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OPPORTUNITIES FOR ENHANCING THE TEXAS FOOD-PROCESSING INDUSTRY

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Opportunities for Enhancing the Texas Food-Processing Industry

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Executive Summary

Economic development concerns state governments because it directly affects residents' standard of living. Therefore, state governments are interested in strategies for strengthening their economies. Measures of strength include output, income, and employment. States with substantial agricultural production can implement a strategy of maintaining or increasing markets for that production, positively affecting all the aforementioned measures. In some states, the focus has been to "add value" to raw agricultural commodities.

This bulletin can aid governmental agencies to make funding decisions about competing opportunities for adding value in various food-processing industries. Texas' food-processing industry is the focus of this research. A survey was conducted to determine the cost components of Texas food processors, the percentages of purchases from Texas, and the reasons for these purchases.

The McMenamin-Haring (1974) procedure was used to update the Texas Input-Output Model to investigate output, income, and employment impacts of increased processing of agricultural commodities. Multipliers were gleaned from the input-output analysis. The input-output results were combined with information about food-processing industry trends obtained from secondary sources and from the survey. As a result, potential benefits associated with the gain or loss of selected Texas food-processing plants were identified.

Acknowledgment

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TABLES

Introduction

State governments are understandably concerned with the condition of their economies — a state's economic environment determines the potential standard of living for residents. Therefore, state governments are becoming increasingly interested in strengthening their economies, specifically in terms of output, income, and employment.

States that receive a substantial proportion of their revenue from agricultural production have the additional consideration of maintaining or increasing markets for that production. In some of these states, the focus has been on "adding value" to raw agricultural commodities (Capps et al. 1988). In 1989, Kraybill and Johnson identified agricultural value-added programs in 22 states. The goals of these programs were twofold: (1) to find new employment opportunities in rural areas and (2) to create additional demand for agricultural products. In general, value-added opportunities are important because they increase returns for production, thus enabling firms to grow. As new sources of economic activities for a region or state, these opportunities are also sources of increased jobs, employment, and government revenues (Nichols 1988).

Investigation of value-added agricultural opportunities has proceeded along three paths. The first examines historical records of state assistance to determine the feasibility and preferred implementation of prospective value-added activities (Kraybill and Johnson 1989; Moore 1987; Greene 1988; Texas Department of Agriculture 1986). The second recommends ways to develop a value-added research agenda, including consideration of its goals, potential inefficiencies, and potential effectiveness. The role of government institutions in value-added research is also addressed (Otto and Williams 1989; O'Rourke 1989; Ferris 1989; Holt 1989; Paarlberg 1989; Christy and Connor 1989; Meyers 1989; Kraybill and Johnson 1989; Tilley 1989; Giertz and Crihfield 1990). The third comprises quantitative models of the output, income, and employment impacts of the introduction of food-processing plants to a region (Sporleder and Hushak 1991; Jones and Mustafa 1972).

Statement of the Problem

Each of the aforementioned approaches provides important insights for defining the research problem described in this bulletin. State governments have limited resources to devote to research on value-added food products. Suggestions for developing a value-added research agenda contain recommendations about types of industries on which to focus and ways to assist new businesses; often, assessing the impacts of the recommendations is not done. Past quantitative research has analyzed output, income, and employment impacts of food industries on regional economies. However, the data for these analyses often represent past trends, and current trends in the food-processing industry are not considered. In addition, primary data pertaining to reasons processors purchase in-state versus out-of-state inputs are rarely collected. Increased purchases of in-state inputs would increase economic activity within the state. The purpose of this bulletin is to integrate primary and secondary data describing the food-processing industry with quantitative estimations of output, income, and employment impacts of potential food-processing plants. This information would greatly aid state governments in allocating their research funds for value-added activities.

Texas provides an interesting example for value-added analysis. Reeh (1990) identified several Texas food industries in which the state's share of national raw commodity production is greater than the state's share of the comparable processed product. These products are meat products, preserved fruits and vegetables, grain mill products, bakery products, and confectionery products. This information indicates that value-added opportunities for increased food processing exist in Texas. In determining which opportunities can strengthen the Texas economy, decision makers could benefit greatly from data organized to facilitate impact assessment of an additional food-processing plant on Texas output, income, and employment and from data to evaluate these impacts in view of the Texas food-processing environment.

Objectives

The primary objective of this bulletin is to facilitate decision making in fund allocation for value-added opportunities among competing food-processing industries. This overall objective will be accomplished by achieving the following sub-objectives:

(1) Identify food-processing trends.

(2) Identify the cost components of food-processing industries and determine food processors' preferences for in- or out-of-state commodities as well as the reasons for these preferences.

(3) Investigate the output, income, and employment impacts of food-processing plants.

Forces Affecting the Food-Processing Industry

Authors generally agree that the three main forces affecting the food-processing industry are technological, institutional, and economic (Christy and Connor 1989; Capps et al. 1988). These three forces dynamically interact, which hinders independent discussion of these forces.

Technological Factors

Food-processing plants are designed and built for current technological processes. Technologically older plants may not be able to compete with new plants because of either a lack of cost competitiveness or an inability to manufacture new products. Recently, there have been many technological innovations in the food-processing industry (Sanderson and Schweigert 1988; Logan et al. 1988; Babb and Chambers 1988). Examples of these innovations include aseptic packaging, irradiation, and biotechnological advances.

Increased market concentration fosters these technological innovations, which increases rivalry in new product development. Increased market concentration also broadens the financial base of firms through both increased retained earnings and an increased ability to borrow (Christy and Connor 1989). In this innovative environment, opportunities may exist for a technologically new value-added plant to replace a technologically obsolete plant.

Institutional Factors

While technology influences the competitive need for new plants, institutional factors influence the ability to create new plants and the incentive for their creation. National legislation affects the economic environment. For example, fiscal and monetary policies influence interest rates, which alter the affordability of capital (Christy and Connor 1989). Immigration laws affect the increasingly immigrant food-processing labor supply (Connor et al. 1985). Foreign, fiscal, and monetary policies influence the existence of export markets (Connor 1988; McCorkle 1988; McCorkle et al. 1988). Environmental and food safety regulations affect the cost of compliance with these regulations (Archibald and Dahl 1988; McCorkle et al. 1988; Connor et al. 1985). Taxation levels influence the amount of revenue necessary to make a profit (McCorkle 1988). All these factors also affect the cost and availability of food-processing inputs; farm and other manufacturing operations are influenced by these regulations, as well as regulations specific to their industries (McCorkle et al. 1988).

When choosing location within the country, however, the food processor can choose the type of state and local legislation to which it is subject. Applicable regulations relate to workmen's compensation insurance, taxation, pollution, and many other aspects affecting the cost of doing business. However, regions can choose to provide financial assistance in terms of timing and mode of investments, reducing regulatory burdens, and supporting a plant's research and development efforts (Connor 1988). State governments need to be sensitive to these factors if they are trying to encourage economic growth through business expansion.

Economic Factors

A food-processing firm determining whether and how it should expand considers the production costs of competing locations (Connor et al. 1985), the competitive structure and organization of the industry, and the demand for the proposed product (both in the United States and abroad). A state government seeking to attract a new plant to the state should be aware of these factors as well.

Production Costs

Food-processing requires inputs of labor, raw food, energy, and capital. A food processor competes with other manufacturers for labor, energy, and capital. The availability of all inputs at competitive prices, especially during peak processing seasons, is of primary importance when choosing a food-processing plant location.

Christy and Connor (1989) noted that having made estimates of future demand growth and

major cost calculations, a food-processing manager is likely to find that each of several final candidate locations is about equally cost effective. In this case, the business climate (tax and regulatory considerations discussed in the previous section, for example) or managerial preferences lead to the final decision.

From a local government's perspective, a perceived benefit of value-added activity is that new plants will purchase some of their inputs from local suppliers, thereby boosting the local economy. Factors involved in the decision to purchase inputs locally include input availability, cost, quality, transportation costs, a firm's national contract, and sole suppliers of certain inputs. Secondary information on these factors is not readily available, and a region might have to survey its food processors to determine how these factors influence the input purchasing decisions of its food processors.

Industry Structure

Industry structure can affect production costs as well as the availability of markets. Connor et al. (1985) list many aspects of market structure, including concentration, conditions of entry, product differentiation, market shares, advertising and other selling costs, economies of scale, multiplant economies of scale, sales diversification, and conglomeration. Building a new value-added processing plant requires considering all elements of industry structure. Barriers to entry are the initial obstacles to overcome. Costs involved in advertising, product differentiation, building the optimal size plant, and so forth must be calculated to ensure that projected revenue can cover projected costs. When an existing firm expands, optimal plant and multiplant economies of scale are most relevant. By investigating these factors, a state government can get a better idea of whether a type of food-processing industry merits further consideration when choosing the one or those in which to invest.

Demand for Food

As stated earlier, a key factor in the success of a new food-processing plant is having a product that people want to purchase. Economic theory relates that demand for any product depends on income, relative prices of commodities, and preferences. To distinguish among food industries, preferences are the focus of this discussion. Preferences as revealed in trends in processed food consumption are examined initially. The demographic composition of the population and the preferences of different demographic groups are also important and are discussed in following text. Finally, foreign preferences are examined and export opportunities are described.

Domestic Consumption Trends

Red meats, including prepared red meats (ham, bacon, sausages), seem to be losing market share to other high-protein food such as poultry, fish, and tofu (Connor and Wills 1988; Logan et al. 1988). Except for the relatively rapid growth of cheese (including imitation cheeses), most dairy products are expected to experience low to moderate growth (Connor and Wills 1988; Babb and Chambers 1988). Most processed fruits and vegetables will probably experience below-average growth; the exceptions are the fast-growing frozen fruit and vegetable industries, in which average growth is expected (Connor and Wills 1988; Carman and French 1988). The high growth in rice milling of recent years was due to expansion of overseas markets; these projections may be too high if less-developed countries achieve the self-sufficiency they seek (Connor and Wills 1988; Farris et al. 1988).

Increased domestic substitution of fructose for sucrose, as well as export demand, bodes well for the wet-corn milling industry, unless nonnutritive sweeteners make substantial inroads. Relatively strong growth for the animal and vegetable oil industries is expected resulting from demand by export markets and the food service industry (Connor and Wills 1988). Among beverages, the recent rapid growth in beer, wine, and soft drinks is likely to decline from the high 1958-1977 rates but to remain above average (Connor and Wills 1988; Farris et al. 1988). Many of the industries making highly convenient and sweet or high-calorie foods (e.g., canned specialties, frozen foods, candy, breakfast cereals) seem likely to experience average to below-average growth. Popular new items (e.g., frozen quiche for microwave ovens) can experience initial bursts of extraordinarily rapid growth, which later decline to average or below-average levels (Connor and Wills 1988).

Demographic Trends

Demand is directly related to changes in total population (Meyers 1989; Christy and Connor 1989). However, the demographic composition influences the impact of the population change on processed food consumption. Demographic factors emphasized by Capps et al. (1988) include age, household size, labor force, and ethnic composition. Kinsey and Heien (1988) also considered health consciousness to be a factor. These five demographic factors are discussed here.

Age

The U.S. population as a whole is aging (Babb and Chambers 1988), which affects the type of foods consumed. Kinsey and Heien (1988) cited several studies by Salathe (1979) that indicated that older people will consume more cheese, poultry, coffee, and tea. Gallo et al. (1979) indicated that consumption of some cereal products, milk, soft drinks, red meat, prepared foods, and food consumed away from home (FAFH) has declined for elderly people. Buse and Fleishner (1982) contended that elderly people living alone spend a larger proportion of their budgets on fresh fruits and vegetables, cereals, bakery goods, and poultry than does the average consumer.

Household Size

Connor et al. (1985) considered the decline in household size to significantly affect the change in demographic composition of the U.S. population. Smaller households cannot realize the same economies of scale in food consumption as do larger households. Smaller households spend more per capita on bakery products, cheese, soft drinks, fish, and food away from home (FAFH) (Sexauer and Mann 1979; Connor et al. 1985). Connor et al. (1985) also noted that larger households consume relatively more dairy products, cereals and breads, pork, poultry, eggs, sugars and sweets, coffee, soup, and prepared foods.

Labor Force Participation

The husband and wife both work outside the home in 40% of all family units (Connor et al. 1985). The major impact of increased participation of women in the labor force has been higher demand for convenience foods (Capps et al. 1985; Redman 1980). The consumption of convenience foods and FAFH will increase as more women become employed full time. This scenario implies that high-quality, easily prepared food will be increasingly demanded.

Ethnic Food Consumption

Sanderson and Schweigert (1988) noted an increasing interest in ethnic foods in the United States. This interest is reinforced by the growth of minority populations in this country (Capps et al. 1988). Internationalization of the food industry will be strengthened by increasing numbers of travelers among countries, increased global communications, and by the international business activities of most major food companies. These companies contribute to the demand and market for new food products from foreign lands (Sanderson and Schweigert 1988).

Specific foods affected by this trend include spices, resulting from the increased popularity of Mexican and other ethnic foods. Prepared foods are also bolstered as many ethnic foods are sold partly or fully prepared. Frozen Mexican and Italian foods were predicted to grow at a rate of 15% between 1982 and 1992 in terms of dollar sales (Kinsey and Heien 1988). Recent increases in the demand for Mexican-style tortillas and snack foods have increased the consumption of special corn meals and flours (Farris et al. 1988).

Health Consciousness

A significant trend in food consumption has grown out of the improved information on diet and health (Kinsey and Heien 1988). Processes that prolong storage and shelf life of fresh foods will take on more importance as consumers demand more fresh and/or natural foods.

Trends can be anticipated in specific food products. Future changes in the demand for dry-milled corn products may occur if corn bran and corn germ flour are successfully marketed to health conscious Americans (Farris et al. 1988). Consumer concerns about the cholesterol content of red meats and dairy products possibly being related to heart disease appear to have negatively affected consumption of these products (Brown and Schrader 1990; Capps and Schmitz 1991; Logan et al. 1988; Babb and Chambers 1988). Processed pork products have the additional disadvantage of being associated with nitrosamines and excessive salt (Logan et al. 1988). Poultry consumption may be increasing faster than that of red meat. This may be due to concerns about the cholesterol content of red meat (Logan et al. 1988). The interest in

natural foods and more active lifestyles may positively affect dairy consumption (Babb and Chambers 1988).

Export Opportunities

Popular opinion suggests that the United States should export processed foods and thus capture more of the value-added activity through overseas sales. Many authors, however, believe that the United States should concentrate on exporting primarily raw agricultural commodities instead of processed agricultural commodities (Connor et al. 1985; Kinsey and Heien 1988; McCorkle 1988; Paarlberg 1989; Connor 1988). Kinsey and Heien (1988) as well as Connor et al. (1985) noted that the United States has a comparative advantage in exporting agricultural commodities. Despite efforts of United States manufacturers to add value to basic products for export abroad, export growth continues to be weighted toward raw agricultural commodities (McCorkle 1988; Christy and Connor 1989).

Although it may be true that the United States should export primarily raw agricultural products, a small export market does exist for processed agricultural products. Connor et al. (1985) noted that the demand for high-value products will increase in developed and middle-income countries because of tourism and influence of American eating patterns. Sanderson and Schweigert (1988) added that the global communications system is reinforcing this demand, as are the numerous food companies participating in international business activities. In addition to processed food, developing countries will demand more semiprocessed products for use in local food-processing.

Location Factors

At the beginning of this section, the success of a new food-processing plant was noted to be a function of consumer's demand for the product and the state's competitiveness in its production. Here, the competitiveness of a plant in rival locations is examined by identifying characteristics of an optimal plant location. Factors involved in the location of a plant include industry competitive structure, transportation infrastructure, adequacy of labor supply, remoteness from market, and business climate, namely, the impact of community regulations that affect the ability of the firm to carry out business activities. For example, to conform to the perfect competition model, an industry must seek to exist in the least-cost location to remain in business.

The coefficient of localization is a quantitative measure that provides a basis for a preliminary decision about which industries to explore further for possible relocation. It measures the relative regional concentration of a specified type of food manufacturer compared with a given base such as population or income (Isard 1960; Capps et al. 1988). If food processing were distributed equally over the population, the coefficient would equal zero. If it were concentrated in one region, it would equal one. Using Isard's procedure, the coefficients of localization in Table 1 were calculated with employment data for each state and the District of Columbia as listed in the *Census of Manufactures* (U.S. Department of Commerce 1987).

Food industries oriented to local consumer demand have coefficients close to zero. There are several reasons for orientation to consumer demand: the manufacturing process may result in an increase in bulk or weight of the inputs, a high degree of product perishability may exist, or the market may be specialized and concentrated. Examples of demand-oriented food industries include packaged fluid milk, ice cream, bread, rolls, cakes, flour, potato chips, shoestring potatoes, and bottled soft drinks. Isard (1960) noted that industries with coefficients close to zero are relatively nonconcentrated regionally and are candidates for moving into an area seeking economic growth. The coefficients of localization listed in Table 1 are closer to zero than they are to one, so these industries are all candidates for introduction into Texas.

Table 1. Coefficients of localization for food-processing industries in the United States.

Industry	Coefficient of localization*
Meat	0.35
Dairy	0.25
Fruit and vegetables	0.32
Grain milling	0.30
Bakery products	0.16
Sugars and confections	0.34
Fats and oils	0.27
Beverages	0.23
Miscellaneous	0.24

*Coefficients were calculated as per Isard (1960) using Census of Manufactures (U.S. Department of Commerce 1987) employment data for each state and the District of Columbia.

Food industries located near input supplies have coefficients close to one. This proximity to input supplies may be desirable because of great weight or bulk loss during the manufacturing process, perishability of the raw material, or transportation rates. Examples of industries include meat packing, meat processing, fruit and vegetable freezing, rice milling, corn refining, and sugar beet processing. In Table 1, however, the coefficients calculated for these industries are not close to one. This discrepancy could be due to the aggregated nature of the data. In addition, more sophisticated techniques may be required in future studies that determine planned plant location.

Food industries for which location decisions are not dominated by cost of delivery to customers or access to nearby input supplies are labeled "footloose" or "mobile." Examples of these industries include breakfast cereals, prepared flour mixes, confectionery, frozen foods, yogurt, processed and imitation cheese, and shortening and cooking oils. Note that even with a strong attraction to demand or supply, a plant may not locate where expected for reasons mentioned at the beginning of this section.

The Texas Food-Processing Industry

In the previous section, trends in the national food-processing industry were examined. However, specific information about the Texas food-processing industry is necessary to determine the potential for enhanced food-processing in Texas. Specific information about cost components of the food-processing industries, food processors' preferences for in- or out-of-state commodities, and reasons for these preferences is required. This information is generally not published, but can be obtained from certain governmental agencies or by surveying food processors. Preferences of food processors and rationales for particular input sources can be determined only by survey methods. This section discusses the Texas food-processing industry by describing the survey methods used in this study and presenting the survey results.

Survey of the Texas Food-Processing Industry

The Sample

The information sought in this survey was obtained from Texas food processors. A list of these manufacturers is available in the *1990 Directory of Texas Manufacturers* compiled by the Bureau of Business Research at the University of Texas at Austin. For this research, the Texas food-processing population consisted of the 1,175 plants listed in the *1990 Directory of Texas Manufacturers* (Bureau of Business Research 1990) that manufactured products classified under Standard Industrial Classification (SIC) code 20, food and kindred products. In addition, the sample consisted of the entire population because each plant was surveyed. The *1990 Directory of Texas Manufacturers* (Bureau of Business Research 1990) lists as many as five different products produced by each plant but does not give the percentage of the total sales of each product. Therefore, the plants listed in the 1990 Directory of Texas Manufacturers (Bureau of Business Research 1990) were classified according to the first product listed on the assumption that this product would be produced in the largest volume. Wildenthal (1992) compared the characteristics of the plants listed in the *Census of Manufactures* (U.S. Department of Commerce 1987) with those listed in the *1990 Directory of Texas Manufacturers* (Bureau of Business Research 1990) and found that the percentages of plants in each category for both sales and employment are highly similar, thus supporting the use of the *1990 Directory of Texas Manufacturers* (Bureau of Business Research 1990) list of food-processing plants to obtain the Texas food-processing population.

Questionnaire Design

The questionnaire for this research was designed to collect the following information about Texas food-processing: (1) description of the cost components of food-processing industries; (2) reasons for input purchases from Texas versus those from other states; (3) the distribution of processed food products among various markets; and (4) the proportion of the output sold in Texas. Because of cost and survey complexity, personal and telephone surveys were not considered as methods of questionnaire administration. Therefore, the survey was designed as

a mail survey. The chief executive officer, as opposed to the purchasing or sales agent, of each plant was the recipient because questions relate to both sales and purchases.

Surveys from the University of Washington, the Nebraska Department of Labor, the University of Illinois, the Texas A&M University System, and the University of Wisconsin were reviewed during questionnaire development. The survey asked for plant sales, purchases, employment, capital expenditure information; a listing of major raw materials and inputs and whether and why they were purchased inside or outside of Texas; and investment in entrepreneurial activities. The question content, response format, and question sequence were patterned after those of the questionnaires discussed in the previous paragraph. The questionnaire was revised after pretests with a local ice cream manufacturer, baker, and meat processor.

Questionnaire Administration

The printed eight-page questionnaire was mailed with a nonpersonalized cover letter having a social utility appeal and signed by Texas A&M University professors recognized by many in the industries being surveyed. The initial questionnaire was mailed under bulk postage, but subsequent mailings were with first-class postage. Confidentiality and anonymity of questionnaire respondents were assured. A deadline was given for a response, and the respondents were asked to indicate whether they wished to receive a copy of the questionnaire results. Three follow-up questionnaires were mailed, and all questionnaire recipients who had not responded were then called. The complexity, time requirements from recipients, and length of the questionnaire were more than would generally be considered acceptable for a mail survey, however. As a result, the response rate was lower than otherwise would be desirable.

Data Analysis

The data gathered from the survey were analyzed in three different ways: comparing the survey response rate to that of previous studies; comparing the respondents with the population; and calculating descriptive statistics from the questionnaire results.

Survey Respondents

Of all the 1,175 plants in the *Census of Manufactures* (U.S. Department of Commerce 1987), only 999 were found to be operational food-processing plants. Responses were received from 186 plants, a 19% response rate. This response rate is not atypical (Mautz and Neumann 1990; Dommeyer 1985).

Comparison of the Population and Questionnaire Respondents

Comparison of the population and questionnaire respondents is important because of the possibility of reaching incorrect conclusions from nonrepresentative respondents (Tull and Hawkins 1987). The comparison of the population of Texas food processors and the questionnaire respondents was conducted on the basis of simple descriptive statistics for food industry, size, and geographic distribution as well as a qualitative choice model to determine the representativeness of the sample.

Descriptive Statistics of the Population and the Sample

The Texas food-processing population for this research is defined as the plants listed in the *1990 Directory of Texas Manufacturers* (Bureau of Business Research 1990), whose products can be classified in SIC 20 (food and kindred products). Wildenthal (1992) showed in detail that the percentage of responding plants in each Texas Input-Output Classification (TIOC) is similar to the distribution of population plants for both food-processing industries and for number of employees. Because of the large percentage of Texas plants that did not release their sales information to the *1990 Directory of Texas Manufacturers* (Bureau of Business Research 1990), the representativeness of the questionnaire respondents in terms of sales volume is not clear. The percentage of responding plants in the Far West/Panhandle and Central regions is much like the percentage of plants in the population of those regions, while the percentage of responding plants in the East and South regions is slightly higher than the percentage of plants in the population of those regions.

Qualitative Choice Model

A sample has response bias if some people being surveyed are more likely to respond than others. A statistical way of examining the re-

sponse bias of the sample is through the use of a qualitative choice model. The aspect of interest is the decision of a food processor to respond to a questionnaire. Therefore, this decision is the dependent variable in the model. In addition, the choice made is associated with characteristics of the food processors. The characteristics of interest are food industry, number of employees, sales volume, and geographic location.

The qualitative choice analysis, its assumptions, and specific procedures are explained in detail by Wildenthal (1992). Plant characteristics of employment, location, and sales did not have a statistically significant impact on whether a food processor completed the survey. Of the food-processing industries, beverage, meat-processing, and grain mill plants were more likely to complete the survey than were "other food" processors, while bakery, poultry, preserved food, feed, and dairy processors were less likely to complete the survey. Perhaps in future studies, bakery, poultry, preserved food, feed, and dairy processors may need to be oversampled to obtain a more representative sample.

Questionnaire Results

As stated in the questionnaire description, the desired information can be classified into four different categories: (1) descriptions of the cost components of food-processing industries; (2) reasons for input purchases from inside Texas or outside Texas; (3) distribution of Texas food products between various markets; and (4) proportion of the output sold in Texas.

Cost

The cost components for the responding Texas food-processing plants are shown in Table 2. These cost breakdowns provide an estimate of the impact of a food-processing plant being introduced into a community. The importance of each category of input can be assessed for typical plant cost components. In this way, if an input category is found inferior or superior to out-of-state inputs, a better assessment of the costs and benefits of changing or promoting the input can be determined.

For the purposes of this discussion, inputs are classified into four categories. Inputs with SIC codes below SIC 20 are classified as raw materials. These inputs include raw agricultural products and minerals. Inputs in SIC 20, food and kindred products, are classified as processed food inputs. Those with SIC codes above SIC 20 are classified as nonfood inputs. These inputs include packaging materials, paper products, food preservatives, vitamins, and other materials. The final category is "other materials" purchased, such as cleaning supplies.

Of particular interest to an agricultural community is the percentage of resources spent on raw products and the percentage of these raw products purchased locally. Table 2 reveals some anomalies. For example, beverage plants do not appear to purchase energy or water or to have depreciation expenses. Although problems exist with the collected data, some generalizations about raw material purchases can be made. Most expenditures of the responding

Table 2. Distribution of total cost by cost components for responding Texas food-processing plants, 1989.

	Food industry							
Material	Meat	Dairy	Feed	Bread	Prsv. food	Other food	Beverages	All
	(Average percentage of total cost)							
Raw ingredients	3.7	59.8	14.9	9.2	29.0	0.8	10.0	15.1
Processed food products	37.1	5.4	23.7	40.3	19.4	78.3	15.0	56.4
Processed nonfood products	4.8	13.6	6.7	6.5	18.9	4.3	22.5	7.8
Other materials	4.6	1.7	38.6	7.0	6.7	0.2	2.5	2.0
Wages/salaries	28.6	7.6	7.0	17.8	10.2	6.8	12.5	7.7
Overhead	13.4	2.9	1.5	8.5	3.9	4.2	25.0	4.1
Depreciation	1.8	2.1	1.8	3.3	4.7	1.3	0.0	1.9
Other production cost	2.3	4.3	3.7	6.0	4.2	1.9	12.5	2.7
Energy	2.8	2.0	1.8	1.4	2.4	2.1	0.0	2.1
Water	0.9	0.6	0.3	< 0.1	0.6	< 0.1	0.0	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Calculations by the author from survey results.

plants are weighted more toward materials (raw materials, processed food inputs, processed nonfood inputs, and other materials) than toward nonmaterial inputs (wages/salaries, overhead, depreciation, other production costs, energy, and water). The exceptions are meat and beverage plants, for which expenditures are distributed almost equally between both costs. The material expenditures of dairy and preserved-food-processing plants are weighted more heavily toward raw ingredients, while those of meat, bakery, and other food-processing plants are spent more on processed food inputs. Beverage plants purchase more processed nonfood inputs than other inputs, and feed manufacturers spend more on other materials.

Percentage of Materials Purchased in Texas

Of interest in this research is the percentage of money spent for out-of-state inputs. This money might instead be redirected toward Texas input purchases, thus strengthening the Texas economy. If a plant is being encouraged to locate in Texas, the availability of inputs is also a consideration. The percentage of raw ingredients, processed food, nonfood, and other materials purchased in Texas by responding Texas food processors is shown in Table 3. These figures indicate which input categories have the greatest potential for increased purchases in Texas. This information can help explain reasons the responding food-processing plants give for their purchase of inputs from in- or out-of-state sources. Note that neither grain mill nor poultry plants responded to this section of the questionnaire, so comments from these industries are not reported.

Raw ingredients. Responding dairy, feed, and beverage processors purchase nearly all their raw ingredients from Texas suppliers. Responding meat processors do not purchase raw ingredients from Texas because the responding meat processors do not slaughter animals but purchase the meat that they further process. This processed meat is classified in this research under processed food inputs. Bakery, preserved food, and other food processors purchase one-quarter to one-half of their inputs from Texas suppliers.

Processed food inputs. Responding dairy, feed, and beverage manufacturers buy approximately 80% of their processed food inputs from Texas suppliers, while meat processors purchase half from Texas sources. Bakeries, preserved food, and other food processors purchase less than one-fourth of their processed food inputs from Texas suppliers.

Processed nonfood inputs. Responding bakeries, preserved food processors, beverage bottlers, and meat packers purchase at least half of their processed nonfood inputs from Texas suppliers, while feed, other food, and dairy processors buy one-quarter to one-third of their processed nonfood inputs from Texas sources.

Other materials. Approximately half of the responding dairy, feed, bakery, and preserved food processors' inputs are provided by Texas suppliers. None of the beverage bottlers' other materials comes from Texas sources, while one-third of the other food processors' and one-fifth of the meat processors' other materials are bought from Texas suppliers.

Reasons for Purchasing Inputs In Texas or Outside Texas

In the previous section, specific food-processing industries are identified as having greater opportunities to increase their purchases of Texas products than do others. Table 4 identifies reasons food processors preferred Texas or out-of-state inputs.

Table 3. Average percentage of purchases from Texas suppliers by responding Texas food-processing plants, 1989.

	Food industry[1]						
Materials	Meat	Dairy	Feed	Bread	Prsv. food	Other food	Beverages
	(Average percentage of purchases in Texas)						
Raw ingredients	0.0	100.0	90.7	45.9	30.1	26.2	100.0
Processed food products	54.0	79.6	82.6	8.1	22.6	0.3	83.3
Processed nonfood products	51.5	31.6	25.2	95.8	90.1	29.7	77.8
Other materials	18.9	57.0	54.7	48.5	67.6	31.8	0.0

Source: Computations by the author from survey results.
[1] Grain mill and poultry respondents did not provide this information.

Table 4. Major reasons for buying materials as cited by Texas food-processing plants, 1989 (186 responding plants).*

Reason	Number of times cited	Percentage of total reasons cited	Number of plants citing this reason	Percentage of plants citing this reason
Availability				
In-state	406	32.2	140	75.3
Out-of-state	215	36.0	91	48.9
Cost				
In-state	365	28.9	129	69.4
Out-of-state	148	24.8	72	38.7
Quality				
In-state	199	15.8	80	43.0
Out-of-state	118	19.7	57	30.6
Transportation				
In-state	202	16.0	80	43.0
Out-of-state	22	3.7	11	5.9
Sole Source				
In-state	42	3.3	33	17.7
Out-of-state	52	8.7	38	20.4
National Contract				
In-state	19	1.5	10	5.4
Out-of-state	27	4.5	12	6.5
Made by Affiliate				
In-state	12	1.0	11	5.9
Out-of-state	8	1.3	6	3.2
Other				
In-state	16	1.3	12	6.5
Out-of-state	8	1.3	6	3.2
Total				
In-state	1261	100.0	186	
Out-of-state	598	100.0	186	

* Each plant could check each reason for any of its primary six materials, labor, or depreciable fixed assets. Thus, each reason could be checked as many as eight times per plant. The second column represents the total number of times that the reason was checked divided by the total number of reasons checked.

This information assists in determining whether an aspect of Texas production that, when promoted, might increase sales of state commodities. Areas in which Texas can improve to be more competitive can be identified as well. However, note that one noninvestigated area is the possibility that some processors may not purchase out-of-state inputs because of state loyalty. In elaborations of these preferences, note that grain mill and poultry plants answered questions in this section but did not answer questions in the previous section on costs.

Availability. As a reason for buying their inputs from Texas suppliers, 140 out of 186 responding plants cited availability (Table 4). Availability was cited by 20% to 75% of the responding plants in each food-processing industry with only two exceptions. Only 1 out of the 23 responding meat processors cited availability of raw materials as a factor in purchasing these inputs from Texas suppliers. Note that few of the responding meat processors slaughter animals, so availability of raw materials is not as relevant for this industry as it is for other industries. In addition, only 2 out of the 19 responding bakeries cited availability of processed nonfood purchases as a factor in purchasing these inputs from Texas suppliers. Many meat, bakery, dairy, and feed processors cited availability as a reason for purchasing processed food inputs. Similarly, several poultry, bakery, dairy, and feed manufacturers noted availability as a reason for their purchases of local raw materials. Several poultry and beverage processors listed availability as a reason for purchasing processed nonfood inputs in Texas. Except for poultry, more than half of all

the inputs discussed in this section are purchased from Texas sources.

Availability of inputs was cited as a reason for buying out-of-state inputs by approximately half of the responding food processors (Table 4). Responding grain mills did not give this reason. Availability was important for processed food bought out-of-state by meat packers, for raw materials purchased out-of-state by preserved food processors, and for processed nonfood products purchased by beverage bottlers.

The reasons plants listed for out-of-state purchases can be generalized into three different cases of input availability. The first case is that of the input in question being available in Texas, regardless of whether it is produced out-of-state. Without considering quality, cost, and other comparisons with out-of-state inputs, Texas input producers just need to make their products available. The second case is that of the input being available in Texas but a processor maintaining an out-of-state supplier. Examples of this case include a citrus processor who maintains an out-of-state source as assurance against a freeze and a fish processor who maintains an out-of-state source so he can process fish during the Texas off-season. These are simply wise business practices that should continue. The third case is an input not being available in Texas and available only from out-of-state sources. Examples of these inputs include pork, turkey, packaged seasonings, lollipop supplies, beverage supplies, processed soybeans (because of the small amount of soybeans produced in Texas), almonds, peppers, and tomatoes, which are not grown in Texas. The demand for these products warrants further investigation to determine whether the Texas market can sustain a supplier and whether the supply of these products, such as soybeans, almonds, tomatoes, and peppers, can be maintained.

Cost. Cost was cited by almost 70% of the questionnaire respondents as a reason they buy Texas inputs (Table 4). When cost is cited as a reason for purchase of Texas inputs, quality and transportation can be factors involved in that cost. These factors are considered later in this report. The specific cost-influenced Texas purchases by poultry, feed, bakery, and beverage plants should be further investigated so they can be promoted in future efforts to seek plant relocations or start-ups in Texas. The food-processing industries that indicated cost is a factor in their decision to purchase out-of-state inputs did not list specific ways in which cost is a factor in their purchase of out-of-state inputs. With only three exceptions, a food processor from each food industry cited cost as a reason for purchase of either raw materials, processed food inputs, or processed nonfood inputs from out-of-state sources. Any of these reasons can be investigated, but the feed, bakery, and other food industries consistently had more than one processor citing this reason for each type of input, and these industries could be studied first. Dairy processors cite cost as a reason for the out-of-state purchase of processed food and nonfood inputs, and these reasons could be part of an initial study as well.

Quality. Forty-three percent of the responding plants cited quality as a reason for buying Texas inputs (Table 4), which could be influenced by loyalty to the state. For out-of-state input quality, feed, bakery, preserved food, and "other food" processors exhibit the main concern for quality of each type of input, while meat processors cite concern for the quality of processed food inputs. These areas warrant further investigation for ways Texas can improve its products. Aspects of Texas input quality valued by beverage, meat, dairy, and bakery processors should be pursued for purposes of promoting Texas inputs.

Transportation. Transportation availability and cost was also cited by 43% of the responding plants (Table 3). Poultry processors were the only processors who did not cite transportation as a consideration for any input purchase. Texas freight rates appear to be favorable for some items and unfavorable for others. Reasons given by Texas dairy, grain, and feed processors for favoring Texas inputs for transportation reasons deserve further investigation. Few of the food processors have problems with Texas transportation. However, transportation considerations of feed mills warrant further study. Other factors to consider include transportation of processed food for meat and preserved food processors, transportation of raw materials for dairy and "other food" processors, and transportation of processed nonfood for "other food" processors.

Sole source. Approximately one-fifth of all responding food processors cited sole source of inputs as a reason for buying either Texas or out-of-state inputs (Table 4). The existence of a sole source is favorable when the source is in

Texas and unfavorable when the source is outside Texas. The existence of a Texas sole source for an input could be promoted to new food-processing plants. When the only source of an input is outside Texas, more work must be done to entice the source to move to Texas. Fortunately, few plants have sole sources outside Texas.

National contract. National contracts for Texas inputs were cited by only 5% of the responding food processors. National contracts restrict input purchases to out-of-state suppliers for only 6.5% of the responding food processors (Table 4). National contracts are similar to sole sources in that they are favorable if the national contract is with a Texas supplier and unfavorable if the contract is not with a Texas supplier. For example, a beverage plant noted that its decisions were controlled by the corporate office. In situations such as this, there is no benefit to be gained from promoting the existence of national contracts for Texas inputs. The existence of national contracts is a difficult situation for Texas input entrepreneurs to overcome. Fortunately, few plants are purchasing inputs out-of-state for this reason.

Made by affiliate. Approximately 7% of the food processors purchased Texas inputs that were made by affiliates (Table 4). Only 3% of the responding food-processing plants purchased out-of-state inputs because they were made by an affiliate (Table 4). As with sole sources and national contracts, inputs made by affiliates are favorable if the affiliate is in Texas and unfavorable otherwise. Much like national contracts, there is no benefit to promoting the existence of an affiliate, and affiliate input transactions are difficult for Texas entrepreneurs to attract. Similar to national contracts and sole sources, it is advantageous that few plants purchase out-of-state inputs made by affiliates.

Other reasons. Seven percent of the responding food processors listed other reasons for buying Texas inputs (Table 4). Three comments are listed in the previous discussion. Other comments deal mainly with convenience issues.

Markets for Texas Food Products

The importance of markets lies in the distinction between final demand markets versus processing markets. When products are sold to final demand markets, value can no longer be added to them. When they are sold to processing markets, more value is added to the products. In this way, more wages and salaries, interest, taxes, and the other value-added components are generated for the economy.

The markets of interest are listed in Table 5. According to the input-output definition, final demand markets are export markets and state, local, and federal governments. Most of the markets listed under "other markets" are final demand markets, as well. Only one market, the processing market, performs further processing of processed food products. The remaining markets, namely the retail firms, hotels, restaurants, institutions, other wholesalers, brokers,

Table 5. Distribution of respondents' sales of Texas food products by market, 1989.

Markets	Food industry								
	Meat	Poultry	Dairy	Grain	Feed	Bread	Prsv. food	Other food	Beverages
	(Percentage of sales)								
Retail firms	35.0	32.9	53.0	5.9	36.7	7.4	34.3	9.0	50.0
State/local govt.	1.5	0.3	1.8	< 0.1	1.2	0.0	0.3	0.1	0.0
Federal govt.	1.5	0.0	1.1	0.4	0.0	0.2	0.4	0.1	< 0.1
Exports	2.2	0.0	1.1	83.6	0.2	3.9	0.1	1.4	0.0
Hotel/restaurant	18.6	6.6	5.1	0.7	0.0	2.3	0.5	2.4	< 0.1
Institutions	3.8	0.4	5.9	1.2	< 0.1	0.9	1.9	0.1	< 0.1
Other wholesalers	21.5	2.2	0.2	6.9	7.2	39.0	34.2	21.6	< 0.1
Brokers	0.0	< 0.1	0.0	0.2	< 0.1	5.3	5.9	0.4	< 0.1
Processors	9.7	5.7	7.9	0.9	0.4	0.0	7.0	19.6	0.0
Co. distribution facility	5.8	48.9	23.2	0.1	9.0	1.9	13.7	28.6	49.9
Other markets	0.4	3.0	0.7	0.1	45.2	39.1	1.7	13.4	0.1
All markets	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Computations by the author from survey results.

and company distribution facilities, add value in terms of time and place to the products.

The grain mill sector is the only sector for which most of the production goes mainly to final demand (84.0%). The meat, dairy, and bakery industries sell roughly 5% of their production to final demand markets. The remaining sectors, however, sell 2% or less of their production to final demand markets. Therefore, given equal capabilities of food-processing industries to adapt to the community, food-processing industries other than the grain mill industry should be chosen for investment.

Further processing of Texas food products occurs for less than 20% of the output in each industry. Almost 20% of the "other food" products are further processed. None of the bakery or beverage products is further processed. However, bakery processors use grain mill products as inputs, so their production generates further economic activity within the food-processing sector. Less than 10% of the remaining industry products are further processed. Given these circumstances, the "other food" products would be favored over other food-processing industries because of the increased employment and income from further processing of the "other food" products.

Another important aspect of markets is how much production is sold to out-of-state processing firms. Table 6 shows the converse of this situation, namely, how much of the production is sold to Texas buyers. The value of this knowledge relates to the desire for further value to be added to commodities in Texas. For example, all the animal feed sold to processors is sold to Texas processors, but for obvious reasons, very little animal feed is sold for further processing. Relative to other food industries, slightly more of the grain and preserved foods are sold to further processors, and most of this production is sold to Texas processors as well. Between 5 and 20% of the remaining products is sold to processors, and between 70 and 99% of this production is sold to out-of-state processors. These figures indicate an opportunity exists to further process the production of these latter industries, namely the meat, poultry, dairy, and "other food" industries. Further study would determine what expected dollar value of commodities is under consideration and the type of processing required.

Contrary to the previously stated desire to increase the amount of production that is further processed is a desire to sell more production to final demand markets out-of-state. Because of the small quantity of production sold to final demand markets and the large percentage of sales of these sectors to Texas firms, most of the final demand sales are sold to Texas buyers.

Industry-by-Industry Evaluation

These findings from the survey are now evaluated on an industry-by-industry basis. This summary will help determine the plausibility of investing in industries identified in the next section as providing promising income or employment opportunities in Texas.

Table 6. Percentage of respondents' sales of Texas food products to Texas destinations, 1989.

	Food industry								
Markets	Meat	Poultry	Dairy	Grain	Feed	Bread	Prsv. food	Other food	Beverages
	(Percentage of sales)								
Retail firms	54.6	100.0	97.5	50.8	85.5	82.1	60.6	26.5	15.1
State/local govt.	24.5	100.0	100.0	38.0	81.4	0.0	40.5	83.5	0.0
Federal govt.	19.4	0.0	100.0	0.0	0.0	100.0	46.0	6.6	100.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hotel/restaurant	61.3	100.0	99.7	42.9	0.0	93.6	90.5	9.3	100.0
Institutions	34.1	100.0	95.6	83.2	100.0	100.0	70.7	47.2	80.2
Other wholesalers	63.1	50.1	80.0	4.5	63.3	60.6	62.4	7.4	51.2
Brokers	0.0	0.0	0.0	20.0	100.0	20.0	10.0	52.0	100.0
Processors	20.7	1.0	6.9	80.0	100.0	0.0	61.6	30.5	0.0
Co. distribution facility	100.0	0.0	59.5	75.0	99.4	100.0	47.4	75.3	0.1
Other markets	90.6	70.0	100.0	92.5	96.8	30.5	61.7	1.6	100.0

Source: Calculations by the author from survey results.

Meat Products

The respondents were not representative of animal slaughterers, so these meat processors could only be surveyed to obtain further information about the raw material preferences of meat processors. The meat processors who did respond to the questionnaire obtained meat from slaughterers and further processed and/or packaged it. From the cost information, another aspect appearing worthy of investigation is the reason meat processors buy other materials out-of-state.

The major reasons for meat processors' purchases of processed food inputs in and out of Texas were availability of these inputs. Processors noted limited availability of pork, turkey, and packaged seasonings, indicating that further study of these markets in Texas might be worthwhile. Quality of Texas food and nonfood inputs, as well as non-Texas food inputs, are also important for Texas meat processors.

Less than 5% of Texas meat processors' sales went to final demand markets. Ten percent went to processors, 80% of which were located out-of-state. Small Texas processors might consider investigating what type of processing occurs out-of-state and determining whether enough processing exists to support a plant. The remaining 85% of the sales went to markets that add value to meat in terms of time and place, such as retail firms, restaurants, and wholesalers.

Poultry Products

Availability and cost of Texas raw materials, as well as the availability of processed Texas nonfood inputs, were important to two of the four responding Texas poultry processors. Two responding processors purchased out-of-state processed nonfood inputs because of cost. These purchases could be further investigated to see whether Texas input suppliers can become more competitive by adjusting some aspect of production.

Less than 1% of the reported Texas poultry production was sold to final demand markets. Eight percent was further processed, almost solely by non-Texas processors. Given the magnitude of sales by poultry plants, processors in Texas may have an opportunity to capture some of this market for further processing. This possibility merits more investigation. More than 90% of the sales went to firms that add time and location value to the processed poultry, primarily by retail firms and their own company's distribution facilities.

Dairy Products

Availability and transportation of Texas raw materials were important reasons for the responding dairy plants' purchases of Texas raw materials, possibly because of the bulk and perishability of raw milk. This hypothesis, however, needs further investigation. Availability and cost of Texas processed food and nonfood inputs were also important considerations for their in-state purchases.

Five percent of the responding dairy processors' sales were made to final demand sectors. Eight percent were made to processors, 7% of whom were located in Texas. This further processing merits more investigation, as dairy sales are fairly large and a large percentage of the value of processed dairy products is being shipped out-of-state. Approximately 85% of dairy products were shipped to firms that add location and time value, especially retail firms and company distribution facilities.

Grain Mill Products

Two out of the five responding grain mill processors bought Texas raw materials and processed nonfood materials for reasons of availability and transportation. Eighty-four percent of sales by responding grain mill processors went to final demand markets, the highest percentage of sales going to final demand of any food industry. One percent went into further processing, 80% of which is processed in Texas. Fifteen percent went to markets, such as retail firms and other wholesalers, that added time and location value.

Animal Feed Products

Responding animal feed processors indicated that availability, cost, and transportation were reasons they purchased raw materials and processed nonfood inputs from Texas suppliers. One manufacturer noted the convenience of buying Texas corn, oats, and milo. Forty-seven percent of animal feed sales went to final demand markets, and less than 1% went to processing. The remaining 52% went to markets that added time and location value to feed, such as retail firms.

Bakery Products

Responding Texas bakeries cited availability, cost, and quality most often as reasons for purchasing Texas processed food products. One baker purchased out-of-state inputs only if the input could not be acquired in Texas. Four percent of bakery sales went to final demand markets. None went to further processors, and the rest went to firms that added time and location value to the baked goods, such as retail firms and other wholesalers. Note that bakeries purchased grain mill products, so increased numbers of bakery plants increased the economic activity of the food-processing sector through grain mill product purchases.

Preserved Foods

Responding preserved food processors in Texas preferred Texas raw materials mainly because of their availability and cost. They also bought out-of-state raw materials because of availability. Cost information supports the importance of this information. This situation may be due to reasons that are difficult to remedy, such as poor Texas crops (citrus) and off-production seasons (fish). Less than 1% of production from responding preserved food plants' was sold to final demand markets. Seven percent was further processed, mainly by Texas processors. The remaining 82% of preserved food production was sold to firms that add time and location value to the products, such as retail firms, other wholesalers, and company distribution firms.

"Other Food" Products

Responding processors in the "other food" category purchased all Texas inputs according to availability and cost. However, reasons were given for buying inputs that could not be obtained in Texas, and awareness of these reasons might be useful for a Texas input entrepreneur starting up a business. Approximately 2% of "other food" products were sold to final demand markets. Twenty percent were further processed, 30% of which were further processed in Texas. The rest went to markets that added value in terms of time and place, such as other wholesalers and company distribution facilities.

Beverages

Responding beverage processors mainly purchased Texas processed nonfood inputs because of their availability, cost, and quality. Processed food inputs were purchased from Texas and out-of-state firms because of availability. Specific inputs were listed for entrepreneurs wishing to undertake further investigation. Less than 1% of beverages went to final demand and none were further processed. They were sold almost exclusively to retail firms and company distribution facilities.

Input-Output Analysis

Because one of the objectives of this study is to evaluate output, income, and employment implications of increased processing of agricultural commodities, the use of an input-output model is called for. Output, income, and employment impacts arising from changes in each sector of the economy are readily calculated from this model. For this study, the 1979 Texas Input-Output Model was updated to 1986 to make it suitable for answering current questions. To make the 184 sectors manageable, the Texas Input-Output Model was aggregated into 47 sectors (listed in Table 7). The model was updated using the technique developed by McMenamin and Haring (1974). The data sources used in the updating process are available from Wildenthal (1992). Fortran programs developed by Ozuna (1986) were used to update the model. The complete Texas Input-Output Model can be found in Wildenthal (1992).

Transaction Table

The sector production disposition is shown in each sector's row of the transactions table, which is presented in Wildenthal (1992). According to this information, the two major purchasers of agricultural products are the export and domestic food-processing sectors. Exports constitute an important market for irrigated cotton (77% of production), dryland cotton (84%), irrigated feed grains (51%), dryland feed grains (55%), and feedlot production (56%). Domestic processing is a large market for dryland (51%) and irrigated (35%) cotton (cotton ginning), forestry (80% to lumber and printing), fisheries (55% to preserved food), range production (60% to meat processing), feedlot production (34% to meat processing), dairy production (78% to dairy processing), and poultry and egg production (5% to poultry processing).

Except for the animal feed sector, the food-processing sectors sell little of their output to the agricultural production sectors. The major

Table 7. Sectors of the updated 1986 Texas Input-Output Model.

1	Irrigated cotton
2	Irrigated food grains
3	Irrigated feed grains
4	Other irrigated crops
5	Dryland cotton
6	Dryland food grains
7	Dryland feed grains
8	Dryland crops and livestock, not elsewhere classified
9	Range livestock production
10	Feedlot livestock production
11	Dairy production
12	Poultry and egg production
13	Cotton ginning
14	Agricultural services
15	Forestry
16	Fisheries
17	Mining
18	Construction
19	Meat products
20	Poultry products
21	Dairy products
22	Grain mill products
23	Animal feeds
24	Bakery products
25	Canned, preserved, pickled, dried, and frozen food
26	Other food and kindred products
27	Beverages
28	Textile and apparel
29	Lumber, paper, printing, and publishing
30	Chemicals and petroleum refining
31	Rubber, leather, plastics, glass, stone, and clay products
32	Metal industries and products
33	Machinery, transportation equipment, and instruments
34	Miscellaneous manufacturing
35	Transportation and communications
36	Utilities
37	Wholesale trade
38	Retail trade
39	Finance, insurance, and real estate (F.I.R.E)
40	Services
41	Households
42	Property payments
43	Federal government
44	State government
45	Local government
46	Capital formation
47	Exports

purchasers of agricultural processed products are the household and export sectors. The only agricultural-processing sectors that do not sell more than half of their products to households are the grain mill, animal feed, and preserved food sectors. Exports are the major market for grain mill products (74%), while feed and preserved food each receive 46% of their revenue from exports. Eight percent of meat products, 6% of grain mill products, and 27% of "other food" products receive further processing from food-processing sectors. Animal feed receives 15% of its revenue from the range production sector and 19% from the poultry and egg production sector. The preserved food sector is unique in having sales of 9% each to the retail and services sectors.

This situation differs greatly from the one outlined in the discussion of the survey of the Texas food-processing industry. This difference is partly due to the structure of the questions addressed in that section. For example, the only means of recording sales to households is to record them as sales to "other markets." "Other markets" do not receive enough sales to account for the high percentage of sales to households revealed in the transactions table. Sales to company distribution centers could account for part of this if the distribution center is considered to be part of the company and it sells directly to consumers. As for export sales, the grain mill sector results are similar for both the survey and the model because responding grain mills sold 84% of their output to export markets. The exports of feed and preserved food products greatly differ because responding plants sold less than 1% to export markets. For sales to processing sectors, the meat and "other food" sales are similar, but grain sales of the responding plants are less than 1% of all sales. Responding preserved food processors sell 34% of their sales to retail firms, as opposed to the model's estimated 9% of sales to retail.

The Texas Input-Output Model results indicate that the main inputs in the production of agricultural products are provided by the final purchases and nonfood manufactured products sectors. All agricultural production sectors except the feedlot and poultry and egg production sectors buy at least half of the value of their inputs from final purchase sectors. Most agricultural production sectors purchase inputs from several nonfood manufacturing sectors.

The three main sources of agricultural processing inputs are the agricultural product, the household, and the import sectors. The meat-processing sector receives 44% of the value of its inputs from agricultural production sectors,

while the poultry-processing sector receives 50% of the value of its inputs from the poultry and egg sector. The bakery products sector receives 30% of the value of its inputs from the household sector. Imports make up 16 to 46% of the value of the inputs purchased by the beverage, grain mill, preserved food, animal feed, and "other food" sectors. The food-processing sectors may purchase some inputs from most sectors. With this much interdependence among sectors, an increase in the amount of food processed is likely to have a positive impact on most other sectors of the economy.

Ranking Sectors by Value Added

Figures for value added by sector indicate the income earned by resources engaged in each activity. As was explained in the input-output analysis discussion, the agricultural and food-processing industries are highly disaggregated, while the other industries are highly aggregated, so it is not surprising to find agricultural production and processing industries ranked in the last 20 positions of the value-added table found in Wildenthal (1992). As a result of the disaggregation, the agricultural sectors have smaller total purchases relative to the aggregated industries and have correspondingly smaller value added. Seven of the food-processing industries are ranked individually between 17 and 26 in contribution to the Gross Texas Product (GTP). "Other food" and kindred products and beverages constitute slightly less than 0.50% of GTP. Meat products make up 0.27%, while bakery, dairy, preserved food, and grain mill products each contribute between 0.11 and 0.16% to GTP. Animal feed is ranked 32 and poultry products are ranked 36, each contributing approximately 0.05% to GTP. All food-processing activities combined contributed 1.8% to GTP, which would place the food-processing industry at twelfth place in GTP. The actual impact of food-processing is larger, however, due to the interdependence of agricultural processing with the other economic sectors.

Agricultural production has a combined contribution of 1.64% of GTP, which would rank thirteenth for contributions to GTP. As was explained in the discussion of the transaction table, final purchase sectors provide more than half of the value of inputs for most agricultural production sectors.

Intersector Purchases

Intersector purchases are purchases by one sector of products from one or more other sectors. The more interconnected the economy, the greater the impact of a plant on GTP. Food-processing industries fall into the middle range, ranking 13 through 23. Meat packers purchase almost 2% of output of Texas sectors, while beverage manufacturers purchase 1% from these sectors. Total intersector purchases for the food-processing industry are 4.8% of those for the whole Texas economy. One would expect that agricultural processing would have a high ranking because agriculture is one of the primary industries in Texas and sufficient time has elapsed for input industries to develop (Mustafa 1971).

While discussing the survey of Texas food processors, ways were identified that suppliers of input for food processors could make their products more attractive to responding food processors. Further investigation into the reasons food processors preferred to purchase inputs in- or out-of-state indicated opportunities for more Texas processed food input purchases by meat, bakery, preserved food, "other food," and beverage manufacturers. Processed nonfood input purchases by meat, dairy, grain mill, feed, "other food," and beverage manufacturers appear promising for such expansion as well. The small percentage of intersector sales by Texas food processors further supports the potential gains from following through on this investigation.

Intersector Sales

The intersector sales vary widely, from 18.48% for fire, insurance, and real estate to 0.02% for dryland cotton. This variation is due to the different stages of production of different outputs — some outputs are ready to be sold to final demand sectors, while others require further processing before final sale. In addition, many sectors sell much of their output outside of the state for further processing.

The food-processing industry sells 1.4% of its production to Texas markets not classified as final demand. Texas sales of the food industries vary greatly as well, but each industry contributes less than 1% to the sales between Texas sectors. This makes sense because the food-processing sectors are less likely to have outputs that require further processing than are sectors

such as those producing raw agricultural products. The Texas food-processing survey indicated that food processors sold 5% or less of their output to final demand, except for grain milling, which sold 84% of its output to final demand. Little of the remaining output went to further processors. Most of the remaining output went to firms, such as distributors, retail firms, and restaurants, that added value to the output by moving it around.

Multipliers

Multipliers are the traditional values used in predicting the effects of planned or induced changes in some sector of the economy. The values calculated for Texas in 1986 are used here. Note that all calculations assume increasing demand for the product. The real usefulness of these figures will be known once the sustainable demand for these products is known. In addition, the following results can also be used to estimate the consequences if a plant leaves the area (decreasing demand).

Output Multipliers

Output multipliers for the 1986 Texas Input-Output Model are shown in Table 8. These figures represent the total change in output of all sectors in the Texas economy generated by a particular sector's delivery of an additional $1 worth of output to final demand. The ranking of sector impacts on the economy changes dramatically when the indirect effects are considered. Poultry products now rank first, with a $1 increase in poultry demand, resulting in a $2.34 increase in Texas output. Eight of the 9 food-processing sectors are ranked in the top 21 output-inducing sectors. Meat products are ranked fourth with a multiplier of 2.16, and dairy products are next with a multiplier of 2.01. Preserved food has a multiplier of 1.93 and is ranked eleventh. Beverages are ranked seventeenth with a multiplier of 1.85, and animal feed products are next with a multiplier of 1.80. Grain products are ranked twenty-first with a multiplier of 1.73, and "other food" products is last with a multiplier of 1.25.

In the discussion of the Texas food-processing survey, Texas food processors were shown to sell most of their output to buyers, which added location value to the products, while in the fifth section, Texas food processors were shown to sell most of their output to households

Table 8. Total dollar change in output per $1 direct change in final demand by sectors of the Texas economy, 1986.

Sector number	Sector name	Output multipliers	Rank
		(Dollars)	
20	Poultry products	2.34	1
12	Poultry and eggs	2.21	2
10	Feedlot livestock production	2.16	3
19	Meat products	2.16	4
21	Dairy products	2.01	5
2	Irrigated food grains	1.98	6
3	Irrigated feed grains	1.96	7
25	Preserved food	1.93	11
11	Dairy	1.91	12
6	Dryland food grains	1.87	13
1	Irrigated cotton	1.86	14
8	Dryland crops and livestock, NEC	1.86	15
27	Beverages	1.85	17
23	Animal feeds	1.80	18
4	Other irrigated crops	1.79	19
24	Bakery products	1.77	20
22	Grain mill products	1.73	21
13	Cotton ginning	1.73	22
7	Dryland feed grains	1.73	24
16	Fisheries	1.71	25
5	Dryland cotton	1.67	27
9	Range livestock production	1.59	31
39	F.I.R.E.	1.50	36
26	Other food and kindred products	1.25	40

and exports (final demand). The difference could be due to response error in the survey or to the market choices presented to the food processors in the survey. In either case, potential output might be greater if products were further processed instead of merely transported or consumed, but no indication of such a possibility exists for this output.

Income Multipliers

The direct income effect is the amount of each dollar increase in the output of each sector that goes to households in the form of wages and salaries, proprietor income, rents, or profits. The total effect is the total change in income as a result of a $1 change in final demand. If the desirable policy objective is to increase income in an economy by increasing output, the sectors with a high total income effect should be targeted (Table 9, column 4).

Efforts would focus on bakery products, and the highest total income effect would be for food-processing sectors, if this were the goal.

Table 9. Total dollar change in income per $1 direct change in income by sectors of the Texas economy, 1986.

Sector number	Sector name	Direct effect	Total effect	Income multipliers	Rank
		(Dollars)			
10	Feedlot livestock production	0.04	0.50	11.55	1
19	Meat products	0.11	0.51	4.61	2
12	Poultry and eggs	0.10	0.42	4.06	4
25	Preserved food	0.12	0.40	3.39	5
20	Poultry products	0.15	0.44	2.92	7
27	Beverages	0.13	0.37	2.88	8
21	Dairy products	0.19	0.50	2.66	10
22	Grain mill products	0.16	0.39	2.45	11
23	Animal feed	0.17	0.41	2.45	12
2	Irrigated food grains	0.25	0.50	2.01	14
11	Dairy	0.32	0.58	1.85	15
3	Irrigated feed grains	0.28	0.52	1.84	17
26	Other food and kindred products	0.10	0.17	1.77	18
6	Dryland food grains	0.30	0.52	1.76	19
24	Bakery products	0.30	0.53	1.74	20
8	Dryland crops and livestock, NEC	0.34	0.59	1.73	21
4	Other irrigated crops	0.32	0.55	1.70	22
1	Irrigated cotton	0.35	0.59	1.66	26
16	Fisheries	0.35	1.56	1.63	27
13	Cotton ginning	0.37	0.60	1.61	28
7	Dryland feed grains	0.35	0.54	1.54	29
39	F.I.R.E.	0.40	0.59	1.48	33
5	Dryland cotton	0.48	0.67	1.40	37
9	Range livestock production	0.49	0.67	1.38	38

Income multipliers represent the total change in income in the economy caused by a $1 change in income for that sector. As seen in Table 9, when indirect effects are taken into account, all agricultural processing sectors rank in the top 20 income-generating activities in the Texas economy (Table 9, column 5). Income multipliers from all sectors range in value from 11.55 for feedlot livestock production to 1.38 for range livestock production. Meat products rank a distant second with 4.61, which is more in line with the rest of the values than that of feedlot livestock production. Preserved food has an income multiplier of 3.39, while animal feeds, grain mill products, dairy products, beverages, and poultry products multipliers range between 2.45 and 2.92. Bakery products and "other food" multipliers are the lowest with 1.74 and 1.77.

Wages and salaries make up much of the costs of a sector with high-income multipliers. If the only policy aim is to increase income in the economy through an initial increase in income in a particular sector, the sectors with the highest income multipliers should be targeted (Table 9, column 5). Meat, with the highest income multiplier for food-processing sectors, would be the focus of attention in this situation. Note that meat also has the second highest total income effect for food-processing industries and should be targeted under either objective.

Employment Multipliers

Direct employment effects indicate the number of people employed per year per unit of output. Total employment effects are computed by considering the repercussions on employment in all sectors as a result of the initial change in final demand in a sector. If the policy goal is to increase employment solely through the expansion of output, the industry with the largest total employment effect receives attention. In terms of food-processing sectors, the target would be the poultry products sector.

Employment multipliers measure the total change in employment resulting from a $1 change in employment in a sector. Employment multipliers are calculated by dividing total employment effects by direct employment effects.

As shown in Table 10, column 5, employment multipliers for Texas sectors range from 6.5 for dairy to 1.22 for other irrigated crops and apparel. Agricultural processing sectors rank from 11 to 33, with a range of values of 3.58 for dairy products to 1.43 for "other food." Beverages rank 13 with a multiplier of 3.12, while meat products are next with 3.08. Grain mill products have a multiplier of 2.77, and both preserved food and animal feed have a multiplier of 2.57. Poultry products have a multiplier of 1.90 and bakery products have 1.87.

As with income effects, the policy objective is critical in the interpretation of the employment effects table. If the objective is to increase employment in the economy by an initial increase in employment in a particular sector, the industry with the largest employment multiplier should be sought. The food-processing industry meeting this criterion is the dairy products sector. It should be noted, however, that employment multipliers do not account for possible underemployed resources and excess capacity, which would dampen the effects projected here (Jones and Mustafa 1972).

Projected Effects of a $1 Million Change in Final Demand

Although it is important to look at the effects of a $1 change in final demand on the economic aspects of the sectors, a state's basis for policy action may depend on which sector has the greatest total impact on state income, output, or employment. In Table 11, the effects of a $1 million change in final demand for each sector's output are examined. The output column contains the same column of figures as found in the third column of Table 8. The income figures are the direct income effects found in the fourth column of Table 9, while the employment figures are the direct employment effects found in the fourth column of Table 10.

The industry receiving attention depends on the objective of the policy maker. If food-pro-

Table 10. Total change in person-years of employment per one person-year direct change in employment by sectors of the Texas economy, 1986.

Sector number	Sector name	Direct effect	Total effect	Employment multipliers	Rank
		(Person-years)			
11	Dairy	1.82	11.81	6.50	2
9	Range livestock production	1.35	7.54	5.58	4
12	Poultry and eggs	2.76	15.33	5.57	5
6	Dryland food grains	1.80	9.60	5.35	6
5	Dryland cotton	1.80	8.86	4.92	7
1	Irrigated cotton	2.53	10.81	4.27	8
7	Dryland feed grains	2.26	8.83	3.92	9
21	Dairy products	3.07	10.99	3.58	11
10	Feedlot livestock production	2.90	9.86	3.39	12
27	Beverages	4.06	12.67	3.12	13
19	Meat products	3.33	10.27	3.08	14
2	Irrigated food grains	4.09	14.48	3.05	15
16	Fisheries	3.07	9.15	2.98	16
22	Grain mill products	3.52	9.75	2.77	17
3	Irrigated feed grains	4.56	11.97	2.62	18
25	Preserved food	6.82	17.56	2.57	19
23	Animal feeds	4.55	11.70	2.57	20
39	F.I.R.E.	5.66	10.78	1.90	22
20	Poultry products	10.94	20.79	1.90	23
24	Bakery products	9.13	17.07	1.87	25
8	Dryland crops and livestock, NEC	18.98	27.59	1.45	32
26	Other food and kindred products	5.69	8.16	1.43	33
13	Cotton ginning	18.94	24.91	1.32	35
4	Other irrigated crops	34.41	41.84	1.22	37

Table 11 . Effects of $1 million change in final demand on output, income, and employment for each sector of the Texas economy, 1986.

Sector number	Name	Total change in: Output	Income	Employment
		(Million dollars)	(Million dollars)	(Person-years)
1	Irrigated cotton	1.86	0.59	10.81
2	Irrigated food grains	1.98	0.50	12.48
3	Irrigated feed grains	1.96	0.52	11.97
4	Other irrigated crops	1.79	0.55	41.84
5	Dryland cotton	1.67	0.67	8.87
6	Dryland food grains	1.87	0.52	9.59
7	Dryland feed grains	1.73	0.54	8.83
8	Dryland crops and livestock	1.86	0.59	27.60
9	Range livestock production	1.59	0.67	7.54
10	Feedlot livestock production	2.16	0.50	9.86
11	Dairy	1.91	0.58	11.81
12	Poultry and eggs	2.21	0.42	15.33
13	Cotton ginning	1.73	0.60	24.92
16	Fisheries	1.71	0.56	9.15
19	Meat products	2.16	0.51	10.27
20	Poultry products	2.34	0.44	20.79
21	Dairy products	2.01	0.50	10.98
22	Grain mill products	1.73	0.39	9.75
23	Animal feeds	1.80	0.41	11.70
24	Bakery products	1.77	0.53	17.07
25	Preserved food	1.93	0.40	17.56
26	Other food and kindred products	1.25	0.17	8.16
27	Beverages	1.85	0.37	12.67
39	F.I.R.E.	1.50	0.59	10.78

cessing industries are to be targeted and the only goal is to expand total output or employment, the poultry industry is the sector to investigate. If the sole goal is to expand income, the bakery industry should be the focus of the analysis. Further analysis into the demand for these products will provide insight into the potential to achieve the values of these coefficients.

Concluding Comments

Summary

State governments are understandably interested in strategies to strengthen their economies in terms of output, income, and employment. In agricultural states, one tactic is to add value to raw agricultural commodities within the state instead of sending commodities outside the state for processing.

Literature describing research on adding value to commodities covers topics such as expanding or developing markets for value-added products, exploring appropriate roles for the government to fund research in value-added activities, evaluating economic growth potential through value-added opportunities in rural economies, observing potential inefficiencies in value-added activity location, and exploring trends in the food-processing industry. In the analysis reported in this bulletin, quantitative analysis of impacts on output, income, and employment from changes in the final demand for processed food products is combined with information about the state's food-processing environment. The framework for this research involves investigation of the major forces affecting the food-processing industry in general and the Texas food-processing industry in specific and provides a brief description of export and location focuses of research on value-added activities. Quantitative results are then interpreted in light of food-processing and location issues.

To further investigate means of sustaining positive trends in output, income, and employment, especially as reported in the previous statistics, a survey was conducted to determine the cost components of Texas food processors, the

percentage of materials they purchase in Texas, and their reasons for these purchase decisions.

For this investigation, there were not enough responses about the cost components of various food-processing sectors to make any generalizations about which types of inputs are most important to their businesses. However, the plants did report whether they buy inputs from in- or out-of-state sources and why they buy inputs where they do. Food-processing industries that purchase large percentages of their raw materials from out-of-state sources include those classified as preserved food, "other food," and dairy plants. Preserved food, "other food," meat, and bakery plants purchase a large percentage of their processed food inputs from out-of-state sources. Purchasers of large percentages of processed nonfood inputs are dairies, bakeries, feed mills, and "other food" processors. Other materials are purchased out-of-state in large percentages by meat packers, beverage bottlers, and "other food" processors.

Overall, almost three-fourths of Texas processors purchase Texas commodities according to availability and cost. The influence of the attitude of buying strictly within Texas was not investigated. Some processors purchase some of their inputs from an out-of-state source for assurance that they have a source should a problem develop with the Texas input supply, such as a Texas citrus freeze. Responding plants indicated that certain inputs, such as turkey, pork, packaged seasonings, beverage supplies, processed soybeans, almonds, peppers, and tomatoes, are available only from out-of-state suppliers. The ability of Texas to support a supplier of these inputs or, in the case of almonds, peppers, and tomatoes, to raise some of these commodities merits further investigation. Poultry processors, feed millers, bakeries, dairies, and beverage bottlers are the major food processors that prefer Texas inputs because of cost.

Input quality and transportation factors were each mentioned by almost half of the plant representatives. Feed millers, bakeries, meat packers, and preserved and "other food" processors prefer Texas inputs because of input quality. Transportation is a factor in the preference of dairy, grain, and feed processors for purchase of Texas inputs. Less than 20% of the respondents indicated that they had a sole source for an input, purchased inputs under national contracts, or purchased inputs made by an affiliate.

Availability and cost were also the most frequently cited factors for out-of-state input purchases. Feed millers, bakeries, and "other food" processors are the main food processors who prefer out-of-state inputs because of cost. Quality was cited by almost one-third of the respondents, and beverage bottlers, meat packers, dairies, and bakeries were the major food processors who prefer out-of-state inputs. Twenty percent of the respondents had a sole out-of-state source. Less than 20% of the responding plants mentioned the purchase of inputs under national contracts or of inputs made by affiliates as reasons for out-of-state purchases.

Input preferences of food processors were studied to seek increased opportunities of marketing Texas agricultural products by emphasizing characteristics that processors like about Texas commodities or by discovering problems with Texas commodities and/or advantages of out-of-state commodities. Further investigation into reasons Texas inputs are preferred may reveal specific aspects of inputs that might be promoted to prospective Texas food processors. Reasons for preferring out-of-state inputs may be further investigated to determine whether aspects of Texas inputs can be improved to enhance the competitiveness of Texas input suppliers. Increased purchases of Texas inputs would provide one means of increasing Texas output, income, and employment.

Quantitative methods of predicting increases in output, income, and employment caused by changes in the amount of input use would enable researchers to prioritize which opportunities they pursue. The McMenamin-Haring (1974) procedure was used to update the Texas Input-Output Model transaction table into a 1986 model that emphasized agricultural production and processing. The transaction table was manipulated to give the direct and total requirements tables. The transactions table and the direct requirements table show that the agricultural processing sectors sell outputs primarily to households and export markets, while inputs primarily come from final demand and nonfood manufacturing sectors. Agricultural production sectors sell output primarily to export and domestic food-processing sectors and purchase inputs primarily from the agricultural production, household, and imports sectors. The model is not set up to detect whether exports are delivered to final demand or processing sec-

tors, so the destination of exports merits further investigation. If Texas products are exported to processors, more investigation on whether the products could be further processed in Texas is warranted. As for imported inputs, the ability of Texas manufacturers to supply these inputs should be further investigated as well.

The total requirements table is the basis of multiplier analysis, which is used to predict the output, income, and employment impacts of an increase in final demand for processed agricultural products. Multipliers represent the total change in output, income, or employment in the economy resulting from a $1 change in final demand for the products of the sector represented by the multiplier. After briefly summarizing the impacts of each industry, the food-processing industry that ranked consistently high by output, income, and employment multipliers will be examined.

Industry-by-Industry Evaluation

This section focuses on applications of the Texas Input-Output Model, which estimates the impact of changes in final demand on aspects of the Texas economy. These results will be evaluated here on an industry-by-industry basis. An important caveat for all results is that the interpretations assume that final demand will sustain the increased employment of production resources. The capabilities of the plants to establish, given the industry structure, is also assumed.

Meat Products

The meat-processing sector has great potential if the policy goal is to increase the output of the Texas economy. On the basis of multipliers, meat processing was ranked fourth of all sectors and second of the food-processing sectors for its impact on output. Meat processing is also an important sector to consider if the aim is to increase income through an initial increase in income as opposed to generating an increase in income through output increases. The meat sector ranks first in total income multipliers and second in all industries, so it could also be considered in attempts to increase income through output increases.

The potential success of the meat industry is not clear, however. In the second section, the demand factors that were considered were not generally favorable for the meat industry. Specifically, the preferences of older people, those in small households, and those interested in health issues negatively impact the demand for meat products. Recently, however, some of the hog industry has relocated to the Panhandle to capture economies of size and scope and to avoid diseases (Mazzocco 1991). The real estate in the Panhandle is relatively inexpensive. It remains to be seen how the value-added meat industry performs in Texas. Further research also is needed to explore Texas' comparative advantage in meat production.

Poultry Products

The poultry sector has the highest output multiplier of all industries. When food industries are considered as a means of increasing employment through output increases, this industry is also noteworthy. When the size of the sector's final demand is considered, however, this sector ranks twenty-second overall and seventh among food-processing industries. For income multipliers, however, it ranks third among food-processing industries.

The potential for success of this industry in achieving its goal is quite high. The demand factors in the second section were favorable to the further growth of the poultry-processing industry. Specific relevant demand factors include both the preferences of older people and those concerned with their health, as well as trends in consumption patterns.

Dairy Products

The dairy-processing sector is a prime consideration when the objective is to evoke an increase in employment through a food-processing industry without concurrently increasing output. Dairy processing has the highest employment multiplier of any food-processing sector. Among food-processing sectors, it has the third highest output multiplier and the fifth highest income multiplier.

The demand factors discussed in the literature review do not provide a clear idea of the potential success in this industry. Locational factors, namely the perishability of dairy products, ensure that a base level of production will exist in Texas. Growth in population centers will increase final demand, which will in turn have output, income, and employment effects, which were estimated with multipliers.

Grain Mill Products

The grain mill sector does not stand out among the areas considered as an area of impact on the Texas economy. It is ranked fourth among food-processing industries for employment multipliers, sixth in income multipliers, and eighth in output multipliers. This lackluster is partly attributable to the limited interaction this sector has with other sectors of the Texas economy. Most of its output goes directly to final demand, specifically exports.

Animal Feed Products

As with the grain mill industry, the animal feed industry does not appear to offer much potential for bolstering the Texas economy. Among food-processing industries, it ranks sixth in output and employment multipliers and seventh in income multipliers.

This sector interacts with other Texas sectors to a greater extent than the grain mill sector does. Most of its output is sold to firms, adding location value to the products. In addition, most of its inputs are purchased from Texas suppliers.

An increase in final demand from the expanding livestock sector could cause an increase in the amount of grain mill products demanded. The grain mill industry is the smallest food-processing sector considered.

Bakery Products

The bakery industry should be considered when the policy objective is to increase income through an increase in output of a food-processing sector. It has the highest total income effect of any food-processing industry. In addition, the demand factors discussed in the literature review are favorable for this industry. Otherwise, however, it is not a strong performer. It ranks seventh among food-processing industries in terms of output multipliers, eighth in employment multipliers, and ninth in income multipliers.

Preserved Foods

The preserved food industry has the second highest income multiplier and total employment effect of any food-processing industry. Thus, when a food-processing industry is being targeted for an initial increase in income or an increase in employment through an increase in output, this industry is worthy of investigation. The demand factors considered in the second section of this bulletin are not clearly in favor of or against this sector. Preserved foods are in the middle of food-processing industries in terms of output multipliers, ranking fourth, and fifth in employment multipliers.

"Other Food" Products

Products in the "other food" category are not prominent in their impacts on the Texas economy. Among food-processing industries, it ranks eighth in income multipliers and ninth in output and employment multipliers. This situation is rather disadvantageous because the demand for many of these products is trending upward. The important consideration is that the market is more likely to sustain additional food-processing plants of this type.

Beverages

When an initial increase in employment is sought through a food-processing industry, the beverage industry should be considered. It ranks second in the agricultural processing sectors for employment multipliers. It also ranks fourth among food-processing industries in terms of income multipliers and fifth in terms of output multipliers. The demand factors are mixed in terms of its future demand.

Applications of this Research

The usefulness of this research can be demonstrated through an example. The figures in Table 11 indicate that a $1 million change in final demand for poultry products generates the highest impact on output and employment of any food-processing industry and the fourth highest impact on income. The poultry industry is the highest ranked industry overall by these indicators and thus will be examined more closely in the following case study.

The *Census of Manufactures* (U.S. Department of Commerce 1987) indicates that the meat and poultry industries combined lost 28 plants (11.48%), and their value-added contributions decreased 20.02% between 1982 and 1987. These losses were some of the highest losses experienced by the Texas food-processing industries over this period. However, the value of their shipments increased 17.04% and their employment increased 11.85%. Trends since 1987 in

the Texas poultry-processing sector are not readily available from secondary data.

From the input-output model, the main markets for poultry products include the households (60.26%), exports (27.15%), service (3.28%), animal feeds (2.82%), and meat-processing (2.23%) sectors. Although increasing demand for poultry products by any sector helps the Texas economy, the economy benefits more from further processing of poultry products when value is added at each processing, handling, or distribution stage (including handling by the service sector). These sectors are not identified individually for the export markets by the input-output model. Determining whether poultry is further processed out-of-state would facilitate the determination of whether poultry could be further processed in Texas instead.

According to the input-output modeling results, major cost components of poultry-processing plants were devoted to inputs from the poultry and egg (49.47%), household (14.97%), and import (16.05%) sectors. The poultry and egg production sector provides the poultry slaughtered by poultry processors, while the household sector provides the laborers to process the poultry. The input-output model does not allow identification of the import markets, so further investigation is required to determine what types of inputs are imported and whether Texas input suppliers could provide these inputs.

To put these figures into perspective, Texas poultry processors shipped $601.4 million worth of processed poultry products in 1986. In addition, median sales of Texas poultry-processing plants in 1990 were $10 to $50 million. Furthermore, in 1986, final demand constituted 91% of total sales for processed poultry products. For simplicity, assume that the median poultry plant size and final demand as a percentage of sales were approximately the same between 1986 and 1990. A 10% change in final demand would be $54.7 million, which could be met by two new poultry-processing plants having sales of approximately $25 million each. The location of these plants could be determined by mathematical programming or spatial equilibrium analysis. Further information from consumer focus group interviews, econometric models, and/or poultry industry experts can be combined to arrive at a clearer assessment of the demand trends for poultry. The other issue is whether additional poultry demanded could be processed by a Texas supplier. Either the poultry and egg, household labor, imported, and other inputs would need to be provided in a greater quantity or an expanding poultry-processing sector would have to seek supplies elsewhere. A further issue to be investigated is whether poultry processors could be attracted to Texas. Currently, most poultry is processed by one large firm in Arkansas. Institutional barriers might deter plants from locating in Texas.

Suggestions for Future Research

Many suggestions for future research were previously mentioned in this chapter. Note that this research has investigated food products at a general food classification level. An initial starting point would be to select one of these general food-processing industries for further study and evaluate the food products at a more detailed level of SIC classification. For example, if the meat industry were chosen, the beef, pork, lamb, veal, sausage, and other meat industries would be evaluated in greater detail to determine any positive impacts on the Texas economy if it were expanded.

As an application, economic and employment impacts associated with the Texas rice industry can be identified and quantified. The rice industry contributes much to the economy of the upper Texas Gulf Coast. Using the previously calculated multipliers, Taylor et al. (1993) calculated the economic impact of the Texas rice industry for the 1992 marketing year to be nearly $850 million. They also reported that 6,266 person-years of employment are created and maintained in association with the industry.

Further evaluation of these specific industries could take the form of econometric analysis of trends in value of shipments, value added, number of plants, and number of employees, as well as demand for the different products. Consultation with industry experts would enhance model estimates because experts can provide information about trends that would not be represented in time-series data, such as new techniques creating new products that may not fit neatly into current product classifications or such as changing production processes and associated costs. Experts could also inform the researcher about institutional or other factors that would preclude locations from consideration by plant managers. These factors could be used to interpret results from mathematical

programming or spatial equilibrium models employed to determine the potential locations of plants. Input-output models could be further modified to yield multiplier and elasticity values for more detailed food-processing classifications. These input-output model results could also be modified to produce other information that might better suit policy makers' objectives, such as water use or tax multipliers.

Many suggestions mentioned in this section are related to further investigation of the general reasons that food processors indicated were factors in their decisions to purchase inputs in Texas or outside Texas. These reasons merit further investigation because they point out areas in which Texas can improve or promote its inputs to potential buyers (new food-processing plants). Further investigation into the destination of exports is warranted to determine whether exported products are further processed and, if so, whether any of this further processing could occur in Texas. These improvements would make the multipliers presented here obsolete, probably increasing their values.

Other research issues that follow up on this research include the creation of regional models for Texas. Because of the size of the state, different regions have different strengths and weaknesses in terms of input availability. In addition, in-depth demand and locational analysis needs to be conducted for the food-processing industries because the basic premise of multiplier analysis is that industries are expanding because of a change in final demand. Another issue for further study is the comparative advantage of Texas relative to other states in food and commodity production. Furthermore, the issue of whether Texas can increase its output, income, and employment by using more Texas (versus out-of-state) commodities in restaurants, transportation, and retail trade merits further investigation. The question of loyalty-based purchase of Texas inputs also needs to be addressed.

Conclusions

Many state governments are interested in investigating opportunities to increase state output, income, and employment. This research has presented a framework for investigating opportunities in the Texas food-processing industry. While additional research will definitely be useful, this framework will aid researchers in organizing a plan for further research that investigates specific opportunities for food-processing plants.

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