

AN ECONOMIC ANALYSIS OF THE PROCESSED  
FRUIT AND VEGETABLE INDUSTRIES

By

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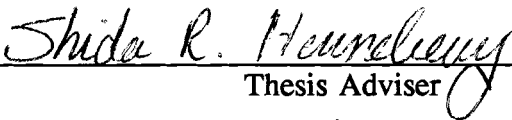
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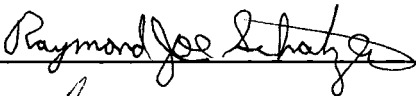
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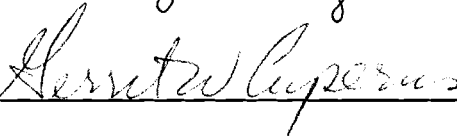
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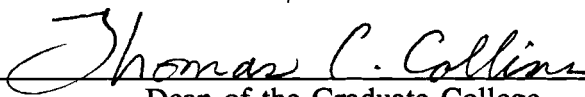
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**CHAPTER I.**

**AN EXAMINATION OF THE STRUCTURE, CONDUCT, AND  
PERFORMANCE OF THE U.S. FOOD PROCESSING INDUSTRY**



**ABSTRACT.** During the last decade, the food processing industry has been experiencing many significant changes. This rapidly expanding industry has been adjusting to consumers' demands for convenience and nutrition. As the fundamental eating patterns of consumers continue to change, technological advancements are being developed to fit the consumer demand. The objectives of this article are: to examine the role of the food processing industry in economic development and to provide an analysis of the many components affecting the structure, conduct, and performance of the food processing industry.

## **INTRODUCTION**

During the last decade, the food processing industry has been experiencing many significant changes. Shifts in demographic and economic structures affect the food processing industry directly. Changes in consumer lifestyles, tastes, and preferences along with technical advancements in agriculture and marketing have had a great impact on the demand for food, which in turn has impacted the food processing industry (Charlet and Henneberry, 1992).

This rapidly expanding industry has been adjusting to consumers' demands for convenience and nutrition. Fundamental eating patterns of Americans are changing dramatically. Only about one half of adult Americans eat three meals a day (Senauer et al., 1991). More women are entering the work force and demanding easier and speedier ways to prepare meals. The changing lifestyles has lead to an increasing number of consumers eating away from home. Nutrition has also become increasingly important to many individuals who are concerned about eating the "right" foods. The processing

industry has been fast at work in an attempt to create new foods and new ways to present these products to consumers.

Given the changes in demand, there is great opportunity for significant growth of the food processing industry in the United States. A growth in the food processing industry is expected to bring in revenue and provide job opportunities for many individuals. Many believe that the growth of the food processing sector in the past few years is just the beginning of a long, prosperous, growth in this manufacturing sector.

This paper examines several important issues related to the structure, conduct, and performance of the food processing industry. The first section of the paper examines the role of the food processing industry in economic development. Next, several structural elements are discussed. These include the size of the industry in the U.S., the concentration of the firm, purchasing channels, employment, locational aspects, recent technological advancements and key issues related to product differentiation. The conduct of the industry is discussed next including issues on marketing, new product introductions, and product pricing. The performance of the processing industry is followed with some estimates of sales and profits. Lastly, U.S. trade of processed foods is examined.

## **THE ECONOMIC IMPORTANCE OF THE FOOD PROCESSING INDUSTRY**

The food marketing system in the United States functions in a variety of ways and uses a variety of distribution systems. Agricultural processing industries provide the essential link between the farmer and consumer, where wheat becomes a loaf of bread and milk becomes packaged cheese or ice cream. Food processors are the principal

buyers of farm output and the major suppliers to food retailers and consumers. U.S. food processors purchase a large percentage of the U.S. farm production. In return, food retailers sell mainly processed foods, beverages, and tobacco products. Food processors ultimately depend on the consumer for the purchase of the final product, even though they usually sell to wholesalers or retailers.

Food processing is a "manufacturing industry that inherently increases the economic value of farm products. It combines labor, machinery, energy and technology to convert bulky farm products into packaged, palatable foodstuffs" (Connor, 1988). Although the food processing industries create a large variety and number of products, all are manufacturers turning raw agricultural inputs into a constantly expanding display of new products (Francis and Petrusis, 1988). In 1992, processing and manufacturing firms added approximately \$116 billion to raw food products. This is about 19 percent of the total value-added by the entire food marketing system (Figure 1). This is up from the 1991 figures which were \$100 billion. However, as a percentage of the entire food marketing system, the processing industry has remained stable (Food Marketing Review, 1992-93).

### **THE STRUCTURE OF THE FOOD PROCESSING INDUSTRY**

Market structure refers to features that determine where a firm might compete in the perfect competition/monopoly spectrum. The structure of the market impacts the conduct of the firms, which in turn influences how well the firm performs competitively (Connor, 1988). The main aspects of the structure of the food processing industry include the size of the industry, firm concentration, production inputs, locational aspects, technology and

product differentiation.

**SIZE** The U.S. economy is divided into ten sectors which includes such branches as agriculture, manufacturing, wholesale, trade, and government. Of these ten sectors, manufacturing is the largest, accounting for about 25% of the U.S. Gross National Product (Connor, 1988). As the largest sector manufacturing, the food processing industry accounts for about 13 percent of all U.S. manufacturing activities (Food Marketing Review, 1992-1993). About 1 out of every 20 U.S. manufacturing companies is a food processor (Food Marketing Review, 1991). Currently, about 400,000 manufacturers, wholesalers, retailers, and food service firms engage in food processing and food distribution. In 1992, the food and beverage industry became the largest major manufacturing sector in terms of shipments in the United States. This industry has more than \$415 billion in shipments, surpassing the transportation equipment industry. (U.S. Industrial Outlook, 1993).

In 1990, there were approximately 20,492 food processors in the United States (U.S. Department of Commerce, Census of Manufacturer's, 1990). In 1992, there were approximately 16,000 food processors (Food Marketing Review, 1992-93). The main reason for the decline in the number of processors was the increased mergers. The processing sector is broken down into about 49 separate food processing and manufacturing industries. These industries are comprised of meat and dairy products, preserved fruits and vegetables, grain milling and bakery products, sugar and confections, fats and oils, beverages, and miscellaneous foods such as fishery products, and coffee.

Even though there has been a decline in the number of food processors, there are vast opportunities for smaller food processors to capture many different market niches or segments by creating a single product designed strictly for a certain consumer segment. These opportunities can also be seen in the following discussion on the firm concentration of the food processing industry.

**FIRM CONCENTRATION** The agriculture processing sector has undergone major reconstruction in the past decade in terms of firm concentration. In the late 1980's, faced with increasing cost of labor, raw products and energy and the rapid changes in consumer tastes and preferences, food processing industries had increased automation and aggressively pursued mergers and acquisitions.

The food system in the 1980's was characterized by increases in leveraged buyouts, mergers, and aggregate concentration. Between 1982 and 1988, nearly 3,400 mergers, divestitures, or leveraged buyouts took place in the food marketing system. Food processing had 2,000 of those 3,400 transactions (Capps, 1992). Philip Morris companies' purchase of Jacobs Suchard for \$3.8 billion and Con Agra's acquisition of Beatrice Company for 1.4 billion were the largest transactions in 1990 (Food Marketing Review, 1991). One of the greatest mergers occurred in 1988 when Philip Morris Company and Kraft merged together for the largest consumer food company in the United States (Senauer et al., 1991).

There are many reasons that food processing companies were acquired at such a fast rate in the late 1980's. Three main reasons are growth, diversification, and profits. Mergers provide means of expanding product lines at a potentially lower rate. Also,

food processing firms often acquire other food processing firms they can use the marketing structure already established by the purchased firms. This enables more products to be absorbed by the same consumers. High profit expectations are one of the most important reasons for buyouts and mergers. Profits and sales of companies operating in two or more markets are almost always more stable than single market firms (Connor, 1988).

In 1992, merger activity increased but not as significantly as the increases in 1989 and 1990. The number of acquisitions fell from 573 in 1988, 208 in 1990, to 181 in 1991 (Food Marketing Review, 1992-93). Reasons for the decrease in merger activity in the last few years center around the economic slowdown in the early 1990's which resulted in cautious buyers and sellers in terms of any restructuring activities even though interest rates were relatively low (Gallo, Dec. 1992). The expectations for the future are not only for increased merger activity in the larger firms resulting from the positive stability in the economy but an increase in the number of smaller processors due to consumer demands of specified products.

***PRODUCTION INPUTS*** In 1992, the food processing industries purchased about \$106 billion of animal and crop products from the U.S. farm sector, an additional \$21 billion in imported agricultural products, and \$9 billion in seafood. Totaling about \$42 billion in 1992, labor is the second largest cost item for food processors (Food Marketing Review, 1992-93). These industries employed almost 1,650,000 workers in 1990, about the same as in 1989. Average hourly earning increased by 2.7 percent in 1990 to \$9.63 per hour (Food Marketing Review, 1991).

**LOCATION AND ECONOMIC IMPACTS** Despite the rural image of the food processing industry, a majority of the large food processing and manufacturing firms in the U.S. are located in a small number of states. There is concentration in two regions, the Sun Belt and the industrial states around the Great Lakes and in the Northeast (Barkema, et al., 1990). Three of the top ten processing states include three Sun Belt states Texas, Florida, and California. Seven of the industrial states in the Great Lakes and Northeast region are in the top ten in terms of their food processing activity. These are Michigan, New Jersey, Wisconsin, Pennsylvania, Illinois, Ohio and New York (Figure 2). They account for one-third of the countries' food processing activity (Barkema, et al., 1990). These states are among the most populous states which enables these firms to distribute products to a large pool of consumers with a relatively low transportation cost.

Although a majority of the food processors and manufacturers are located in a small number of states and close to metropolitan areas, these traditional locations may be changing. Given that many rural and farm communities have experienced negative trends in economics and population growth, food processing industries offer opportunities for expansion and development. Some of the factors that have contributed to the negative trends include: the recession in agriculture, the increased competition for rural manufacturers, and the inability of rural areas to share fully in the growth of the service sector (Pulver, 1989). In an attempt to attract processing firms to these rural areas, communities have started offering economic advantages such as tax breaks and lower production costs. Officials in farm-dependent states are turning to the food processing

industry as a critical source of economic growth in the 1990's (Barkema, et al., 1990). The expansion of the food processing industry is expected to increase output, income, and employment in the states they are located, strengthening the economies of these states. However, there is not a consensus on the perceived affects of the food processing industry establishing new branch plants in rural communities.

According to Smith and Fox (1990), recruiting manufacturing businesses is not likely to be an effective job creation strategy. Their reasoning is because there has been no net growth in U.S. manufacturing employment since 1969. The argument is based on a survey that showed that startups of new branch plants of large firms accounted for an average of only about 15,900 new jobs in each state from 1970-1979. Therefore they argue that a noticeable growth rate in jobs in a state is unlikely to result from the relocation of manufacturing businesses, and only limited growth is likely to occur from new branch sites (Smith and Fox, 1990).

Even though there may not be a consensus on the affects of the employment growth rate with the expansion of food processing firms, there still may be an opportunity for rural communities to capitalize on the expansion of firms through increased output and income for those communities and states, which in turn will benefit the people of those states.

Rural communities may also offer the opportunities for small processors to establish profitable firms with incentives such as tax breaks and lower production costs, whereas they might not be able to afford to establish their firm where these incentives were not offered. These opportunities for small processors also opens a realm of consumer market



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niches or segments which can be very profitable. Technology is another leading factor that has enabled the food processing industry to capture many consumer market segments. This important structural aspect of the industry is discussed next.

**TECHNOLOGY** A new generation of farm and food technology has enabled food producers to target many different consumers (Barkema, et al., 1993). In the past several years, a great number of new and revised technologies have been in the works. A major contributor to this influx of advanced technology is the consumer's shift in demand for more convenient and healthier foods. The food industry has responded to the change in demand by introducing new lines of food products.

There are many technologies on the verge of commercialization, while others are not so advanced. In the past, when technological advancements were made, they were directed mainly towards increasing the output, decreasing cost or a combination of the two. In the technological advancements of today, economic benefits are targeted but there is also a move towards producing products to fit certain market segments (Barkema et al., 1993).

One of the food manufacturing sector's key assets is the rapidly changing developments in food production. The new technologies include ways to replace fat in animal products by oat or other grain derivatives, methods of more effectively developing good tasting foods that can be microwaved, new forms of packaging that are more appealing to consumers, and continued improvements in the taste of all food products.

Many firms in the processing industries are spending more time and money on research to develop new technologies. These firms have found that technological research

and development have benefited them in terms of profits along with consumer acceptance. Along with the new technology to create new products comes the challenge of enabling the consumer to distinguish between the new products and other products. This step is where product differentiation plays a vital role in the success of new products.

***PRODUCT DIFFERENTIATION*** Product differentiation is an element of market structure that is key to the conduct and performance of many different firms or industries. Differentiation can be defined as the boundary to which buyers consider the products made by different manufacturers as imperfect substitutes (Connor and Willis, 1988). The degree of product differentiation refers to the extent to which offerings of competing sellers are imperfect substitutes. When substitutability is perfect, the products are undifferentiated and no seller can charge a higher price (Marion, 1986). A useful indicator in an industry to determine the extent of product differentiation is the average or typical level of advertising. A more detailed explanation of the impacts of advertising will be discussed in the conduct of the food processing sector.

It is normally very difficult for a manufacturer to enter a market that has differentiated products. One of the biggest problems is image differentiation that the manufacturer has to obtain and hold on to by brand advertising. There is substantial empirical evidence that product differentiation is the most ominous barrier to entry in the manufacturers' brand channels of food processing industries (Connor and Willis, 1988). Differentiation becomes even more difficult with the changes occurring in the economic and consumer realm.

## STRUCTURAL CHANGES

There has been a rapid but continuous change in the structure of the food processing sector over the past decade. The food processing industry is growing in terms of smaller firms and new product introductions by these smaller firms. In terms of firm concentration, the top twenty firms still control a majority of the market even though there has been a significant decrease in merger activity in the last few years. Geographical locational aspects are important issues for processors to establish a firm or processors branching out to other locations.

Like other major U.S. industries, the food manufacturing industries have been affected by economic, technical, political, and natural changes interacting in various ways. The process has been increased, decreased, and redirected at different times by domestic economic, political, and social conditions (McCorkle, 1988). Factors such as composition of the work force, the population's lifestyle, and the structure of the family have affected the food processing industry since the middle of the century. These continue to be at the forefront of factors contributing to the changes in the food processing industry.

*Population and family size decline* In previous decades, a major factor influencing demand for food was an increase in population growth. Rapid increases in population assured food industry expansion in the past. The food industry can no longer depend upon the growth of the population to expand its industry because population growth in the U.S. is in fact decreasing. In 1990, the population of the U.S. of 250 million people was increasing at half the rate seen in the mid 20th century. Expected increases in the

population is only 15% in the thirty year period which started in 1980. The growth rate is expected to be less than 0.2% per year (Senauer, et al., 1991). Along with the declining population growth, there has also been a decline in the size of the family. There has been an increase in the number of single-parent families and a decrease in the average number of children per family. The average number of people per family is down to 3.2 which is lower than the average of 4.8 persons per family in 1900 and 3.8 persons per family in 1950 (U.S. Department of Commerce, Bureau of Census).

Even though the population decline is a negative attribute for the processing industry, the decline in the number of family members provide opportunities to package products to accommodate the smaller family as well as the single dweller. This has shown to be a very profitable aspect for the food processing industry. Along with the population decline, there has been an increase in the age distribution mostly due to the baby boom of the 1950's.

***Age Distribution*** There has been an increase in the average age in the U.S. From a median age of 23 in 1900, it took 80 years for the population to reach a median age of 30. Surprisingly, it will only take 15 more years for the median age to increase to over 36 years of age (Cox and Foster, 1985). As the number of older Americans increases, the share of the total food dollar will also increase. Because this older, more health conscious consumer group demands a greater mix of food with more fruits and vegetables and less red meat, the food processing industry has the opportunity to capitalize on this market by providing an array of low salt, healthier image foods.

***Lifestyle Changes*** With the rise in the cost of living, rise in single family dwellers, and

rise in divorces, more women are entering the work-force than twenty years ago. This has a great impact on consumer demand. This group of consumers is demanding convenience in preparation of foods at home as well as consumption away from home. For this group of consumers, pre-packaged mixes, frozen entrees, multi-ingredient packages, and prepared salads are just a few of the new products food processors have introduced. More women in the labor force is just one aspect of the changing lifestyles of individuals in our country today.

The general lifestyle for many individuals is very fast paced. Most consumers are demanding convenience in the preparation and consumption of food. This fast paced lifestyle has led to growth of new products such as frozen or microwave ready meals. The processing industry has had great success with these products. Even though consumers are demanding convenience, they are not sacrificing nutrition.

**Nutrition** Nutritional considerations have been an important factor in food processing due to the overwhelming consumer demand for nutritious products. The trend from high fat, high calorie diets to low fat, low calorie diets has affected the food processing industry. Technology has brought many new "healthy" products to the consumer market. One of the major changes that will help educate and answer questions on each product is the new labeling law. Many of the processors may benefit from this new law. The positive affects of the new law may be in terms of increased sales. On the other hand, increased costs resulting from this new law may also have a negative impact on food processors.

**Ethnic Mix** The ethnic mix is changing due to differential birth rates and immigration.

Growth rates among ethnic groups in the U.S. are very uneven. Non-Hispanic whites increased at a rate of .5% in 1990. Hispanics and other races except blacks grew at a rate of 2.7%, blacks at a rate of 1.5% (Senauer, et al., 1991).

The fastest growing ethnic groups are Hispanics and Asians. This change causes a higher demand for an ethnic mix of foods expanding product differentiation for the processing industry by creating more market niches. Along with the many new products that have been directed towards the ethnic diversity of our country, comes a positive alternative for the food processor in terms of providing new products for the overall consumer market.

### **THE CONDUCT OF THE FOOD PROCESSING INDUSTRY**

Market conduct refers to the coordination of decision making to determine prices to charge, produce to output, product designs to offer, and potential competitors.

### **MARKETING**

The definition of marketing can range from developing new products, to merchandising. Forecasting future prices, increasing domestic sales, developing an advertising strategy and designing a marketing plan that will address all of the above, are various issues addressed in marketing.

***New Product Introductions*** Over the past five years, new grocery product introductions has risen. The nation's food processors introduced over 16,100 new grocery products in 1991, an increase of nearly 22% over 1990. Almost 17,000 new products were produced in 1992. In 1993, 17,600 new products were brought to market. Comparing the years between 1988 to 1993, there has been a 40% increase in new grocery product

introductions (Figure 3). New products bearing health claims continue to rise in number. Claims such as low/no cholesterol, added high-fiber, reduced/low fat seem to be high in new product introductions.

**Advertising** For food processors and manufacturers, advertising is a vital component of their marketing plan. Advertising for the food and tobacco industry has been higher than any other major category in the manufacturing industry in terms of dollars spent since 1954 (Marion, 1986). Food marketing firms spent an estimated \$11.7 billion in direct consumer advertising in 1991 (Figure 4). By most industry estimates, food processors spend about \$2 on retail promotion for every \$1 in direct consumer advertising through trade shows, promotions, discounts, allowances, and other incentives (Gallo, 1992).

Since advertising is so important to food processors, the price of advertising is also significant. From 1991 to 1992, nighttime network television prices showed no increase, and cable television prices rose four percent. Network radio prices showed no increase, and consumer magazines increased an average of 6.2 percent (Food Marketing Review, 1992-93). These price changes have led to a slight increase in the processor's advertising costs.

## **PRODUCT PRICING**

Even though there is more concentration in the food processing industry, the industry still tries to acquire and/or maintain market shares through price competition. This ultimately shifts in the consumers' favor. In 1991, consumer prices were increased only 2.9% compared with 5.8% in 1990. This increase was the smallest in six years (Gallo,



Dec. 1992). From 1989 to 1990, grocery store food prices gained 2.6% and food service prices gained 3.4%. Price competition to gain market shares was seen in both the retail and fast food sectors in 1991 and 1992. Major discounts such as coupons, were given in these sectors for the third consecutive year (Gallo, Dec. 1992).

## **THE PERFORMANCE OF THE FOOD PROCESSING INDUSTRY**

Performance of a market is directly impacted by the structure and conduct of that market and can ultimately be used as a measure of the success of the firms. Performance is measured by many factors such as profitability, capital expansion, foreign trade, research and development, and productivity (McCorkle, 1988).

### **PROFITABILITY**

Even though the economy was stagnant and low in sales volume in 1990 and 1991, food processors maintained the same level of profit from operations for both years. The performance of the food processing industry was boosted by the decline in the value of the U.S. dollar. Food and tobacco processors' profits rose from \$34 billion in 1990 to \$36.2 billion in 1992 (Food Marketing Review, 1992-93). The food processing industry has been profiting in the last decade even when the economy has been lagging.

A research report by Gallo (1993) addressed the performance of the U.S. manufacturing sector during economic stagnation. The year 1991 was used as the study year because there was a recession the entire year. The results indicated that volume growth in food was slowed by the recession but it was not negative. It did increase by one percent. From the supply side, the economic slowdown was very beneficial to the food manufacturing industries. Profitability of food manufacturing is affected by price

and wages, foreign exchange rates, and interest rates due to the fact that the U.S. food manufacturing industry is global, highly leveraged and labor intensive (Gallo, June 1993).

Processed food sales are presumably less affected by an economic slowdown than is the rest of the economy because food is a noncyclical commodity (Gallo, 1993). Research indicates that even when the rest of the economy suffers, the food processing and manufacturing industries are still profiting. A very good indication is given that the food processing industry will expand and increase in the future even when the economy slows down.

## **INTERNATIONAL TRADE AND THE POTENTIALS FOR GROWTH**

In 1992, agricultural products consisted of ten percent of the total U.S. merchandise exported and four percent of merchandise imported. These percentages are quite small compared to the composition of the U.S. merchandise trade with the world. Even though trade of agricultural commodities is relatively small in the big picture, trade data indicates that U.S. agriculture trade has been one major reason for the decline in the trade balance deficit. The United States is one of the world's largest exporters and importers of processed foods. In 1991, for the first time since about 1978, there was a trade surplus in processed food and beverages. An estimated \$22.2 billion in exports, 5.9 percent of product shipments compared to an estimated \$21.1 billion in total imports. Twenty-five U.S. firms with foreign affiliates accounted for nearly one fourth of the export market in 1990 (U.S. Industrial Outlook, 1993).

Total U.S. processed food and beverage exports grew 23 percent during the 1990-

1992 periods (U.S. Industrial Outlook 1993). The Foreign Agricultural Service of the USDA classifies agricultural exports based on how close they are to their final consumer form. There are 3 categorizations: bulk (free from processing), intermediate (semi-processed) and consumer-oriented (little additional processing). In 1990, the U.S. exported 53.8% of its agricultural products in bulk form, 22.7% in intermediate form and 23.5% in consumer oriented form. About 72 percent of the total U.S. processed food exports are low value-added products such as fats and oils, food ingredients, corn products, meat, poultry, and fish products. An estimated 45 percent of U.S. imports are high value-added consumer-ready products such as confections, bakery foods, and various gourmet fruit and vegetable products. Many believe that this trend will continue for the near future (U.S. Industrial Outlook, 1993).

Many consumers are becoming more conscious about buying products that are made or grown in the United States. This effort is made easier by producers advertising that their products are grown in the United States. More advertising and consistency in the quality and availability of the products in the future will help domestic consumers chose to buy domestically.

### **SUMMARY AND CONCLUSIONS**

Although the food processing industry has always been important, with the constant change of demand for food due to changes in demographics, consumer preferences, economics, and technology, its importance is escalating. With these changes, the processing industry will continue to prosper. New technologies, research, and development will be used in the immediate future to bring new products onto the market.

As with the structure of the food processing industry, the conduct of the industry seems to be perpetuating in a positive direction. Positive aspects are found with the rapid increase in new product introductions. Moreover, advertising expenditures have grown in the past years. Given that advertising is an important component of market development, the industry as a whole is expected to benefit from advertising expenditures. Additionally, prices during the 1990's has had a negative impact on the industry. The decrease in consumer product pricing resulting in decreased profits for processors may have been overcome as a result of the firms engaging in major cost-reduction strategies, greater plant efficiencies and other savings measures in 1991 and 1992 because of higher debt levels (Gallo, Dec. 1992).

The performance of the food processing industry is very promising. The industry has been profiting in slow economic times when other industries have been impacted negatively. Increased profits in the future can be seen from exports if processors can capture more consumer market segments overseas. Also, profits can be seen in the future if the industry can provide consistent quality and availability for products purchased domestically which are currently purchased as exports.

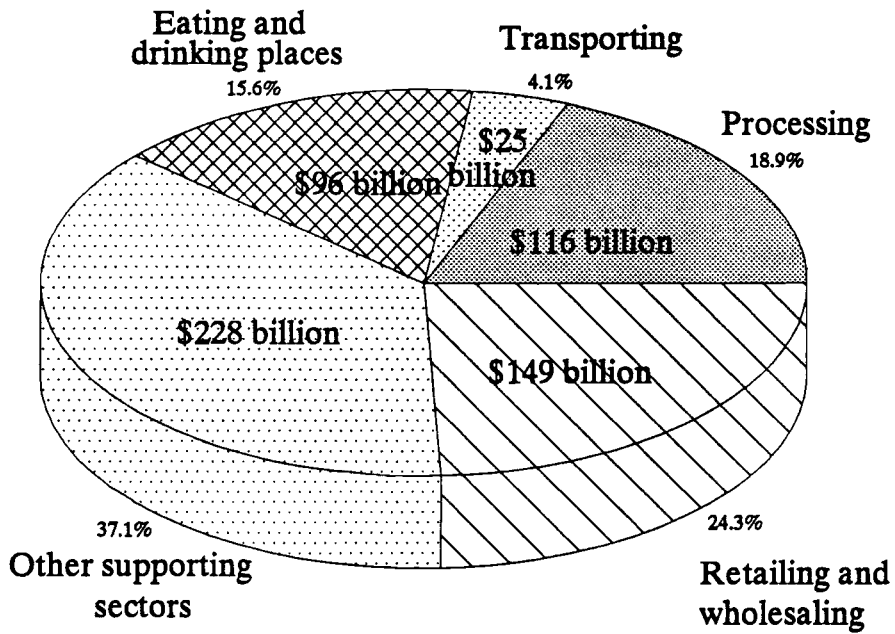
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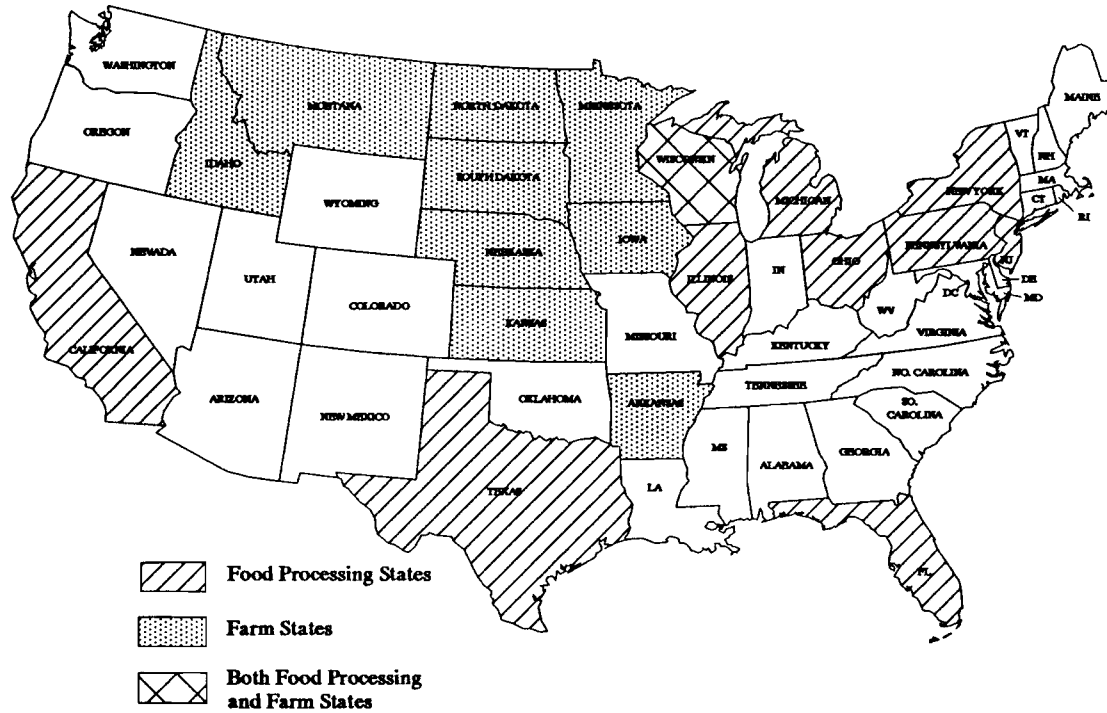
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**FIGURE 1. ESTIMATED VALUE ADDED IN THE FOOD MARKETING SYSTEM, 1992**



Source: Based on data from Food Marketing Review, 1992-93

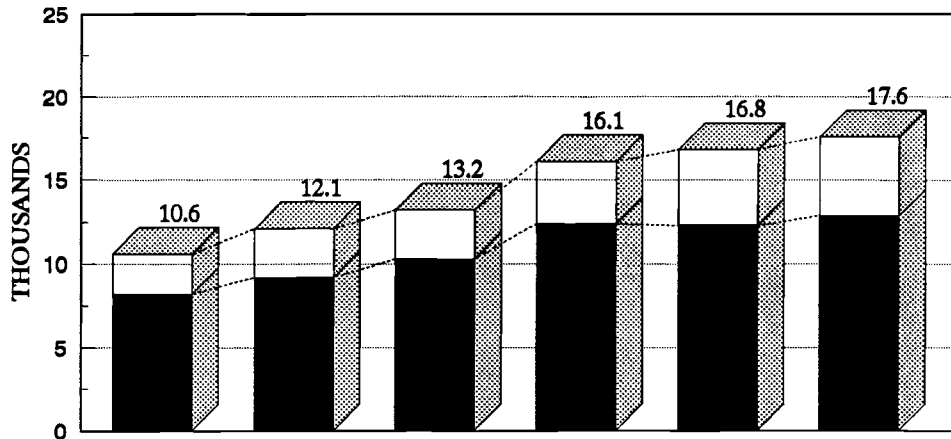
**FIGURE 2. THE LEADING FARM AND FOOD PROCESSING STATES**



Source: Barkema, et al. p.9



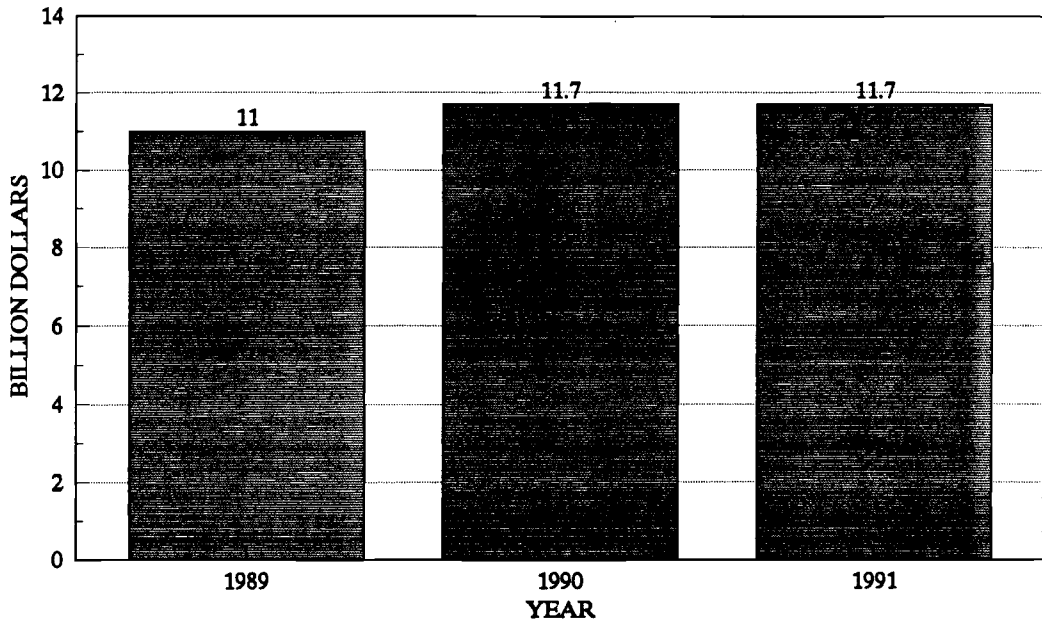
**FIGURE 3. NEW GROCERY PRODUCT INTRODUCTIONS, 1988-1993**



YEAR	1988	1989	1990	1991	1992	1993
FOOD <span style="display: inline-block; width: 10px; height: 10px; background-color: black; vertical-align: middle;"></span>	8.2	9.2	10.3	12.4	12.3	12.9
NONFOOD <span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; vertical-align: middle;"></span>	2.4	2.9	2.9	3.7	4.5	4.7

Source: Based on data from Food Marketing Review, 1992-1993

**FIGURE 4. FOOD RELATED ADVERTISING, 1989-1991**



Source: Gallo, Dec. 1992, p. 9

**CHAPTER II.**

**MID-SOUTH REGION'S VALUE ADDED FOOD INDUSTRY:  
AN ANALYSIS OF FRUIT AND VEGETABLE PROCESSORS**

**ABSTRACT.** Responses from a survey of Mid-South fruit and vegetable processors from Oklahoma, Texas, and Arkansas were used to identify structural characteristics, marketing activities, and food safety requirements. Survey results indicate there are several successful fruit and vegetable processors in each state that have been in business for less than fifteen years. There is also an indication that there are many different types of production practices and marketing strategies used by these processors.

### **INTRODUCTION**

The food processing industry can be characterized as one of the fastest growing industries in the United States. This rapidly expanding industry has been affected by shifts occurring in demographic and economic structures associated with changes in consumer lifestyles, tastes, and preferences. As consumers become more health conscious, the increased demand for fruits and vegetables becomes more prevalent. As a result, fruit and vegetable processors have had the responsibility of responding to consumer demand by creating good tasting, healthy, easy to prepare products. In order to be successful with these new products, structural as well as production and marketing factors have been transformed.

Three Mid-South region states, Texas, Arkansas, and Oklahoma, were included in an analysis of structural characteristics as well as marketing strategies of fruit and vegetable processors. This study was conducted to determine factors that have contributed to the success of these processors. Each of these states differ in terms of size of the state, population, types of agricultural commodities produced, and volume of production. Each state has different types of major commodities that are produced which

in turn dictates what types of food processing is more prevalent in the state.

## **OBJECTIVES**

In this study, the Mid-South fruit and vegetable processors were surveyed through mail surveys and follow-up phone surveys. The specific objectives of this study are:

1) To identify and describe demographic and structural characteristics of the fruit and vegetable processors in the Mid-South region, 2) To identify and describe the marketing activities, production practices, and food safety considerations of these processors, and 3) To identify factors that have been important in market development and longevity associated with these processors.

## **PROCEDURES**

A mail survey was designed to obtain relevant information needed to meet the above objectives. Mail surveys have become very prevalent for use in research and education but there are shortcomings to their use (Christenson, 1975). A major downfall associated with mail surveys comes from the low rate of response, which is usually not more than fifty percent (Dillman, et al., 1974). In this analysis, the total number of fruit and vegetable processors surveyed was 89 and the total number of responses received with usable data was 31. An aggregate response rate for the survey of was 44%. Another limitation may include the fact that non-respondents may have different opinions than the respondents. Due to the small number of fruit and vegetable processors in Oklahoma and Arkansas, mail surveys along with telephone surveys were conducted to attempt to obtain a higher response rate and avoid biasness.

A list of 54 fruit and vegetable processors from Texas was obtained from both the

Texas Food Processors Association's 1994 Directory along with a mailing list from the Texas Department of Agriculture. Eight surveys were "returned to sender" from the Postal Service. Sixteen surveys were returned with usable data resulting in a 30% response rate.

A list of seven fruit and vegetable processors located in Arkansas was obtained from the Ozark Food Processors Association Membership Directory 1993. Two surveys were "returned to sender" from the Postal Service and one survey was returned with unusable data. Only two surveys were returned with usable data resulting in a 20% percent response rate. Due to the small number of respondents from Arkansas, an attempt was made to conduct the surveys by phone. The attempt was unsuccessful due to the fact peak season for several processors was during the time of the survey.

A list of approximately 28 fruit and vegetable processors from Oklahoma was obtained from the Oklahoma Food and Product Directory published by the Oklahoma Department of Agriculture. Due to the small number of fruit and vegetable processors in Oklahoma, data for this study was collected using both mailings of the survey and personal interviews with the processors. A total of thirteen Oklahoma processors responded with information concerning their processing activities and marketing strategies. This is almost a fifty percent response rate.

## **OVERVIEW OF THE FOOD PROCESSING INDUSTRY**

Food processing is a "manufacturing industry that inherently increases the economic value of farm products. It combines labor, machinery, energy and technology to convert bulky farm products into packaged, palatable foodstuffs" (Connor, 1988). Currently,

about 400,000 manufacturers, wholesalers, retailers, and food service firms engage in food processing and food distribution. In 1992, the food and beverage industry became the largest major manufacturing sector in terms of shipments in the United States. This industry has more than \$415 billion in shipments, surpassing the transportation and equipment industry (U.S. Industrial Outlook, 1993). In 1993, processing and manufacturing firms added value to approximately \$116 billion of raw food products. This is about 19 percent of the total value-added by the entire food marketing system. This is up from the 1991 figures which were \$100 billion. However, as a percentage of the entire food marketing system, the food processing industry has remained stable (Food Marketing Review, 1992-1993). In 1991, U.S. preserved fruits and vegetable manufacturers added \$22.043 million to raw products and employed 215.9 thousand workers (U.S. Dept. of Commerce, 1990).

The Mid-South region produces only a small percentage of the total U.S. processed fruit and vegetable activity. Together, these three states only account for seven percent of the total U.S. activity in processed fruits and vegetables. Although relatively small, this industry has been growing and provides great employment and profit potential in the studied states.

**TEXAS.** Texas ranks among the top food processing states in terms of value-added by manufacturers. Texas food processing firms have accounted for \$8 billion in value-added. This is 5.5% of the total U.S. food processing activities in 1991. Employment in Texas reached 83,300 in 1991, comprising 5.6% of the nation's total employment in food processing (U.S Department of Commerce, 1990). The processed food group consisting

of preserved fruits and vegetables in Texas accounts for \$982 million in terms of value-added (U.S. Department of Commerce, 1990). This is approximately 4.5% of the U.S. total value-added for preserved fruits and vegetables. Texas employs 8,700 people in this processing area, which is 4% of the U.S. total employment.

Texas has a comparative advantage 'over Oklahoma and Arkansas due to the size of the state and large its population. This state has good transportation routes to several central population centers which enables processors to distribute their products to a large population at lower transportation costs.

**ARKANSAS.** Arkansas food processing activities comprise about two percent of the total U.S. food processing industry in terms of value-added. This places Arkansas in the top twenty food processing states. The total value-added for Arkansas was \$2670 million and the food processing industry employed approximately 47,000 people in 1991 (U.S. Department of Commerce, 1990). Arkansas contributed \$571 million in value-added preserved fruits and vegetables in 1991. This is 2.5% of the total value-added for U.S. preserved fruits and vegetables. Next to meat products, preserved fruits and vegetables are second in terms of value-added in Arkansas. In 1991, 5,300 people were employed in this processed food group (U.S. Department of Commerce, 1990). The state has a small number of major fruit and vegetable processing firms that account for a majority of the activity in the state in this processing group. These firms also employ the majority of the people associated with fruit and vegetable processing in the state.

The food processing industry in Arkansas has indicated a slow but definite increase over the last few years despite its small population size and lack of a major population



center. The fruit and vegetable processing sector has the potential to expand by creating smaller, more specialized processing firms that would contribute to different consumer market segments.

**OKLAHOMA.** The food processing industry in Oklahoma consists of only a relatively small portion of the U.S. total food processing activity. Oklahoma accounts for less than one percent of the nation's total in both value-added and employment. The state's food processing industry had value-added of \$990 million along with employment of only 14,700 people in 1991. Oklahoma contributed \$104 million in value-added in the preserved fruit and vegetable group. In terms of employment, Oklahoma had 1,600 people working in this group.

Oklahoma has been one of many farm states in which research has indicated great potential for growth in food processing activities. Oklahoma is centrally located with good transportation routes to population centers. Problems inhibiting Oklahoma's growth are problems that can be found in many small farm states. Some of the problems are the structural characteristics, size, and inadequate marketing strategies associated with current food processing firms in the state. These problems associated with Oklahoma food processors will be addressed soon, as construction of a new Food Processing Research and Technology Center is underway at Oklahoma State University in Stillwater and should be ready in 1997.

#### **SURVEY RESULTS: DEMOGRAPHIC AND STRUCTURAL CHARACTERISTICS**

Canned products were the primary category (48%) describing the types of products produced by the processors surveyed. Frozen products comprised 16% of the

respondents, followed by dehydrated products with 13%, seasonings and dry blends with 13%, dry bulk/bagged products with 7%, and pickling 3% (Figure 5).

The wide array of processors surveyed provides a good opportunity to analyze the characteristics of different types of processors with regards to their structure and marketing activities. Seventy-seven percent of the respondents from Oklahoma were canned processors. The remaining twenty-three percent produced either frozen or dehydrated products. Arkansas respondents comprised of one processor that produced canned products and one that produced frozen products. Texas has the widest array of respondents consisting of twenty-five percent producing canned products with the same percentage producing blended seasonings, and nineteen percent producing frozen products. The remaining processors produced dehydrated products, pickling products, or dry bulk/bagged products (Figure 5).

Over the last decade, many companies have taken advantage of certain market segments by creating new businesses. Thirty-four percent of the total respondents have been in operation less than ten years (Figure 6). Four of these processors indicate annual gross sales of more than \$500,000. This is a good indication of the success new businesses are achieving as a result of responding to consumer demands. Thirty-one percent of the respondents have been in business between ten and thirty years.

Four of these processors indicate they also have annual gross sales of more than \$500,000. The remaining thirty-four percent of the respondents have been in business for more than thirty years. Nine processors that have been in business longer than thirty years have annual gross sales of more than \$500,000. Over half of the respondents

(52%), had annual gross sales of more than \$500,000, 16% had sales between \$50,000 and \$100,000. Sales for 10% of the respondents were between \$100,000 and \$250,000 (Figure 7). Oklahoma only had five respondents that had annual gross sales of over \$500,000. With no response from three processors, of the remaining five respondents, one has been in business less than fifteen years with four in business less than ten years. Both respondents from Arkansas had annual gross sales of \$500,000 or more, while Texas has a majority (56%) over \$500,000. The information provided on annual gross sales was obtained from seventy-four percent of the respondents, as eight processors declined to answer this optional question (Figure 7).

### **LOCATIONAL ASPECTS**

An understanding of the reasons processors establish their companies in certain locations is an important aspect of this study. Approximately sixty-one percent of the processors surveyed indicate their companies were located in urban areas as opposed to rural areas. Many of the processors indicated that the most important factors considered when deciding on the location for their company were history (the company has been established there for a number of years), easy access to producers and buyers, good transportation routes, and low cost associated with production. One factor that was not important was low land prices.

Some of these important locational factors may be a downfall for the states included in the study in terms of luring new food processing firms to their area. A majority of the large food processing and manufacturing firms in the U.S. are located in a small number of states. There is concentration in two regions, the Sun Belt and the industrial

states around the Great Lakes and in the Northeast (Barkema, et al., 1990). These three states do not grow a very large percentage of the fruits and vegetables produced in the United States. The inadequate supply of fresh products could be a drawback for processors looking to establish a plant in any of these states. The positive factor for these three states is the well-established transportation routes that enable products to be transported throughout the U.S. with ease.

### **PURCHASING OF INPUTS**

In 1992, the food processing industries purchased about \$106 billion in animal and crop products from the U.S. farm sector, an additional \$21 billion in imported agricultural products, and \$9 billion in seafood (Food Marketing Review, 1992-93). Only forty-two percent of the respondents purchased at least a portion of their fruit and vegetable inputs from the state in which their company is located. Of these respondents, eighty-five percent indicated these purchases have increased over the last five years and over sixty percent said their input purchases from producers in their state have increased by more than twenty-five percent. This increase in purchases from fruit and vegetable producers in the state from which the processors are located could be attributed to the purchasing advantages indicated by the respondents. The purchasing advantages, in order of importance include: lower freight costs, freshness, better prices, and availability. The disadvantages include unsteady supply or no supplier at all, low volume, low quality, and inconsistent packaging. Due to the relatively small number of fruit and vegetable growers in Oklahoma and Arkansas, a majority of the processors from these two states must purchase their inputs from other states in the U.S. or internationally. Only five of the

respondents (31%) from Texas purchase their inputs from Texas produce growers. This is attributed to the unsteady supply or no supply at all indicated by the respondents. Several respondents feel they must keep out-of-state suppliers on-hand in case there is a shortage of the inputs they need.

**Purchasing Agents.** In determining the vendors through which processors purchase their inputs, forty percent indicated that they purchase directly from local farmers or producers. Thirty-two percent purchase through a wholesale broker and twenty-four percent purchase through a wholesale produce vendor. Only one respondent indicated they purchase through a farmer's cooperative.

There are many factors that determine the purchasing behaviors of processors. In this survey the processors were asked to rank in order of importance what characteristics they looked for when purchasing their fruit and vegetable inputs from suppliers. The two major factors indicated were consistency of quality year round and dependable deliveries. The respondents also indicated price was in the top three in terms of importance. Dependable volume of supply and consistency over a long period of time were also important factors. These factors emphasize the reasons processors are not purchasing from their own states. Because these states produce relatively low volumes of fruits and vegetables, processors must go out of state to receive a consistent supply.

**Quality control.** A majority of the respondents have implemental quality control procedures to control the quality of the fruit and vegetable inputs they purchase. Forty-two percent indicate they use marketing contracts to control quality, while thirty-two percent refuse delivery if the inputs are not the quality required by the processor. Other

procedures included offering a price according to the level of quality, personal inspections, and forward contracts. Two processors indicated they use competent suppliers which decreased the problem of quality control. Many of the processors used a combination of the above procedures to control the quality and get the best possible inputs they require.

**Input prices.** The prices processors pay for fruit and vegetable inputs are determined by market prices, agreements between supplier and processor, and by market demand. The most significant factor indicated by the respondents in determining the price they pay for their inputs are prices set by suppliers. Broker and distributor prices were also a determining factor followed by regional market prices. The prices determined by contracts and market demand were only used by a small number of the processors surveyed.

## **PRODUCTION PRACTICES AND MARKETING ACTIVITIES**

When the processors were asked what strategies would be implemented if consumer demand for their products increased, eighty-one percent of the processors indicated they would increase production. Eleven percent said they would pull products that were in storage, leave the production level the same, or charge a higher price for their product.

The small percentage of processors that would charge a higher price for their product may indicate that the industry tries to acquire and/or maintain market shares through price competition. This ultimately shifts in the consumers' favor. In 1991, consumer prices were increased only 2.9% compared with 5.8% in 1990. This was the smallest increase in six years (Gallo, 1992). Only three processors indicated they would purchase

from other processors to meet consumer demand. All three of these processors were from Texas indicating that Texas processors may have an advantage of purchasing from other processors because of the large number of processors in the state. The processors also indicated they adjust their distribution and storage activities according to consumer demand.

A majority (70%) of research and development personnel surveyed from the top 100 food processing firms indicate they are paying more attention to "regulatory-related questions/problems/changes" in 1993 compared to 1992. None reported less attention and the other respondents reported the same level of time/money spent (Sperber, 1993).

Ninety-four percent of the respondents in our survey indicated they expect to expand their production volume in the future. Only two of the respondents said they would not expand production. Both of these respondents have been in business for fifty years or more.

**Consumer perception.** The processors were asked their perception of the way consumer demands for given products have changed over the last five years. Many of the respondents indicated consumers are demanding more frozen fruits and vegetables, along with more microwave ready meals, sodium reduced foods, and added nutrients such as Calcium. Most suggested that the consumer is willing to pay for added convenience that products offer. Due to the wave of nutritional issues, the respondents indicated that consumers are demanding less canned fruits and vegetables, less preservatives, and less chemical additives (Table I). These results are typical of the nutritional and health conscious behavior the consumers have taken on in the last decade.

Results from a survey of the top 100 food processors in the U.S. indicated processors believe healthy, organic, and low fat foods will be of high importance in the next five to ten years. Moderate importance was given to frozen and irradiated and refrigerated products. Processors indicated that the trend will be away from dehydrated and retorted products (Sperber, 1993).

Many processors are responding consumer demand not only by increasing production but by creating new product introductions. Over the past five years, new grocery product introductions have been on the rise. The nation's food processors introduced over 16,100 new grocery products in 1991, almost 17,000 in 1992, and 17,600 in 1993. Comparing the years between 1988 and 1993, there has been a 40% increase in all new grocery product introductions (Food Marketing Review, 1992-93).

**Product Pricing.** A majority (61%) of the processors surveyed indicated cost of production plus mark-up (profit margin) was the most significant factor in determining the price set for the products the processors sell. Nineteen percent indicated the second price determining factor was market demand. The remaining processors determine the price for their products based on contract agreements or competitor's prices.

**Marketing Outlets.** Our survey indicated many processors are using a combination of several different types of outlets. Brokers, independent retailers, and chain retailers are the three outlets used most. Institutions such as schools, hospitals, and churches, restaurants, distributor warehouses, and consumers direct are other outlets that are being used to market processed fruit and vegetable products (Table II).

**Advertising.** For food processors and manufacturers, advertising is a vital component



of their marketing plan. Advertising for the food and tobacco industry has been higher than any other major category in the manufacturing industry in terms of dollars spent since 1954 (Marion, 1986). By most industry estimates, food processors spend about \$2 on retail promotion for every \$1 in direct consumer advertising through trade shows, promotions, discounts, allowances, and other incentives (Gallo, 1992).

The wide array of different types of processors surveyed, results in many different forms of advertising being conducted to promote products. Newspaper advertising was the most important form of advertising followed by mail flyers, magazines, radio, television, signs/billboards, and demonstrations in stores. A small number of processors indicate they use state labels on their products from the state in which their products are made. This labeling design is becoming popular indicating some consumers are state loyal and prefer to buy from local processors when given the opportunity. Six of the processors indicated they use no form of advertising (Table III). All of these processors using no form of advertising have been in business for less than ten years and a majority have gross annual sales of less than \$500,000. This may indicate they do not have the resources as of yet to extensively advertise their products extensively. Oklahoma processors use newspapers and "Made In Oklahoma" labels as the top two forms of advertising while Texas processors choose newspapers and magazines as their top two forms. Arkansas processors used television, mail flyers and magazines to advertise their products (Table III).

**Distribution.** Over half of the processors surveyed distribute their products on a national level, while twenty percent distribute on a regional basis. The remaining processors

distribute their products to the state in which their company is located or within a certain area of the state in which they are located (Figure 8). Fifty percent of the respondents from Oklahoma, forty-five percent respondents from Texas, and all the respondents from Arkansas distribute nationally. Four of the respondents from Texas and four from Oklahoma distribute regionally with seven respondents from Texas and two from Oklahoma distributing statewide. National distribution by processors indicates there is a large market for their products. Larger processors from these states are forced to distribute on a regional and national scale due to the small percentage of population in the Mid-South as compared to other regions of the country.

Transportation expenses are a significant factor in determining the geographical distribution area a company might serve. Almost seventy-five percent of the respondents use commercial trucking companies to transport their products. The high percentage of commercial trucking use could be attributed to more than half of the respondents receiving more the \$500,000 in gross annual sales. The remaining twenty-five percent of the processors use refrigerated vehicles, private automobiles, or tractor-trailer rigs to transport their products privately. A small number of processors indicated that they transport their products using both commercial and private transportation.

## **FOOD SAFETY**

Consumers are becoming more vocal on the issues pertaining to pesticides that are used in the production of fruits and vegetables. First, the processors were asked if there were specific pesticide restrictions put on fruit and vegetable inputs they purchase. Fifty-four percent of the respondents said they did specify pesticide restrictions while forty-six

percent said they did not. Of the respondents that indicated they did specify restrictions, these restrictions were: absolutely no pesticides, only USDA approved pesticides, and contract specifications between producers and buyers on pesticides. When asked how pesticide restrictions have changed over the past ten years, processors indicated that they have changed dramatically, become more strict, and harder to enforce. One processor indicated there is almost a universal restriction specification on pesticide use.

Sixty-seven percent of the processors surveyed indicated they have checked for pesticide residues in the past with the same percentage indicating they are planning to check for pesticide residues in the future. Eighty percent of the respondents feel that the government is adequately regulating the use of pesticides by producers.

Due to the fact that food safety and use of pesticides were an important aspect of this study, respondents were asked to give their perception on the concern of pesticides for four groups consisting of producers, grocers, consumers, as well as fellow processors. The respondents indicated that all the groups were very to moderately concerned with pesticides with no group having no concern. Processors listed themselves as most concerned with grocers as least concerned. This is an indication that the issue of pesticides is a concern for every group but there is no real measure of how each group is addressing this concern. (Table IV).

In comparison, the survey results from the top 100 processing companies indicated food safety is the "cornerstone of industry regulation". Respondents indicated food safety concerns of microbial hazards (highest concern), pesticides, mycotoxins, chemical additives, carcinogens, and package/product interactions (all moderate concern) (Sperber,

1993).

## **SUMMARY AND CONCLUSIONS**

From the survey results several conclusions can be made about the demographic and structural characteristics as well as the marketing activities and production practices of the food processors in the Mid-South region. Even though the Mid-South region does not have a large number of fruit and vegetable processors, a majority of them are doing very well in terms of profitability, production, and marketing. Each of these states provides a potential for other fruit and vegetable processors to relocate or expand into the Mid-South because of established transportation routes. One negative element included the limited amount of fresh produce that is grown in the region.

The processors that have been in business for less than fifteen years have been very successful showing high annual gross sales. Several factors have been involved in the accomplishments of these processors as well as most of the other respondents involved in the survey. As the market has become more consumer oriented, processors have had to shift their innovations, production practices, and marketing activities to better fit the consumer realm. Indication was given by the processors that consumer demand determined production practices in terms of increasing or decreasing production. Some processors also indicated market demand was a price determining factor. Advertising was another important factor to many of the respondents. A realization has been made that advertising products improves the chance of the success of the products.

Finally, all of the respondents perceived processors, producers, grocers, and consumers to be concerned about food safety and chemical residues with processors as

most concerned and grocers perceived as least concerned.

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**TABLE I. CHANGES IN CONSUMER DEMAND PERCEIVED BY  
FRUIT AND VEGETABLE PROCESSORS**

	<b>DEMAND MORE</b>	<b>DEMAND LESS</b>	<b>NO CHANGE</b>
	-----# OF RESPONDENTS-----		
Canned Fruits and Vegetables	6	13	3
Frozen Fruits and Vegetables	14	3	4
Microwave Ready Meals	21	0	1
Sodium Reduced Foods	17	4	3
Preservatives	2	18	3
Chemical Additives	1	19	3
Added Nutrients (eg. Calcium)	13	2	6
Willingness to pay for added convenience	16	1	6

Respondents were asked their perception of the changes in consumer demand for the products listed. Each respondent did not answer each listing. A total of twenty-three processors responded to the survey.

**TABLE II. OUTLETS USED BY MID-SOUTH FRUIT AND VEGETABLE PROCESSORS TO MARKET THEIR PRODUCTS**

	<b>Total # of respondents using the outlet</b>	<b>OK</b>	<b>AR</b>	<b>TX</b>
Brokers	16	4	1	11
Independent Retailers	16	5	2	9
Chain Retailers	13	6	2	5
Institutions	10	4	1	5
Distributor Warehouses	10	3	2	5
Restaurants	9	4	1	4
Other Wholesalers	9	0	2	7
Consumers Direct	7	4	3	0

A total of thirty-one processors responded to the survey.



**TABLE III. FORMS OF ADVERTISING USED BY THE MID-SOUTH  
FRUIT AND VEGETABLE PROCESSORS**

	Number of Respondents using each form	OK	AR	TX	% OF Respondents using each form
Newspaper	10	5	1	4	23
None	6	1	0	5	13
Mail Flyer	6	2	2	2	13
Television	5	2	2	1	11
State Grown Labels	5	4	0	1	11
Magazines	5	0	2	3	11
Radio	3	2	0	1	7
Signs/Billboards	2	1	0	1	5
Demos in Stores	2	2	0	0	5

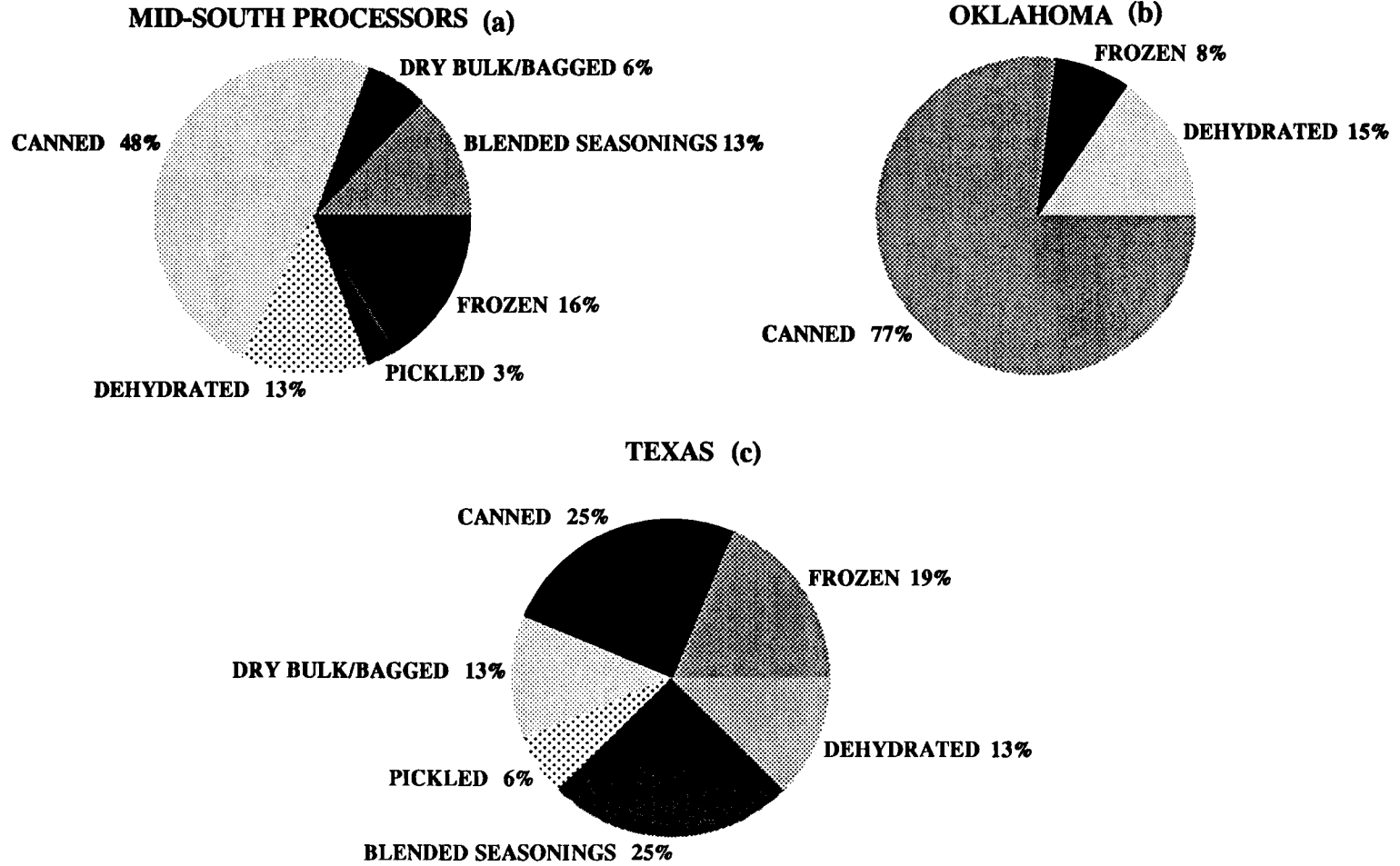
Each respondent was asked what form(s) of advertising was used in promoting their product(s). A total of thirty processors responded to the survey.

**TABLE IV. RESPONSES FROM MID-SOUTH FRUIT AND VEGETABLE PROCESSORS ON THE CONCERN OF PESTICIDE RESIDUES**

HOW CONCERNED ARE THE FOLLOWING ABOUT PESTICIDE RESIDUES?				
	VERY CONCERNED	MODERATELY CONCERNED	SOMEWHAT CONCERNED	NO CONCERN
	-----# of Respondents-----			
PRODUCERS	6	8	4	0
PROCESSORS	8	8	2	0
GROCERS	2	9	7	0
CONSUMERS	6	9	3	0

A total of eighteen processors responded to the survey.  
 Concern was calculated with Very concerned=4 and No concern=1

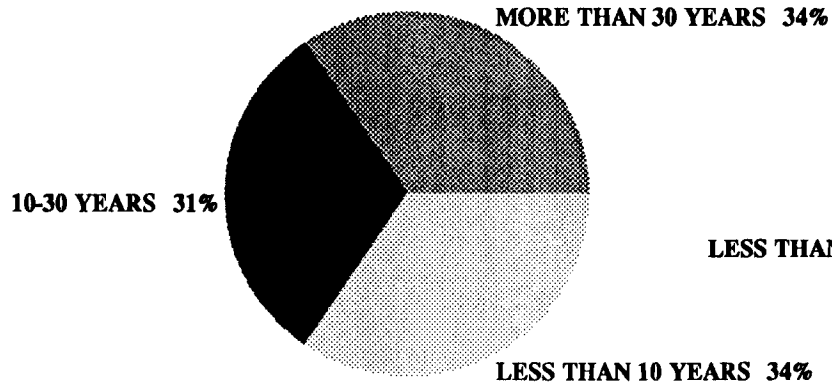
**FIGURE 5. TYPES OF PRODUCTS PRODUCED BY MID-SOUTH  
FRUIT AND VEGETABLE PROCESSORS**



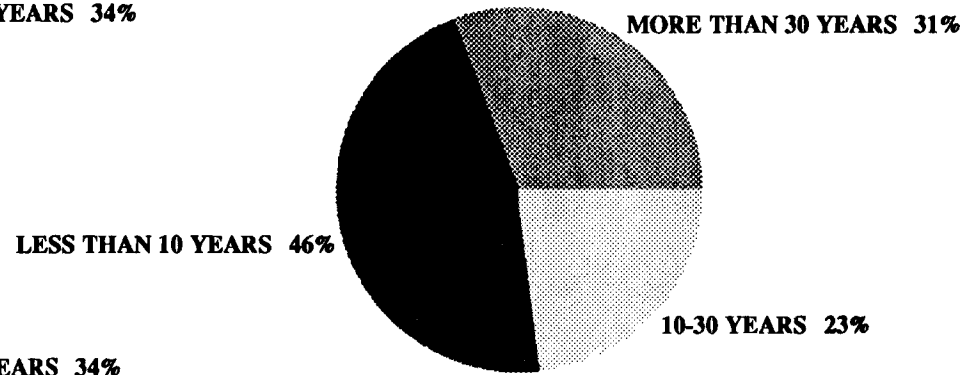
(a) Total respondents=31 (b) Oklahoma respondents=13 (c) Texas respondents=16

**FIGURE 6. YEARS IN OPERATION FOR MID-SOUTH  
FRUIT AND VEGETABLE PROCESSORS**

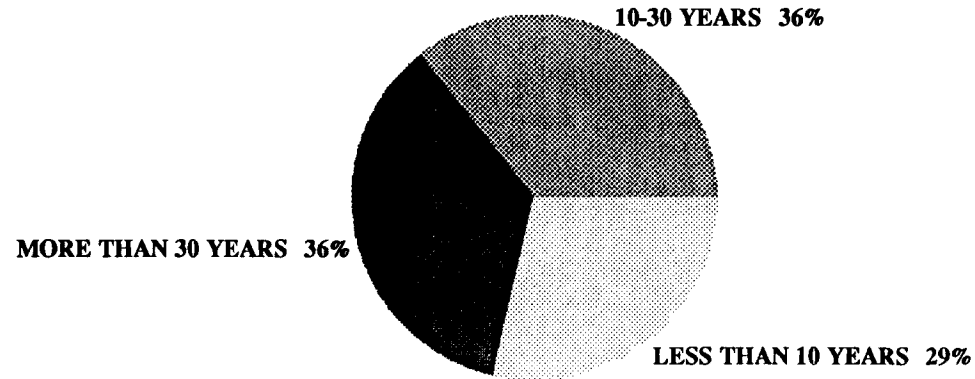
**MID-SOUTH PROCESSORS (a)**



**OKLAHOMA (b)**



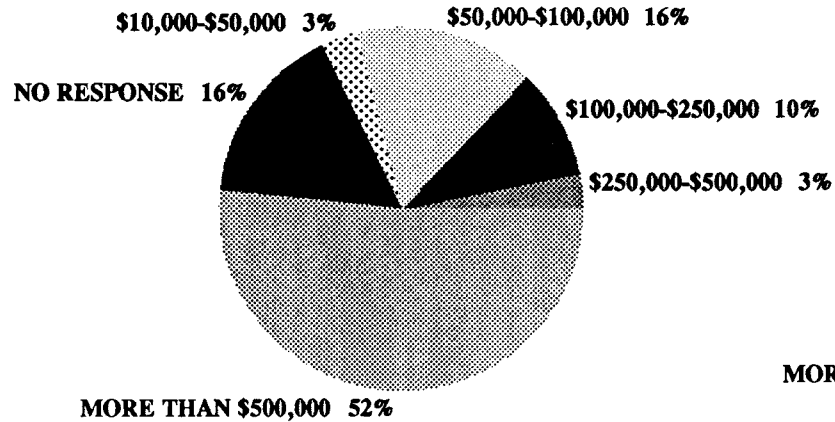
**TEXAS (c)**



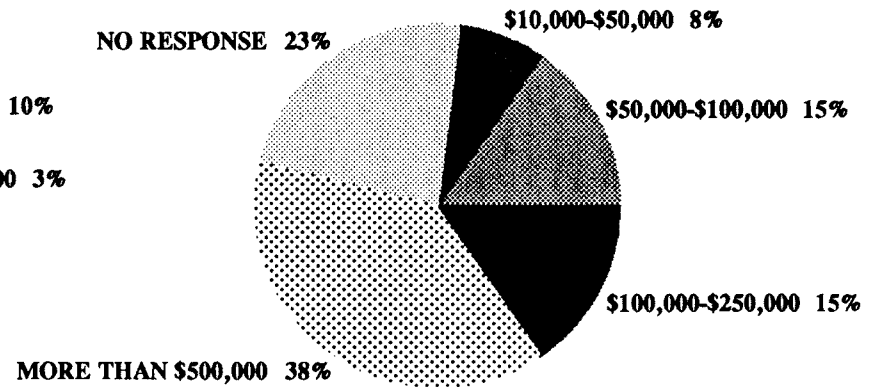
**(a) Total respondents=29 (b) Oklahoma respondents=13 (c) Texas respondents=14**

**FIGURE 7. ANNUAL GROSS SALES OF MID-SOUTH  
FRUIT AND VEGETABLE PROCESSORS**

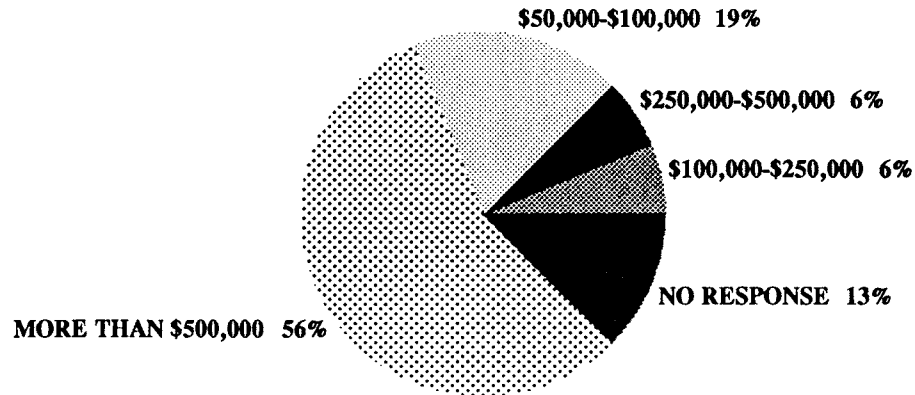
**MID-SOUTH PROCESSORS (a)**



**OKLAHOMA (b)**

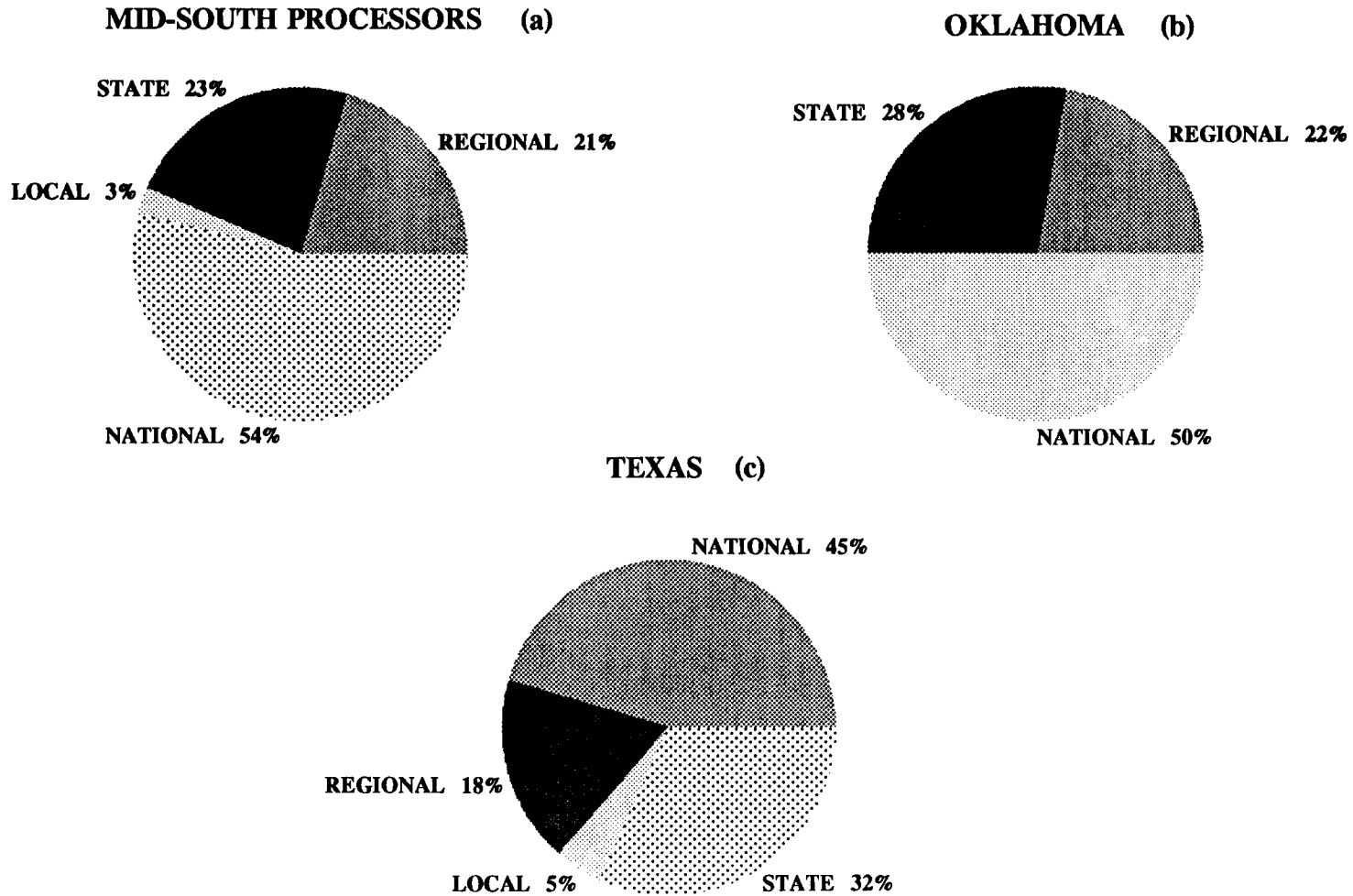


**TEXAS (c)**



**(a) Total respondents=26 (b) Oklahoma respondents=10 (c) Texas respondents=14**

**FIGURE 8. DISTRIBUTION AREAS OF MID-SOUTH  
FRUIT AND VEGETABLE PROCESSORS**



**(a) Total respondents=31 (b) Oklahoma respondents=13 (c) Texas respondents=16**

## **CHAPTER III.**

### **FRESH VERSUS PROCESSED FRUITS AND VEGETABLES: AN ANALYSIS OF DEMAND**

**ABSTRACT.** The demand for fruit and vegetable products has changed significantly over the last decade not only in terms of higher levels consumed but also the composition of the products consumed. This study empirically estimates the impact of economic and demographic factors on the demand for fresh and processed fruits and vegetables in the U.S. using the linear approximation of an Almost Ideal Demand System. A time-series based demand system analysis of the market for fresh and processed fruit and vegetable products in the U.S. is developed incorporating the effects of changes in prices and demographic factors using the AIDS model. Results reveal most price variable coefficients are highly significant. Several demographic factors also significantly affect the budget allocation for fresh as well as processed fruits and vegetables.

## **INTRODUCTION**

During the last decade, a number of significant changes have occurred in the food industry. An increase has been seen in per capita food consumption since 1970. This demand growth has been brought about by economic and socio-demographic factors such as changes in the level, distribution, and sources of income, the demographic composition of the population, consumer preferences, prices, foreign trade, and the increased consumer awareness of health and nutrition.

The general objective of this study is to identify key factors that have impacted the consumption of fresh relative to processed fruits and vegetables in the U.S. The linear approximation of an Almost Ideal Demand System (AIDS) is used to quantify the impact of economic and demographic variables on the demand for fresh and processed fruits and vegetables. The first section of the paper gives an overview of the fruit and vegetable



industry. Next, the theoretical framework, model specification, and procedures for the AIDS model used in this study are discussed. Sources and context of data are discussed next followed by results and conclusions attained from this study.

### **A PROFILE OF FRUIT AND VEGETABLE CONSUMPTION TRENDS**

The consumption of fruits and vegetables has increased by approximately ten percent from the early 1980's until 1994. The overall use of fruits and vegetables has increased in terms of fresh and processed products. Consumers are buying more fresh produce, frozen, and dried fruits and vegetables, canned tomatoes and canned fruit, and less fruit juice and canned vegetables. Per capita consumption of all vegetables (fresh and processed) rose about fifteen percent from 335.6 pounds in 1970 to 396.6 pounds in 1993. Consumption of fresh vegetables has risen by about ten percent since 1970. Processed vegetable per capita consumption has increased by nineteen percent with large growth being found in processed tomatoes and potatoes (Putnam and Allshouse, 1994). The quantity of vegetables used for freezing has increased while the quantity used for canning has declined. Not all canned vegetable consumption has declined but much has due to increased consumer demand for products with less sodium and preservatives.

Fresh fruit per capita consumption rose almost nineteen percent from 101 pounds in 1970 to 124 pounds in 1993. This increase was largely due to the significant increase in demand for fresh non-citrus fruit and melons. Processed fruit consumption has risen by a total of sixteen percent since 1970. Even though there is an increase in consumption over this time period, consumption of processed fruits has fluctuated up and down. An example of this fluctuation is seen by the consumption levels for 1991 and

1992. In 1991 consumption of processed fruits was 152 pounds per person and in 1992 consumption dropped by eight percent to 139 pounds per person (Putnam and Allshouse, 1994) . Over the last few years, there have been significant increases in the consumption of many fruit products such as frozen and dried fruits but there has also been profound decreases in fruit juices such as citrus juices and prune juice.

Many factors such as household composition, female labor force participation and nutritional aspects affect the consumer demand for food. The average household composition in 1993 was 2.63 which is down significantly from 4.8 persons per family in 1900 and 3.2 persons per family in 1970 (U.S. Department of Commerce). Some factors affecting the decrease include an increase in the number of single parent families and a decrease in the average number of children per family.

There has also been an increase of women entering the work force due to the rise in the cost of living, rise in single family dwellers, and rise in divorce. In 1970, there were 31.5 million women in the labor force compared to 58.4 million in 1993 (U.S. Department of Commerce). The number has almost doubled. This group of consumers demand convenience in preparation of foods at home as well as consumption away from home. Data on food expenditures show that female-headed households spend less money on food but this does not necessarily imply that they have lower food consumption or nutrition. Lower food expenditures may result from purchasing less food, more cheaper foods, less of costlier foods (such as convenience foods or more expensive food away from home), or a combination of these (Lutz, et al., 1993). However, this group of consumers spend about the same as two-parent households on fruit and vegetable

products (Frazao, 1993).

The trend from high fat, high calorie diets to low fat, low calorie diets has had significant affects on the entire food industry. Consumers have become more health conscious resulting in a greater demand for fruits and vegetables in order to fulfill their daily nutritional requirements. Encouraging fruit and vegetable consumption is a major emphasis of the Federal Government's dietary guidance policy (Putnam, 1994).

### THE AIDS MODEL

The demand model selected as the framework for this study is the Almost Ideal Demand System (AIDS) which was introduced by Deaton and Muellbauer (1980). The AIDS model has several distinct advantages over other demand models. A few advantages include: easy estimation, no priori restrictions are imposed on the degree of substitution among commodities, and the functional form is consistent with household budget data by allowing for nonlinear Engel curves. The AIDS model consists of simultaneous properties which are not seen in any other demand models (Deaton and Muellbauer, 1980).

The general AIDS model can be specified by:

$$W_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln P_j + \beta_i \ln (X/P) \quad (1)$$

where  $i$  and  $j$  are commodities in a separable group (fresh fruits, fresh vegetables, processed fruits, processed vegetables, and all other foods),  $W_i$  is the average budget share for the  $i$ th commodity,  $P_j$ 's are nominal prices,  $X$  is expenditure on all commodities in the separable group,  $\gamma_{ij}$ 's are the price coefficients,  $\beta_i$  is the

expenditure coefficient, and P is a price index defined as:

$$\ln P = \alpha_o + \sum_i \alpha_i \ln P_i + 1/2 * \sum_i \sum_j \gamma_{ij} \ln P_i \ln P_j \quad (2)$$

The index P from equation (2) makes equation (1) a nonlinear system of equations. To avoid nonlinear systems estimation, Stone's Index is used as a convenient approximation for P as suggested by Deaton and Muellbauer (pg.316).

Stone's Index is defined as:

$$\ln P^* = \sum_{i=1}^n W_i \ln P_i \quad (3)$$

Replacing  $P^*$  in equation (1) by the Stone's Index in equation (3) makes the equation the Linear Approximation of the Almost Ideal Demand System (LA/AIDS) (Blanciforti and Green, 1983).

Since  $X$  is total expenditure on all commodities in the separable group rather than total income, the demand system is a conditional one (Hayes et al., 1990). Implication is given that the demand for these fruit and vegetable products is separable with respect to the rest of the items in the consumer's budget. Consumers conceptually decide how much to spend on fruits and vegetables and then allocate this among the specific products. This indicates that elasticities are all first stage elasticities which are obtained from the first stage of a two stage budgeting system. The first-stage decision is based on price indexes for fruits and vegetables as well as other food and non-food groups. The demand relations in the second-stage for individual products within the fruit and vegetable categories are not estimated in this study.

Although LA/AIDS does not implicitly impose the theoretical restrictions of homogeneity, Slutsky symmetry, and adding up, these restrictions can easily be imposed. To conform to the classical constraints of demand theory, the following restrictions are imposed on the model:

$$\sum_{i=1}^n \alpha_i = 1; \quad \sum_{i=1}^n \gamma_{ij} = 0; \quad \sum_{i=1}^n \beta_i = 0 \quad \text{(Adding-Up) (4)}$$

$$\sum_j \gamma_{ij} = 0 \quad \text{(Homogeneity) (5)}$$

$$\gamma_{ij} = \gamma_{ji} \quad \text{(Slutsky symmetry) (6)}$$

Provided that equations (4), (5), and (6) hold, the estimated demand functions add up to total expenditure (4), are homogeneous of degree zero in prices and income taken together (5), and satisfy Slutsky symmetry (6) (Deaton and Muellbauer, 1980). Because the separable group expenditure shares ( $W_i$ 's) sum to one, the adding up condition is built in the model. That is, the adding up condition is always assumed to hold when the unrestricted model is estimated.

### MODEL SPECIFICATION AND PROCEDURES

In this study, a separable group composed of fresh fruits, fresh vegetables, processed fruits, processed vegetables, and other food is analyzed. Demographic variables used in the analysis are household size, number of women in the work force, and consumption of animal fat. Time trend was also considered in alternative specifications although it was left out of the model due to the high correlation found between time and the majority of the variables in the study. Most of the correlation coefficients were above .95.

Incorporating demographic and economic variables into the AIDS model as well as other demand models has become very prevalent. An example can be found in the study by Heien and Pompelli (1988) where the impacts of economic and demographic factors on the demand for steak, roast, and ground beef are estimated using the AIDS model. The LA/AIDS model for fresh fruits, fresh vegetables, processed fruits, processed vegetables, and other food, using  $P^*$  rather than  $P$ , and incorporating the demographic variables used in this study is specified as:

$$W_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln P_j + \beta_i \ln(X/P^*) \quad (7)$$

In this study demographic variables were incorporated into the AIDS model by allowing the intercept to be a function of demographic variables:

$$\alpha_i = \rho_{i0} + \sum_{j=1}^s \rho_{ij} d_j = 0 \quad i = 1, \dots, n \quad (8)$$

where  $d_j$  is the  $j$ th demographic variable of which there are  $s$ . Under this specification, the adding up criterion now requires that:

$$\sum_{i=1}^n \rho_{i0} = 1 \quad \sum_{i=1}^n \rho_{ij} = 0 \quad (j=1, \dots, s)$$

Through their influences on the budget shares ( $w$ 's), the demographic variables affect the magnitude not the sign of the price and income elasticities. Demographic variables do not affect the classification of goods as luxuries or necessities but they do however affect whether or not demand is elastic (Heien and Pompelli, 1988).

Due to the fact the product shares ( $W_i$ ) sum to one, a demand system with five individual expenditure share equations would be singular. Therefore, one of the

equations must be dropped to estimate the equations as a system. Other food was the deleted variable in this study. The parameters for the omitted equation can be calculated by using the adding-up restrictions in equation (4).

Providing no cross-equation restriction is used, equation (7) can be estimated using Ordinary Least Squares (Deaton and Muellbauer, 1980). Equation (7) can be estimated as a set of seemingly unrelated regressions with the symmetry restriction imposed. In this study, the seemingly unrelated regression procedure (SUR) in SAS was used to estimate the parameters of the system. Symmetry and homogeneity of zero in prices and expenditures are imposed on the system. Price and expenditure elasticities are calculated for each category from the estimated share values, although elasticities for other food are calculated predicted share values.

Two other models were also considered and estimated. These two models were Cobb-Douglas (double-log) model and the linear model. These models were considered because of the simplicity with which their parameters and elasticities can be related to the estimates found in the AIDS model. Consideration was also given to these two models in order to find the "best" model for the study. Several alternative specifications of these two models were estimated by dropping different variables to attempt to obtain statistically significant variables. This was done because of the high correlation that was found among several variables. The estimates did not indicate results that were consistent with economic theory.

Marshallian and Hicksian price elasticities are calculated from the following equations:

$$\epsilon_{ii} = -1 + \gamma_{ii} / W_i - \beta_i \quad (9)$$

$$\epsilon_{ij} = \gamma_{ij} / W_i - \beta_i * W_j / W_i \quad (10)$$

$$\epsilon_{ii}^* = -1 + \gamma_{ii} / W_i + W_i \quad (11)$$

$$\epsilon_{ij}^* = \gamma_{ij} / W_i + W_j \quad (12)$$

where  $\epsilon_{ij}$  's denote Marshallian elasticities and the  $\epsilon_{ij}^*$  's denote Hicksian elasticities.

Expenditure elasticities are computed as:

$$\eta_i = 1 + \beta_i / W_i \quad (13)$$

## DATA

Annual data covering 1970-1993 from the USDA series *Food Consumption, Prices, and Expenditures* (Putnam and Allshouse, 1994) constitute the major source of economic information used in the estimation of this demand system. Per capita consumption figures obtained were on a farm weight basis although conversion was made to a retail weight basis according to the conversion factors in Putnam and Allshouse. The prices used in the empirical analysis of this study are consumer price indices for each category in the study (fresh fruits, fresh vegetables, processed fruits, and processed vegetables). The consumer price index for all food is used as a substitute for the retail price of other



food (Gould, et al., 1990).

Expenditures for the first four categories (fresh fruits, fresh vegetables, processed fruits, processed vegetables) were obtained by multiplying prices times per capita consumption levels. Expenditures for other food were obtained by subtracting the first four expenditures from total per capita food expenditures. Household size data and number of women in the labor force were obtained from various issues of *Statistical Abstract of the United States* (U.S. Department of Commerce).

## RESULTS

The estimation revealed that fresh and processed fruits and vegetables compose an average of about thirty percent of the allocated total food budget share. In Table V, the parameter estimates of the AIDS model are given for fresh fruits, fresh vegetables, processed fruits, processed vegetables, and other food for the time series 1970-1993. The Cobb-Douglas (double-log) model and the linear model were also estimated. Both of these models showed patterns similar to the AIDS model but considerably fewer variables showed statistical significance and elasticities were more erratic among sizes. Therefore, because these models were conceptually and empirically inferior to the AIDS model, these estimation results are not shown.

Results indicate that many of the price and expenditure coefficients are significant with a large percentage being highly significant. The  $R^2$  for the estimated system is high (.95), indicating most of the variability in the budget shares (dependent variables) are explained by the independent variables. Table VI presents the Marshallian and

expenditure elasticities for the demand system. All of the own-price coefficients are statistically significant at the 1% level. As expected in economic demand theory, negative signs for the own-price elasticities are found for fresh fruit, fresh vegetables, processed fruit, and other food. The own-price elasticity for processed vegetables is positive. Justification for this could be made due to the demand for processed vegetables, especially frozen vegetables. The total per capita consumption of processed vegetables has risen by almost twenty percent since 1970 and the per capita consumption of frozen vegetables has risen by over forty percent. Even though prices for processed vegetables have continued to rise at a very rapid rate over this time period, consumers are still demanding more processed vegetable products. All expenditure elasticities are positive as expected from economic theory. All categories except other food have estimated expenditure elasticities between zero and one indicating these products are normal goods. The expenditure elasticities for the first four products are relatively close ranging from .7022 for processed fruits to .9023 for fresh vegetables.

The compensated (Hicksian) elasticities (Table VII) indicate whether the categories are net substitutes or net complements. Fourteen out of the twenty cross-price Marshallian elasticities in Table VI are negative indicating that the income effect outweighs the substitution effect in fourteen out of twenty cases in this study. Eight out of the twenty cross-price Hicksian elasticities are positive (Table VII). Positive cross-price Hicksian elasticities are net substitutes.

Each of the three demographic variables considered in the study were statistically significant for at least one of the studied categories. Results indicate that none of the

demographic variables were significant across all categories. This indicates the importance of observing the demand for fruit and vegetable products separately. Women in the labor force showed significant impacts on the budget share allocated to fresh fruits and fresh vegetables. Data shows that as the number of women in the work force has increased, the demand for these products has also increased. Surprisingly, significance was not found in processed vegetables. This may indicate that lumping all processed vegetables into one category does not capture the increased budget share allocated towards frozen vegetables and a decreased amount allocated towards canned vegetables by women in the work force. Household size was statistically significant for fresh fruit and fresh and processed vegetables. Results indicate as household size decreased, the demand for these products has increased. Smaller households demand smaller amounts as well as convenience when purchasing their food products. The consumption of animal fat was significant for fresh and processed vegetables indicating as the per capita consumption of fat declined, the budget allocation for fresh and processed vegetables has increased. This result seems to be consistent with the consumer trend of becoming more health conscious and cutting back on fat especially saturated fats which are mostly animal fat.

## **SUMMARY AND CONCLUSIONS**

This paper uses the LA/AIDS model to estimate price and expenditure elasticities of demand for five food groups: fresh fruit, fresh vegetables, processed fruit, processed vegetables, and other food. The AIDS model was expanded to include demographic variables by designating the intercept as a linear function of demographic variables. In

general, the price variable coefficients are significant. All products except fresh fruit and processed vegetables are net substitutes according to the Hicksian elasticities. The demographic variables used in the analysis were household size, women in the labor force, and consumption of animal fat. Different variables were significant for each commodity. One demographic variable was not consistently significant for all commodities in the demand system.

This demand analysis has shown there are strong cross-price effects among fruit and vegetable products. It has also shown that demographic variables impact each commodity in different ways. Demographic factors significantly affect the budget allocation for the commodities in this study. Difficulty is found when attempting to compare the results of this study to those found by other studies because data, time periods, and models are dissimilar.

The results indicate important information that can be used as a basis for the fruit and vegetable industry in meeting increasing consumer demand. Also, this study can be used as a reference for similar studies conducted in the future on the changing fruit and vegetable industry.

The results found in this study offer several explanations for the increased budget share allocation for fresh and processed fruits and vegetables. As shown in the body of the paper, demographic factors such as household size, women in the labor force, and consumption of fat are important aspects to the marketers of these products. Marketing efforts can be focused in the direction of consumer market segments which would consider allocating a larger percentage of their budget towards these fruit and vegetable

products if they were introduced to them in different packages or they displayed other added features. In conclusion, the results indicate positive aspects associated with considering additional consumer information along with new product information in assessing market opportunities for fruit and vegetable products.

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**TABLE V. PARAMETER ESTIMATES OF THE LA/AIDS MODEL,  
FRESH AND PROCESSED FRUITS AND VEGETABLES, 1970-1993**

VARIABLES	PRICE VARIABLES						DEMOGRAPHIC VARIABLES			
	CONST	FF	FV	PF	PV	OF	HS	CFAT	WILF	EXPEND
FRESH FRUITS	-.1611 (-2.337)*	.0451 (4.743)**	-.0060 (-.964)	-.0295 (-.322)**	.0056 (.592)	-.0151 (-.929)	.0706 (3.941)**	-.0007 (-1.492)	.0139 (2.637)**	-.0170 (-1.108)
FRESH VEGETABLES	-.1418 (-2.455)*	-.0060 (-.964)	.0845 (10.4)**	-.0228 (-2.5)*	.0020 (.242)	-.0575 (-4.28)**	.0752 (4.808)**	-.0008 (-1.992)*	.0107 (2.509)*	.0084 (-1.014)
PROCESSED FRUITS	.0938 (1.156)	-.0295 (-3.22)**	-.0228 (-2.56)*	.0569 (3.280)**	-.0126 (-.999)	.0081 (.383)	.0249 (1.112)	-.0008 (-1.343)	-.0153 (-2.48)	-.0233 (-1.7)*
PROCESSED VEGETABLES	-.0615 (-.651)	.0056 (.592)	.0020 (.242)	-.0126 (-.999)	.1402 (7.54)**	-.1351 (-6.43)**	.0905 (3.577)**	-.0016 (-2.351)*	.0032 (.453)	-.0280 (-1.7)*
OTHER FOOD	1.2706 (1.814)	-.0151 (-.920)	-.0575 (-1.033)	.0081 (.217)	-.1351 (-5.1)**	.1996 (3.629)**	.2581 (6.6)**	.0042 (4.71)**	-.0003 (-2.75)**	.0767 (2.37)

\*significance at 5% level

\*\*significance at 1% level

T-Values are in parentheses.

CONST=Constant, FF=Fresh Fruits, FV=Fresh Vegetables, PF=Processed Fruits,  
PV=Processed Vegetables, HS=Household Size, CFAT=Consumption of Animal Fat,  
WILF=Women in Labor Force

**TABLE VI. MARSHALLIAN DEMAND ELASTICITIES,  
FRESH AND PROCESSED FRUITS AND VEGETABLES, 1970-1993**

	FF	FV	PF	PV	OF	EXPEND
FRESH FRUITS	-.29	-.079	-.442	.104	-.123	.83
FRESH VEGETABLES	-.063	-.017	-.225	.033	-.599	.87
PROCESSED FRUITS	-.356	-.265	-.251	-.129	.300	.70
PROCESSED VEGETABLES	.541	.041	-.097	.336	-1.08	.73
OTHER FOOD	-.030	-.097	.002	-.216	-.775	1.12



**TABLE VII. HICKSIAN DEMAND ELASTICITIES,  
FRESH AND PROCESSED FRUITS AND VEGETABLES, 1970-1993**

	FF	FV	PF	PV	OF
FRESH FRUITS	-.238	-.007	-.377	.193	.429
FRESH VEGETABLES	-.005	.067	-.184	.130	-.0009
PROCESSED FRUITS	-.311	-.204	-.196	-.054	.765
PROCESSED VEGETABLES	.117	.105	-.039	.416	-.599
OTHER FOOD	.041	-.0002	.090	-.096	-.035

VITA

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Candidate for the Degree of

Master of Science

Thesis:            **AN ECONOMIC ANALYSIS OF THE PROCESSED  
FRUIT AND VEGETABLE INDUSTRIES**

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