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Applying a Hybrid Methodology for Measuring the Economic Contribution of the Food and Fiber System to the Louisiana Economy

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Executive Summary

This paper outlines a methodology for measuring the contribution of the food and fiber system to the Louisiana economy. A sector-based approach is followed that identifies the key sectors required to meet the demands of food and fiber products and services in the state economy from households, government, other local institutions and exports. All industry sectors that produce more than 50 percent of their output to meet these demands were considered a food- and fiber-related sector. Based on this approach, a number of statistics were calculated that measured the size and scope of the Louisiana food and fiber system.

- The value of products and services generated by food and fiber sector-related industries exceeded $25 billion in 2005. Approximately $17 billion of output was generated by food and fiber product industries, and more than $8 billion was generated by food and fiber service industries.
- The total value-added created from food and fiber activities was $8.27 billion in 2005. Value-added decreased by 3.53 percent from the 2004 total of $8.57 billion. Much of this reduction is a direct or indirect result of hurricanes Katrina and Rita.
- Food product manufacturing was the largest contributor of value-added among Louisiana food and fiber product industries. In 2005, food product manufacturing contributed $1.69 billion in value-added to the state's economy. The paper manufacturing sector ranked second with $1.34 billion in value-added, and crop and animal production was third with $855 million.
- Total value-added generated by the food and fiber system contributed approximately 5.35 percent of the total value-added in Louisiana in 2004. This percentage compares to 9.49 percent for Alabama, 14.22 percent for Arkansas, 9.73 percent for Mississippi and 4.74 percent for Texas. The annual contribution of the U.S. food and fiber system to the national economy is 5.59 percent.
- The Louisiana food and fiber system employed just fewer than 250,000 full-time and part-time workers in 2005, contributing 10 percent of the total employment in Louisiana. The largest individual food and fiber product employer was the crop and animal production sector. Farm proprietors, farm workers and contract laborers exceeded 33,000 jobs. This amount decreased

from 37,000 jobs in 2001 since increases in farm productivity continue to allow farmers to increase the value of farm output while decreasing employment.

- Employees in the food and fiber system received $4.34 billion in wages, salaries and other employee compensation in 2005. This amount is about 6 percent of the total compensation earned by employees across all sectors of the state economy.
- More than 90 percent of all Louisiana parishes have at least 10 percent of their employment generated by the food and fiber system.

Introduction

The structure of agriculture changed dramatically in the last century. In 1920, the farm population exceeded 32 million (Cramer, Jensen and Southgate 2001). By 1998 that number had declined to just under 5 million, driven by several factors including improvements in technology that have increased the productivity of farm laborers.

Also, the supply chain of food and fiber has changed. At the beginning of the 19th century, farms raised many of their own inputs toward the production of other agricultural outputs (for example, corn for hogs). In today's 21st century economy, farmers purchase a large percentage of their inputs from nontraditional agricultural industries, and an increasing number of farms are corporately owned. Other agricultural commodities such as poultry are vertically controlled by a handful of companies. These large enterprises often purchase the material inputs necessary to produce the raw agricultural output as well as further process and market the food product output. This industrialization of agriculture led Davis and Goldberg (1957) to coin the term agribusiness to cover "the sum total of all operations involved in the manufacture and distribution of farm supplies; production operations on the farm; and the storage, processing and distribution of farm commodities and items made from them."

Yet, since Davis and Goldberg's definition of agribusiness, the food and fiber system has continued to expand based on the food consumption choices made by households. The consumption of food away from home increased from 18.4 percent of total U.S. household consumption at the coining of the term agribusiness in 1957 to 39.9 percent in 2003 (Economic Research Service 2005). A larger proportion of today's food product is purchased by food service suppliers. Hence, Davis and

Goldberg's definition of agribusiness in today's food and fiber system is much larger given the specialization of production and the large percentage of inputs purchased by farmers, processors and distributors.

Choosing a Definition for the Food and Fiber System in Louisiana

Defining agriculture for a state or nation has many implications for both individual households as well as regions. For example, the Farm Bill extends financial benefits to those producing core agricultural outputs as well as those enterprises that process and distribute its raw food and fiber products. Part of the argument for providing these financial benefits by federal and state governments is the contribution that agriculture provides to the larger economy. The challenge becomes identifying the appropriate contribution. For example, the Economic Research Service of USDA defined all food and fiber sector employment to have contributed 17.1 percent of all U.S. employment in 2000 (Edmondson 2002). A narrower definition of agriculture, however, that counted only farm employment would have identified only 1.7 percent employment. These definitions also affect the size of agricultural imports and exports that have a direct impact on trade negotiations with other countries.

Which number should be used to define agriculture, and how does this number compare to other sectors of the economy? The remainder of this section presents various approaches used by states and the federal government to define agriculture and applies a methodology for measuring the contribution of the food and fiber system in Louisiana.

Many states generate formal and informal publications that describe the contribution or impact of agriculture on their respective economies. Recent examples include Deller (2004), Spurlock (2004), Popp et al. (2001), Bills (2001) and Hughes and Harrison (1997) among others. All of these publications take a supply-side methodological approach to describing the economy. That is, they describe the magnitude of the agricultural economy by measuring the size of the economic variables of all industries considered "agriculture."

These studies typically highlight four key economic variables.

- Output – Includes the value of all products produced by an agricultural industry in a given year. It also may be defined as the sales of the products of an agricultural industry adjusted for inventory changes.

- Employment – Includes the number of full-time and part-time jobs generated by an agricultural industry.
- Income – Includes the total wages, salaries and owner-operator/proprietor income earned by employees of an agricultural industry.
- Value-added – Includes total output minus nonlabor business expenses. It is typically used to measure gross state product (GSP).

The supply side approach sums one or more of each of these economic variables for all sectors of the economy defined as agriculture. Among state analyses, the most common variable used to measure the size of agriculture is value-added. It is typically chosen for three reasons.

- Data availability – Value-added data are estimated annually for every state by the Bureau of Economic Analysis (BEA).
- Ease of comparison – Value-added is estimated for more than 60 sectors from BEA, providing a comparative economic analysis with other sectors of a state's economy.
- Comprehensive measure of contribution – The income variable considers earnings only of individuals. Output measures over estimate the contribution due to double counting[1] and are not typically used for comparison purposes across different sectors. Value-added shows the increased financial contribution that a sector in the agricultural supply chain creates toward the value of the final food and fiber product or service consumed.

In addition, employment and income variables are generated at the state level for detailed industry sectors from BEA. Output variables are not calculated annually for all sectors of a state's economy.

Income and employment data also are available at the parish level from BEA but can be incomplete because of disclosure limitations.[2] One alternative approach to estimating output, employment, income and value-added data at the parish (county) level is to use an input-output model developed at the parish level that estimates these vari-

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[1]Double counting occurs when the output of one agricultural unit serves as the input of another agricultural unit. Counting the output of all agricultural units counts the value of some outputs twice overestimating the impact.

[2]In many small regions, there may only be one establishment for a given economic sector. Statistical organizations such as BEA often withhold publishing data in these regions to maintain confidentiality of the financial statistics of a single establishment.

ables. One of these models is Impact Analysis for Planning (IMPLAN) (Minnesota IMPLAN Group 2000). IMPLAN combines available local data with algorithms using state and industry production assumptions to estimate these data at the parish level. Further, it provides estimates for 509 industrial sectors at the county level as compared to the 60 variables available from BEA annually. Unfortunately, these variable estimates at the local level often will not add up to the same values as the economic variables estimated by BEA. Hence, they are typically used to present data that are not calculated by BEA such as parish-level industry output.

State impact studies that follow a supply-side approach make a distinct assumption. That is, once an industry is defined as a food- and fiber-related industry, the entire economic contribution of that industry is considered part of the economic contribution of food and fiber to the state. This assumption has the potential to overstate the economic contribution of the food and fiber sector when industries defined as "food and fiber" generate nonfood and fiber products. This assumption does not typically cause problems for sectors that produce raw agricultural or processed food and fiber products since most of their output is used in the production of food products consumed; however, sectors that are more remotely connected to the food and fiber sector – equipment manufacturers and trade sectors – may incorrectly associate a large proportion of their output as agriculturally related when they are not. For food and fiber contribution studies that tend to be "promotional" pieces, a broad-based definition of food and fiber sectors is used that includes core agricultural production, agricultural inputs, agricultural processing, distribution, wholesaling, retailing and food services. More conservative definitions of agriculture include only production agriculture sectors or production agriculture and agricultural processing sectors.

A second approach to measure the contribution of agriculture is the demand-side approach. This approach, rather than focusing on the technical production of agricultural products, focuses on measuring the economic variables associated with meeting the direct demand for consumable agricultural products. This approach has been most recently followed by Edmonson (2002) and explained in Edmondson et al. (1995).

In this approach, the demand of final consumers, those individuals who consume a finished product or service and do not use it as an input into the production of another product (mostly households), is

considered the starting point. This final demand is then applied to an input-output model that identifies the output that is both directly and indirectly generated to meet this demand for food and fiber products and services. Through the use of the input-output model, the total output, income, employment and value-added can be calculated using this approach. This approach minimizes the flaws of the supply-side approach because it correctly identifies both the forward and backward links necessary to meet the end consumer's final demand. That is, for food and fiber products and services, it identifies the backward links – the output of raw agricultural commodities as well as nonagricultural product inputs necessary to generate each dollar's worth of food product purchases. Further, it counts the forward links – the transportation, wholesaling and retailing margins necessary to produce each dollar's worth of food and fiber output. As a result of its focus on food and fiber products and services, the demand approach considers the magnitude of the economic variables calculated as measuring the size of the U.S. food and fiber system. The increase in output across all sectors of the economy necessary to meet the demands for food and fiber products and services by domestic households, government and foreign markets can also be considered the value of production lost if all food and fiber demands were met by imports.

It is difficult to ascertain ex ante (beforehand) which approach generates a larger economic variable. The demand approach does not contribute the output of all traditional agricultural industries to the food and fiber system as does the supply-side approach. On the other hand, the economic contributions needed to meet food and fiber final demand of nonagricultural based sectors such as transportation, wholesaling and retailing are included in the demand-side approach but not traditionally in the supply-side approach.

Methodology for Calculating the Contribution of the Louisiana Food and Fiber System

We follow a hybrid approach for calculating the economic contribution of the food and fiber system to the Louisiana economy. Similar to Edmondson et al. (1995), the final demand for food and fiber products and services from Louisiana households is first estimated. These estimates are obtained from household expenditure estimates provided by the Louisiana IMPLAN model generated by the Minnesota IMPLAN Group (2000). Additional final demands from federal, state

and local governments as well as net inventory changes and capital expenditures are added to household expenditures to obtain total gross commodity demand for food products. Out-of-state (import) purchases are then subtracted from these commodities to obtain total commodity demand for in-state food and fiber products and services from in-state institutions. Further, demand for food and fiber products and services from outside the state (exports) are added. Thus, total demand for Louisiana food and fiber products and services includes both in-state demands (adjusted for out-of-state purchases) and export demand. A detailed description of the sectors included and procedure for calculating out-of-state purchases can be found in the Appendix.

To account for the overall economic contribution of the food and fiber system to the state, total final demand for food and fiber products was applied to an input-output model of the state economy to estimate both the direct as well as the indirect demands for products and commodities from food and fiber related sectors. To accomplish this task, the total demand for Louisiana food and fiber products was applied to the Louisiana IMPLAN input-output model. Based on the interlinkages of sectors in the state economy, the model estimated the total increases in output from all sectors of the Louisiana economy necessary to meet local and export demands for food and fiber products and services.

The approach first identifies the output effects associated with meeting the final demand for all 509 IMPLAN sectors. These sectors are then matched to one of 64 BEA sectors. The output effects are then aggregated and compared to the aggregated total industry output.[3] If the aggregate output change needed to meet the final demands exceeds 50 percent of the aggregated (BEA sector) output, the BEA sector is classified as a food- and fiber-related sector. These sectors can be identified in the BEA datasets each year to develop an annual time series of the food and fiber system as well as compare it to other sectors of the state economy.

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[3]The comparisons used here to determine the food and fiber system sectors were based on industry output comparisons using IMPLAN 2001 data. See Fannin and Henderson (2005). It is important to note that the underlying production functions used to calculate industry output are based on the economic census conducted every five years. No expectation of additions or deletions to the sectors would be considered part of the food and fiber system over that time. Since there is an approximate six-year lag between the economic census and structural revisions to the IMPLAN datasets, a re-evaluation of sectors in the food and fiber system would not need to take place until 2008 when 2002 Economic Census data are incorporated into the IMPLAN production functions.

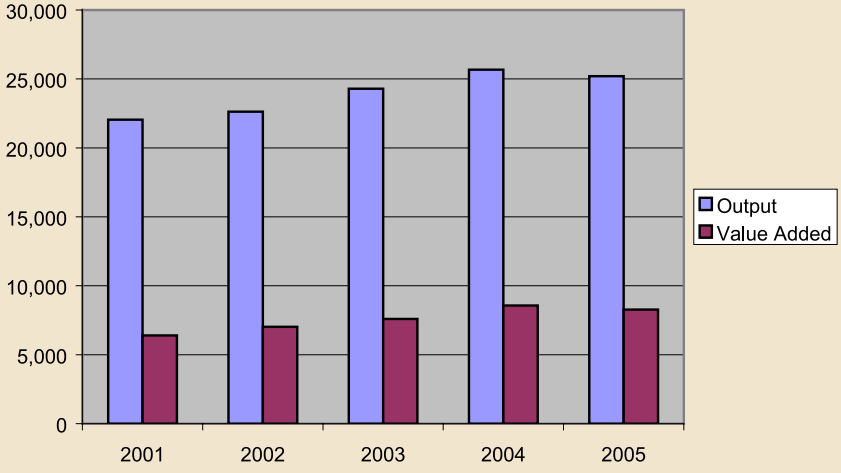
BEA's sectoral classification scheme follows the North American Industrial Classification System (NAICS). A concordance matching all BEA industry sectors to the main classification sectors of this manuscript can be found in the Appendix. Value-added from sectors classified as food- and fiber-related sectors are summed to calculate total value-added for the food and fiber system in Louisiana. In a similar fashion, food and fiber system employment and employee compensation are calculated. Output is not directly reported by BEA; therefore, output for each sector of the economy is estimated from various sources. See Appendix for details.

Contribution of Louisiana Food and Fiber System to the Louisiana Economy

Output and Value-added

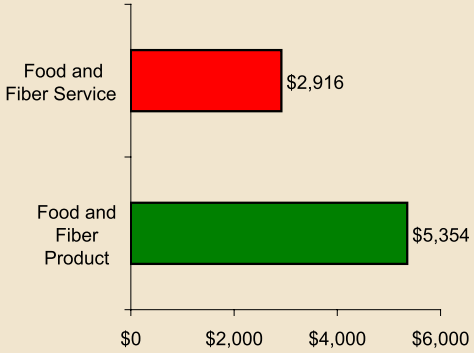
Preliminary estimates indicate that the total value of food and fiber products and services produced in Louisiana exceeded $25.1 billion in 2005.[4] This output contributed $8.27 billion in value-added to the Louisiana economy in the same year. Total output and value-added between 2001 and 2005 are shown in Figure 1. As shown in Figure 2, food and

Figure 1. Output and Value Added of the Louisiana Food and Fiber System (Millions of Dollars)



[4]Only aggregate Louisiana food and fiber system output was estimated for 2005. All estimates in the manuscript are in nominal terms unless explicitly stated otherwise. See the Appendix for details of the output estimation procedure.

Figure 2. Distribution of Value-Added Generated by the Food and Fiber System, 2005 (Millions of Dollars)



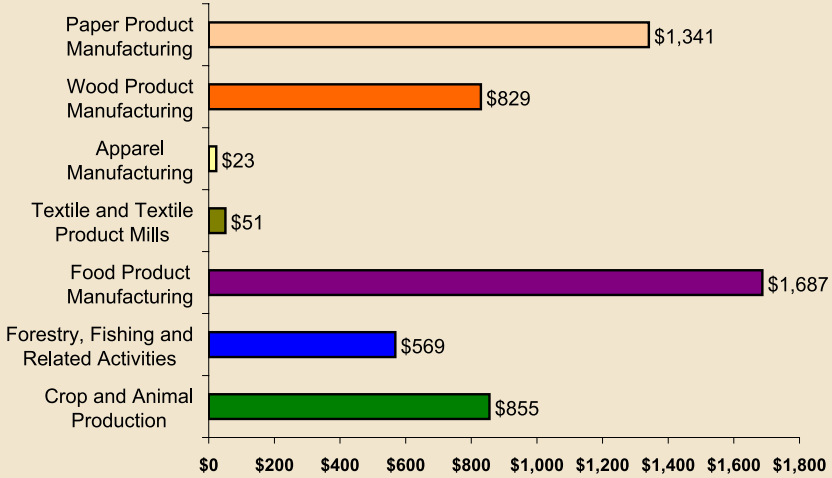
fiber product sectors created $5.35 billion, or approximately 65 percent of the total value-added of the Louisiana food and fiber system. Food and fiber service sectors (primarily restaurants) create approximately $2.92 billion, or 35 percent of the total value-added of the food and fiber system.[5]

A more detailed breakdown of food and fiber product sectors shows the contribution by individual sectors of the economy. As can be seen from Figure 3, the largest food and fiber product sector is the food product manufacturing sector. This sector created $1.69 billion in value-added for the state economy in 2005. This amount totaled 31.51 percent of Louisiana food and fiber product value-added in 2005. The second largest sector, paper product manufacturing, created $1.34 billion in value-added, or 25.04 percent of the food and fiber product value-added total. Crop and animal production was the third largest contributor, with $855 million in value-added in 2005, or 15.98 percent of the total.[6] Forestry, fishing and related activities generated $569 mil-

[5]The hybrid approach was compared to a demand-side approach based on the most recent demand data available from IMPLAN (2001). Output effects needed to meet food and fiber final demand in 2001 were multiplied by initial (first year) output percentages from Liew (2000) to estimate total output produced in 2001. Total output from the demand side approach was estimated at $15.947 billion as compared to the 2001 hybrid approach estimate of $22.052 billion. Hence, the hybrid approach was 38 percent higher than the demand-side approach in 2001.

[6]Crop and animal production includes traditional commodities such as cotton, sugarcane, rice and cattle as well as animal aquaculture such as catfish, crawfish and pet turtles grown in non-native environments.

Figure 3. Value-Added Created by Food and Fiber Product Sectors, 2005 (Millions of Dollars)

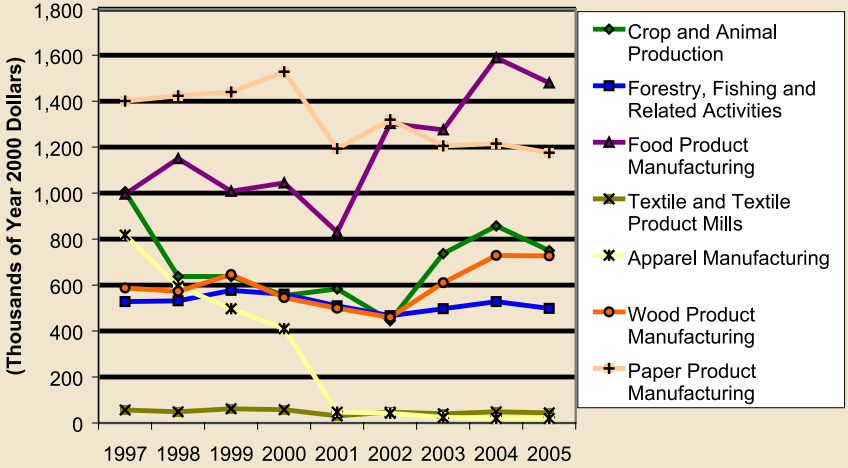


lion, or 10.62 percent of the total.[7] Wood product manufacturing created $829 million in 2005, or 15.48 percent of the total food and fiber product sector in the Louisiana economy.

A nine-year overview of Louisiana food and fiber related sectors shows some general trends emerging between 1997 and 2005 in Figure 4.[8] Three sectors showed overall upward trends in value-added creation in the last three to four years: food product manufacturing, crop and animal production and wood product manufacturing. These sectors all trend upward starting between 2001 and 2002 – at the end of the most recent U.S. recession. Much of the crop and animal production growth can be explained by record harvest in major commodity crops for the state. Likewise, the wood product manufacturing increase is attributed to increased demand from construction materials in the first half of the decade because of increased new home construction brought about by

[7]Forestry, fishing and related activities includes forest business activities such as loggers and independent timber tract operators. Fishing activities include both freshwater fisheries in their natural habitat as well as marine fisheries.
[8]Before 1997, BEA used the standard industrial classification (SIC) system to identify establishment. No effective method of bridges the two classification systems, resulting in comparisons to data before 1997 as incomplete.

Figure 4. Historical Contribution of Food and Fiber Product Sectors to the Value-Added of the Louisiana Economy (Adjusted for Inflation, Base Year=2000)



lower mortgage rates. Forestry, fishing and related activities as well as textiles and textile product mills have had very little change in value-added contribution over the period. Two sectors showing declines included the paper manufacturing sector and the apparel manufacturing sector. Paper product manufacturing has dropped from the top contributor to food and fiber product value-added to second place as competition from imports as well as substitute products such as plastics continue a downward trend for this industry. Apparel manufacturing saw a significant drop off in the 1990s when major apparel manufacturers shut down plants in Louisiana and moved production to nondomestic manufacturing facilities. In 2005, apparel manufacturing barely registered as a measurable food and fiber product sector since it lost 97 percent of the value-added it generated since 1997.[9]

Overall, the food and fiber system grew from $7.28 billion in 1997 to $8.27 billion in 2005, or a 13.66 percent increase over the nine-year

[9]Data for 2005 are based on multiplying the 2005 earnings estimate for each industry times the 2004 value-added to earnings ratio. The 2005 earnings estimate for each industry does include the impacts of hurricanes Katrina and Rita. Employee compensation data for earnings were derived from quarterly census of employment reports by the Bureau of Labor Statistics, and proprietor earnings were estimated internally by BEA.

period. Food and fiber product sectors grew from $5.17 billion to $5.35 billion, or 3.63 percent, and food and fiber services grew from $2.11 billion to $2.92 billion, or a 38.26 percent increase over the same nine-year period. In general, food and fiber services showed measurable growth over the period whereas value-added creation in food and fiber product sectors was flat and failed to keep up with inflation during the period.

Employment and Employee Compensation

Although value-added grew in the food and fiber system in Louisiana, employment actually declined over the four-year period. The total jobs generated declined from 249,674 to 246,512, or a 1.27 percent decrease during the four-year period. Food- and fiber-product sector jobs saw a 10 percent decline in employment and are now below the 100,000 job mark for the first time this decade, as seen in Table 1. This

Table 1. Full-Time and Part-Time Jobs Generated by the Louisiana Food and Fiber System.

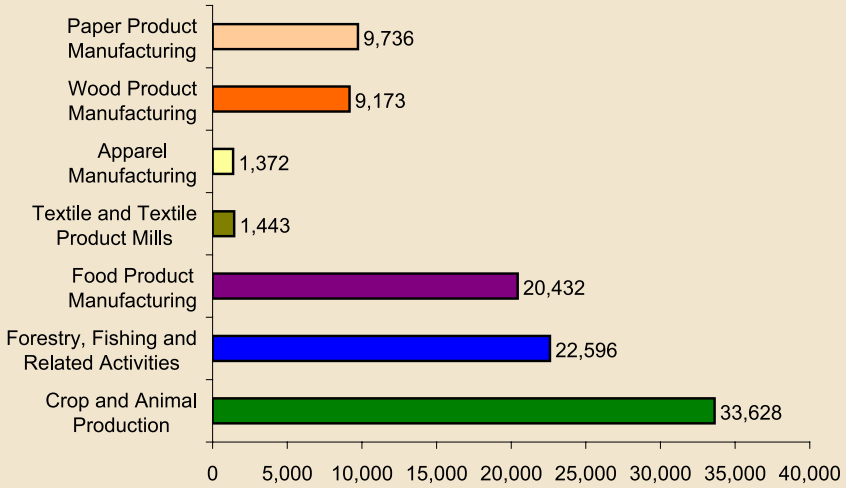
	2001	2005	Percent Change
Food and Fiber Product	109,589	98,380	-10.23
Food and Fiber Service	140,085	148,132	5.74
Total Food and Fiber System	249,674	246,512	-1.27

Source: BEA Gross State Product Series, 2006a.

decline is likely because of the increased productivity of farms as well as increased labor productivity from food and fiber product manufacturers. Food and fiber service employment, however, did increase from 140,085 to 148,132, or 5.74 percent over the period. The Louisiana food and fiber service employment increase follows the general increase in percentage of the U.S. food expenditure budget that is consumed away from home.

A more detailed breakdown of food and fiber product employment can be seen in Figure 5. The Crop and Animal Production Sector was the largest provider of jobs, with almost 34,000 jobs, or 34.18 percent of all food and fiber product jobs in Louisiana in 2005. Forestry, fishing and related activities was the second largest job provider, with more than 22,000 jobs, or 22.97 percent of the food and fiber product employment total. The food product manufacturing sector was the third

Figure 5. Full-Time and Part-Time Jobs by Louisiana Food and Fiber Product Sector, 2005



largest provider, with just over 20,000 jobs, or 20.77 percent of employees of food and fiber product sectors in Louisiana.

Some sectors that ranked high in value-added were lower in job creation. For example, the paper manufacturing sector generated the second highest percentage of value-added of all food and fiber product sectors (25.04 percent), but ranked fourth in job creation among the same sectors by providing just under 10,000 jobs, or 9.90 percent of the total jobs in the sector. This difference can be primarily attributed to the characteristic that value-added per employee is higher in the paper manufacturing sector, resulting in the sector having to hire fewer employees. The crop and animal production sector and forestry, fishing and related activities sector hire a larger percentage of seasonal employees who are added to this total. These sectors generate less value-added per employee, resulting in their relatively lower levels of value-added creation.

Employee compensation includes those wages and salaries paid to employees and is one component of value-added. As can be seen in Table 2, total employee compensation grew from $4.14 billion in 2001 to $4.34 billion in 2005, or 4.98 percent over the four-year period. Employee compensation grew by only grew by 0.97 percent for food and fiber product sectors, from $2.40 billion in 2001 to $2.42 billion in 2005. This 0.97 percent employee compensation increase exceeded

Table 2. Employee Compensation Generated by the Louisiana Food and Fiber System.

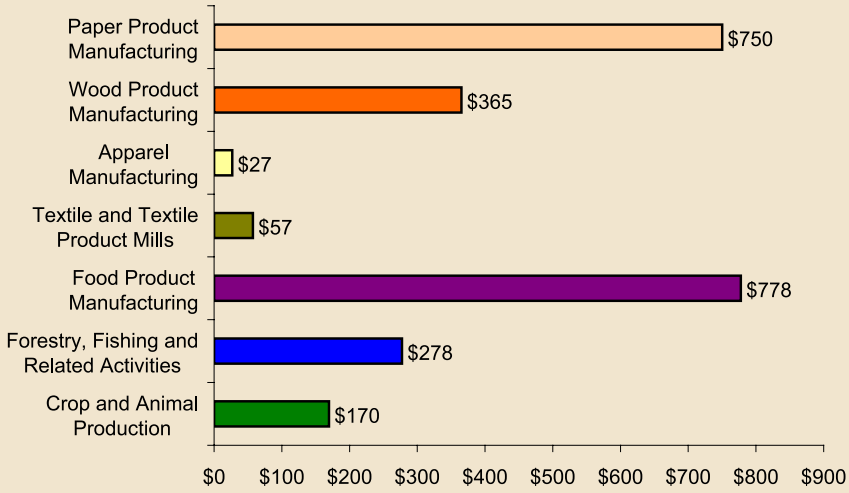
	2001	2005 (Millions of Dollars)	Percent Change
Food and Fiber Product	2,401	2,424	0.97
Food and Fiber Service	1,734	1,917	10.53
Total Food and Fiber System	4,135	4,341	4.98

Source: BEA Gross State Product Estimates, 2006a.

the 10.23 percent employment decrease, suggesting that compensation per employee did increase during the period in the sector (at least in nominal terms). Employee compensation in the food and fiber service sector increased by 10.53 percent, from $1.73 billion in 2001 to $1.92 billion in 2005.

The breakdown of employee compensation by food and fiber product sector can be seen in Figure 6. The food product manufacturing sector provided the highest level of employee compensation among food and fiber product sectors, totaling $778 million, or 32.10 percent of all food and fiber product employee compensation in 2003. Paper manufacturing was second, with $750 million, or 30.94 percent. Wood product manufacturing generated the third highest level of employee

Figure 6. Employee Compensation by Food and Fiber Product Sector, 2005 (Millions of Dollars)



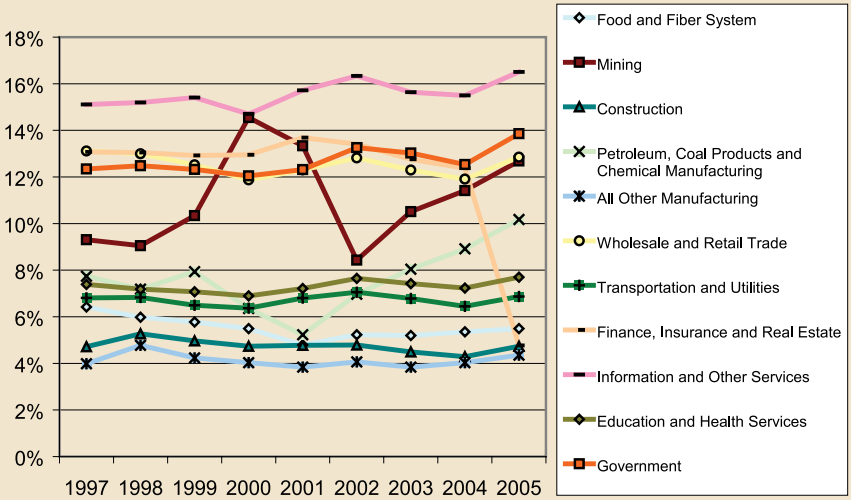
compensation among food and fiber product sectors, with $365 million, or 15.06 percent of the food and fiber product total for Louisiana.

Comparisons Between the Food and Fiber System and Rest of the Economy

The food and fiber system is just one of a number of economic sectors that contributes to value-added in Louisiana. To gain an understanding of the relative importance of the food and fiber system in Louisiana, we present a historical contribution of the food and fiber system as compared to other major economic sectors of the state economy in Figure 7.

As can be seen from the figure, three trends are most evident. Eight of the major industry sectors have maintained their position ranking of importance or only switched one ranking position prior to 2005: All Other Manufacturing, Construction, Food and Fiber System, Transportation and Utilities, Education and Health Services, Wholesale and Retail Trade, Government, and Information and Other Services. A second category can be considered cyclical sectors that, because of their relative magnitude in the state, can have major effects on overall value-added in the state. These include the mining sector and the petroleum, coal products and chemical manufacturing sector. The mining sector in

Figure 7. Historical Value-Added Contribution of Industrial Sectors to the Louisiana Economy

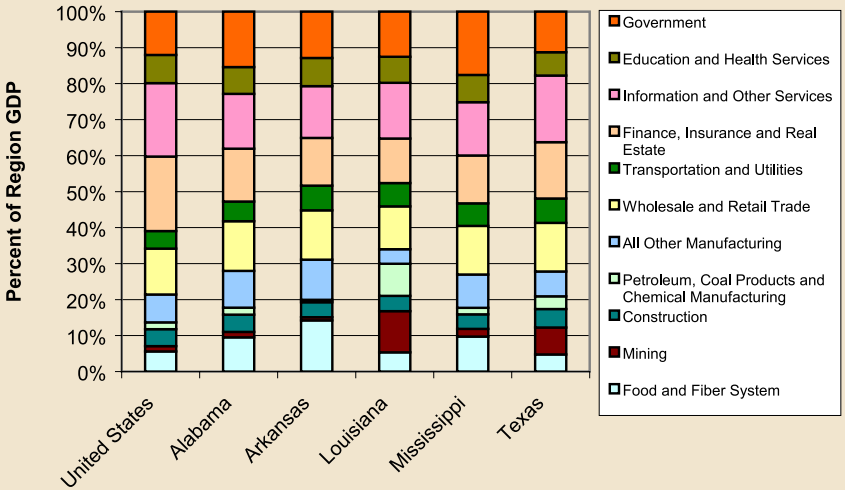


Source: BEA Gross State Product Estimates, 2006(a).

1997 was the fifth highest contributor to value-added. By 2000 it had almost surpassed information and other services sector as the largest value-added contributor. But by 2002, it had slipped back to fifth. Since the upsurge in energy prices over the past couple of years, the mining sector has rebounded and now is trending upward in importance on the overall state economy. Similarly, the petroleum, coal products and chemical manufacturing sector saw a period in 2002 where it was the eighth most important economic sector of the state in terms of value-added, but has now recovered in 2005 to be the fifth most important sector to the state. A third category consists entirely of the finance, insurance and real estate sector. This sector lost almost two-thirds of its contribution to state GDP in 2005 because of hurricanes Katrina and Rita. This sector will rebound as the insurance sector is able to pass along rate increases to cover losses from the storm as well as when homes are rebuilt in the storm region.

To gain a greater understanding of how the food and fiber system in Louisiana compares to other states, we evaluate the relative contributions of each main sector of the aggregate economy for Louisiana to its neighboring states and the entire Unted States in Figure 8.

Figure 8. Percent of Gross State Product - Selected Regions, 2004



Source: BEA Gross State Product Series, 2006(a)

Note: Gross state product (GSP) percentages are based on the summation of the identical combinations of BEA sectors identified as part of the food and fiber system for Louisiana. The percentage of overall GDP contributed by the food and fiber system to the U.S. economy will differ from Economic Research Service (ERS) estimates because of alternative definitions. See Edmonson et al. 1995 for a description of ERS methodology.

In a comparison of five Southern states, Louisiana ranks fourth, with 5.35 percent of value-added in Louisiana generated from the food and fiber system in 2004. This proportion is similar to both Texas (4.74 percent) and the national average (5.59 percent). Arkansas contributed the largest proportion among selected Southern states to its value-added, with 14.22 percent of Arkansas value-added generated from the food and fiber system, more than twice the national average. Alabama and Mississippi were similar in structure, with 9.73 percent and 9.49 percent of their states' value-added generated from food and fiber related sectors.

In regard to the remaining sectors, Louisiana depends more on mining (oil and gas extraction) and petroleum, coal products and chemical manufacturing than do neighboring states. Over one-fifth of the total value-added of the Louisiana economy depended on these two sectors in 2004. The state with the second greatest dependence on these sectors was Texas with approximately 11 percent. The remaining Southern states were below 4 percent.

In contrast, the all other manufacturing sector is much more dominant in neighboring states than in Louisiana. The contribution to value-added from the all other manufacturing sector in the remaining Southern states ranges from 6.88 percent in Texas to 11.17 percent in Arkansas. This compares to only 4.03 percent in Louisiana. The dominance of the mining and petrochemical manufacturing sectors in Louisiana have kept the state from depending on other manufacturing and service sectors for generating its value-added. This divergence from regional and national averages may be a factor influencing the divergence in economic performance between Louisiana and national economies.

Food and Fiber Contribution by Parish

Although detailed industry data on value-added, income and employment are widely available at the state level, such data at the sub-state level are much less available. In some cases, such as in gross state product (value-added), no estimate is reported by any federal or state statistical agency at the parish level. In other cases, such as with employment data, sub-state statistics may be only partially available because of disclosure limitations. A new strategy for estimating undisclosed data, however, was recently employed using county business patterns (CBP) data from the U.S. Census Bureau (Isserman and Westervelt 2006). Census annually collects the number of employees that work in each establishment in each county by the detailed six-digit

NAICS sector. This survey is based on the employment of all establishments that employ individuals located in the Census Bureau's business register. The CBP covers almost all industrial sectors, with the main exceptions being farm and government employment. CBP employment estimates are based on total full-time and part-time employment for the week of March 12 each year. CBP does not disclose actual employment in a sector of a county when that estimate would directly or indirectly disclose the employment of an individual establishment. The CBP dataset, however, does disclose the total number of establishments by employment range as well as the employment range for the overall sector even if the actual employment estimate is withheld.

Isserman and Westervelt (2006) overcome this disclosure problem by developing and applying a descent-gradient algorithm to estimate 1.5 million undisclosed estimates within the 2002 CBP dataset.[10] This approach provides estimates for all six-digit NAICS sectors by county for the entire United States.

We apply the Isserman and Westervelt dataset to analyze employment distribution by parish in Louisiana in 2002. In particular, we apply the same NAICS sector base used in calculating overall food and fiber system employment for Louisiana parishes. Farm and government employment from the Bureau of Economic Analysis State and Local Personal Income dataset (2006b) was used to calculate employment totals in these sectors not covered by CBP. Individual employment estimates for each sector in the Louisiana food and fiber system are evaluated and their relative contributions to each parish's overall economy are presented in Figures 9–11.

The food and fiber system contributes approximately 10 percent to total employment in Louisiana. Based on Figure 9, 58 of the 64 parishes in the state exceed this state average. That is, employment in 90 percent of Louisiana parishes depends more on the food and fiber system than the state average. The food and fiber system accounts for more than one-third of employment in 21 of 58 parishes and between 10 percent and 25 percent in another 10 parishes. Geographically, most nonmetropolitan parishes in North Louisiana depend on the food and fiber system for more than one-fourth of their employment.

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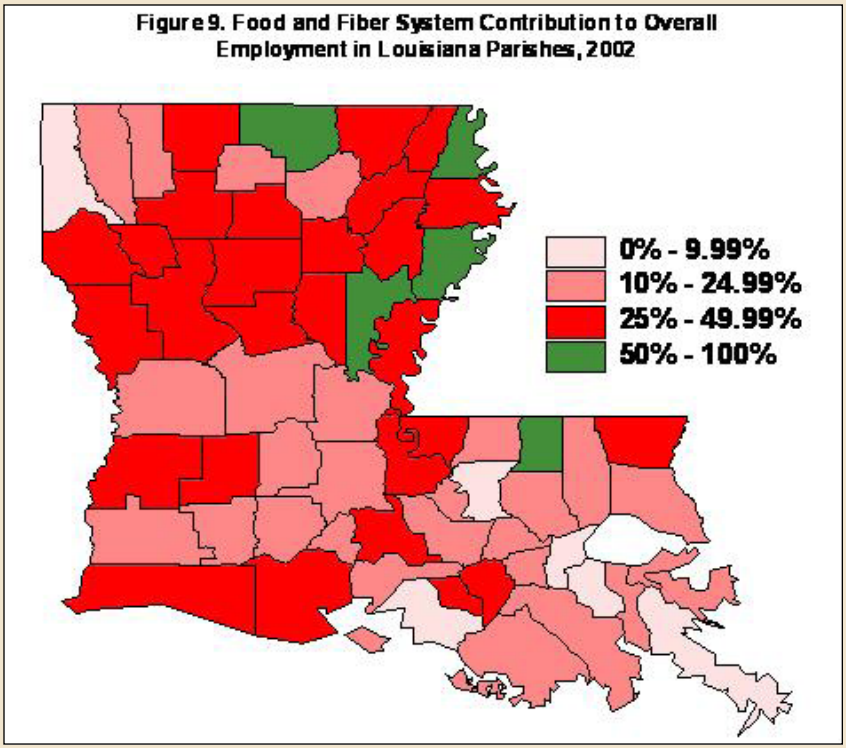
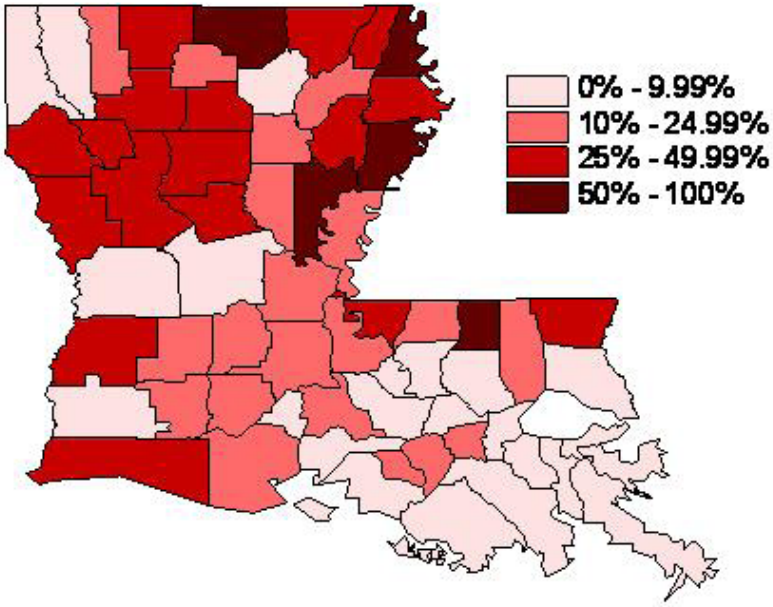
[10]The descent-gradient algorithm takes advantage of firm count data at the parish level by employment range to calculate midpoints to estimate the number of employees by sector by parish. An adjustment procedure on original estimates is then used to harmonize estimate sums by sector with their disclosed state sector totals.



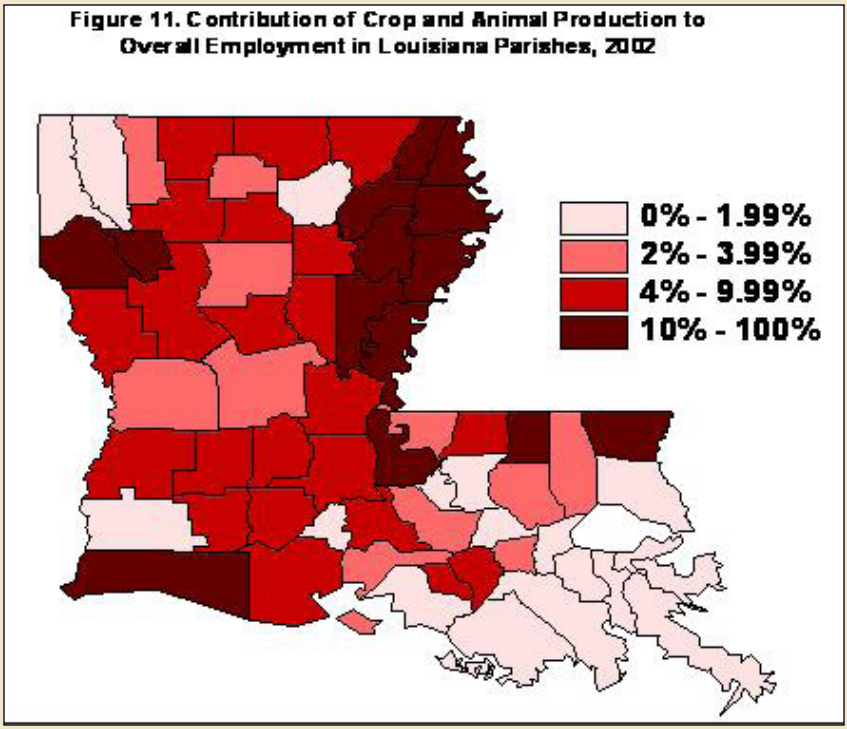
For most parishes, the food and fiber service sector does not import measurable revenue from outside the local parish economy. That is, the food service establishments such as restaurants mostly serve customers from within the parish or region. Hence, in Figure 10, we focus on evaluating the dependence of parishes to food and fiber product sectors, the sectors most likely to create high-paying jobs, demand high-skill workers and export their products outside the state. As can been seen from the figure, the food and fiber product sector is a measurable contributor to total employment in almost all rural parishes of northern and southwestern Louisiana. Food and fiber product employment contributes at least 10 percent of total employment in 41 parishes. In six of these parishes, food and fiber product employment contributes more than 25 percent of total employment and more than 33 percent in 16 parishes. Consequently, more than one-third of all Louisiana parishes depend on the food and fiber product sectors for one-fourth or more of their total employment.

Figure 10. Contribution of Food and Fiber Product Sectors to Overall Employment in Louisiana Parishes, 2002



When we focus strictly on farm employment in Figure 11, we see that Northeast Louisiana parishes depend mostly on farming for employment. Both the state and national proportion of total employment in farm activities is slightly less than 2 percent. In Louisiana, 46 parishes exceed this 2 percent threshold. Of these parishes, 35 have more than 4 percent of their total employment generated from farming activities, a level more than twice the national average. In 13 parishes more than 10 percent of employment depends on farming. In five parishes farm employment exceeds 20 percent.

How might we compare the relative dependency of parishes on individual food and fiber product sectors? One approach is to evaluate the top five parishes in each food and fiber product sector and compare the relative contributions to their parish's economies. The employment concentration ranges between 20.47 percent and 29.32 percent for the top five crop and animal production parishes. This compares to a range of 4.72 percent to 22.42 percent for food manufacturing and 6.46 percent to 19.21 percent for paper product manufacturing. These results



suggest that, for those parishes that are highly farming dependent, they are more dependent on farming than other parishes that are dependent on their dominant food and fiber product sectors.

Another approach for evaluating diversity of the food and fiber product system is the entropy index (Siegel, Johnson and Alwang 1995). The entropy index is used to measure the relative diversity or concentration of an economy. The entropy index is calculated as

$$EI = -\sum_{i=1}^{N} X_i \ln X_i \qquad (1)$$

where X is the share of employment or income in an economy. An economy that is perfectly concentrated would be an economy that generated all of its employment from one sector of the economy and would take the value of zero in the entropy index. An economy that is equally diversified would contain an equal number of employees in each sector

of the economy and would be equivalent to the natural log of the number of economic sectors.

The average entropy index for the 64 parishes in Louisiana was 0.33 with a median of 0.31. The average parish entropy index was only 16 percent of the perfectly diversified index value of 1.95 suggesting that most parishes are heavily concentrated in only one or two food- and fiber-product sectors. Such results are not surprising given that parishes typically maintain high employment in sectors that have a geographic competitive advantage from access to a natural resource such as soil or climate or a raw material such as timber.[11]

The following caveats should be considered when evaluating these statistics. First, nonfarm proprietor employment is not included in this dataset. Nonfarm proprietor employment is taken from IRS tax forms when a filer reports self-employment income. This self-employment income does not contain sector identification; therefore, nonfarm food and fiber proprietors that do not employ individuals are not counted in the employment statistics. Second, the data are based on the sum of full-time and part-time employment in a parish's economy. Food and fiber product sectors that employ a larger percentage of part-time employees may present a relatively higher employment compared to sectors that employ a low percentage of part-time employees. Finally, CBP data are based on the number of employees recorded the week of March 12. For sectors that have more seasonal employment, these estimates may be higher or lower than the sector's average full-time and part-time employment for the year.

Implications for Economic Development in Louisiana

In total, Louisiana's food and fiber system has shown slow, but steady growth in the current decade to date. Initial data after hurricanes Katrina and Rita suggest that the major food and fiber sectors have shown small downturns in economic activity, but not catastrophic losses in the short-term. Despite the hurricanes, value-added contributions of the food and fiber system are on track to meet previously

[11]It should be noted that the entropy index is sensitive to the number of sectors that are classified. Hence, if we were to use a larger number of five- and six-digit NAICS category sectors rather than a smaller number of two- and three-digit categories for our food and fiber product classification, we may see higher entropy index scores.

defined goals for the state. Total value-added generated by the food and fiber system of $8.27 billion in 2005 is on track for meeting total value-added goals of $8.8 billion set forth in Louisiana's major planning document, Vision 2020 (Louisiana Vision 2020 published in 2003). The ability to address specific challenges, however, will affect long-term viability of the food and fiber system.

For food and crop production as well as many agricultural processing enterprises, increased energy costs have tightened operating margins and have increased the emphasis on efficiency in production. Sustained high costs in the future will challenge such sectors as rice production in Southwest Louisiana as well as paper product manufacturing across the state. At the same time, academicians, business leaders and politicians should look for opportunities to implement increased cluster activity set out in Vision 2020. A recent food and fiber example includes the decision of an out-of-state window and door manufacturer to locate in North Louisiana (Bonnette 2006). In this case, the enterprise took advantage of input conditions, including an abundant natural resource base (timber) as well as choosing to co-locate the facility directly across the street from an existing establishment that had historically been the enterprise's major vendor of its glue input, thereby reducing one of its major input costs. Opportunities to attract both out-of-state establishments as well to grow businesses of in-state entrepreneurs and create jobs in these clusters may help to offset losses from changing input conditions facing historical food and fiber products generated in Louisiana.

Conclusions

The intent of this research was to develop and apply a methodology for measuring the economic contribution of the Louisiana food and fiber system to the state economy. Food- and fiber-related sectors were identified based on whether 50 percent or more of a sector's total output was required to meet the demand for food and fiber products in Louisiana.

Results indicated that the value of products and services from the food and fiber system increased 14 percent over the most recent four-year period to a total of $25.1 billion in 2005. The value-added created from these outputs reached $8.27 billion.

Employment in Louisiana's food and fiber system declined over the four-year period between 2001 and 2005 dropping 1.27 percent. The food and fiber sector provided just over 246,000 jobs in 2005. Employee compensation grew 4.98 percent over the same period and totaled $4.34 billion.

Louisiana's economy depends much less on the food and fiber system than many of its neighboring states. The food and fiber system in Louisiana contributed 5.35 percent of the total value-added in Louisiana in 2004. Although this mirrored the national average of 5.59 percent, it was much smaller than the neighboring states of Arkansas (14.22 percent), Alabama (9.73 percent) and Mississippi (9.49 percent).

At least 10 percent of employment in more than 90 percent of Louisiana parishes depends on the food and fiber system. Most North Louisiana parishes depend on one or more food and fiber product sectors, contributing to more than 25 percent of their parish's employment. The crop and animal production sector in particular generates more than 10 percent of the employment of 14 parishes mostly in Northeast Louisiana.

Although the growth of Louisiana's food and fiber system has recently followed 20th century U.S. average growth rates, the sector continues to be challenged by globalization from the demand side and quality labor force and capital investment on the supply side. These issues will have to be constantly addressed if the Louisiana food and fiber system is to remain a significant component of the state economy.

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Appendix

Calculation of Final Demands for the Louisiana Food and Fiber System

The final demands of the Louisiana food and fiber system are based on five key components of final demand: (1) direct demand for food and fiber products from households; (2) direct demand for food and fiber products from federal, state and local governments; (3) increases in inventory held by raw and finished food and fiber product industries; (4) capital expenditures; and (5) export demand of food and fiber products. Each of these components is estimated from the Louisiana IMPLAN Model (Minnesota IMPLAN Group 2000). A list of all IMPLAN sectors used to compute final demands is identified in Fannin and Henderson (2005).

Total state final demand for food and fiber products was calculated by the following formula:

Total State Final Demand = (Household Demand + Government Demand + Inventory Increases + Capital Expenditures) * Regional Purchase Coefficient + Export Demand (Foreign + Domestic)

Here, total state final demand for all sectors except exports is multiplied by a regional purchase coefficient (RPC). The RPC is a coefficient that measures the total local commodity demand that is met by local commodity production. In other words, the RPC estimates what proportion of products are purchased in state versus out of state. RPCs are estimated for each of the 509 commodities in the IMPLAN model using an econometric procedure. More details describing the calculation of RPCs can be found in the IMPLAN User's Manual (Minnesota IMPLAN Group 2000). By multiplying these final demands by their associated RPCs, the total final demand met by imports is subtracted from total final demand.

At this point, each demand category provided by IMPLAN is calculated in producer prices. Producer prices represent the price to produce a commodity, but not the actual price paid by the purchaser. Purchaser prices represent prices paid by end consumers for any commodity, including the producer price for the commodity, plus all costs associated with distribution and marketing the product or service to the end consumer. These are known as margins. The purchaser price paid by government would include all transportation margins (road, rail, water, air), plus wholesale trade margins. Households, in addition to paying transportation and wholesale margins, pay a retail margin.

To account for the potential impact that demand has on trade and transportation sectors from distribution and marketing of food products, trade and transportation margins were estimated from the IMPLAN model. First, local demands for food products and services (net of imports) were divided by that individual product or services margin as calculated by IMPLAN to convert producer price to purchaser price. Then, the total value of food and fiber demand was multiplied by each of the transportation and trade margin categories in IMPLAN.[12] The additional final demands from the transportation and trade sectors are then added to the existing food and fiber final demand (in producer prices). This total final demand (net of imports) is then applied to the Louisiana IMPLAN Input-Output Model to estimate total changes in output across all industry sectors.

Calculating 2005 Preliminary Estimates for Output and Value-added of the Louisiana Food and Fiber System

Output is not calculated directly by the Bureau of Economic Analysis. Estimates were obtained from various sources including the Louisiana Agricultural Statistics Service (2004), Economic Census from the US Census Bureau (2005), Annual Survey of Manufacturers (2006), and IMPLAN (Minnesota IMPLAN Group 2000). When direct estimates were not available from these sources, estimates were calculated using variable methods. Table A1 provides an overall description of the methods used to estimate output for the detailed sectors of the food and fiber system in Louisiana.

Value-added estimates for 2005 were based on applying a value-added to earnings ratio. Value-added for each BEA sector in 2004 was divided by total earnings (employee compensation plus proprietor income) from each sector in the same year. This ratio was multiplied by initial 2005 earnings estimates by industry for Louisiana to calculate 2005 value-added estimates in each sector.

[12]Total food and fiber demand by households was multiplied by retail trade, wholesale trade and transportation margins. Government and all other demands were multiplied by wholesale trade and transportation margins. This approach recognizes that governments typically pay wholesale prices for most of the goods and services they purchase.

Table A1. Procedures for Estimating Output for Food and Fiber Sectors.

Food and Fiber Sector	Output Sources
Crop and Animal Production	The 2001-2004 estimates were obtained through Gross Farm Income estimates from Louisiana Agricultural Statistics Service Annual Bulletin. The 2005 estimate was calculated by multiplying the 2004 Value-added (VA) estimate by the 2003 Output to BEA VA ratio.
Forestry, Fisheries and Related Activities	The 2001-2005 estimates were obtained by multiplying 2001-2004 VA estimates by the 2001 Output to Value-added ratio from the aggregated Forestry, Fishing and Related Activities IMPLAN sector.
Food Product Manufacturing	The 2001 estimate was obtained from multiplying the 2001 Value of Shipments estimate for Food Product Manufacturing by the proportion of Value of Shipments from Food and Beverage Product Manufacturing contributed by Food Product Manufacturing in the 2002 Economic Census. The 2002 estimate came from the Economic Census; 2003-2004 estimates came from the Annual Survey of Manufacturers; the 2005 estimate came from multiplying the 2005 VA estimate by the 2004 Annual Survey of Manufacturers (ASM) Value of Shipments to 2003 BEA VA ratio.
Textiles and Textile Product Mills	The 2002 estimate was obtained from the Economic Census; the 2001, 2003 and 2004 estimates were obtained from multiplying the proportion of 2002 Value of Shipments from Textiles and Textile Product Mills that were Textile Product Mills by the 2001, 2003 and 2004 ASM Value of Shipments for Textile Product Mills. The 2005 estimate was obtained by multiplying the 2005 VA estimate by the 2004 output estimate to 2004 BEA VA ratio.
Apparel Manufacturing	The 2001 and 2004 estimates were obtained from multiplying the proportion of 2002 Value of Shipments from Apparel and Leather Manufacturing that was Apparel Manufacturing from the Economic Census by the 2001 and 2004 Value of Shipments for Apparel Manufacturing. The 2002 estimate came from the Economic Census. The 2003 estimate was obtained from multiplying the 2002 Value of Shipments to 2002 BEA VA ratio by the 2003 VA estimate. The 2005 estimate was obtained by multiplying the 2005 VA estimate by the 2004 output estimate to 2004 BEA VA ratio.

Wood Product Manufacturing	The 2002 estimate was obtained from the Economic Census; the 2001, 2003 and 2004 estimates were obtained from the Annual Survey of Manufacturers; the 2005 estimate was obtained by multiplying the 2005 VA estimate to the 2004 ASM Value of Shipments to BEA VA ratio.
Paper Manufacturing	The 2002 estimate was obtained from the Economic Census; the 2001, 2003 and 2004 estimates were obtained from the Annual Survey of Manufacturers; the 2005 estimate was obtained by multiplying the 2005 VA estimate to the 2004 ASM Value of Shipments to BEA VA ratio.
Food and Fiber Service	The 2002 estimate was obtained from the Eating and Drinking Places sector in the Economic Census; the 2001, 2003, 2004 and 2005 estimates were obtained from multiplying the 2002 Value of Shipments to 2002 BEA VA ratio by 2001, 2003, 2004 and 2005 VA estimates.

Table A2. BEA Sectors Used in Main Sector Classification.

BEA Code	BEA Sector Name	Main Classification
4	Crop and animal production (Farms)	Food and Fiber System
5	Forestry, fishing and related activities	Food and Fiber System
7	Oil and gas extraction	Mining
8	Mining, except oil and gas	Mining
9	Support activities for mining	Mining
10	Utilities	Transportation and Utilities
11	Construction	Construction
14	Wood product manufacturing	Food and Fiber System
15	Nonmetallic mineral product manufacturing	All Other Manufacturing
16	Primary metal manufacturing	All Other Manufacturing
17	Fabricated metal product manufacturing	All Other Manufacturing
18	Machinery manufacturing	All Other Manufacturing
19	Computer and electronic product manufacturing	All Other Manufacturing
20	Electrical equipment and appliance manufacturing	All Other Manufacturing
21	Motor vehicle, body, trailer and parts manufacturing	All Other Manufacturing
22	Other transportation equipment manufacturing	All Other Manufacturing
23	Furniture and related product manufacturing	All Other Manufacturing
24	Miscellaneous manufacturing	All Other Manufacturing

26	Food product manufacturing	Food and Fiber System
27	Textile and textile product mills	Food and Fiber System
28	Apparel manufacturing	Food and Fiber System
29	Paper manufacturing	Food and Fiber System
30	Printing and related support activities	All Other Manufacturing
31	Petroleum and coal products manufacturing	Chemical, Petroleum and Coal Products Manufacturing
32	Chemical manufacturing	Chemical, Petroleum and Coal Products Manufacturing
33	Plastics and rubber products manufacturing	All Other Manufacturing
34	Wholesale trade	Wholesale and Retail Trade
35	Retail trade	Wholesale and Retail Trade
37	Air transportation	Transportation and Utilities
38	Rail transportation	Transportation and Utilities
39	Water transportation	Transportation and Utilities
40	Truck transportation	Transportation and Utilities
41	Transit and ground passenger transportation	Transportation and Utilities
42	Pipeline transportation	Transportation and Utilities
43	Other transportation and support activities	Transportation and Utilities
44	Warehousing and storage	Transportation and Utilities
46	Publishing, including software	Information and Other Services
47	Motion picture and sound recording industries	Information and Other Services
48	Broadcasting and telecommunications	Information and Other Services
49	Information and data processing services	Information and Other Services
51	Federal Reserve banks, credit intermediation and related services	Finance, Insurance and Real Estate
52	Securities, commodity contracts, investments	Finance, Insurance and Real Estate
53	Insurance carriers and related activities	Finance, Insurance and Real Estate
54	Funds, trusts and other financial vehicles	Finance, Insurance and Real Estate
56	Real estate	Finance, Insurance and Real Estate
57	Rental and leasing services and lessors of intangible assets	Finance, Insurance and Real Estate
59	Legal services	Information and Other Services
60	Computer systems design and related services	Information and Other Services
61	Other professional, scientific and technical services	Information and Other Services
62	Management of companies and enterprises	Information and Other Services

64	Administrative and support services	Information and Other Services
65	Waste management and remediation services	Information and Other Services
66	Educational services	Education and Health Care Services
68	Ambulatory health care services	Education and Health Care Services
69	Hospitals and nursing and residential care facilities	Education and Health Care Services
70	Social assistance	Education and Health Care Services
72	Performing arts, museums and related activities	Information and Other Services
73	Amusements, gambling and recreation	Information and Other Services
75	Accommodation	Information and Other Services
76	Food services and drinking places	Food and Fiber System
77	Other services, except government	Information and Other Services
79	Federal civilian	Government
80	Federal military	Government
81	State and local	Government

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