, the most recent year that relevant GDP and IMPLAN data were available.

As in our previous reports, the economic contribution of Arkansas' Aggregate Agriculture Sector was computed using data and input-output (I-O) modeling software (IMPLAN version 3.0) from Minnesota IMPLAN Group, Inc. (MIG; Stillwater, Minn.). Data here are reported for 2011 (MIG, 2012). Contributions are reported in terms of employment, labor income, and value added (introduced previously and described in depth in section 1.3). The only sectors included as part of the agriculture sector in the analysis are those directly producing agricultural products, processing raw agricultural products, or providing agricultural services to producers. Any sector less than 100% tied to agriculture is not included as part of the Aggregate Agriculture Sector (such as restaurants, grocery stores, fertilizer manufacturers and distributors). The Aggregate Agriculture Sector is made up of three types of industries: agricultural production industries, agricultural processing industries, and agriculture-related industries. Definitions for these industries for this analysis are provided below and in Appendix A. Additionally, the indirect and induced contributions of the non-agricultural sectors are included in the total contribution of agriculture. The contribution includes the direct, indirect and induced effects of agricultural production and processing activities, and excludes the direct effect of the food services and drinking industry. "Contribution analysis" typically describes that portion of a region's economy that can be attributed to an existing industry, event, or policy by identifying all the direct and backward linkages in the study area (Alward, 2012).

The results of the economic contributions of agriculture are presented for the following sectors: Crops Sector, Animal Agriculture Sector, Forestry Sector, and Aggregate Agriculture Sector. For the first three sectors, agriculture is defined as those production and processing sectors in IMPLAN directly related to that sector (crops, animal, or forestry). Agricultural retail is not included as a component of Aggregate Agriculture, although some retail activity is captured in the indirect and induced effects. The IMPLAN industries used to create those sectors are presented in Appendix A, Tables 1-3. Aggregate Agriculture is defined as the sum of all four sectors: Crops, Animal Agriculture, Forestry, and the Agriculture-Related Sectors (presented in Appendix A, Table 4). Aggregate Agriculture includes all of the IMPLAN industries listed in Appendix A, Tables 1-4.² In some cases, results are presented as production and processing contributions instead of by Sector. The Aggregate Agriculture Sector's IMPLAN industries are presented grouped by production and processing in Appendix A, Tables 5-6. State level IMPLAN data for Arkansas for 2011 (the most recent data available) were used to calculate all contributions (MIG, 2012). The relevant employment, labor income, and value added contributions of agriculture are detailed in Appendix B and are summarized below. All labor income and value added figures are reported in current (nominal) 2011 dollars, unless otherwise noted.

1.2.1 General Procedures

For the economic contribution analysis of the agriculture sector, the entire measure of economic activity in the industries that make up the Aggregate Agriculture Sector (crop, livestock, and forestry production and processing industries, and ag-related activities) are considered to be 100% agriculture. There are several key considerations in the construction of the IMPLAN I-O models used to measure the economic contribution of the Aggregate Agriculture Sector. For each step of the analysis, careful consideration was taken to ensure that the analysis reflects accurately the Arkansas Aggregate Agriculture Sector. The main steps for constructing the model were data reconciliation, selection of multipliers, editing industry production, estimating trade flows, creating activities, and editing local purchase percentages (MIG, 2000).

The Aggregate Agriculture Sector is made up of three broad categories of agricultural industries: agricultural production industries, agricultural processing industries, and agricultural-related industries. The output data for the agricultural production industries (IMPLAN sectors 1-14)³ were checked for accuracy against the latest available estimates for the value of production from NASS and ERS. The agricultural production data in IMPLAN are sometimes unreliable for three reasons. First, output data for all industries outside of agriculture are estimated from a large number of sources, but data for agricultural production are derived entirely from NASS value of production data and the most recent U.S. Census of Agriculture. Due to NASS publication lags, IMPLAN data are often released using preliminary estimates for a given year. To check the accuracy of the IMPLAN data, the agricultural production industries are compared against finalized NASS/ERS data for the relevant year. Second, there are also non-disclosure problems, particularly at the county level (which is why analysis is done at the state level); this makes data reconciliation between IMPLAN and NASS data difficult at the county level. Third, employment and income data for the agriculture sectors are difficult to estimate since there are no employment and earnings data

collected on a commodity basis. The only farm employment and income data are derived from BEA's Regional Economic Information System (REIS) program but these are only single farm employment and income numbers for all agriculture sectors combined. MIG collects estimates of output and creates vectors of employment and income to allocate the single REIS value to the separate IMPLAN agricultural production sectors (Lindall, 1998). MIG encourages analysts with better agriculture data to use it when building models (Olson and Lindall, 2009).

The default IMPLAN data for IMPLAN agricultural production sectors 1-14 were updated with the most recent NASS/ERS output estimates for the state of Arkansas, collected from the USDA Economics, Statistics and Market Information System (ESMIS; USDA NASS, 2013). The default output data was changed to reflect the NASS/ERS output estimate. For Hogs and Pigs and for Cattle and Calves, gross income is used instead of value of production or cash receipts because it is defined as cash receipts plus on-farm or home consumption of slaughtered animals, which is most similar to other commodities' measurements. For *Grain Farming* (sector 2), the value of output was calculated as the sum of only wheat, corn for grain, oats, and grain sorghum. The value of rice farming was omitted from sector 2 in order to analyze the rice industry (*Rice Farming and Rice Milling*) using IMPLAN's analysis by parts (ABP) methods (section 1.2.2 and Appendix C). For any sector where a change was made to the value of output, a change corresponding to the percent change in output was also made to all four components of value added. This holds the relationship between Total Industry Output and Total Value Added (a fundamental relationship in I-O analysis) constant, and the model production functions are left unchanged. Additionally, for *Poultry and Egg Production* (sector 13), output per worker estimates are edited to reflect the 2011 poultry farm estimates from Arkansas Natural Resources Commission (ANRC, 2013). These numbers are newer and more accurate than those used by MIG to estimate poultry employment; this method allows for the number of jobs in sector 13 to be

changed to reflect the most recent output per worker. Output per worker is calculated by first estimating the total number of poultry production jobs and multiplying the number of farms by 2.49; this method presumes one operator per farm plus 1.49 additional workers per operator (USDA, 2007). Then, the data year output value divided by total poultry employment yields the updated estimate for output per worker for that year. Output and employment for *Flour Milling and Malt Manufacturing* (sector 43) were also edited to remove the value of rice milling so that the rice industry could be analyzed using IMPLAN's ABP methods.

Multipliers describe the response of the economy to a change in economic activity and estimate changes in output, employment, income and value added. When analyzing the economic contributions of the Aggregate Agriculture Sector, type SAM (Social Accounting Matrix) multipliers are used to incorporate household expenditures into the models and to calculate the indirect and induced contributions. Type SAM multipliers are the direct, indirect and induced effects where the induced effect is based on both study area data and additional information in the social account matrix. The SAM framework tracks both market and non-market flows. Non-market flows are transactions between non-industrial institutions such as households to government, government to households, and so on. These flows are called "inter-institutional transfers" (Alward and Lindall, 1996). The SAM multiplier approach enables the model to account for commuting, social security tax payments, household income tax payments, and savings; it accounts for income that is not normally re-spent immediately within the region, such as commuting workers who live outside the region and retirement benefits. I-O models built with Type SAM multipliers usually have results that are lower than an I-O model built with Type II multipliers (also available in IMPLAN). The Type SAM is the most appropriate choice for analyzing the contributions of the agriculture sector.

Estimating trade flows across regional boundaries is possibly the largest source of error in non-survey I-O models (Stevens and Trainor, 1980) and the se-

lection and use of the regional purchase coefficient (RPC) is one way to eliminate some of the errors. Because of the longitudinal nature of this research series, IMPLAN's Econometric RPC model was employed to make comparisons with previous years' results more compatible. The RPC represents the proportion of intermediate demands and local demands for a specific commodity that will be satisfied by local production (Olson and Lindall, 2009). For example, a RPC value of 0.80 means that 80% of the final demand for the industry is provided by local producers. The remainder (20%) is the portion imported from outside the region. To avoid overestimation of the Aggregate Agriculture Sector, the model RPCs must be set to zero for agricultural industries (see Appendix A), instructing the model not to purchase products and services from the Aggregate Agriculture Sector. This removes the agriculture sectors from the production function and eliminates multiple counting of economic activity in these sectors.

When conducting contribution analysis, IMPLAN allows the user to edit commodities produced by industries for the change in final demand. In the study, any byproduct commodity produced in a sector included in the Aggregate Agriculture Sector was set to zero so the industry production of the primary commodity is 100%. Therefore, the sector is solely responsible for the entire value of the product being sold (e.g., *Oilseed Farming* industry is solely responsible for the entire value of soybeans produced; soybeans are not produced in any other sector). By specifying that each agricultural industry only produce its primary commodity, no byproducts exist and therefore no indirect or induced effects are calculated in the defined agricultural sectors.

In order to measure the contribution of each industry, industry change activities for each industry in the Aggregate Agriculture Sector were created. The year of each event equaled the data year, and the output values for each event equaled the industry output value previously used in data reconciliation. This method allows IMPLAN to estimate the contribution of the industry to the local economy instead of an additional impact from an industry.

The final important procedure is to

estimate the portion of activity that accrues to the local (in this case the state) economy by editing the Local Purchase Percentages (LPPs) in the industry change activities for every IMPLAN agricultural industry. Only the portion of an industry's value that is produced locally should accrue to the local economy. For instance, output in the *Oilseed Farming* industry (sector 1) involved the LPP being set to 100%, which means the entire output value of the industry accrued to the region because the goods in the sector are produced within the study region. Alternately, an activity measuring spending by tourists on gasoline and oil would involve setting the LPPs to the SAM value, an estimate of the actual percent of expenditures made in the study area. Estimating the economic contribution of the Aggregate Agriculture Sector to the state involved setting each LPP to 100% for each industry considered part of the Aggregate Agriculture Sector.

1.2.2 Analysis by Parts

Arkansas's largest grains industry is rice, unlike all other U.S. States. Differences in the makeup of the output value of the grains industry, and therefore the industry spending patterns for grains production and processing, in Arkansas warranted changes in the contribution analysis methods. Richardson and Outlaw (2010) previously reported on the U.S. rice industry's contribution to the U.S. economy using IMPLAN's analysis by parts methods (Alward, 2012). ABP allows the IMPLAN user to account for industry activity outside of the 440 sectoring scheme. For example, ABP could be used in an impact analysis to estimate effects of a new industry in an economy (e.g., switchgrass production and processing into ethanol) or in a contribution analysis to estimate the effects of a piece of an existing industry separately (e.g., rice production independently instead of as a component of *Grains Farming* sector). In this study, *Rice Farming* and *Rice Milling* comprise the rice industry. *Rice Farming* was removed from *Grain Farming* (sector 2), and *Rice Milling* was removed from *Flour Milling and Malt Manufacturing* (sector 43). Appendix C presents additional technical details about ABP.

1.2.3 Measures of Economic Contribution

Total economic contributions are made up of three separate components: 1) direct contributions - generated by farm production and processing of crops, poultry, livestock and forest products; 2) indirect contributions - generated when agricultural firms purchase materials and services from other Arkansas businesses; and 3) induced contributions - result when employees of agricultural firms and their suppliers spend a portion of their income within Arkansas. Each of these contributions makes up an important part of the total economic contribution of the Arkansas agriculture sector. The overall definition of the Aggregate Agriculture Sector in this study is limited to only those sectors considered to be 100% tied to agriculture, as defined in section 1.2. However, the indirect and induced contributions measure the contributions of those industries that are linked to agriculture but may not be entirely defined as agriculture. These industries represent important economic bases of many communities across the state and contribute to the jobs, income and value added in these communities due to their relationships with agriculture. Because sectors are interlinked throughout the state, expansion in activities in one sector may result in expansion in other sectors. Therefore, the contributions accruing in other sectors as a result of agricultural production and processing are included in the total economic contribution.

Economic contributions are often measured in terms of: 1) total industry output, 2) wages and labor income (wages, salaries, and proprietor income), 3) total value added, and 4) employment. I-O analysis can be used to assess the economic contribution of an existing sector. These measures are thought of as a sector's gross contribution to the regional economy. This is accomplished by "removing" the sector of choice from the I-O model and examining how this removal affects the economic activity in the region. This provides an estimate of the contribution of the sector by looking at the losses experienced (or activity generated) by the sector of interest.

Employment includes all wage and salary employees, as well as self-employed jobs, in a given sector. All jobs are not equal; they pay different wages, require different skills and different work hours, etc., which makes aggregate estimates or comparisons across regions and industries problematic. However, jobs as a measure of economic contribution are easily understood and an important component of economic activity. Labor income consists of two parts: first is proprietary income, which includes all income received by self-employed individuals including private business owners, owner-operators, etc.; second is wages, which includes all worker salaries, payments, and fringe benefits paid by employers. Value added represents all payments to workers (labor income) plus indirect taxes and other property-type income, such as pay-

ments for rents, royalties, and dividends. Value added is comparable to GDP by State but is measured using different data sources and methods, so the data may not be precisely equal. Value added is the income and indirect business taxes generated by the activity and offers a more complete examination of the total economic contribution of an activity on a region; therefore, economists generally prefer value added to output as the measure for assessing the contribution of a given industry or activity to a region's economy (Olson and Lindall, 2009). Income and value added are also relatively clear measures of economic contribution that can be directly compared across industries and regions that contain a range of different economic activities.

Measuring the economic importance of an industry using output can be mis-

leading. Output represents the dollar value of an industry's total production, but can also be thought of as the sum of the goods and services used to provide a product. Economic contribution analyses estimate the contribution of production (output) by including purchases from other industries to produce the inputs required to create this output; therefore, output includes the production of intermediate goods which are included in another industry's output. Summing the output of all industries would include multiple counting of some goods and services. Gross sales receipts overestimate the economic size of an industry because the values of inputs are recounted at each succeeding stage of production. As a result, output should not be used as a measure of economic contribution and is not reported here.

1.3: The Aggregate Agriculture Sector

In 2011, agriculture made substantial contributions to the Arkansas economy in terms of employment, labor income, wages, and value added (see Box 1). The Aggregate Agriculture Sector provided 259,243 jobs, or almost 17%, of state employment (Table 1). That is, more than one in six Arkansas jobs can be attributed to agriculture. In that same year, agriculture paid \$10.1B, or 15% of state labor income. Wages accounted for \$7.9B, or 78% of total labor income generated by agriculture. Additionally, the Aggregate Agriculture Sector added \$17.0B of value to the state economy, or 17% of state value added. That is, more than \$1 out of every \$6 in value added can be attributed to agriculture. Details of these contributions are presented in Appendix B, Table 1 and are summarized in Tables 1 through 3 below.

Agriculture generates employment in all 20 of the 2-digit NAICS sectors. Almost three-quarters of all agriculture-generated jobs are in five sectors (Box 2). The poultry industry (comprised of *Poultry Processing* and *Poultry and Egg Produc-*

tion) alone provides 38,377 jobs, or one in four jobs generated by agriculture in Arkansas. *Poultry Processing* employed 28,881 of these workers. The remaining 9,496 workers were employed in *Poultry and Egg Production*.

The far-reaching contributions of agriculture are seen in the distribution of agriculture-generated value added throughout the economy. Box 3 shows the five sectors that benefit most from value added generated by agriculture. Note that three of those

sectors (*Wholesale Trade, Transportation and Warehousing, and Real Estate and Rental*) lie outside of the agriculture sector as defined here. Although almost half of all agriculture-generated value added accrues outside agricultural sectors, these sectors are closely tied to agriculture. For instance, *Wholesale Trade* contains businesses such as grain and livestock wholesalers as well as farm supply wholesalers.

Box 1. Total Contribution of Arkansas Agriculture, 2011	
Employment	259,243 jobs (1 out of 6 Arkansas jobs)
Wages	\$7,872M (13% of Arkansas wages)
Labor Income	\$10,148M (15% of Arkansas labor income)
Value-Added	\$17,046M (\$1 out of \$6 Arkansas value added)

Source: MIG (2012).
NOTE: Presented in current dollars.

Box 2. Employment Generated by Agriculture, 2011 Top Five NAICS Industries^a	
Agriculture, Forestry, Fishing and Hunting	78,700 jobs (88% of the jobs are in agricultural production)
Manufacturing	75,644 jobs (95% of the jobs are in agricultural processing)
Transportation and Warehousing	12,594 jobs
Health and Social Services	12,011 jobs
Retail Trade	11,292 jobs
Top Five Total	190,240 jobs (73% of all jobs generated by Agriculture)

^aBased on 2-Digit NAICS aggregation (USCB, 2006).
Source: MIG (2012).
Note: presented in current dollars.

Table 1. The Aggregate Agriculture Sector's Contribution to Arkansas' Economy, 2011.

	Employment ^a			Labor Income ^b			Value Added ^c		
	Number of Jobs	% Total	% Total Arkansas Jobs	Million \$	% Total	% Total Arkansas Labor Income	Million \$	% Total	% Total Arkansas Value Added
Production ^d	69,433	26.8	4.4	1,489	14.7	2.2	2,643	15.5	2.6
Processing ^e	71,719	27.7	4.6	3,805	37.5	5.7	6,173	36.2	6.0
Ag-Related ^f	9,267	3.6	0.6	234	2.3	0.4	193	1.1	0.2
Direct Contribution	150,419	58.0	9.6	5,527	54.5	8.3	9,008	52.8	8.7
Indirect Effects	60,552	23.4	3.9	2,965	29.2	4.4	4,980	29.2	4.8
Direct + Indirect Contribution	210,971	81.4	13.5	8,492	83.7	12.7	13,988	82.1	13.5
Induced Effects	48,272	18.6	3.1	1,656	16.3	2.5	3,058	17.9	3.0
Total Contribution	259,243	100.0	16.6	10,148	100.0	15.2	17,046	100.0	16.5

Source: Computed using the 2011 Arkansas database from MIG (2012).

Note: Presented in current dollars.

^a Equivalent to full- and part-time jobs (MIG, 2000).

^b Labor income represents all forms of employment income; it is the sum of employee compensation and proprietor income (MIG, 2000).

^c Value added is the sum of employee compensation, proprietary income, other property type income, and indirect business taxes.

^d Appendix A, Table 3 lists sectors of direct agricultural production in terms of IMPLAN sectors.

^e Appendix A, Table 3 lists sectors of direct agricultural processing in terms of IMPLAN sectors.

^f Ag-related sectors include agricultural sectors not categorized as agricultural production or processing. These sectors are Fishing, Hunting, and Trapping; Agriculture and Forestry Support Activities; and New Farm Housing Units and Additions and Alterations.

Within Crops Sector production industries, *Oilseed Farming*, *Rice Farming*, and *Cotton Farming* add the largest amount of value, while in the Animal Agriculture Sector, the poultry industry (*Poultry and Egg Production* and *Poultry Processing*) contributes the largest value. In the Forestry Sector, the top five contributors to value in the economy are *Paper Mills*, *Sawmills and Wood Preservation*, *Veneer and Plywood Manufacturing*, *Sanitary Paper Product Manufacturing*, and *Paperboard Container Manufacturing*. About 34% (\$3.1B) of direct value added by agriculture accrues in Crops, 32% (\$2.9B) in Animal Agriculture, and 32% (\$2.9B) in Forestry. The remaining 2% accrues in the Agriculture-Related Sector.

As with value added, much of the income attributable to agricultural activity is generated outside of agricultural sectors. Box 4 shows the five

sectors that generate the most income as the result of agricultural activity in Arkansas. In 2011, \$4.6B, or 45% of all labor income, went to workers in non-agricultural sectors. Within the agricultural sectors, the top three crops production sectors, the poultry industry, and the top five forestry sectors received \$3.0B, or 30% of all labor income generated by agriculture.

Agriculture's direct contribution to the state economy is measured by the sum of the contributions of farm production, processing of farm products, and agriculture related sectors. There were 150,419 workers employed by the agricultural production, processing and agriculture related sectors (Table 1). The owners, operators, and workers of these farms and businesses received over \$5.5B in labor

Box 3. Value Added Generated by Agriculture, 2011 Top Five NAICS Industries^a

Manufacturing	\$6,616M
(93% of the value added is in agricultural processing)	
Agriculture, Forestry, Fishing and Hunting	\$2,835M
(93% of the value added is in agricultural production)	
Real Estate and Rental	\$1,073M
Wholesale Trade	\$1,002M
Transportation and Warehousing	\$867M
Top Five Total	\$12,393M
(73% of all value added generated by Agriculture)	

^aBased on 2-Digit NAICS aggregation (USCB, 2006). Source: MIG (2012).

Note: Presented in current dollars.

Box 4. Labor Income Generated by Agriculture, 2011 Top Five NAICS Industries^a

Manufacturing	\$4,023M
(95% of labor income is in agricultural processing)	
Agriculture, Forestry, Fishing and Hunting	\$1,722M
(86% of labor income is in agricultural production)	
Transportation and Warehousing	\$656M
Wholesale Trade	\$574M
Health and Social Services	\$542M
Top Five Total	\$7,518M
(74% of all labor income generated by Agriculture)	

^aBased on 2-Digit NAICS aggregation (USCB, 2006). Source: MIG (2012).

Note: Presented in current dollars.

income (Table 1); 69% of direct labor income went to workers and business owners in processing industries. Agricultural production, processing, and agriculture-related industries directly added value of \$9.0B to the Arkansas economy; 69% was from processing industries. The crops industries employed close to half (45%) of agricultural production and processing employees, while the animal agriculture industries employed 37% and the forestry industries 19% (Table 2).

Indirect contributions result when agricultural firms purchase raw materials and services from other Arkansas businesses to produce their products. In 2011, there were 60,552 workers employed by industries supplying goods and services to

the farm production and processing industries. The workers and owners of these establishments received \$3.0B in labor income and these industries added value of almost \$5.0B to the state economy (Table 1).

Induced contributions result when employees of agricultural firms and employees of the raw material and service firms spend a portion of their income on local purchases. There were 48,272 workers employed by businesses providing goods and services to the employees in agriculture and its supplying industries. These employees and the proprietors of these businesses received roughly \$1.7B in labor income and added value of almost \$3.1B to the Arkansas economy.

1.3.1 The Crops Sector

The Crops Sector includes all enterprises engaged in the production and processing of cotton, food and feed grains, oil bearing crops, fruits, nuts and vegetables, and hay and pasture (Appendix A, Table 1). The Crops Sector's direct contribution on the state economy is measured by the sum of the contributions of crop production and processing of crops products.

In 2011, the Crops Sector provided 62,918 jobs within the Aggregate Agriculture Sector, or 4% of state employment (Table 3 and Box 5). The workers and business owners received \$1.6B in labor income (\$828M of that in wages), or 3%

Table 2. The Contribution of Major Agricultural Sectors to Agricultural Production and Processing, 2011.

	Employment ^a		Labor Income ^b		Value Added ^c	
	Number of Jobs	% Total	Million \$	% Total	Million \$	% Total
Production						
<i>Crops</i>	47,639	33.8	887	16.8	1,595	18.1
<i>Animal Agriculture</i>	17,597	12.5	481	9.1	923	10.5
<i>Forestry</i>	4,197	3.0	121	2.3	125	1.4
Production Total	69,433	49.2	1,489	28.1	2,643	30.0
Processing						
<i>Crops</i>	15,279	10.8	753	14.2	1,467	16.6
<i>Animal Agriculture</i>	34,403	24.4	1,200	22.7	1,932	21.9
<i>Forestry</i>	22,037	15.6	1,851	35.0	2,774	31.5
Processing Total	71,719	50.8	3,805	71.9	6,173	70.0
Prod. + Proc. Total	141,152	100.0	5,293	100.0	8,815	100.0

Source: Computed using the 2011 Arkansas database from MIG (2012).

Note: Presented in current dollars.

^a Equivalent to full- and part-time jobs (MIG, 2000).

^b Labor income represents all forms of employment income; it is the sum of employee compensation and proprietor income (MIG, 2000).

^c Value added is the sum of employee compensation, proprietary income, other property type income, and indirect business taxes.

Table 3. The Crops Sector's Direct Contribution to Arkansas' Economy, 2011.

	Employment ^a			Labor Income ^b			Value Added ^c		
	Number of Jobs	% Direct Impact	% Total Arkansas Jobs	Million \$	% Direct Impact	% Total Arkansas Labor Income	Million \$	% Direct Impact	% Total Arkansas Value Added
Production ^d	47,639	31.7	3.1	887	16.0	1.3	1,595	17.7	1.5
Processing ^e	15,279	10.2	1.0	753	13.6	1.1	1,467	16.3	1.4
Direct Impact	62,918	41.8	4.0	1,640	29.7	2.5	3,062	34.0	3.0

Source: Computed using the 2011 Arkansas database from MIG (2012).

Note: Presented in current dollars.

^a Equivalent to full- and part-time jobs (MIG, 2000).

^b Labor income represents all forms of employment income; it is the sum of employee compensation and proprietor income (MIG, 2000).

^c Value added is the sum of employee compensation, proprietary income, other property type income, and indirect business taxes.

^d Appendix A, Table 5 lists sectors of direct agricultural production in terms of IMPLAN sectors.

^e Appendix A, Table 6 lists sectors of direct agricultural processing in terms of IMPLAN sectors.

of state labor income. The Crops Sector added \$3.1B, or 3%, to state value-added. The rice industry (*Rice Farming*, and *Rice Milling*) represented 13% of jobs, 17% of labor income, and 18% of value added in the overall Crops Sector (Box 6). A summary is presented in Table 3. Details are provided in Appendix B, Table 2.

1.3.2 The Animal Agriculture Sector

The Animal Agriculture Sector includes all enterprises engaged in the production and processing of animals, including poultry and egg, cattle, dairy farm, hogs and pigs, other animal agriculture, processed meat, and dairy processing industries (Appendix A, Table 2). The Animal Agriculture Sector's direct contribution on the state economy is measured by the sum of the contributions of animal production and processing of animal products. This sector accounted for 52,000 jobs in 2011, or over 3% of state employment, and these workers and business owners received \$1.7B in labor income, or almost 3% of state labor in-

Box 5. Direct Contribution of the Crops Sector, 2011	
Employment	62,918 jobs
Wages	\$828M
Labor Income	\$1,640M
Value-Added	\$3,062M

Source: MIG (2012).
Note: Presented in current dollars.

come (Table 4). Of this labor income, 84% (\$1.4B) was attributable to wages. In 2011, the Animal Agriculture Sector added \$2.9B of value to the state economy, or almost 3% of state value added (Table 4 and Box 7). *Poultry and Egg Production* and *Poultry Processing*⁴ provided 74% of jobs, 82% of income and 79% of value added in the Animal Agriculture Sector in 2011 (Box 8). However, overall, the *Poultry and Egg Production* and *Poultry Processing* generated 1 out of 4 of all agricultural jobs, and \$1 out of every \$4 of agricultural value added. Table 4 provides a summary of the Animal Agriculture Sector's total contribution on Arkansas' economy; details can be found in Appendix B, Table 3.

1.3.3 The Forestry Sector

The Forestry Sector is primarily comprised of commercial logging, forest products, furniture and wood and paper

Box 6. Direct Contribution of the Rice Industry (Rice Farming and Rice Milling)	
Employment	7,957 jobs (13% of Crops jobs)
Wages	\$84M (10% of Crops wages)
Labor Income	\$280M (17% of Crops labor income)
Value-Added	\$543M (18% of Crops value added)

Source: MIG (2012).
Note: Presented in current dollars.

processing enterprises (Appendix A, Table 3). The Forestry Sector's direct contribution to the state economy is measured by the sum of the contributions of forestry production and processing. Processed goods derived from forestry production are the third largest component of processed agricultural goods, in terms of employment, labor income, and value added. There were 26,234 jobs (almost 2% of state employment) in the Forestry Sector in 2011, and these workers and business owners received \$2.0B in labor income, or 3% of state labor income. The Forestry Sector added \$2.9B of value to the state economy, or almost 3% of total state value-added (Table 5 and Box 9). Within this sector, *Paper Mills, Sawmills and Wood Preservation, Veneer and Plywood Manufacturing, Sanitary Paper Product Manufacturing*, and *Paperboard Container Manufacturing* comprised 52% of forestry jobs, and 63% and 69% of forestry income and value added, respectively (Box 10). These contributions are summarized in Table 5. Details can be found in Appendix B, Table 4.

Box 7. Direct Contribution of the Animal Agriculture Sector, 2011	
Employment	52,000 jobs
Wages	\$1,419M
Labor Income	\$1,681M
Value-Added	\$2,855M

Source: MIG (2012).
Note: Presented in current dollars.

Table 4. The Animal Agriculture Sector's Direct Contribution to Arkansas' Economy, 2011.

	Employment ^a			Labor Income ^b			Value Added ^c		
	Number of Jobs	% Direct Impact	% Total Arkansas Jobs	Million \$	% Direct Impact	% Total Arkansas Labor Income	Million \$	% Direct Impact	% Total Arkansas Value Added
Production ^d	17,597	11.7	1.1	481	8.7	0.7	923	10.2	0.9
Processing ^e	34,403	22.9	2.2	1,200	21.7	1.8	1,932	21.4	1.9
Direct Impact	52,000	34.6	3.3	1,681	30.4	2.5	2,855	31.7	2.8

Source: Computed using the 2011 Arkansas database from MIG (2012).

Note: Presented in current dollars.

^a Equivalent to full- and part-time jobs (MIG, 2000).

^b Labor income represents all forms of employment income; it is the sum of employee compensation and proprietor income (MIG, 2000).

^c Value added is the sum of employee compensation, proprietary income, other property type income, and indirect business taxes.

^d Appendix A, Table 5 lists sectors of direct agricultural production in terms of IMPLAN sectors.

^e Appendix A, Table 6 lists sectors of direct agricultural processing in terms of IMPLAN sectors.

Box 8. Direct Contribution of the Poultry Industry (Poultry and Egg Production and Poultry Processing)

Employment
38,377 jobs (74% of Animal Agriculture jobs) (1 out of 4 agricultural jobs)
Wages
\$1,137M (80% of Animal Agriculture wages) (30% of agricultural wages)
Labor Income
\$1,385M (82% of Animal Agriculture labor income) (25% of agricultural labor income)
Value-Added
\$2,254M (79% of Animal Agriculture value added) (\$1 out of \$4 agricultural value added)

Source: MIG (2012).
Note: Presented in current dollars.

Box 9. Direct Contribution of the Forestry Sector, 2011

Employment
26,234 jobs
Wages
\$1,393M
Labor Income
\$1,972M
Value-Added
\$2,899M

Source: MIG (2012).
Note: Presented in current dollars.

Box 10. Direct Contribution of the Top Five Forestry Industries: Paper Mills, Sawmills and Wood Preservation, Veneer and Plywood Manufacturing, Sanitary Paper Product Manufacturing, and Paperboard Container Manufacturing

Employment
13,544 jobs (52% of Forestry jobs)
Wages
\$882M (63% of Forestry wages)
Labor Income
\$1,250M (63% of Forestry labor income)
Value-Added
\$2,007M (69% of Forestry value added)

Source: MIG (2012).
Note: Presented in current dollars.

Table 5. The Forestry Sector's Direct Contribution to Arkansas' Economy, 2011.

	Employment ^a			Labor Income ^b			Value Added ^c		
	Number of Jobs	% Direct Impact	% Total Arkansas Jobs	Million \$	% Direct Impact	% Total Arkansas Labor Income	Million \$	% Direct Impact	% Total Arkansas Value Added
Production ^d	4,197	2.8	0.3	121	2.2	0.2	125	1.4	0.1
Processing ^e	22,037	14.7	1.4	1,851	33.5	2.8	2,774	30.8	2.7
Direct Impact	26,234	17.4	1.7	1,972	35.7	3.0	2,899	32.2	2.8

Source: Computed using the 2011 Arkansas database from MIG (2012).

Note: Presented in current dollars.

^a Equivalent to full- and part-time jobs (MIG, 2000).

^b Labor income represents all forms of employment income; it is the sum of employee compensation and proprietor income (MIG, 2000).

^c Value added is the sum of employee compensation, proprietary income, other property type income, and indirect business taxes.

^d Appendix A, Table 5 lists sectors of direct agricultural production in terms of IMPLAN sectors.

^e Appendix A, Table 6 lists sectors of direct agricultural processing in terms of IMPLAN sectors.

1.4: Summary of the Contribution of Agriculture in 2011

In 2011, the Aggregate Agriculture Sector contributed 150,419 direct jobs, or almost 10% of state employment. In addition, the Aggregate Agriculture Sector contributed 108,824 indirect and induced jobs, for a total contribution of almost 17% of state employment. Indirect and induced jobs were created in all 20 of the 2-digit NAICS aggregated industries. The largest production sector was the Crops Sector, accounting for two-thirds of direct employment and half of labor income and value added in agricultural production. The most

direct processing jobs were attributable to the Animal Agriculture Sector, which accounted for almost half of processing jobs. The Forestry Sector was the leader in agricultural processing direct labor income and value added, accounting for about \$2 in every \$5 of each. When production and processing are combined, the Crops Sector, Animal Agriculture Sector, and Forestry Sector each contributed almost equally to value added. Our analysis indicates that the Arkansas Aggregate Agriculture Sector plays a significant role in generating jobs, income,

and value added throughout the state's economy. World and domestic price stability and associated agricultural and food policies will continue to have a significant impact on Arkansas agriculture and its contribution to the Arkansas economy. Continued strength of agriculture is of paramount importance if the social and economic fabric of rural Arkansas communities is to be retained and if the essential infrastructure and services that translate into an acceptable quality of life for its residents are to be maintained.

End Notes

- ¹ This report presents two economic analyses of the agricultural sector in Arkansas. The analyses have separate and distinct scopes, definitions, and methodologies and the results of each analysis should not be compared as they are different measures of economic contribution. Please see the Definitions and Styles section for more.
- ² *Rice Farming* and *Rice Milling* comprise the rice industry. The two are not default IMPLAN sectors, but are presented as such for clarity of results. These industries were analyzed separately from their default IMPLAN sectors, *Grain Farming* and *Flour Milling and Malt Manufactur-*
- ing*, respectively, using IMPLAN's analysis by parts (ABP) methods. *Rice Farming* and *Rice Milling* are presented like IMPLAN sectors in Appendix A, Table 1; and Appendix B, Tables 1 and 2, but not in Appendix A, Tables 5 and 6. Any references to data for the Crops Sector include the value of both *Rice Farming* and *Rice Milling*, while any references to production (processing) include the value of *Rice Farming* (*Rice Milling*).
- ³ Although sectors 15 and 16 are also production sectors (forestry), no newer or more accurate data is available to update these sectors.
- ⁴ One important change in recent years occurred in the poultry production sector where large productivity gains have been experienced. The amount of labor required to produce the same output on poultry farms has decreased and the majority of poultry output is increasingly produced on fewer acres. This is reflected in the employment number associated with poultry production in this report which has decreased since the 2001 report. The reason for such a drop reflects productivity gains occurring over the past 10 or more years that were only recently adjusted for in the IMPLAN data set.

Literature Cited

- ADWS (Arkansas Department of Workforce Services Labor Market Information/BLS Programs). 2013. Rice milling annual average employment and total calendar wages. Data available by request only. 2 Capitol Mall, Little Rock, AR 72201. dws.arkansas.gov. Accessed 13 May 2013.
- Alward, A. 2012. "Estimating the contribution of a current industry using IMPLAN version 3.0." MIG (Minnesota IMPLAN Group, Inc.).
- Alward, G. and S. Lindall. 1996. "Deriving SAM multiplier models using IMPLAN." Paper presented at 1996 IMPLAN user conference.
- ANRC (Arkansas Natural Resources Commission). 2013. Number of poultry farms in Arkansas. Data available by request only. 101 East Capitol, Suite 350, Little Rock, AR 72201. www.anrc.arkansas.gov. Accessed 18 Sept. 2013.
- English L., J. Popp and W. Miller. 2013. Pocket Guide Economic Contribution of Arkansas Agriculture 2013. Pocket guide. Arkansas Agricultural Experiment Station University of Arkansas System Division of Agriculture, Fayetteville.
- Flanders, A. 2010. "AG1259-2010 Crop Enterprise Budgets for Arkansas Field Crops Planted in 2010 (All Crops) (Interactive MS Excel Files)." Arkansas Agricultural Experiment Station, University of Arkansas System Division of Agriculture. www.uaex.edu/depts/ag_economics/previous_budgets.htm. Accessed 21 Sept. 2012.
- Goodwin, H.L., J. Popp, W. Miller, G. Vickery and Z. Clayton-Neiderman. 2002. Impact of the Agricultural Sector on the Arkansas Economy. Research Report 969. Arkansas Agricultural Experiment Station University of Arkansas System Division of Agriculture, Fayetteville.
- Kemper, N., J. Popp and W. Miller. 2009. Economic Contribution of the Agriculture sector to the Arkansas Economy in 2007 and Revised Estimates for 2006. Research Report 987. Arkansas Agricultural Experiment Station Division of Agriculture, Fayetteville.
- Lindall, S. 1998. "How does MIG estimate that pesky agricultural data anyway?" An MIG Knowledge Base Article. Minnesota IMPLAN Group, Inc., Stillwater, Minn.
- McGraw, K., J. Popp and W. Miller. 2011. Economic Contribution of the Agriculture sector to the Arkansas Economy in 2009. Research Report 990. Arkansas Agricultural Experiment Station, University of Arkansas System Division of Agriculture, Fayetteville.
- MIG (Minnesota IMPLAN Group, Inc.). 2000. IMPLAN Professional Version 2.0 Social Accounting and Impact Analysis Software User Guide, Analysis Guide, and Data Guide. 2nd edition. Stillwater, Minn.
- MIG (Minnesota IMPLAN Group, Inc.). 2012. IMPLAN data files: 2011 data for state of Arkansas. Stillwater, Minn.
- Olson, D. and S. Lindall. 2009. IMPLAN Professional Version 2.0 Software, Analysis, and Data Guide. Minnesota IMPLAN Group, Inc. Stillwater, Minn.
- Popp, J., N. Kemper and W. Miller. 2007. Impact of the Agricultural Sector on the Arkansas Economy in 2003. Research Report 981. Arkansas Agricultural Experiment Station, University of Arkansas System Division of Agriculture, Fayetteville.

- Popp, J., N. Kemper, W. Miller, K. McGraw and K. Karr. 2010. The Economic Contribution of the Agricultural Sector to the Arkansas Economy in 2008. Research Report 989. Arkansas Agricultural Experiment Station, University of Arkansas System Division of Agriculture, Fayetteville.
- Popp, J., G. Vickery and W. Miller. 2005. Impact of the Agricultural Sector on the Arkansas Economy in 2001. Research Report 975. Arkansas Agricultural Experiment Station, University of Arkansas System Division of Agriculture, Fayetteville.
- Richardson, J. and J. Outlaw. 2010. Economic Contributions of the U.S. Rice Industry to the U.S. Economy. Agricultural and Food Policy Center, Texas A&M University, College Station, Texas.
- Stevens, B. and G. Trainor. 1980. "Error generation on regional input-output analysis and its implications for non-survey models," in *Economic Impact Analysis: Methodology and Applications*, ed. S. Pleeter, 68-79. Amsterdam: Martinus Nijhoff.
- USCB (U.S. Census Bureau). 2006. 2007 North American Classification System (NAICS). www.census.gov/eos/www/naics/. Accessed 9 Sept. 2013.
- USCB (U.S. Census Bureau). 2013. "North American Industry Classification System Frequently asked questions (FAQs)." www.census.gov/eos/www/naics/faqs/faqs.html#q1. Accessed 9 Sept. 2013.
- USDA (U.S. Department of Agriculture). 2007. Census of Agriculture. www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp. Accessed 9 Sept. 2013.
- USDA ERS (U.S. Department of Agriculture Economic Research Service). 2013. Rice Yearbook 2011/12: Data files. Table 2: Rough and milled rice (rough equivalent): Marketing year supply, disappearance, and price; Table 3: Long grain rough and milled rice (rough equivalent): Marketing year supply, disappearance, and price; Table 4: Medium/short grain rough and milled rice (rough equivalent): Marketing year supply, disappearance, and price; Table 17: Milled rice: Average price, fob mills, at selected milling centers. usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1229. Accessed 9 Sept. 2013.
- USDA NASS (U.S. Department of Agriculture National Agricultural Statistics Service). 2013. Commodity production and values data for 2007-2011. usda.mannlib.cornell.edu/MannUsda/homepage.do;jsessionid=118B9D6A6FF48DA1BEC379A03362B1D0. Accessed 9 Sept. 2013.

Appendix A

Description of IMPLAN Sectors and Aggregation Schemes

Table 1. Components of the Crops Sector as Defined by IMPLAN Sectors, 2011.

Aggregate Sector	Sector ID	IMPLAN Sector
CROPS PRODUCTION	1	Oilseed farming
	2	Grain farming
	N/A	Rice farming
	3	Vegetable and melon farming
	4	Fruit farming
	5	Tree nut farming
	6	Greenhouse, nursery, and floriculture production
	7	Tobacco farming
	8	Cotton farming
	9	Sugarcane and sugar beet farming
10	All other crop farming	
CROPS PROCESSING	43	Flour milling and malt manufacturing
	N/A	Rice milling
	44	Wet corn milling
	45	Soybean and other oilseed processing
	46	Fats and oils refining and blending
	47	Breakfast cereal manufacturing
	48	Sugar cane mills and refining
	49	Beet sugar manufacturing
	50	Chocolate and confectionery manufacturing from cacao beans
	51	Confectionery manufacturing from purchased chocolate
	52	Nonchocolate confectionery manufacturing
	53	Frozen food manufacturing
	54	Fruit and vegetable canning, pickling, and drying
	62	Bread and bakery product manufacturing
	63	Cookie, cracker, and pasta manufacturing
	64	Tortilla manufacturing
	65	Snack food manufacturing
	66	Coffee and tea manufacturing
	67	Flavoring syrup and concentrate manufacturing
	68	Seasoning and dressing manufacturing
	69	All other food manufacturing
	70	Soft drink and ice manufacturing
	71	Breweries
	72	Wineries
	73	Distilleries
	74	Tobacco product manufacturing
	75	Fiber, yarn, and thread mills
	76	Broadwoven fabric mills
	77	Narrow fabric mills and schiffli machine embroidery
	78	Nonwoven fabric mills
	79	Knit fabric mills
80	Textile and fabric finishing mills	
81	Fabric coating mills	
82	Carpet and rug mills	
83	Curtain and linen mills	
84	Textile bag and canvas mills	
85	All other textile product mills	
86	Apparel knitting mills	
87	Cut and sew apparel contractors	
88	Men's and boys' cut and sew apparel manufacturing	
89	Women's and girls' cut and sew apparel manufacturing	
90	Other cut and sew apparel manufacturing	
91	Apparel accessories and other apparel manufacturing	

Note: Sector ID "N/A" indicates an industry not original to the IMPLAN 440 scheme.

Table 2. Components of the Animal Agriculture Sector, Defined by IMPLAN Sectors, 2011.

Aggregated Sector	Sector ID	IMPLAN Sector
ANIMAL PRODUCTION	11	Cattle ranching and farming
	12	Dairy cattle and milk production
	13	Poultry and egg production
	14	Animal production, except cattle and poultry
ANIMAL PROCESSING	41	Dog and cat food manufacturing
	42	Other animal food manufacturing
	55	Fluid milk and butter manufacturing
	56	Cheese manufacturing
	57	Dry, condensed, and evaporated dairy product manf.
	58	Ice cream and frozen dessert manufacturing
	59	Animal (except poultry) slaughtering and rendering
	60	Poultry processing
	61	Seafood product preparation and packaging
	92	Leather and hide tanning and finishing
93	Footwear manufacturing	
94	Other leather and allied product manufacturing	

Table 3. Components of the Forestry Sector as Defined by IMPLAN Sectors, 2011.

Aggregated Sector	Sector ID	IMPLAN Sector
FORESTRY PRODUCTION	15	Forestry, forest products, and timber tract production
	16	Commercial logging
FORESTRY PROCESSING	95	Sawmills and wood preservation
	96	Veneer and plywood manufacturing
	97	Engineered wood member and truss manufacturing
	98	Reconstituted wood product manufacturing
	99	Wood windows and doors and millwork manufacturing
	100	Wood container and pallet manufacturing
	101	Manufactured home (mobile home) manufacturing
	102	Prefabricated wood building manufacturing
	103	All other miscellaneous wood product manufacturing
	104	Pulp mills
	105	Paper mills
	106	Paperboard mills
	107	Paperboard container manufacturing
	108	Coated and laminated paper, packaging paper and plastics film manf.
	109	All other paper bag and coated and treated paper manufacturing
	110	Stationery product manufacturing
	111	Sanitary paper product manufacturing
	112	All other converted paper product manufacturing
	295	Wood kitchen cabinet and countertop manufacturing
296	Upholstered household furniture manufacturing	
297	Nonupholstered wood household furniture manufacturing	
300	Office furniture manufacturing	
301	Custom architectural wood manufacturing	

Table 4. Components of the Agriculture-Related Sector as Defined by IMPLAN Sectors, 2011.

Aggregated Sector	Sector ID	IMPLAN Sector
AGRICULTURE RELATED	17	Commercial fishing
	18	Commercial hunting and trapping
	19	Support activities for agriculture and forestry

Table 5. Components of Agricultural Production as Defined by IMPLAN Sectors.

Aggregated Sector	IMPLAN Sector
CROPS PRODUCTION	Oilseed farming; Grain farming; Vegetable and melon farming; Tree nut farming; Fruit farming; Greenhouse and nursery production; Tobacco farming; Cotton farming; Sugarcane and sugar beet farming; All other crop farming
ANIMAL PRODUCTION	Cattle ranching and farming; Poultry and egg production; Animal production, except cattle and poultry
FORESTRY PRODUCTION	Forestry, forest products, and timber tract production; Commercial logging

Table 6. Components of Agricultural Processing as Defined by IMPLAN Sectors.

Aggregated Sector	IMPLAN Sector
CROPS PROCESSING	Flour milling and malt manufacturing; Wet corn milling; Soybean and other oilseed processing; Fats and oils refining and blending; Breakfast cereal manufacturing; Sugar cane mills and refining; Beet sugar manufacturing; Chocolate and confectionery manufacturing from cacao beans; Confectionery manufacturing from purchased chocolate; Nonchocolate confectionery manufacturing; Frozen food manufacturing; Fruit and vegetable canning, pickling, and drying; Bread and bakery product manufacturing; Cookie, cracker, and pasta manufacturing; Tortilla manufacturing; Snack food manufacturing; Coffee and tea manufacturing; Flavoring syrup and concentrate manufacturing; Seasoning and dressing manufacturing; All other food manufacturing; Soft drink and ice manufacturing; Breweries; Wineries; Distilleries; Tobacco product manufacturing; Fiber, yarn, and thread mills; Broadwoven fabric mills; Narrow fabric mills and schiffli machine embroidery; Nonwoven fabric mills; Knit fabric mills; Textile and fabric mills; Fabric coating mills; Carpet and rug mills; Curtain and linen mills; Textile bag and canvas mills; All other textile product mills; Cut and sew apparel contractors; Men's and boys' cut and sew apparel manufacturing; Women's and girls' cut and sew apparel manufacturing; Other cut and sew apparel manufacturing; Apparel accessories and other apparel manufacturing
ANIMAL PROCESSING	Dog and cat food manufacturing; Other animal food manufacturing; Fluid milk and butter manufacturing; Cheese manufacturing; Dry- condensed- and evaporated dairy products; Ice cream and frozen dessert manufacturing; Animal (except poultry) slaughtering and rendering; Poultry processing; Seafood product preparation and packaging; Leather and hide tanning and finishing; Footwear manufacturing; Other leather and allied product manufacturing
FORESTRY PROCESSING	Sawmills and wood preservation; Veneer and plywood manufacturing; Engineered wood member and truss manufacturing; Reconstituted wood product manufacturing; Wood windows and doors and millwork manufacturing; Wood container and pallet manufacturing; Manufactured home (mobile home) manufacturing; Prefabricated wood building manufacturing; All other miscellaneous wood product manufacturing; Pulp mills; Paper mills; Paperboard mills; Paperboard container manufacturing; Coated and laminated paper, packaging paper and plastics film manufacturing; All other paper bag and coated and treated paper; Stationery product manufacturing; Sanitary paper product manufacturing; All other converted paper product manufacturing; Wood kitchen cabinet and countertop manufacturing; Upholstered household furniture manufacturing; Non-upholstered wood household furniture manufacturing; Office furniture manufacturing; Custom architectural wood manufacturing

Appendix B

Agriculture-Generated Activity by Sector

Table 1. Agriculture-Generated Activity by Sector, 2011.

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
60	Poultry processing	28,881	962.270	1,544.931
2	Grain farming	22,305	117.583	225.049
1	Oilseed farming	14,865	363.290	690.395
13	Poultry and egg production	9,496	423.034	708.948
319	Wholesale trade businesses	8,752	574.442	1,001.946
413	Food services and drinking places	8,681	150.515	219.813
19	Support activities for agriculture and forestry	8,471	231.924	187.097
335	Transport by truck	8,337	409.584	500.654
N/A	Rice farming	6,359	165.214	327.324
360	Real estate establishments	5,903	55.497	423.036
39	Maintenance and repair construction of nonresidential structures	5,111	204.197	218.244
95	Sawmills and wood preservation	4,313	443.586	505.272
14	Animal production, except cattle and poultry	4,096	28.131	99.199
381	Management of companies and enterprises	4,056	428.279	493.811
11	Cattle ranching and farming	3,832	28.559	103.865
16	Commercial logging	3,799	107.735	88.686
53	Frozen food manufacturing	3,798	168.165	230.204
105	Paper mills	3,326	316.764	658.467
394	Offices of physicians, dentists, and other health practitioners	3,144	224.020	231.020
397	Private hospitals	3,023	152.578	169.565
8	Cotton farming	2,591	119.124	227.856
382	Employment services	2,444	49.912	55.195
107	Paperboard container manufacturing	2,425	147.542	180.040
388	Services to buildings and dwellings	2,228	44.209	53.650
329	Retail Stores - General merchandise	2,185	52.833	90.240
354	Monetary authorities and depository credit intermediation activities	2,151	102.891	376.853
62	Bread and bakery product manufacturing	2,062	88.699	111.745
398	Nursing and residential care facilities	1,975	57.685	66.502
59	Animal (except poultry) slaughtering, rendering, and processing	1,829	81.091	58.744
96	Veneer and plywood manufacturing	1,780	228.215	338.223
340	Warehousing and storage	1,776	72.009	93.660
99	Wood windows and doors and millwork manufacturing	1,734	149.652	160.934
111	Sanitary paper product manufacturing	1,700	114.321	325.489
324	Retail Stores - Food and beverage	1,650	54.150	71.261
N/A	Rice milling	1,598	114.596	215.194
109	All other paper bag and coated and treated paper manufacturing	1,586	87.105	100.408
414	Automotive repair and maintenance, except car washes	1,584	50.230	58.770
356	Securities, commodity contracts, investments, and related activities	1,560	44.689	47.461
425	Civic, social, professional, and similar organizations	1,526	43.184	38.144
368	Accounting, tax preparation, bookkeeping, and payroll services	1,443	64.056	92.606
20	Extraction of oil and natural gas	1,369	38.691	155.137
320	Retail Stores - Motor vehicle and parts	1,358	62.966	78.587
400	Individual and family services	1,343	28.886	28.447
93	Footwear manufacturing	1,234	37.688	45.744
330	Retail Stores - Miscellaneous	1,227	20.972	37.005
333	Transport by rail	1,199	105.095	178.289
65	Snack food manufacturing	1,155	68.207	203.477
54	Fruit and vegetable canning, pickling, and drying	1,146	61.413	111.026
367	Legal services	1,093	59.973	94.018
432	Other state and local government enterprises	1,054	38.290	62.618

Table 1. (Continued).

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
31	Electric power generation, transmission, and distribution	1,032	117.797	479.626
399	Child day care services	1,028	20.589	26.010
369	Architectural, engineering, and related services	1,018	53.579	54.587
10	All other crop farming	939	60.935	63.402
411	Hotels and motels, including casino hotels	930	19.290	33.783
42	Other animal food manufacturing	914	48.968	99.083
106	Paperboard mills	846	83.389	162.995
296	Upholstered household furniture manufacturing	841	33.993	48.952
327	Retail Stores - Clothing and clothing accessories	825	14.576	24.234
149	Other plastics product manufacturing	819	34.310	54.461
331	Retail Nonstores - Direct and electronic sales	818	11.018	39.099
100	Wood container and pallet manufacturing	807	54.562	61.545
386	Business support services	785	19.824	20.762
85	All other textile product mills	775	42.261	54.891
325	Retail Stores - Health and personal care	754	29.435	36.673
86	Apparel knitting mills	747	19.977	25.304
41	Dog and cat food manufacturing	734	31.153	110.734
357	Insurance carriers	728	41.394	93.687
70	Soft drink and ice manufacturing	723	43.771	56.050
391	Private elementary and secondary schools	705	12.855	12.496
374	Management, scientific, and technical consulting services	703	42.186	44.860
295	Wood kitchen cabinet and countertop manufacturing	661	25.788	21.473
323	Retail Stores - Building material and garden supply	653	21.062	29.294
396	Medical and diagnostic labs and outpatient and other ambulatory care services	639	30.143	45.559
339	Couriers and messengers	626	21.106	37.199
142	Plastics packaging materials and unlaminated film and sheet manufacturing	618	35.493	66.995
426	Private household operations	617	7.703	7.703
326	Retail Stores - Gasoline stations	616	17.809	33.442
377	Advertising and related services	606	26.777	47.450
64	Tortilla manufacturing	590	27.476	39.782
379	Veterinary services	551	13.835	15.749
417	Commercial and industrial machinery and equipment repair and maintenance	540	27.075	33.456
387	Investigation and security services	538	11.675	12.390
98	Reconstituted wood product manufacturing	515	70.025	75.574
17	Commercial Fishing	514	1.565	3.340
351	Telecommunications	493	40.837	144.430
328	Retail Stores - Sporting goods, hobby, book and music	489	8.599	11.055
393	Other private educational services	471	12.706	17.414
401	Community food, housing, and other relief services, including rehabilitation services	470	12.380	12.376
97	Engineered wood member and truss manufacturing	468	40.791	62.034
380	All other miscellaneous professional, scientific, and technical services	431	16.617	48.008
427	US Postal Service	430	30.518	27.152
55	Fluid milk and butter manufacturing	412	22.004	49.940
419	Personal care services	411	13.487	14.665
341	Newspaper publishers	410	12.473	16.897
403	Spectator sports companies	408	5.366	4.823
15	Forestry, forest products, and timber tract production	398	13.487	36.036
395	Home health care services	389	15.254	16.283

Table 1. (Continued).

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
322	Retail Stores - Electronics and appliances	383	13.669	16.219
392	Private junior colleges, colleges, universities, and professional schools	379	10.133	11.050
424	Grantmaking, giving, and social advocacy organizations	378	12.461	11.376
372	Computer systems design services	376	25.110	18.686
32	Natural gas distribution	365	29.943	72.727
88	Men's and boys' cut and sew apparel manufacturing	339	9.418	12.443
321	Retail Stores - Furniture and home furnishings	335	10.472	13.691
410	Other amusement and recreation industries	316	5.962	8.774
421	Dry-cleaning and laundry services	315	10.931	10.804
338	Scenic and sightseeing transportation and support activities for transportation	307	7.691	7.777
390	Waste management and remediation services	305	15.507	26.475
409	Amusement parks, arcades, and gambling industries	305	5.422	6.860
376	Scientific research and development services	303	19.045	21.202
407	Fitness and recreational sports centers	296	4.337	5.513
45	Soybean and other oilseed processing	290	14.342	17.547
68	Seasoning and dressing manufacturing	287	9.492	12.728
18	Commercial hunting and trapping	281	0.194	2.104
348	Radio and television broadcasting	278	19.642	10.661
355	Nondepository credit intermediation and related activities	275	19.078	17.660
6	Greenhouse, nursery, and floriculture production	271	29.106	27.525
297	Nonupholstered wood household furniture manufacturing	271	10.197	13.877
358	Insurance agencies, brokerages, and related activities	269	11.899	16.919
73	Distilleries	268	19.310	212.107
384	Office administrative services	257	12.160	10.920
362	Automotive equipment rental and leasing	239	25.751	49.824
141	All other chemical product and preparation manufacturing	231	13.551	21.117
359	Funds, trusts, and other financial vehicles	223	4.633	12.446
404	Promoters of performing arts and sports and agents for public figures	220	2.426	3.516
113	Printing	217	9.670	11.090
108	Coated and laminated paper, packaging paper and plastics film manufacturing	212	14.828	20.931
3	Vegetable and melon farming	211	25.814	27.515
40	Maintenance and repair construction of residential structures	208	9.514	18.993
389	Other support services	199	6.608	12.343
91	Apparel accessories and other apparel manufacturing	196	6.024	6.299
63	Cookie, cracker, and pasta manufacturing	193	12.782	24.283
416	Electronic and precision equipment repair and maintenance	193	13.349	16.632
46	Fats and oils refining and blending	193	8.584	46.484
418	Personal and household goods repair and maintenance	188	12.264	13.860
69	All other food manufacturing	187	5.462	8.299
12	Dairy cattle and milk production	173	1.080	10.674
103	All other miscellaneous wood product manufacturing	164	11.071	14.483
336	Transit and ground passenger transportation	164	3.888	4.801
143	Unlaminated plastics profile shape manufacturing	161	8.911	14.234
402	Performing arts companies	160	1.268	1.482
110	Stationery product manufacturing	158	5.050	6.333
365	Commercial and industrial machinery and equipment rental and leasing	154	25.415	39.701
375	Environmental and other technical consulting services	151	8.591	9.393
47	Breakfast cereal manufacturing	145	6.910	24.948
373	Other computer related services, including facilities management	144	20.142	27.144

Table 1. (Continued).

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
415	Car washes	144	2.721	3.032
58	Ice cream and frozen dessert manufacturing	142	6.142	8.948
33	Water, sewage and other treatment and delivery systems	137	6.414	12.807
420	Death care services	134	5.891	6.283
84	Textile bag and canvas mills	129	6.064	7.354
422	Other personal services	119	5.340	5.908
301	Custom architectural wood manufacturing	109	7.862	7.893
195	Machine shops	107	5.116	5.745
370	Specialized design services	106	5.435	8.606
412	Other accommodations	105	2.267	3.544
61	Seafood product preparation and packaging	102	2.487	2.949
423	Religious organizations	101	2.454	6.794
346	Motion picture and video industries	98	2.205	3.998
126	Other basic organic chemical manufacturing	94	8.114	13.612
115	Petroleum refineries	93	10.069	85.817
158	Glass container manufacturing	86	4.455	7.096
337	Transport by pipeline	85	30.581	33.167
29	Support activities for oil and gas operations	82	5.566	6.841
332	Transport by air	82	5.156	8.631
207	Other industrial machinery manufacturing	82	5.772	7.408
300	Office furniture manufacturing	81	3.202	5.462
283	Motor vehicle parts manufacturing	81	2.292	3.076
125	All other basic inorganic chemical manufacturing	80	6.713	11.639
352	Data processing, hosting, ISP, web search portals and related services	79	3.667	9.698
246	Printed circuit assembly (electronic assembly) manufacturing	78	3.081	4.166
363	General and consumer goods rental except video tapes and discs	74	8.411	6.819
148	Plastics bottle manufacturing	71	4.210	8.474
56	Cheese manufacturing	71	4.098	5.500
94	Other leather and allied product manufacturing	69	3.283	4.097
72	Wineries	67	4.187	6.910
429	Other Federal Government enterprises	66	6.578	7.747
344	Directory, mailing list, and other publishers	64	3.347	6.459
78	Nonwoven fabric mills	61	2.627	4.419
371	Custom computer programming services	61	3.477	3.675
147	Urethane and other foam product (except polystyrene) manufacturing	57	3.854	6.537
4	Fruit farming	55	3.993	3.804
190	Metal can, box, and other metal container (light gauge) manufacturing	55	3.457	6.470
203	Farm machinery and equipment manufacturing	54	3.351	7.344
247	Other electronic component manufacturing	54	2.930	3.483
130	Fertilizer manufacturing	52	4.178	7.079
5	Tree nut farming	43	1.623	2.594
342	Periodical publishers	42	1.780	2.542
52	Nonchocolate confectionery manufacturing	42	1.220	2.044
383	Travel arrangement and reservation services	41	1.516	2.552
44	Wet corn milling	41	2.796	6.424
197	Coating, engraving, heat treating and allied activities	40	1.702	2.361
131	Pesticide and other agricultural chemical manufacturing	38	2.675	9.826
146	Polystyrene foam product manufacturing	38	1.800	3.927
43	Flour milling and malt manufacturing	34	1.786	3.354
431	State and local government electric utilities	33	1.955	4.213
378	Photographic services	32	0.636	1.777

Table 1. (Continued).

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
309	Dental laboratories manufacturing	31	1.610	1.421
302	Showcase, partition, shelving, and locker manufacturing	30	1.810	2.521
405	Independent artists, writers, and performers	30	2.178	4.070
139	Toilet preparation manufacturing	30	1.951	5.777
81	Fabric coating mills	29	0.793	1.009
220	Cutting tool and machine tool accessory manufacturing	29	1.801	2.016
89	Women's and girls' cut and sew apparel manufacturing	28	1.016	1.330
145	Laminated plastics plate, sheet (except packaging), and shape manufacturing	27	2.334	3.886
90	Other cut and sew apparel manufacturing	25	0.620	0.692
385	Facilities support services	25	1.014	2.234
243	Semiconductor and related device manufacturing	25	1.162	4.097
308	Ophthalmic goods manufacturing	25	1.287	2.526
144	Plastics pipe and pipe fitting manufacturing	24	1.349	2.581
406	Museums, historical sites, zoos, and parks	24	0.808	1.777
228	Material handling equipment manufacturing	23	1.451	1.984
364	Video tape and disc rental	23	0.998	1.520
314	Sign manufacturing	22	0.980	0.813
185	Handtool manufacturing	21	0.962	1.345
71	Breweries	21	1.296	6.682
140	Printing ink manufacturing	20	1.579	1.653
80	Textile and fabric finishing mills	19	0.292	0.358
270	Storage battery manufacturing	19	1.276	1.640
334	Transport by water	18	1.241	2.729
112	All other converted paper product manufacturing	18	0.866	1.154
83	Curtain and linen mills	17	1.243	1.830
118	Petroleum lubricating oil and grease manufacturing	17	1.444	7.202
350	Internet publishing and broadcasting	17	0.798	0.665
101	Manufactured home (mobile home) manufacturing	17	1.838	1.704
366	Lessors of nonfinancial intangible assets	17	0.565	21.470
87	Cut and sew apparel contractors	16	0.269	0.321
67	Flavoring syrup and concentrate manufacturing	16	1.092	9.427
137	Adhesive manufacturing	15	1.426	2.010
82	Carpet and rug mills	15	0.477	0.702
267	Motor and generator manufacturing	15	1.167	1.718
222	Turbine and turbine generator set units manufacturing	15	1.066	2.431
21	Mining coal	14	0.844	1.765
57	Dry, condensed, and evaporated dairy product manufacturing	13	0.817	1.238
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	13	0.699	1.101
117	Asphalt shingle and coating materials manufacturing	12	0.692	4.138
204	Lawn and garden equipment manufacturing	12	0.432	0.770
66	Coffee and tea manufacturing	11	0.254	0.495
198	Valve and fittings other than plumbing manufacturing	11	0.667	1.545
240	Audio and video equipment manufacturing	10	0.432	0.666
135	Biological product (except diagnostic) manufacturing	10	0.522	0.846
430	State and local government passenger transit	10	0.282	- 0.381
306	Surgical appliance and supplies manufacturing	9	0.687	1.262
127	Plastics material and resin manufacturing	9	0.702	1.287
307	Dental equipment and supplies manufacturing	9	0.503	0.914
116	Asphalt paving mixture and block manufacturing	9	0.794	4.053

Table 1. (Continued).

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
266	Power, distribution, and specialty transformer manufacturing	8	0.485	0.671
25	Mining and quarrying stone	8	0.415	1.261
102	Prefabricated wood building manufacturing	8	0.598	0.616
219	Special tool, die, jig, and fixture manufacturing	7	0.420	0.403
199	Plumbing fixture fitting and trim manufacturing	7	0.365	0.533
193	Hardware manufacturing	7	0.382	0.595
303	Mattress manufacturing	7	0.287	0.590
345	Software publishers	7	0.479	1.001
196	Turned product and screw, nut, and bolt manufacturing	7	0.324	0.440
353	Other information services	7	0.239	0.451
151	Rubber and plastics hoses and belting manufacturing	7	0.393	0.638
343	Book publishers	7	0.311	0.681
27	Mining and quarrying other nonmetallic minerals	6	0.345	0.787
159	Glass product manufacturing made of purchased glass	6	0.304	0.405
408	Bowling centers	6	0.095	0.146
51	Confectionery manufacturing from purchased chocolate	6	0.150	0.307
187	Ornamental and architectural metal products manufacturing	5	0.294	0.346
133	Pharmaceutical preparation manufacturing	5	0.416	1.120
138	Soap and cleaning compound manufacturing	5	0.250	0.957
272	Communication and energy wire and cable manufacturing	5	0.419	0.610
349	Cable and other subscription programming	5	0.204	0.204
122	Synthetic dye and pigment manufacturing	5	0.313	0.488
174	Aluminum product manufacturing from purchased aluminum	5	0.224	0.367
24	Mining gold, silver, and other metal ore	5	0.339	1.445
76	Broadwoven fabric mills	5	0.149	0.194
317	All other miscellaneous manufacturing	5	0.156	0.204
194	Spring and wire product manufacturing	5	0.236	0.344
157	Other pressed and blown glass and glassware manufacturing	5	0.193	0.283
75	Fiber, yarn, and thread mills	5	0.079	0.104
231	Packaging machinery manufacturing	4	0.281	0.281
242	Bare printed circuit board manufacturing	4	0.206	0.248
202	Other fabricated metal manufacturing	4	0.223	0.326
273	Wiring device manufacturing	4	0.207	0.327
152	Other rubber product manufacturing	4	0.213	0.364
213	Other commercial and service industry machinery manufacturing	4	0.270	0.479
282	Travel trailer and camper manufacturing	4	0.084	0.094
171	Steel product manufacturing from purchased steel	4	0.189	0.309
208	Plastics and rubber industry machinery manufacturing	4	0.181	0.204
275	All other miscellaneous electrical equipment and component manufacturing	4	0.141	0.165
121	Industrial gas manufacturing	3	0.269	0.612
170	Iron and steel mills and ferroalloy manufacturing	3	0.259	0.560
347	Sound recording industries	3	0.143	0.412
244	Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	3	0.131	0.199
114	Support activities for printing	3	0.119	0.134
274	Carbon and graphite product manufacturing	3	0.235	0.366
184	Cutlery, utensil, pot, and pan manufacturing	3	0.215	0.338
263	Household refrigerator and home freezer manufacturing	3	0.171	0.231
260	Lighting fixture manufacturing	3	0.166	0.218
201	Fabricated pipe and pipe fitting manufacturing	3	0.128	0.162

Table 1. (Continued).

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
311	Sporting and athletic goods manufacturing	3	0.111	0.163
183	Crown and closure manufacturing and metal stamping	3	0.152	0.225
280	Truck trailer manufacturing	3	0.080	0.092
291	Boat building	2	0.085	0.119
245	Electronic connector manufacturing	2	0.114	0.151
186	Plate work and fabricated structural product manufacturing	2	0.143	0.182
225	Other engine equipment manufacturing	2	0.143	0.224
239	Other communications equipment manufacturing	2	0.137	0.193
252	Totalizing fluid meters and counting devices manufacturing	2	0.060	0.084
298	Metal and other household furniture (except wood) manufacturing	2	0.072	0.071
269	Relay and industrial control manufacturing	2	0.108	0.143
305	Surgical and medical instrument, laboratory and medical instrument manufacturing	2	0.152	0.226
278	Heavy duty truck manufacturing	2	0.088	0.111
256	Watch, clock, and other measuring and controlling device manufacturing	2	0.111	0.139
172	Alumina refining and primary aluminum production	2	0.101	0.189
134	In-vitro diagnostic substance manufacturing	2	0.084	0.102
224	Mechanical power transmission equipment manufacturing	2	0.074	0.097
279	Motor vehicle body manufacturing	2	0.053	0.065
289	Railroad rolling stock manufacturing	1	0.061	0.111
313	Office supplies (except paper) manufacturing	1	0.079	0.154
238	Broadcast and wireless communications equipment manufacturing	1	0.100	0.120
210	Vending, commercial, industrial, and office machinery manufacturing	1	0.074	0.082
132	Medicinal and botanical manufacturing	1	0.085	0.128
251	Industrial process variable instruments manufacturing	1	0.055	0.069
236	Computer terminals and other computer peripheral equipment manufacturing	1	0.046	0.064
206	Mining and oil and gas field machinery manufacturing	1	0.093	0.124
268	Switchgear and switchboard apparatus manufacturing	1	0.067	0.102
119	All other petroleum and coal products manufacturing	1	0.085	0.412
214	Air purification and ventilation equipment manufacturing	1	0.061	0.099
229	Power-driven handtool manufacturing	1	0.066	0.123
205	Construction machinery manufacturing	1	0.065	0.128
169	Miscellaneous nonmetallic mineral product manufacturing	1	0.061	0.101
299	Institutional furniture manufacturing	1	0.039	0.090
150	Tire manufacturing	1	0.055	0.093
192	Arms, ordnance, and accessories manufacturing	1	0.033	0.066
162	Concrete pipe, brick, and block manufacturing	1	0.033	0.052
286	Other aircraft parts and auxiliary equipment manufacturing	1	0.032	0.045
217	Industrial mold manufacturing	1	0.032	0.031
249	Search, detection, and navigation instruments manufacturing	1	0.035	0.049
254	Analytical laboratory instrument manufacturing	1	0.024	0.032
166	Cut stone and stone product manufacturing	1	0.016	0.019
221	Rolling mill and other metalworking machinery manufacturing	1	0.043	0.045
178	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	1	0.021	0.048
200	Ball and roller bearing manufacturing	1	0.035	0.057
284	Aircraft manufacturing	1	0.030	0.050
92	Leather and hide tanning and finishing	1	0.029	0.039
211	Optical instrument and lens manufacturing	1	0.027	0.028
218	Metal cutting and forming machine tool manufacturing	0	0.025	0.025

Table 1. (Continued).

Sector ID	Aggregate Agriculture Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
285	Aircraft engine and engine parts manufacturing	0	0.026	0.041
180	Nonferrous metal foundries	0	0.015	0.020
177	Copper rolling, drawing, extruding and alloying	0	0.015	0.033
216	Air conditioning, refrigeration, and warm air heating equipment manufacturing	0	0.023	0.027
315	Gasket, packing, and sealing device manufacturing	0	0.021	0.023
318	Broom, brush, and mop manufacturing	0	0.017	0.034
50	Chocolate and confectionery manufacturing from cacao beans	0	0.015	0.024
191	Ammunition manufacturing	0	0.023	0.053
230	Other general purpose machinery manufacturing	0	0.020	0.024
163	Other concrete product manufacturing	0	0.015	0.019
161	Ready-mix concrete manufacturing	0	0.013	0.018
290	Ship building and repairing	0	0.010	0.014
227	Air and gas compressor manufacturing	0	0.019	0.023
153	Pottery, ceramics, and plumbing fixture manufacturing	0	0.011	0.014
165	Abrasive product manufacturing	0	0.014	0.027
237	Telephone apparatus manufacturing	0	0.019	0.034
233	Fluid power process machinery manufacturing	0	0.018	0.022
253	Electricity and signal testing instruments manufacturing	0	0.008	0.011
294	All other transportation equipment manufacturing	0	0.008	0.018
188	Power boiler and heat exchanger manufacturing	0	0.012	0.016
257	Software, audio, and video media for reproduction	0	0.004	0.005
189	Metal tank (heavy gauge) manufacturing	0	0.009	0.012
226	Pump and pumping equipment manufacturing	0	0.011	0.015
304	Blind and shade manufacturing	0	0.006	0.006
250	Automatic environmental control manufacturing	0	0.004	0.007
261	Small electrical appliance manufacturing	0	0.006	0.012
136	Paint and coating manufacturing	0	0.008	0.012
312	Doll, toy, and game manufacturing	0	0.005	0.009
154	Brick, tile, and other structural clay product manufacturing	0	0.004	0.006
310	Jewelry and silverware manufacturing	0	0.004	0.006
316	Musical instrument manufacturing	0	0.003	0.003
164	Lime and gypsum product manufacturing	0	0.004	0.007
168	Mineral wool manufacturing	0	0.002	0.003
287	Guided missile and space vehicle manufacturing	0	0.004	0.005
182	Custom roll forming	0	0.002	0.003
179	Ferrous metal foundries	0	0.001	0.002
181	All other forging, stamping, and sintering	0	0.001	0.001
129	Artificial and synthetic fibers and filaments manufacturing	0	0.001	0.002
160	Cement manufacturing	0	0.001	0.001
30	Support activities for other mining	0	0.000	0.001
292	Motorcycle, bicycle, and parts manufacturing	0	0.000	0.001
173	Secondary smelting and alloying of aluminum	0	0.000	0.000
167	Ground or treated mineral and earth manufacturing	0	0.001	0.001
259	Electric lamp bulb and part manufacturing	0	0.000	0.000
38	Construction of other new residential structures	0	0.000	0.000
7	Tobacco farming	0	0.000	0.000
9	Sugarcane and sugar beet farming	0	0.000	0.000
22	Mining iron ore	0	0.000	0.000
23	Mining copper, nickel, lead, and zinc	0	0.000	0.000
28	Drilling oil and gas wells	0	0.000	0.000

Table 2. Crops Contributions by Sector, 2011.

Sector ID	Crops Sector Contribution to	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
2	Grain farming	22,305	117.583	225.049
1	Oilseed farming	14,865	363.290	690.395
N/A	Rice farming	6,359	165.214	327.324
53	Frozen food manufacturing	3,798	168.165	230.204
8	Cotton farming	2,591	119.124	227.856
62	Bread and bakery product manufacturing	2,062	88.699	111.745
N/A	Rice milling	1,598	114.596	215.194
65	Snack food manufacturing	1,155	68.207	203.477
54	Fruit and vegetable canning, pickling, and drying	1,146	61.413	111.026
10	All other crop farming	939	60.935	63.402
85	All other textile product mills	775	42.261	54.891
86	Apparel knitting mills	747	19.977	25.304
70	Soft drink and ice manufacturing	723	43.771	56.050
64	Tortilla manufacturing	590	27.476	39.782
88	Men's and boys' cut and sew apparel manufacturing	339	9.418	12.443
45	Soybean and other oilseed processing	290	14.342	17.547
68	Seasoning and dressing manufacturing	287	9.492	12.728
6	Greenhouse, nursery, and floriculture production	271	29.106	27.525
73	Distilleries	268	19.310	212.107
3	Vegetable and melon farming	211	25.814	27.515
91	Apparel accessories and other apparel manufacturing	196	6.024	6.299
63	Cookie, cracker, and pasta manufacturing	193	12.782	24.283
46	Fats and oils refining and blending	193	8.584	46.484
69	All other food manufacturing	187	5.462	8.299
47	Breakfast cereal manufacturing	145	6.910	24.948
84	Textile bag and canvas mills	129	6.064	7.354
72	Wineries	67	4.187	6.910
78	Nonwoven fabric mills	61	2.627	4.419
4	Fruit farming	55	3.993	3.804
5	Tree nut farming	43	1.623	2.594
52	Nonchocolate confectionery manufacturing	42	1.220	2.044
44	Wet corn milling	41	2.796	6.424
43	Flour milling and malt manufacturing	34	1.786	3.354
81	Fabric coating mills	29	0.793	1.009
89	Women's and girls' cut and sew apparel manufacturing	28	1.016	1.330
90	Other cut and sew apparel manufacturing	25	0.620	0.692
71	Breweries	21	1.296	6.682
80	Textile and fabric finishing mills	19	0.292	0.358
83	Curtain and linen mills	17	1.243	1.830
87	Cut and sew apparel contractors	16	0.269	0.321
67	Flavoring syrup and concentrate manufacturing	16	1.092	9.427
82	Carpet and rug mills	15	0.477	0.702
66	Coffee and tea manufacturing	11	0.254	0.495
51	Confectionery manufacturing from purchased chocolate	6	0.150	0.307
76	Broadwoven fabric mills	5	0.149	0.194
75	Fiber, yarn, and thread mills	5	0.079	0.104
50	Chocolate and confectionery manufacturing from cacao beans	0	0.015	0.024
7	Tobacco farming	0	0.000	0.000
9	Sugarcane and sugar beet farming	0	0.000	0.000
48	Sugar cane mills and refining	0	0.000	0.000
49	Beet sugar manufacturing	0	0.000	0.000
74	Tobacco product manufacturing	0	0.000	0.000
77	Narrow fabric mills and schiffli machine embroidery	0	0.000	0.000
79	Knit fabric mills	0	0.000	0.000
Total		62,918	1,639.998	3,062.256

Note: Sorted by total number of jobs descending. Sector ID "N/A" indicates an industry not original to the IMPLAN 440 scheme.

Table 3. Animal Agriculture Contributions by Sector, 2011.

Sector ID	Animal Agriculture Sector Contribution to:	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
60	Poultry processing	28,881	962.270	1,544.931
13	Poultry and egg production	9,496	423.034	708.948
14	Animal production, except cattle and poultry	4,096	28.131	99.199
11	Cattle ranching and farming	3,832	28.559	103.865
59	Animal (except poultry) slaughtering, rendering, and processing	1,829	81.091	58.744
93	Footwear manufacturing	1,234	37.688	45.744
42	Other animal food manufacturing	914	48.968	99.083
41	Dog and cat food manufacturing	734	31.153	110.734
55	Fluid milk and butter manufacturing	412	22.004	49.940
12	Dairy cattle and milk production	173	1.080	10.674
58	Ice cream and frozen dessert manufacturing	142	6.142	8.948
61	Seafood product preparation and packaging	102	2.487	2.949
56	Cheese manufacturing	71	4.098	5.500
94	Other leather and allied product manufacturing	69	3.283	4.097
57	Dry, condensed, and evaporated dairy product manufacturing	13	0.817	1.238
92	Leather and hide tanning and finishing	1	0.029	0.039
Total		52,000	1,680.834	2,854.634

Note: Sorted by total number of jobs descending.

Table 4. Forestry Contributions by Sector, 2011.

Sector ID	Forestry Sector Contribution to:	Employment (Jobs)	Income (Million \$)	Value Added (Million \$)
95	Sawmills and wood preservation	4,313	443.586	505.272
16	Commercial logging	3,799	107.735	88.686
105	Paper mills	3,326	316.764	658.467
107	Paperboard container manufacturing	2,425	147.542	180.040
96	Veneer and plywood manufacturing	1,780	228.215	338.223
99	Wood windows and doors and millwork manufacturing	1,734	149.652	160.934
111	Sanitary paper product manufacturing	1,700	114.321	325.489
109	All other paper bag and coated and treated paper manufacturing	1,586	87.105	100.408
106	Paperboard mills	846	83.389	162.995
296	Upholstered household furniture manufacturing	841	33.993	48.952
100	Wood container and pallet manufacturing	807	54.562	61.545
295	Wood kitchen cabinet and countertop manufacturing	661	25.788	21.473
98	Reconstituted wood product manufacturing	515	70.025	75.574
97	Engineered wood member and truss manufacturing	468	40.791	62.034
15	Forestry, forest products, and timber tract production	398	13.487	36.036
297	Nonupholstered wood household furniture manufacturing	271	10.197	13.877
108	Coated and laminated paper, packaging paper and plastics film manufactu	212	14.828	20.931
103	All other miscellaneous wood product manufacturing	164	11.071	14.483
110	Stationery product manufacturing	158	5.050	6.333
301	Custom architectural wood manufacturing	109	7.862	7.893
300	Office furniture manufacturing	81	3.202	5.462
112	All other converted paper product manufacturing	18	0.866	1.154
101	Manufactured home (mobile home) manufacturing	17	1.838	1.704
102	Prefabricated wood building manufacturing	8	0.598	0.616
104	Pulp mills	0	0.000	0.000
Total		26,234	1,972.466	2,898.581

Note: Sorted by total number of jobs descending.

Appendix C

IMPLAN Analysis by Parts, Technical Details

The contribution of the two industries was estimated using ABP instead of traditional IMPLAN contribution methods (section 1.2.1). Using the direct effects as inputs, IMPLAN can estimate the indirect and induced effects attributable to the rice industry, instead of estimating the rice industry's contribution as a part of the *Grains Farming* and *Flour Milling and Malt Manufacturing* sectors. In order to measure the total contribution of agriculture when using these methods, the direct effects of an industry analyzed by parts must be manually added into the IMPLAN results at the end of the contribution analysis. The main steps in ABP within a contribution analysis for an industry were collection/estimation of direct effects of the industry, data reconciliation, and estimating the industry spending pattern of the industry.

The first step in ABP is the calculation of direct effects to be used as inputs and presented as the direct contributions in the study results. The optimal scenario to estimate direct effects for an industry is to collect data for each of the following measurements: employment, output, employee compensation and proprietor income, indirect business taxes, other property type income, intermediate expenditures, and an industry spending pattern (or production budget). In some cases, exact data may be unavailable and effects must be estimated using available measurements. The integral relationships between these measurements were used to maintain the IMPLAN definitions and assumptions: total value added plus intermediate expenditures equals output; employee compensation plus proprietor income equals labor income; and labor income plus other property type income plus indirect business taxes equals total value added.

Employment and employee compensation for *Rice Milling* were collected from the Arkansas Department of Workforce Services Labor Market Informa-

tion/BLS Programs (ADWS, 2013). *Rice Milling* output was calculated from the 2012 Rice Yearbook data for milling year 2011/12 as Arkansas rough rice total disappearance times the U.S. average milling rate times the weighted average of the Arkansas milled rice price (USDA ERS, 2013). This calculated output value times IMPLAN's intermediate expenditures absorption coefficient (0.880; MIG, 2012) from the 2007 IMPLAN 509 sectoring scheme that last included *Rice Milling* as a separate industry were used to calculate *Rice Milling's* intermediate expenditures and total value added (output times the valued added absorption coefficient). The 2010 sector 43, *Flour Milling and Malt Manufacturing*, ratio of labor income to total value added (0.423; MIG, 2012) was retained to estimate the value of labor income for *Rice Milling*: 0.423 times total value added. Any labor income not attributable to employee compensation was considered to be proprietor income. Similarly, the ratios from 2010 sector 43 for other property type income and indirect business taxes to total value added were used to estimate the values of *Rice Milling's* other property type income and indirect business taxes.

Rice Farming output was collected from NASS along with all other production data used in data reconciliation described in section 1.2.1 (USDA NASS, 2013). To estimate employment, 2009 Arkansas output per worker from Richardson and Outlaw (2010) was first adjusted for inflation using the IMPLAN output deflator (1.023; MIG, 2012) for sector 2, *Grain Farming*. Employment for *Rice Farming* was calculated by dividing 2010 output by the adjusted output per worker value. The value of employee compensation for *Rice Farming* was collected from a weighted average (conventional and hybrid varieties, flood irrigation) production budget for Arkansas rice in 2010 (Flanders, 2010). The output value times IMPLAN's 2010 in-

termediate expenditures absorption coefficient from sector 2, *Grain Farming*, were used to calculate *Rice Farming's* intermediate expenditures and total value added (output times valued added absorption coefficient). The 2010 sector 2, *Grain Farming*, ratio of proprietor income to total value added (0.749; MIG, 2012) was retained to estimate the value of proprietor income for *Rice Farming*: 0.749 times total value added. *Rice Farming's* labor income estimate was therefore reported as the sum of employee compensation collected from the production budget and the calculated proprietor income value. Similarly, the ratio from 2010 sector 2 for indirect business taxes to total value added was used to estimate the value of *Rice Farming's* indirect business taxes. IMPLAN considers other property type income to be a leakage, so any left-over total value added was attributed to other property type income.

Data reconciliation for ABP is applicable for contribution analysis, but is not necessary for impact analyses. In a contribution analysis, data reconciliation involves removing the value of the industries being analyzed from their original sectors to avoid double counting and overestimation. As stated in section 1.2.1, the value of output of sector 2, *Grain Farming*, was calculated as the sum of only wheat, corn for grain, oats, and grain sorghum, and employment and value added components were adjusted accordingly. Output, employment, and value added components for sector 43, *Flour Milling and Malt Manufacturing* were edited to remove the value of *Rice Milling* by subtracting the known employment of *Rice Milling* from IMPLAN's original employment estimate for sector 43 to calculate the new number of employees in sector 43. Sector 43 in Arkansas comprises rice milling and flour milling (a measurable malt manufacturing industry does not exist in Arkansas). However, editing this sector by using

output and adjusting components of value added was not possible because flour milling data could not be disclosed, and the output estimate for rice milling was greater than IMPLAN's original estimate for sector 43. These factors resulted in the estimated value of flour milling being zero, which was known to be inaccurate.

The industry spending pattern is the first of two activities required by ABP. Common sources for industry spending patterns are current IMPLAN sectors, the IMPLAN 509 sectoring scheme sectors, external production budgets, or data from other sources. The industry spend-

ing pattern is composed of events detailing the percent of each dollar of output attributable to intermediate expenditures in each sector. This activity generates the "first round" of spending due to industry activity: indirect effects due to industry purchases and the induced effects from those industries' proprietors' and employees' spending. The events were set to occur in 2010, LPPs were set to the SAM value, and the activity level was set to the industry output value. For *Rice Milling* the industry spending pattern from the 2007 IMPLAN 509 sectoring scheme that last included *Rice*

Milling as a separate industry was used. For *Rice Farming*, the current 2010 industry spending pattern for sector 2, *Grain Farming*, was used. The second type of activity required to complete the ABP is the labor income change activity. This activity simply has two events for 2010: employee compensation and proprietor income. Each event was set to each respective industry's values for employee compensation and proprietor income. This activity generates the "second round" of spending in the ABP: the induced effects due to the industry's proprietors' and employees' spending.

UofA

DIVISION OF AGRICULTURE

RESEARCH & EXTENSION

University of Arkansas System