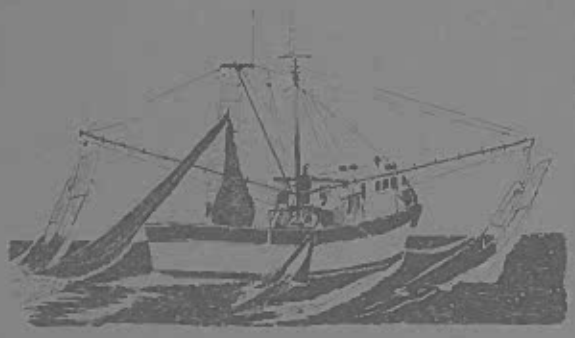
THE TEXAS SHRIMP INDUSTRY

A Briefing Report



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Acknowledgment

This report is essentially derived from data provided by two individuals. One is employed by the Federal government, and the other operates a firm that has been long-recognized for timely and accurate price reports covering a variety of agricultural products.

All production data were provided by Ms. Margot Hightower with the National Marine Fisheries Service's Statistical Operations Team in Galveston. The discussion and analysis of wholesale prices is based solely on materials that have been graciously provided by Mr. Paul B. Brown, Jr., of Urner Barry, Inc., publisher of the twice weekly market news report *Seafood Price Current*. We are indebted to Ms. Hightower, the National Marine Fisheries Service, Mr. Brown, and the firm of Urner Barry, Inc., for providing us with such a timely source of production and pricing information that contributes to what we feel is the in-depth nature of this report.

The U.S. food industry relies on timely, precise information. Collecting, validating and summarizing such data are not trivial procedures. Specific skills and a significant commitment of time are required to complete this task. Both Ms. Hightower and Mr. Brown have gone out of their way to provide us with materials from which we can draw conclusions. Without their respective contributions, this report would not be possible.

Improvements in this publication have been made by thoughtful reviews from the following individuals connected with Texas A&M University: Richard A. Edwards (Professor and Extension Specialist; Economist — Agribusiness), Gary Graham and Russell Miget, (both Associate Professors and Extension Specialists — Marine Fisheries), Mike Hightower (Deputy Director, Sea Grant College Program), and William R. Younger (Matagorda County Marine Extension Agent).

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Texas Marine Advisory Service
TAMU-SG-92-501
July 1992

Publication of this document was supported in part by Institutional Grant NA16RG0457-01 to Texas A&M University from the National Sea Grant Office, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and by funds provided by The Texas Shrimp Association.

Executive Summary

The purpose of this report is to present current trends and conditions in the Texas shrimp industry and evaluate how these factors impact individual production, processing and marketing firms. In 1991 landings continued the gradual increase that began in 1989. Last year's landings were among the top five harvests in the last 32 years, amounting to 59 million pounds of shrimp tails. The nominal value of the catch also increased through the combination of increased landings, generally improved market prices, and a greater proportion of larger shrimp comprising aggregate landings. The only other year that posted a higher nominal landed value than last year's $197 million was 1986 with $229.6 million.

The processing and marketing section addresses contemporary operational practices of shoreside facilities, particularly as they relate to maintenance of profitability in an environment of continual, often unpredictable, price changes. Since shrimp is traded worldwide, pricing is constantly in a state of flux as the market responds to supply changes. Despite the size of the world shrimp market, there are no marketing tools that enable processors to protect their inventory values. Thus, the financial community has had two prime questions: "What happens to inventory values?" and "What tools can processors use to minimize the deleterious impact of price declines?"

The effect of price variation on inventory values is estimated using periodic prices. Obvious limits exist in such estimates, not the least of which is the implicit assumption that processors make purchases in the wholesale market. While processors may, at certain times of the year, purchase raw materials from one another to complete an order, the majority of shrimp is purchased from fishermen. Thus, the computed percentage changes in inventory value represent a worst case scenario.

Inventory values fluctuate by year, quarter, inventory turnover and count size. In 1990 wholesale prices for most sizes continued to recover from 1989. Not surprisingly, out of the 24 quarters evaluated in 1991 (four quarters per year multiplied by six count sizes of shrimp), 17 of these reflected appreciation in inventory value. Some quarterly changes are a direct response to differences in supply. Most notable are the systematic declines in inventory value that occur in the third quarter of each year due to extensive production occurring within that time frame (roughly half of all shrimp produced in 1991 were harvested in the third quarter). Maximum devaluation using the computed inventory turnover ratio of 42 days for 16-20, 26-30, 31-35, 36-40, and 41-50 count shrimp were: -11.60 percent, -8.02 percent, -8.42 percent, -8.14 percent and -7.44 percent, respectively. Processors are accumulating inventory during this quarter, rather than holding it, so these devaluations are less relevant to profitability than they may seem. Factoring out the obvious declines in response to the opening of the Gulf of Mexico in mid-July, devaluation of inventories in other quarters was much less pronounced except in the 21-25 sizes. Using the same turnover rate of 42 days for 16-20, 26-30, 31-35, 36-40 and 41-50 count shrimp, these maximum declines were: -4.01 percent, -5.25 percent, -4.83 percent, -5.42 percent, and -5.02 percent, respectively.

The count size 21-25 presents a unique challenge to the domestic industry since the data pertaining to imports and wholesale price movements suggest that this size is the "black tiger" shrimp cultured in Southeast Asia. Any time the supply of an item abruptly increases, the price weakens. The relatively high prices for large shrimp are, in part, attributed to their relative scarcity compared to more abundant medium sizes. Thus, the historic bellwether of the industry, large shrimp, may be losing some of its prominence in response to greater supplies that return relatively lower and more volatile prices. With most processors diversifying their customer base with a greater proportion of retail business, and because mid-sized shrimp lend themselves to various additional processing methods, these size intervals are becoming the new hallmark of consistency.

While there are no methods to protect inventory values, successful processors rely on a combination of techniques to minimize the impact of constant price changes. Among these are marketing a greater proportion of more convenient shrimp products with gross margins substantial enough to weather periodic depressed prices; a quick turning inventory given the constraints inherent in purchasing, preserving and holding a seasonally produced item; and diversification into other marine foods.

The U.S. market for shrimp is roughly 800 million pounds (NMFS, 1991)[1,2]. Because demand far exceeds domestic landings, shrimp are imported from practically every tropical and subtropical coastal country in the world. Domestically produced shrimp maintains about a 30 percent share of the total U.S. market. While the domestic market share has declined over time, this has occurred because of significant growth in the total shrimp market, *not* declines in production levels.[3]

The Texas shrimp industry is a mature, sophisticated component of the state's larger food production, processing and marketing complex that harvests an open access resource, processes indigenous harvests as well as imports, and distributed a wide line of shrimp products nationwide. Shrimp remains the kingpin of the Texas seafood economy. Much of the industry's historic success has resulted from two primary factors: The insightful entrepreneurial spirit of both fishermen and processors and effective partnerships with financial institutions to meet various credit requirements inherent in food production and processing industries.

Today, commercial lenders require more information in evaluating loan requests than ever before. While a borrower's financial position is still at the heart of a lender's decision, industrial performance data are playing a larger role in helping financial institutions position, maintain and justify their credit policies and loan portfolios. Against this backdrop of ever-increasing information needs, it is unfortunate that the information base for commercial fisheries is small and fragmented compared to that of other sectors. Also, what data are available have seldom been summarized and shred with financial institutions.

The first such report was produced and distributed in 1991 with the expressed purpose of helping commercial lenders better understand the size and current operating conditions of the Texas shrimp industry. The current effort seeks the same objective of communicating pertinent information about Texas' largest commercial fishing industry by highlighting parameters that reflect current conditions in the production and processing sectors. Specifically, this report focuses on the two broad areas of production history from both long- and short-term viewpoints and marketing conditions confronting processing interests.

The summary of national market conditions has been omitted because necessary statistics for 1991 are not released until late in the second quarter of 1992, and including these data would postpone the report. With Gulf production beginning in earnest in July, the authors believed more utility would be gained by omitting the national information and presenting the most current (1991) Texas profile early enough for decision-making purposes.

Superscript numbers refer to End Notes.

Texas Shrimp Production

Historical overview

History views shrimp as a seasonally available product that was harvested at the mouths of bays in Spring and early Summer. Today, shrimp are harvested in each month of the year. This changed from seasonal to year-round production is the result of producers' collective vision and drive to excel. Early on, fishermen began devising, testing and redesigning their fishing gear so they could actively hunt shrimp. Additionally, pioneering fishermen began exploration of Gulf waters for shrimp, ultimately discovering the brown shrimp (*Penaeus aztecus*) that, today, accounts for roughly 80 percent of Texas shrimp landings. With efficient gear and abundant offshore shrimp resources, production rapidly increased.

Texas maintains two shrimp fisheries. The bay industry focuses on the interconnected coastal bay system from Sabine Lake to Corpus Christi Bay, while the offshore sector specializes in shrimp production Gulfwide.[4] Those in the bay shrimp fishery typically use smaller craft and return to port on a daily basis. Additionally, many bay operators may shift to production of oysters from public reefs in those months when shrimp fishing is considered marginal or when the season is closed.

Conversely, the economics of offshore seafood production and the rigors of the unpredictable Gulf environment have necessitated the use of much larger vessels capable of remaining at sea for extended periods of time. Rather than switching fisheries as most bay fishermen do, many offshore operators traverse the Gulf of Mexico, attempting to take advantage of seasonally abundant shrimp from Florida to Texas. In contrast, some producers prefer to concentrate their efforts in selected regions near their homeport.

Resource management measures differ between bay and Gulf shrimp fisheries as well. The Texas Parks and Wildlife Department manages shrimp resources through the Texas Shrimp Fisheries Management Plan in the coastal bay complex as well as Texas' portion of the territorial sea (from the beach out to nine nautical miles). Bay shrimp management is accomplished primarily by seasons. Bay shrimp seasons are from mid-May through mid-July and again from mid-August through mid-December.

The federal portion of the Gulf (from nine to 200 nautical miles offshore) is managed by the National Marine Fisheries Service in conjunction with the Gulf of Mexico Fisheries Management Council. Federal management is generally consistent with that of the Texas Parks and Wildlife Department. The most noticeable Gulf shrimp management measure is the "Texas Closure," which prohibits shrimp production in the Gulf off Texas from mid-May through mid-July so smaller shrimp have more opportunity to grow in offshore waters and, thus, become more valuable.

Three components of Texas shrimp production are presented in this section. First, 1991 production is summarized. Next, long-term trends in Texas shrimp production are presented, which provides a perspective of the inherent variability in harvests over time and the changes in harvests between the bay and Gulf sectors. Finally, the seasonality of harvest is updated from the 1990 report by examining reported 1991 monthly shrimp production data for both the bay and Gulf fisheries.

Review of 1991

Texas shrimpers collectively produced 59 million pounds of shrimp (expressed on a shell-on, headless weight basis) in 1991.[5] This was 2.6 million pounds (4.5 percent) above 1990, and almost 9 million pounds (15 percent) above 1989 harvests. While not a record harvest, this level of production has been surpassed in only four of the last 32 years.

These 59 million pounds had an ex-vessel value of $197 million. Landed value increased $21 million (12 percent) above 1990, and roughly $40 million (20 percent) above 1989. Landed value is influenced by:

- Volume of the catch;
- composition of the catch (i.e., the proportion of small, medium and large shrimp); and
- market conditions that determine per pound prices.

As the season opened last July, producers reported harvests of relatively large shrimp. Therefore, with a greater proportion of larger, more valuable shrimp comprising the catch, landed values increased. Production in 1991 was just 4.5 percent above that recorded for 1990, yet landed value was up 12 percent. Therefore, the *primary* contributors to increased dockside value were a greater proportion of larger shrimp in the catch and slightly improved market prices over those reported in 1990.

Historical annual shrimp landings

Aggregate Texas Landings. Between 1960 and 1991, Texas shrimp landings have averaged 50 million pounds (Figure 1). Importantly, there is no discernible long-term trend in these data. Rather, landings vary in an irregular, cyclical pattern. This suggests the difficult, imprecise nature of forecasting relative abundance and composition of annual catches.

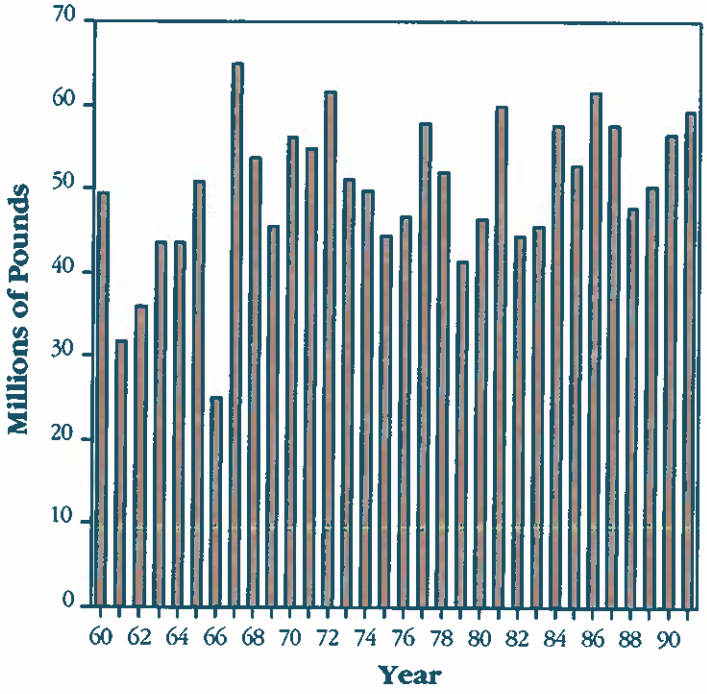

Figure 1. Texas shrimp landings 1960 through 1991.

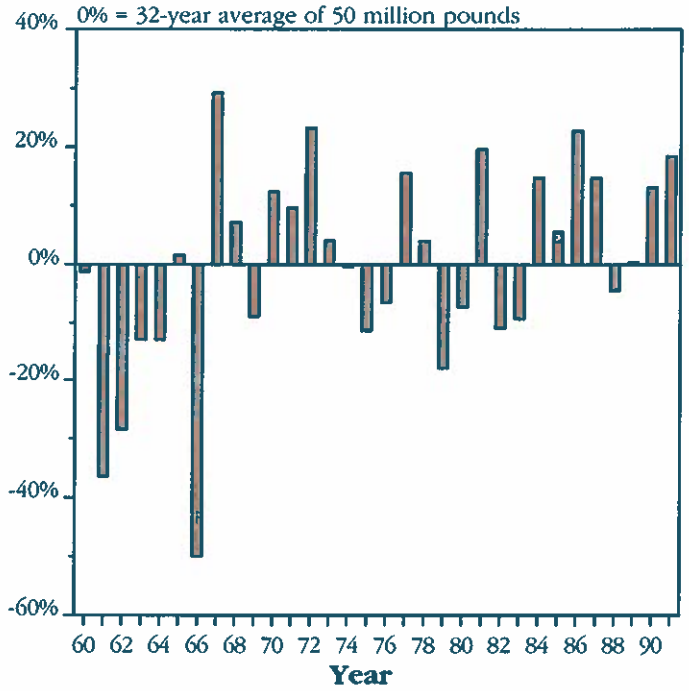

Figure 2. Percentage difference between annual Texas landings and the computed 32-year average.

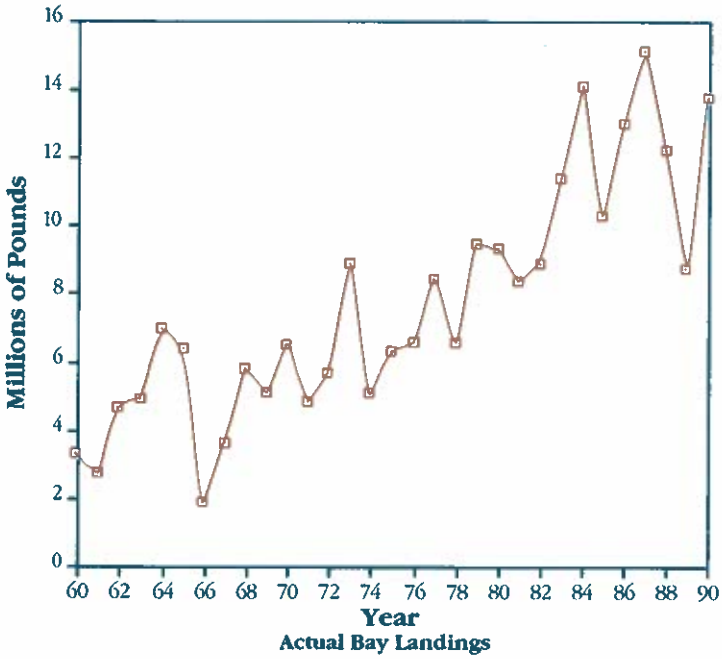

Figure 3. Trends in shrimp landings from the Texas bay complex, 1960 through 1991.

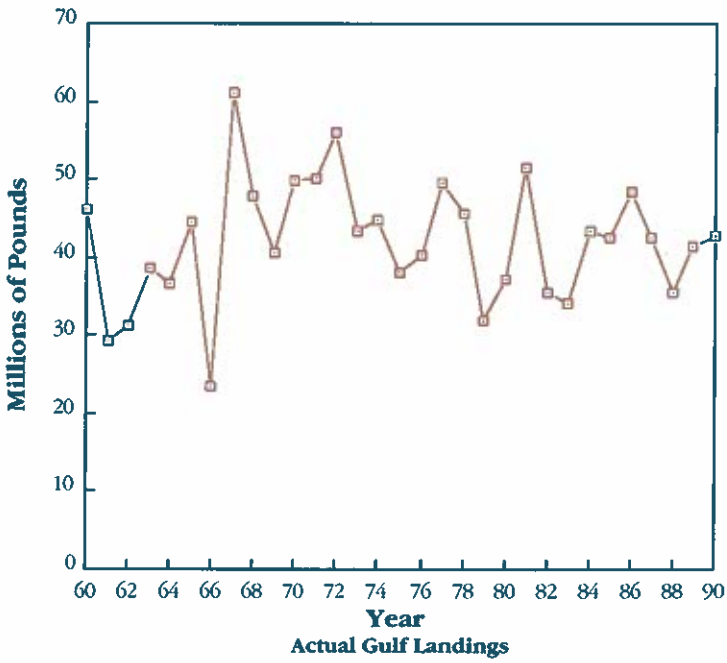

Figure 4. Trends in shrimp landings from the Texas offshore fishery, 1960 through 1991.

Annual Texas shrimp production has been somewhat erratic, ranging from 30 percent above the historic mean to 50 percent below the 32-year average (Figure 2). Annual shrimp production has at least equaled 60 million pounds in only four of the last 32 years—1967, 1972, 1981 and 1986. Yearly harvests of less than 40 million pounds were recorded during 1961, 1962 and 1966. Such annual fluctuations are a common condition since shrimp abundance is more dependent on environmental conditions and is less impacted by fishing effort.[6] Perhaps the best example of the effect environmental conditions have on production can be found in historical minimum and maximum harvests. A paltry 25.1 million pounds was produced in 1966. The *following year*, shrimp production amounted to 64.8 million pounds, the largest harvest on record.

Production Trends for the Texas Bay Complex. Since 1961, shrimp produced from the coastal bays has gradually trended upward, accounting for an increasing share of total harvests (Figure 3). Another way to examine this is by computing average annual landings over three ten-year periods that correspond to each of the three decades for which data are complete.[7] Between 1960 and 1969, bay shrimp production comprised 10.3 percent (4.6 million pounds) of average total landings in that decade. In the 1970s, average landings from the bay complex amounted to 6.9 million pounds, contributing 13.3 percent of the total, average, Texas shrimp production. During the 1980s, a substantial increase in the proportion of shrimp harvested in the coastal bay complex occurred. Bay shrimp landings average 21.4 percent (11.2 million pounds) of total average landings between 1980 and 1989.

Production Trends in the Gulf of Mexico. Shrimp harvests from the Gulf of Mexico have neither systematically increased nor decreased over time (i.e., no discernible trend) in the last 32 years (Figure 4). Gulf producers have, on average, landed 84 percent of all shrimp caught in Texas since 1960. Because of this, annual variations in offshore production tends to mirror that in the more aggregated data depicted in Figure 1.

Monthly 1991 shrimp production

Seasonality is an important concept in the fisheries with implications for production and earnings whether it is a naturally occurring phenomenon or mandated as a resource management tool. Lenders should recognize how different times of the year affect production possibilities, and, therefore, the ability to repay funds. Monthly production data for both the bay and offshore Texas shrimp fisheries show that once a season begins, landings rapidly increase primarily because the shrimp are more concentrated. This makes production more efficient. Conversely, having a vessel non-operational around the opening of these seasons may mean forfeiture of a large percentage of total, annual revenue and difficulty in meeting the current portion of financial obligations.

Last year the offshore sector produced 3.5 times more shrimp than the bay complex (46 million pounds versus 13.1 million pounds). At $171.5 million, however, the value of Gulf shrimp is 6.7 times that of total bay shrimp landings ($25.6 million). This difference in value exists because the offshore sector harvests larger, more valuable shrimp. In 1991, the computed ex-vessel price per pound for the bay sector was $1.95 as compared to $3.73 for the Gulf industry.

Bay Shrimp Production. The bay shrimp fleet produced 13.1 million pounds of shrimp (shell-on, headless weight) worth $25.6 million in 1991. This comprised 22 percent of the 1991 Texas shrimp harvest and 13 percent of total landed value. Between January and April, cumulative *bait* shrimp landings in the coastal bay complex amounted to 587,150 pounds, which is roughly 4.5 percent of annual bay shrimp production.[8] With the opening of the spring season (mid-May to mid-July), however, bay shrimp landings and corresponding ex-vessel value significantly increase (Figure 5, Table 1). Last year during the 60-day spring season, 7.9 million pounds were produced with an ex-vessel value of $12.2 million. This season alone contributed to 60 percent of annual production and 47.6 percent of corresponding landed value generated from the Texas bay complex.

Offshore Shrimp Production. Gulf shrimp production in 1991 amounted to 46 million pounds (shell-on, headless weight) worth approximately $171.5 million. Except for the closure off Texas between mid-May and mid-July (the exact interval of time is set by the Texas Parks and Wildlife Department), offshore production occurs year-round.[9] Between January and June, cumulative landings accounted for 10.9 million pounds worth $42.8 million, or about 25 percent of total offshore production and landed value (Figure 6, Table 2). Once the annual closure was lifted and the Gulf off Texas re-opened, however, 29 percent of total annual production was harvested in just two weeks.

Table 1. Monthly Shrimp Production and Corresponding Ex-Vessel Value for the Texas Bay Shrimp Fishery: 1991.

	Landings (1,000 lb.)				Ex-Vessel Value ($1,000)			
	Monthly		Cumulative		Monthly		Cumulative	
Month	Lbs	Pct	Lbs	Pct	Dollars	Pct	Dollars	Pct
1	31.25	0.2	31.25	0.2	84.88	0.3	84.88	0.3
2	79.38	0.6	110.63	0.8	187.04	0.7	271.92	1.1
3	109.56	0.8	220.19	1.7	325.28	1.3	597.20	2.3
4	366.96	2.8	587.15	4.5	990.32	3.9	1,587.51	6.2
5	3,370.22	25.6	3,957.37	30.1	4,993.32	19.5	6,580.83	25.7
6	3,123.82	23.8	7,081.19	53.9	4,495.35	17.6	11,076.19	43.3
7	1,413.14	10.8	8,494.33	64.6	2,680.22	10.5	13,756.41	53.8
8	1,065.80	8.1	9,560.13	72.8	3,026.79	11.8	16,783.20	65.7
9	1,087.66	8.3	10,647.79	81.0	2,978.80	11.7	19,762.00	77.3
10	2,213.77	16.8	12,861.55	97.9	5,371.26	21.0	25,133.26	98.3
11	200.57	1.5	13,062.13	99.4	293.18	1.1	25,426.44	99.5
12	77.78	0.6	13,139.90	100.0	133.11	0.5	25,559.55	100.0

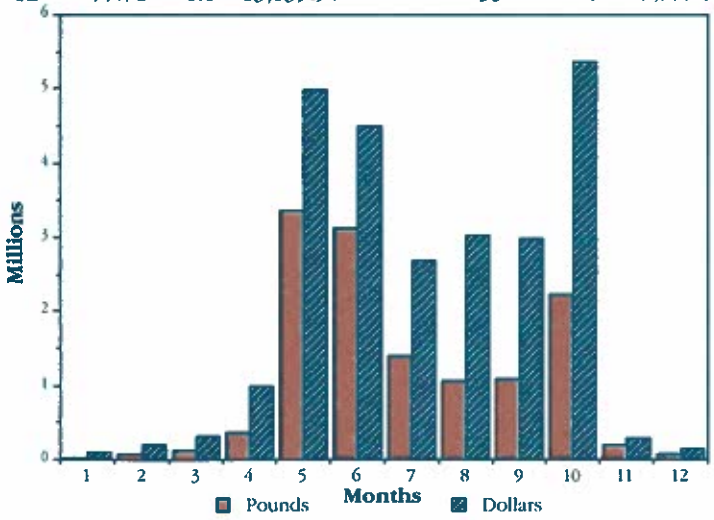

Figure 5. Monthly landings and ex-vessel value for the Texas bay shrimp fishery, 1991.

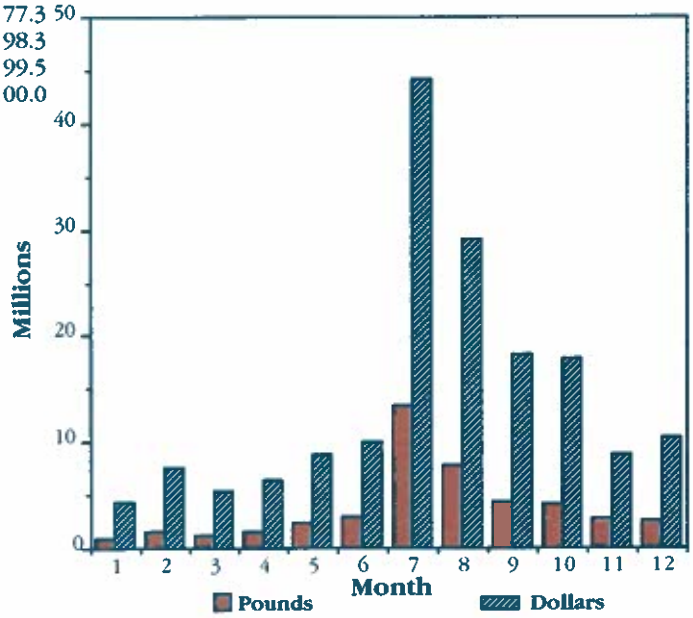

Figure 6. Monthly landings and ex-vessel value for the Texas Gulf shrimp fishery, 1991.

Table 2. Monthly Shrimp Production and Corresponding Ex-Vessel Value for the Texas Offshore Shrimp Fishery: 1991.

	Landings (1,000 lb.)				Ex-Vessel Value ($1,000)			
	Monthly		Cumulative		Monthly		Cumulative	
Month	Lbs	Pct	Lbs	Pct	Dollars	Pct	Dollars	Pct
1	965.27	2.1	965.27	2.1	4,513.23	2.6	4,513.23	2.6
2	1,596.52	3.5	2,561.78	5.6	7,530.67	4.4	12,043.91	7.0
3	1,251.02	2.7	3,812.80	8.3	5,464.33	3.2	17,508.23	10.2
4	1,694.51	3.7	5,507.31	12.0	6,405.77	3.7	23,914.01	13.9
5	2,319.77	5.0	7,827.09	17.0	8,844.68	5.2	32,758.68	19.1
6	3,080.53	6.7	10,907.62	23.7	9,994.34	5.8	42,753.03	24.9
7	13,377.73	29.1	24,285.35	52.8	44,222.21	25.8	86,975.23	50.7
8	7,768.20	16.9	32,053.55	69.6	29,073.00	17.0	116,048.23	67.7
9	4,330.26	9.4	36,383.80	79.0	18,329.61	10.7	134,377.84	78.4
10	4,272.02	9.3	40,655.82	88.3	17,937.51	10.5	152,315.35	88.8
11	2,720.02	5.9	43,375.84	94.2	8,775.89	5.1	161,091.24	93.9
12	2,662.32	5.8	46,038.16	100.0	10,390.71	6.1	171,481.94	100.0

*Processing and Marketing Shrimp**

Historical Overview

Investment in shoreside processing facilities was a natural reaction to increased, year-round shrimp harvests. Still, shrimp processors initially faced monumental product preservation and materials handling dilemmas. Just as pioneering shrimp fishermen invented, adapted and explored to boost harvests and productivity, processors also found solutions to their problems.

Specially designed freezing equipment enabled processors to inventory shrimp for sale throughout the year. Today, practically all shrimp are distributed and sold in the frozen state. Likewise, as Texas processors began marketing shrimp according to count sizes (i.e., the number of tails per pound), some objective, efficient means of sorting shrimp into customary size intervals was required. This equipment, developed in Harlingen, Texas, is still the standard means worldwide for classifying shrimp by size.[11]

Success in processing and marketing shrimp was first measured by a processor being able to meet year-round commitments. Typically the market for shrimp was best during the first half of the year, but production occurred during the second half. Thus, processors purchased shrimp when it was available, held it in frozen storage, and drew down inventories between January and June. With ex-vessel price inversely proportional to local abundance and knowing that wholesale prices typically increased during the first half of the year, earnings from inventory speculation became a significant revenue stream for many processors.

Inventory speculation still occurs as a normal course of business operations, which should be expected considering the inherent lag between purchases of raw materials, processing and sales.[12] Holding inventory for the sole purpose of anticipated price increases is now the exception among most processors, however, since several related conditions have diminished the advantages but increased the costs and risks of this practice. These conditions include greater availability of shrimp throughout the year; less definitive information about total quantities, relative proportion of count sizes comprising overall supplies, and price; and less change in seasonal prices among certain size categories.

Greater Availability of Shrimp. Greater year-round availability of shrimp facilitates purchase of various sizes from many tropical or subtropical coastal countries worldwide. With shrimp products such as shell-on, headless varieties (the raw material for most full line processors) traded along commodity lines, large quantities can be procured with a telex, fax or telephone call.

Less Information About Quantity and Size Composition. Shortly after World War II, U.S. shrimp prices were routinely set by conditions in the Texas shrimp industry. Today, however, local conditions are less important in determining prices. This makes the computation of appropriate offering prices (i.e., boat or ex-vessel price) more difficult since buyers must set a price high enough to attract producers but low enough to prevent amassing overpriced inventory. Limited information about quantity and count size composition also subjects inventory to a greater risk of unexpected price changes.

In agriculture, unexpected price changes are a common phenomenon at both the producer and processor levels. Unlike other widely traded agricultural commodities such as livestock, grain, cotton, etc., there is neither a futures market for shrimp nor an established practice of forward contracting shrimp prices. Without these marketing tools, no mechanism exists for processors to protect historic inventory values.

Less Change in Price. Because of aquaculture, *certain sizes* of shrimp have become more prevalent in the market, thereby changing the traditional contribution each count size makes to total supply. With larger, more stable supplies within some size categories, the amplitude of price changes over time has become less pronounced. This reduces the risk of adverse price changes, but also reduces the potential margins from speculation.

Current operating characteristics

Today, shrimp processing and marketing firms are judged successful not by the amount of raw materials they can stockpile but rather how efficiently products can be manufactured that meet market needs. These firms are mainstream players within the meat processing sector, and the extent of shrimp processing varies by facility. The least processed product sold through customary marketing channels (i.e., producer → processor → distributor → retail interests) is the shell-on, headless form that has been sorted by size, packed in 5-pound boxes, block frozen and mastercartoned into 50-pound cases. These steps have not changed appreciably over the years, and a few firms still specialize in this level of processing activity.

As processing, marketing and distribution functions have become more technical, complex, regulated, expensive and risky while being potentially more profitable, shrimp processing establishments have responded by becoming larger. Many processors maintain a full line of shrimp products determined by a combination of:

**Refer to End Note 10.*

- The extent of convenience or value (e.g., peeled, breaded, ready-to-eat, etc.);
- freezing method, which produces blocks of product or singly frozen shrimp;
- mode of packaging (bulk or full-view consumer containers).

Most of these firms have even diversified into other marine foods. This is a logical strategy for a successfully performing brand that increases sales opportunities and improves competitive advantage. Such diversification also improves the firm's weighted average gross margin and ensures more complete utilization of processing and distribution assets.

Historically, processors focused on serving the shrimp needs of the food service sector. Today, processing establishments seek a customer base comprised of firms in both the food service and retail food sectors. By relying on sales from such a broad, diversified customer base, cyclical and credit risk are reduced.[13] The specific type of customer served in each sector is based, in part, on geography. Processors frequently deliver directly to retail interests (both food service and retail food firms) within a certain geographic radius, but distribute to wholesale firms outside their primary service area that, in turn, drop ship to retail accounts. The decision to serve end users or use intermediaries is primarily based on the processor's balancing reuqired service against distribution cost.

Increased processing capacity has necessitated expansion of both geographic trading areas and product lines. Current assets are required to fuel this expansion, and most processors' capital needs are generally skewed toward short-term borrowing. All processing and marketing firms need credit to fund accounts receivable. Shrimp processors also need significant short-term credit to fund inventories because of the high unit cost of purchases as compared to other meats and the need to accumulate shrimp during peak production periods for later processing and sale. The nature of such short-term borrowing suggests that lenders examine both an individual firm's credit policy and the extent to which price variation may impact inventory value. Credit policies are individual decisions and are not addressed in this report. Price discovery, price variability and the derived changes in inventory valuation are subsequently discussed for a range of count sizes.

Components of shrimp value

The essence of shrimp value is size, with larger shrimp always commanding higher unit prices relative to smaller ones. Shrimp are classified according to count size, which refers to the number of shrimp comprising one pound. For example, with 16-20 count tails the buyer expects the pack to average 18 tails per pound and be comprised of shrimp that range in size from 16 per pound to 20 per pound. As shrimp size decreases, the range of individual sizes comprising each interval increases. This size range can be as small as 2 (e.g. from 10 to 12 per pound or 13 to 15 per pound), and as wide as 100 (e.g. 201 to 300 per pound). The shrimp market is segmented along a series of sizes, with each count size having its own niche in the market. Large shrimp (e.g. shrimp no smaller than 21 to 25 to the pound) are typically marketed in more exclusive restaurants while mid sized shrimp (e.g. 31 to 35 through 41 to 50) are a mainstay in moderately priced food service establishments and the retail food sector.

The unit price is also influenced by market form, with more convenient forms such as shrimp peeled from 36 to 40 count tails commanding higher prices than the unpeeled 36 to 40 tails. While the two main determinants of value are size and market form within a count size, other factors such as country of origin, pack style, color and species affect final price. Regardless of species, most users consider all penaeid shrimp of the same or contiguous count size to be substitute products.

Pricing

Boat Level. Ex-vessel and wholesale prices typically move in concert since the reported wholesale value is used as the benchmark from which boat prices are computed. However, fishermen typically land a distribution of sizes. Therefore, some means is required to categorize boat-run shrimp into customary size intervals since each count size has a unique price. In Texas, the classification method used depends upon where unloading occurs.

The Brownsville and Port Isabel ports use the "pack out" method. With this approach, all shrimp pass through mechanical sorting equipment that objectively measures the diameter of the tail. Once sorted, the producer knows the exact quantity of each count size produced. Moving up the coast from the Rio Grande valley, another approach is used to compute ex-vessel value. This is known as the "box weight" method, and, rather than using mechanical grading technology, it relies on a "grab" sample chosen from every 100-pound box the producer lands to determine count size. This classification method is strong impetus for producers to sort shrimp aboard the vessel so that each box is as homogeneous as possible.

Wholesale Level. Wholesale prices are the manifestation of a world-traded commodity entering the U.S. duty free.[14] The price for each particular size is dependent on current supply, supplies of similarly sized shrimp, and individual needs of buyers. Prices of most all count sizes *tend* to move in the same direction over time. However, price variation within some count sizes can be dra-

matic. This typically occurs when the supply of a particular size abruptly changes (Figure 7). In 1989, the wholesale price of 16-20 and 21-25 count Gulf brown shrimp declined about 35 percent between January and December. This price drop was in response to significant quantities of black tiger shrimp (*Penaeus monodon*), a large shrimp cultured in Southeast Asia, being diverted to the U.S. rather than Japan, the traditional marketplace for "black tigers."[15]

A situation similar to that in 1989 occurred last year. In the first half of 1991, shrimp prices continued the recovery that began in 1990. But beginning in May, prices for most sizes declined. Two factors account for this decrease. Last year a significant proportion of shrimp imports were 21-25 counts or larger, and 31-40 sizes. According to import data collected by the U.S. Customs Service and reported by the National Marine Fisheries Service, these large shrimp accounted for 40 percent (121 million pounds) of all shell-on headless shrimp entering the U.S (Koplin, 1992).[16] Besides imports of large-sized shrimp, local processors reported larger than normal shrimp being produced once the "Texas closure" was lifted. This further depressed the price for large shrimp. Mid-sized shrimp fared similarly since roughly 18 percent of all imported shell-on, headless product was in the 31-40 count range (54 million pounds).[17] Such changes in supply with concomitant price responses provide graphic evidence that the only consistency in shrimp prices are their constant state of flux.

Annual Summary of Wholesale Prices by Count Size. This section focuses on the past five years of wholesale shrimp prices, and presents some rudimentary analyses as a means of assessing the risk that processors accept with various count sizes.[18] Landed values increased last year, in part because of improved market prices. Average, nominal prices for 1991 were up for all sizes except 21-25 counts (Figures 8 through 19). Examining the computed average annual wholesale price on a count size basis indicates that 16-20 counts increased by 6.6 percent ($6.59 vs. $6.18 in 1990), 26-30 counts increased by 6.4 percent ($5.12 vs. $4.81 in 1991), and 31-35 counts increased by 3.2 percent ($4.51 vs. $4.37 in 1990). The 36-40 and 41-50 count sizes were roughly equivalent to those in 1990. A 1.3 percent decrease ($5.42 vs. $5.49) was noted in the 21-25 count size over 1990.

Visually scanning annual and monthly price plots of each count size provides few clues in estimating future prices. To examine why prices change as they do, each count size was subjected to an objective evaluation of the contribution trend and seasonal effects have on explaining total variation of monthly prices between 1987 and 1991. These results are expressed in percentage terms, with discrete values computed for trend and seasonal effects. The difference between 100 percent and the summation of trend and seasonal percentages is designated as a residual percentage.[19] This procedure is generally used for preliminary screening of time series data to ascertain which type of model best "fits" the data set and, therefore, would provide the most accurate forecast.

Unfortunately, variation in price for each count size was "explained" with different percentages of trend, seasonal and residual variation (Figure 20, Table 3). The contribution of trend was most pronounced among large shrimp: 48 percent for 16-20 counts and 49.5 percent for 21-25 count shrimp. For sizes smaller than 21-25 per pound, the importance of trend effects are significantly reduced. On the other hand, seasonal variation was a significant component of total variation in these smaller count sizes, accounting for 36 percent to 67 percent of total variation. Most troubling among all count sizes was the relatively high percentage of residual (unclassified) variation that ranged from 22 percent for 36-40 counts to 39 percent for 41-50 counts. The conclusion drawn from this evaluation is that each count size is influenced by varying degrees of trend and seasonal variation, with a significant percentage of variation remaining unclassified. This suggests that forecasting would have to be done for each count size using a different type of model. The implication is simply that since prices are influenced by a number of variables, timely, accurate forecasts of shrimp prices are all but impossible.[20]

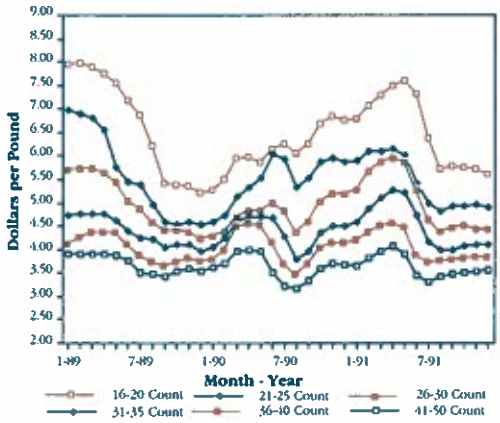

Figure 7. Computed average monthly wholesale prices for shell-on headless shrimp, 1989 through 1991.

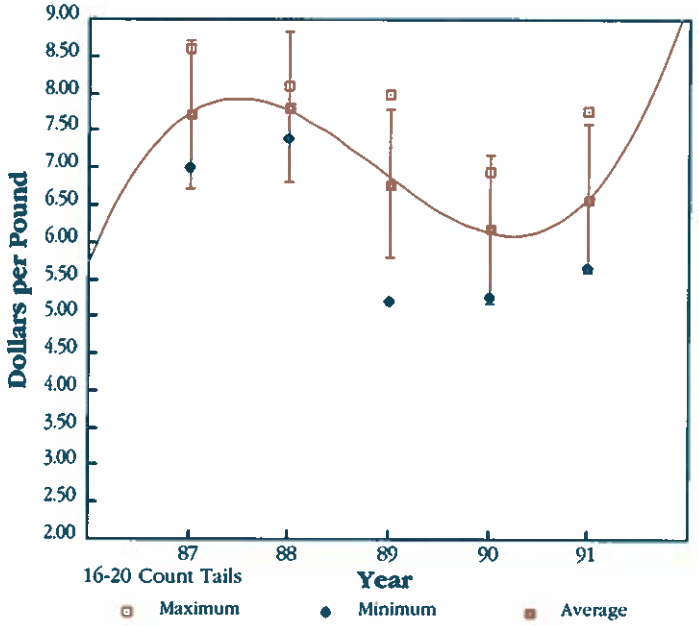

Figure 8. Minimum, maximum and mean wholesale prices for shell-on, headless shrimp.

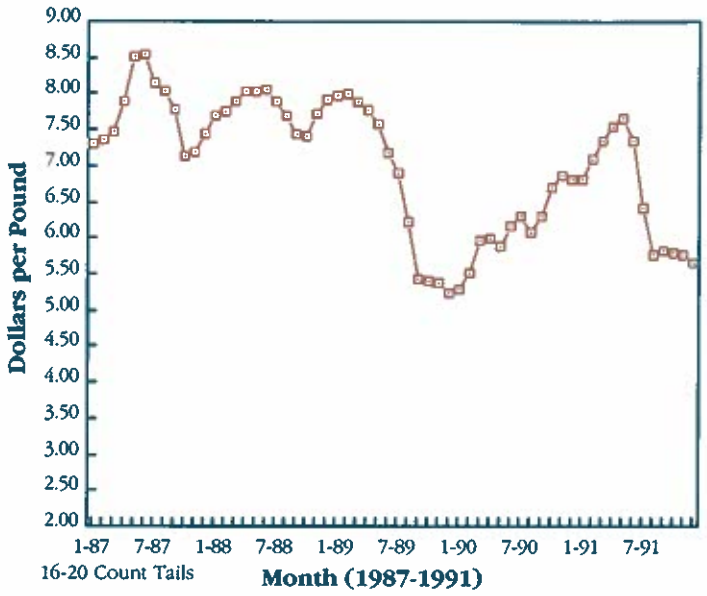

Figure 9. Monthly average wholesale prices for shell-on, headless shrimp.

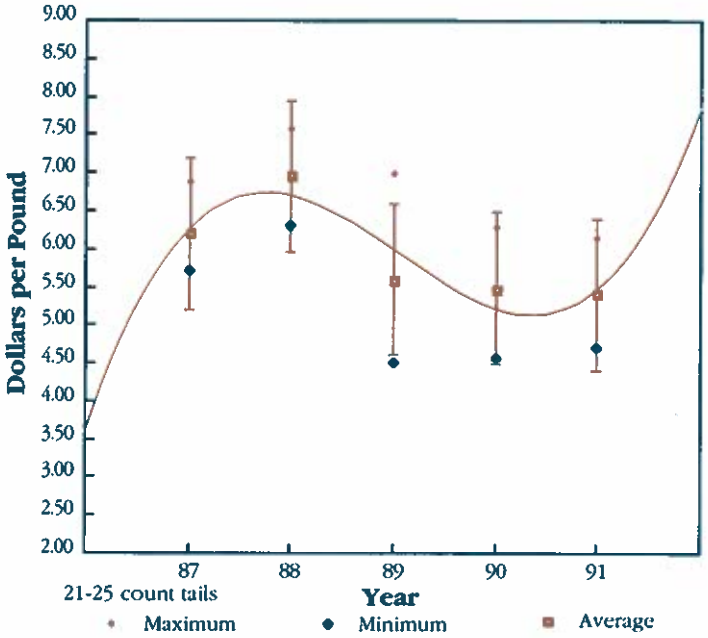

Figure 10. Minimum, maximum and mean wholesale prices for shell-on, headless shrimp.

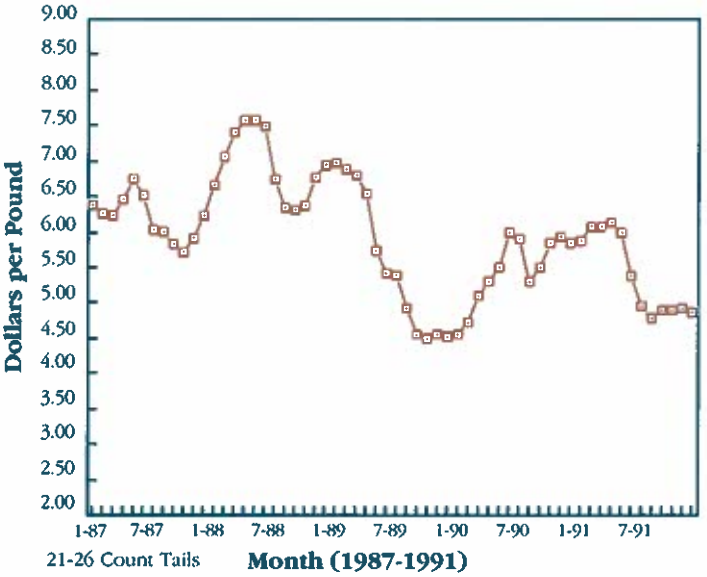

Figure 11. Monthly average wholesale prices for shell-on, headless shrimp.

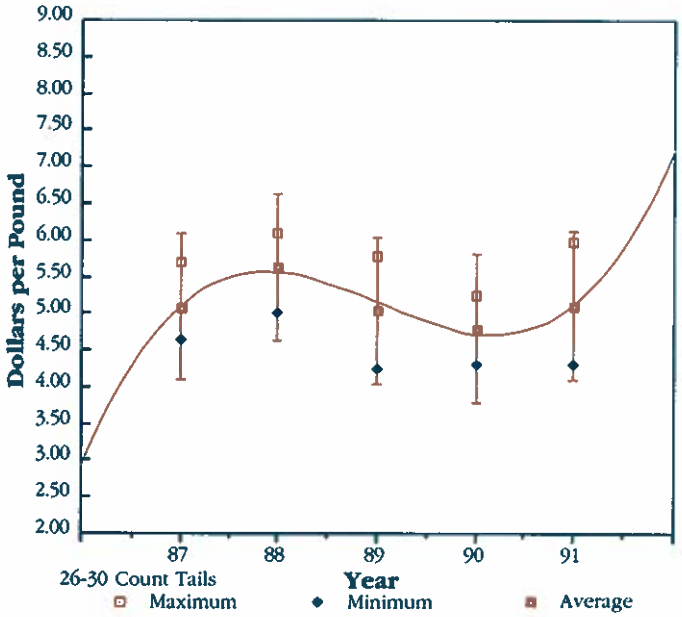

Figure 12. Minimum, maximum and mean wholesale prices for shell-on, headless shrimp.

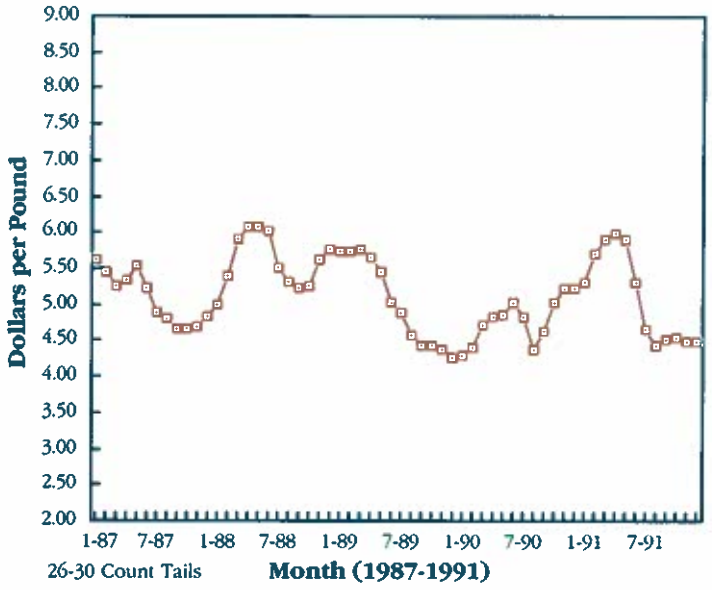

Figure 13. Monthly average wholesale prices for shell-on, headless shrimp.

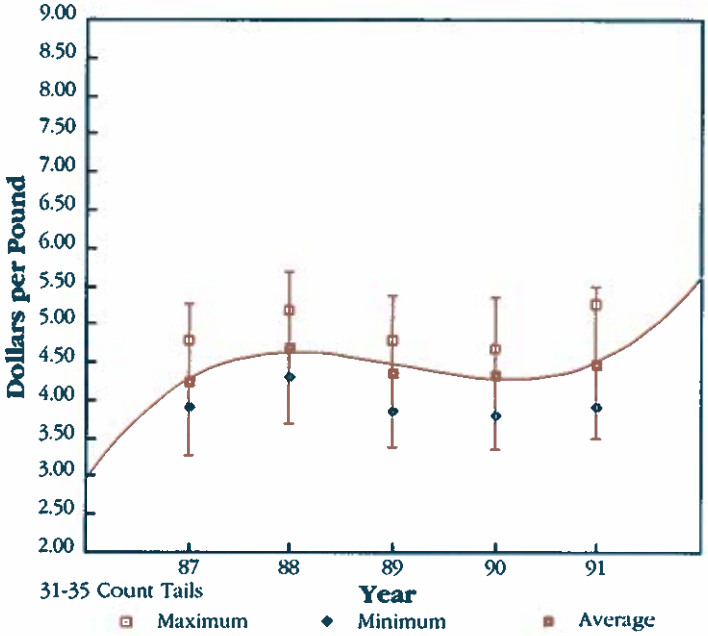

Figure 14. Minimum, maximum and mean wholesale prices for shell-on, headless shrimp.

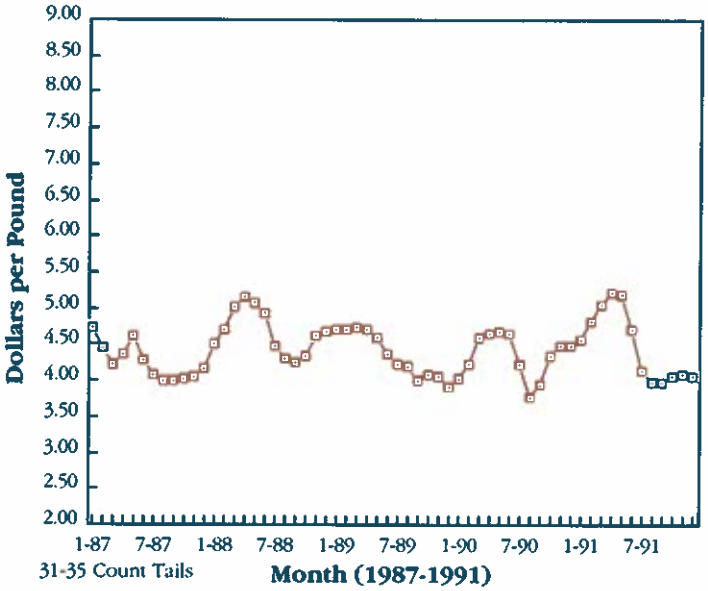

Figure 15. Monthly average wholesale prices for shell-on, headless shrimp.

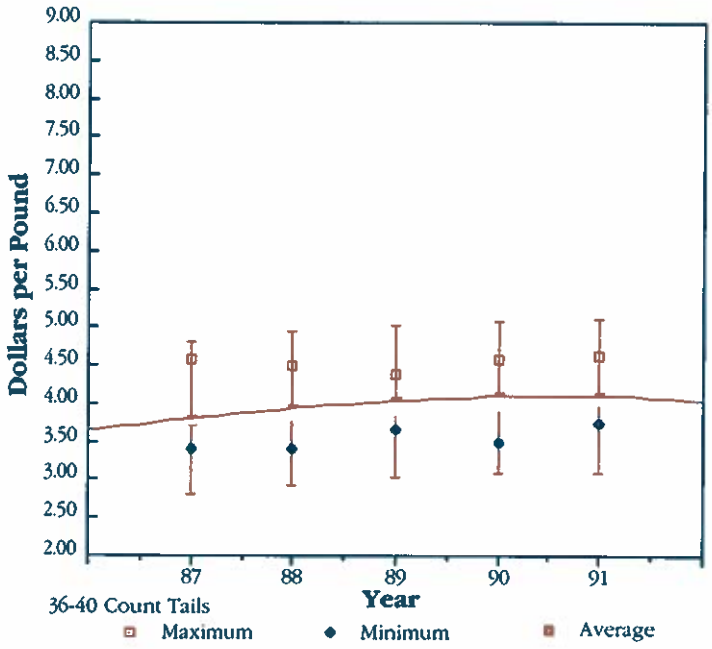

Figure 16. Minimum, maximum and mean wholesale prices for shell-on, headless shrimp.

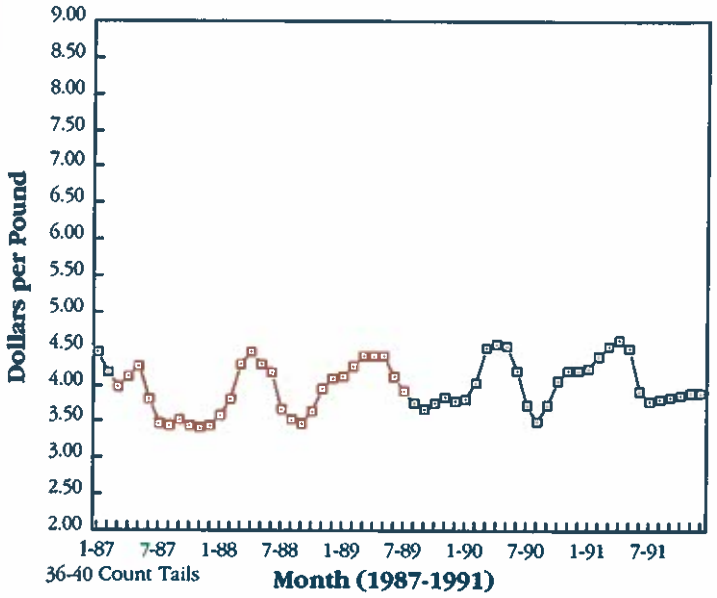

Figure 17. Monthly average wholesale prices for shell-on, headless shrimp.

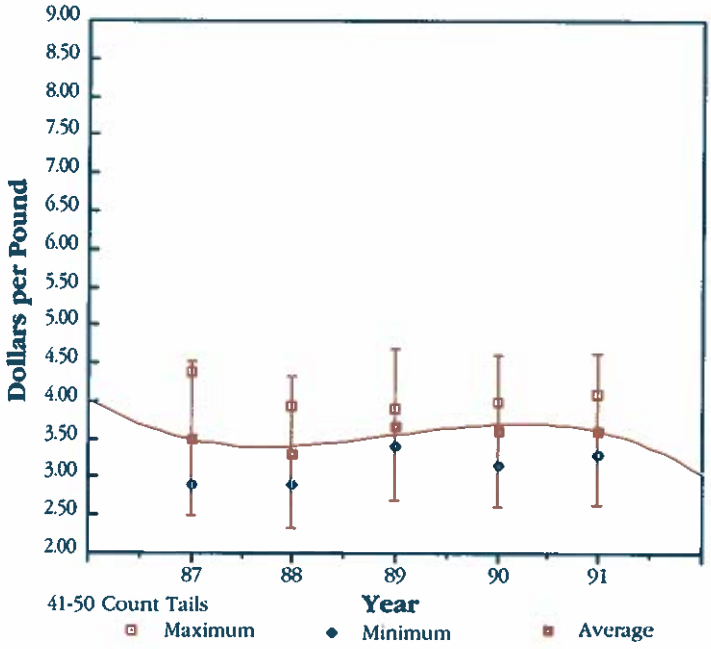

Figure 18. Minimum, maximum and mean wholesale prices for shell-on, headless shrimp.

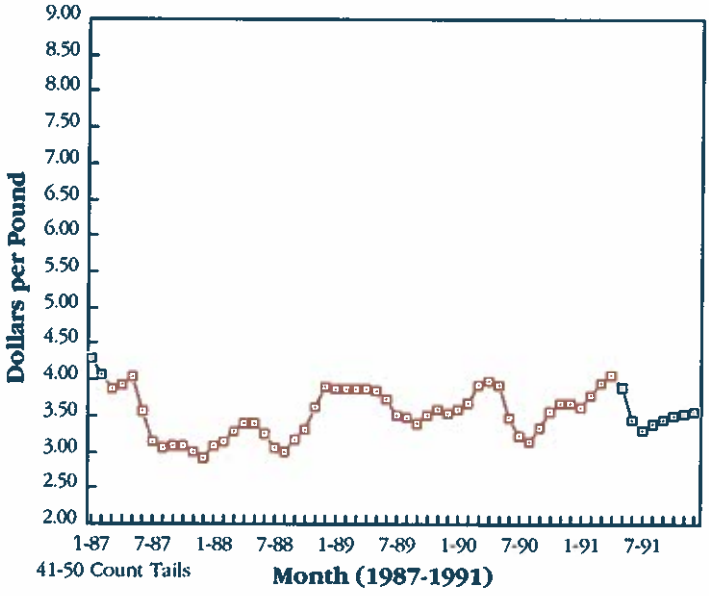

Figure 19. Annual minimum, maximum and mean wholesale prices for shell-on, headless shrimp.

Effect of price changes on inventory value

When confronted with requests to fund inventories, some lenders have been willing to support only a fraction of total need. Part of this hesitancy exists because protecting inventory value through hedging or long-term forward contracting is not possible. But while there are no mechanisms to protect the value of shrimp inventoried in frozen storage, the effect of adverse price changes can be minimized through two primary means: marketing a greater proportion of more processed products (e.g. peeled, breaded, individually quick frozen, or combinations thereof); and rapid turnover of inventory through aggressive sales efforts. As discussed previously, diversification into other seafood products also benefits the firm.

The Effect of Processing. Not surprisingly, the more processing shrimp undergo, the better the gross margins. Relatively unprocessed products such as shell-on, headless shrimp that are sorted by size, boxed and frozen typically return a gross margin of 7 to 10 percent (U.S. ITC, 1985). However, gross margins dramatically improve when shrimp are processed beyond the block-frozen, shell-on, headless stage. For example, reported gross margins on shrimp peeled from 31-60 count sizes average 34 percent (Roberts and Keithly, 1991). Breaded products generate an even greater gross margin (reported at 48 percent) since less than one pound of shrimp is required to manufacture one pound of finished, breaded product (Roberts and Keithly, 1991).

The following example demonstrates this idea. Assume that 41-50 count shrimp were purchased for $3.00 per pound, but the price dropped 12 percent before they could be sold. Applying the same gross margin percentage (9 percent) on current value returns a unit sales price 10 cents *less* than original product cost. However, peeling that same product results in a greater gross margin (34 percent), which more than offsets both the 12 percent price decline *and* the amount of shell-on headless tails required to produce 1 pound of peeled shrimp. Under the same 12 percent price decline, the new unit selling price exceeds historic cost by $1.28. A similar argument follows for breaded product, but the effect is greater. All processing and marketing firms strive to increase their gross margins. In shrimp processing, raw materials availability and the flexibility to manufacture exactly what the customer wants not only makes the processor a more successful marketer, it also provides a source of defense against constantly changing prices.

Inventory Turnover. In food processing, turnover of inventories depends on the type of processing and firm size (measured using total assets) (Greig, 1984). For example, meat processors (SIC 2010) with assets of less than $250,000 experienced a turnover rate of 52 times per year while firms in that sector with assets exceeding $250 million had a turnover rate of 11.4 times per year. On the other hand, fruit and vegetable processing seeks to preserve a relatively seasonal harvest, which require large inventories relative to sales. Small preserved fruits and vegetable processors (SIC 2030) reported inventory turns of 12.8 times per year while the largest firms indicated 4.9 turns per year.

No industry-wide inventory turnover information is available for shrimp processors. However, given the extreme seasonality of production (49 percent of annual harvests occurred in the third quarter last year) and the fact that most shrimp are marketed in the frozen state, it would be *incorrect* to compare turnover rates of shrimp processing establishments with those of the meat processing sector. Perhaps a better comparison would be to use data pertaining to preserved fruit and vegetable processing.

To *estimate* quantitatively the effect of price changes, percentage differences in price were computed under three inventory turnover rates of 28 days (13 times annually), 42 days (8.7 times annually), and 61 days (6 times annually) using ex-warehouse (wholesale) prices published twice weekly in *Seafood Price Current* by Urner Barry, Inc.[21] The turnover rate of 42 days is an actual value computed from financial statements. Other inventory turnover intervals of 28 and 61 days were used to "bracket" this 42-day rate, thereby allowing examination of how different inventory turnover rates affect the firm's exposure to changing prices and inventory values. Percentage differences in wholesale price between each selected time interval were computed for all six customary count sizes between 1987 and 1991. These data were then averaged into quarterly values for presentation purposes.

It is essential to recognize that these computations represent a *worst case situation* for the processor because of several implicit assumptions that exist in using a published data set. Each assumption is enumerated and discussed below insofar as it differs from conditions processors actually face. In a related vein, differences in the way that inventory turns are sometimes calculated also affect the extent of implicit assumptions.

Assuming that inventory turnover was computed by dividing cost of goods sold by inventory, two assumptions warrant discussion. First, use of wholesale prices as a data set suggests that processors purchase *all* their shrimp in the wholesale market, which, in fact, does not happen. In reality, processors' weighted average unit shrimp cost is much less than the wholesale price since practically all shrimp purchases are made from fishermen.[22] Furthermore,

Table 3. The Percentage Contribution Trend, Seasonal and Residual Variation Made in Explaining Monthly, Ex-warehouse Prices Between 1987 and 1991

	Percent Contribution to Total Variation by Type of Effect		
Count Size	Trend	Seasonal	Residual
16-20	48.28	15.94	35.78
21-25	49.56	18.63	31.82
26-30	24.96	36.97	38.07
31-35	16.32	58.89	24.79
36-40	11.45	66.71	21.84
41-50	16.52	44.08	39.40

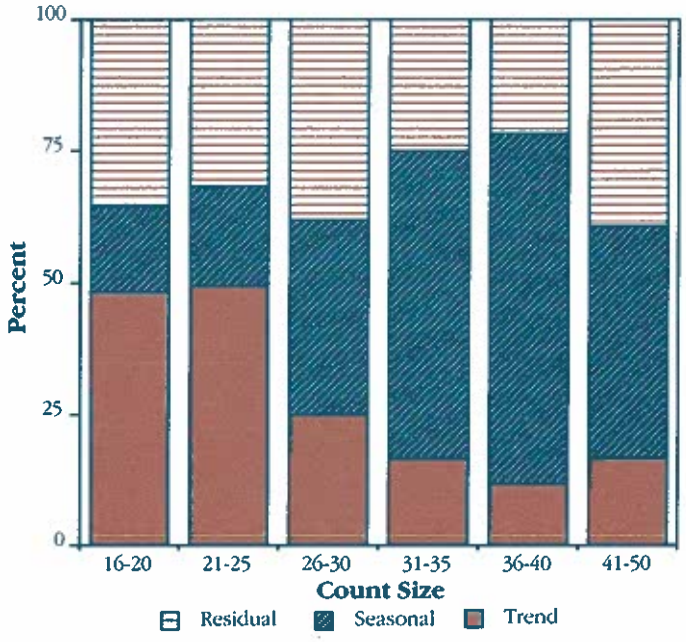

Figure 20. The composition of trend, seasonal and residual variation in monthly wholesale price data.

Table 4. Maximum Percent Declines During the Third Quarter: 1987-1991

	Computed Inventory Turnover Rates		
Count Size	28 Day	42 Day	61 Day
16-20	-6.48	-11.60	-15.05
21-25	-5.10	-7.49	-10.66
26-30	-4.47	-8.02	-13.19
31-35	-4.86	-8.42	-13.15
36-40	-5.09	-8.14	-11.44
41-50	-3.67	-7.44	-11.99

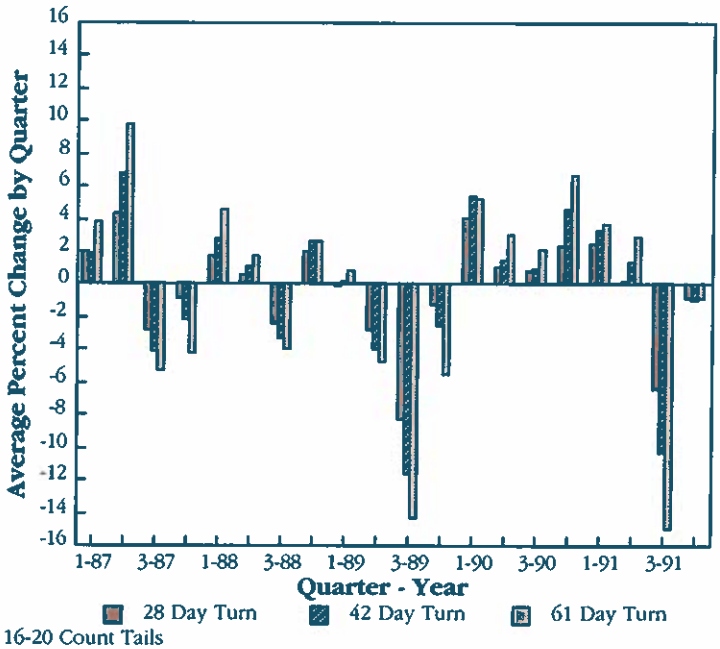

Figure 21. Wholesale, shell-on, headless shrimp price changes under three inventory turnover rates.

reported prices are per-pound selling prices, and reflect cost only in those instances when one processor buys from another. Second, computations using price alone fail to weight the effect of price changes by the quantities purchased throughout the year. Specifically, with 40 percent of annual production occurring in July and August, prices at the ex-vessel level customarily decline, and, therefore, depress the weighted average purchase price.

Assuming that inventory turnover is computed by dividing sales by inventory, an implicit assumption in addition to those mentioned above exists.[23] In particular, using a published data set to compute price changes assumes that processors buy and sell the same market form, since the only market form reported is shell-on, headless. However, processors' product lines contain various items, each with different prices, different percentages of raw material cost, different levels of convenience and different gross margins. This increased amount of convenience, coupled with a lower unit shrimp cost than selling price, would further reduce the impact of price declines on inventory value.

Except for 21-25 counts, the maximum devaluation between 1987 and 1991 occurred in the third quarter (Table 4). This systematic decline in inventory values is in response to production. Figures 21 through 26 highlight quarterly percentage changes in inventory value using the estimating procedure outlined above. However, with this quarter accounting for such a large percentage of total annual harvest, declines in price, and, thus, inventory value, are a normal course of events. Also, the impact of price changes on processing firms during the third quarter is minimal since processors are *accumulating* rather than *holding* inventory.

During the first, second or fourth quarters the maximum percentage decline in inventory values has been *much* less pronounced when compared to the third quarter with one exception (Table 5). During 1989, the second quarter produced a decline of 12.6 percent as a result of importation of similar-sized black tigers from Southeast Asia.

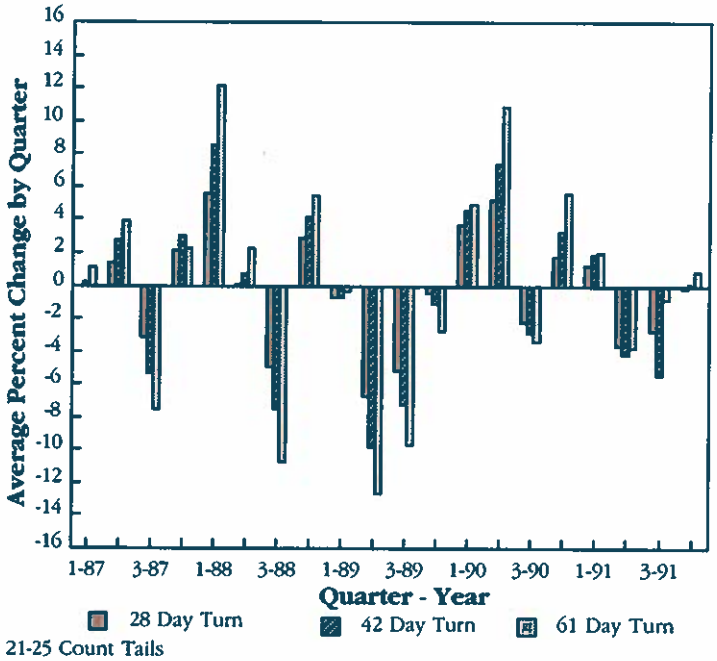

Figure 22. Wholesale, shell-on, headless shrimp price changes under three inventory turnover rates.

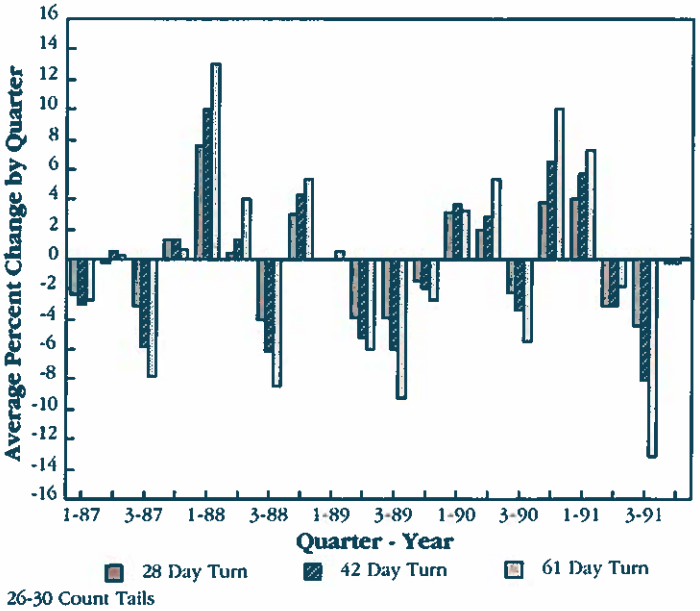

Figure 23. Wholesale, shell-on, headless shrimp price changes under three inventory turnover rates.

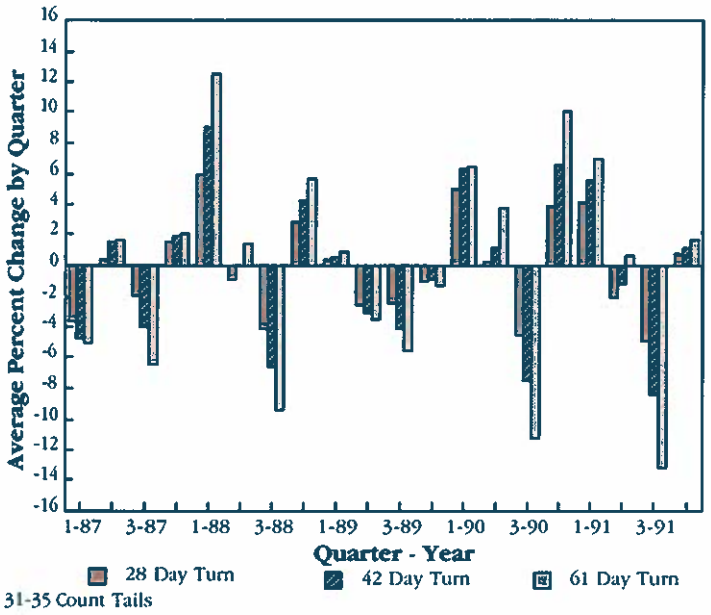

Figure 24. Wholesale, shell-on, headless shrimp price changes under three inventory turnover rates.

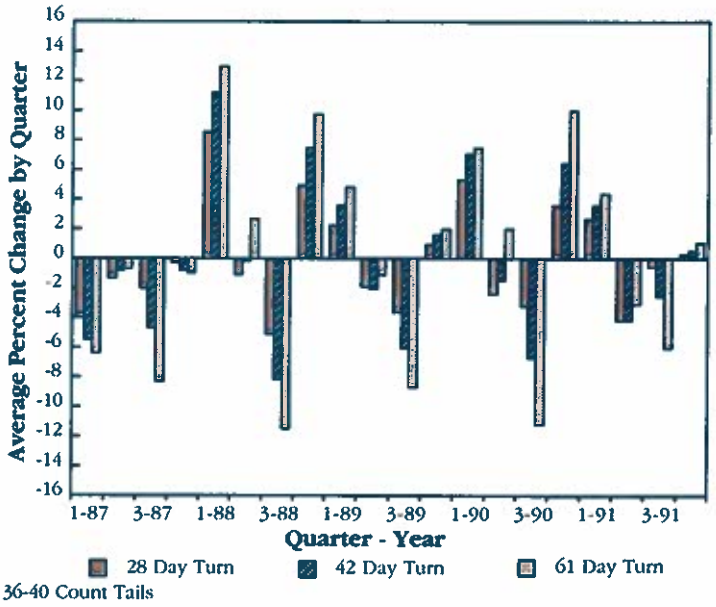

Figure 25. Wholesale, shell-on, headless shrimp price changes under three inventory turnover rates.

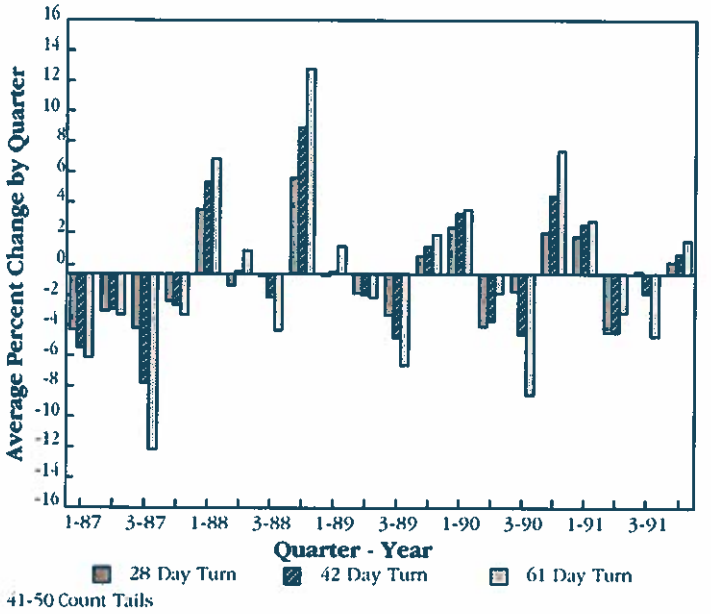

Figure 26. Wholesale, shell-on, headless shrimp price changes under three inventory turnover rates.

Table 5. Maximum Percentage Declines During Inventory *Holding* Periods (Quarters 1, 2 and 4)

	Computed Inventory Turnover Rates		
Count Size	28 Day	42 Day	61 Day
16-20	-2.90	-4.01	-4.85
21-25	-6.62	-9.72	-12.64
26-30	-3.91	-5.25	-5.93
31-35	-.362	-4.83	-5.03
36-40	-4.15	-5.42	-6.39
41-50	-3.97	-5.02	-5.75

Summary and Conclusions

Last year, Texas shrimpers produced 59 million pounds of shrimp tails, making 1991 one of the top 5 years out of the last 32. The nominal landed value of $197 million makes 1991 the second highest year dollar-wise, with the historic maximum being recorded in 1986. Production in 1991 continued a gradual upward trend since 1989, but the main contributors to relatively high-landed value were improved market prices and larger, more valuable shrimp comprising a greater percentage of the total catch.

Looking back over aggregate Texas shrimp landings data between 1960 and last year, annual harvests are in a constant state of flux. Perhaps the best example of this is that the lowest harvest on record (25.1 million pounds) and the 32-year peak of 64.8 million pounds occurred in sequential years! Harvests have varied on an irregular, somewhat cyclical basis. Because shrimp are short-lived organisms, annual abundance appears to be more controlled by environmental conditions than fishing effort.

While annual harvests are relatively unpredictable, the seasons provide fairly consistent production possibilities due to life history and resource management strategies. Bay shrimp production peaks during the 60-day Spring season and again in the Fall. Conversely, 40 percent of the offshore fishery's annual production occurs between mid-July and August. Combining monthly production from bay and Gulf industries, the third quarter of 1991 accounted for 49 percent of total, annual landings.

Since the 1940s, Texas shrimp processors have undergone a metamorphosis from setting the price for both purchases and sales to that of a price-taker, particularly on sales. This has occurred ostensibly because shrimp demand has outpaced domestic production, making greater levels of imports necessary. But along with market growth has come dilution of power in the domestic processing sector.

Despite the phenomenal growth in the U.S. shrimp market in the last 11 years, the price discovery and exchange functions are still underdeveloped when compared to other widely traded agricultural commodities. The lack of information about worldwide supplies prevents long-term forward contracting to "lock in" a price, and there may not be enough of a market for organized futures trading to occur. Without these marketing tools, the processor has no way to protect the value of his frozen inventory from devaluation.

The quantitative effect of three inventory turnover rates on inventory value was estimated on a quarterly basis using published wholesale prices for six sizes of shrimp. While predicated on a "worst case scenario," this analysis indicated that a well-tuned inventory policy minimizes the risks (as well as the rewards) of constant price changes. During inventory accumulation periods (the third quarter) prices drop and inventory values experience the most severe declines (4 to 15 percent depending on turnover rate and count size). However, during periods when inventory is actually held, maximum devaluations are less than 7 percent with the exception of the 21-25 size, which currently competes head-to-head with Southeast Asian black tiger shrimp.

While processors cannot protect inventory value, they can *and do* manage their businesses to minimize the effect of constantly changing prices. This is accomplished by marketing a greater proportion of further processed products that carry higher gross margin percentages; attempting to turn inventories as rapidly as possible by seeking out direct, volume sales opportunities with retail interests; and by diversifying into other marine foods besides shrimp.

End notes

1. *Only the Gulf (offshore) and bay food shrimp industries are discussed in this report. The bait shrimp sector, while contributing roughly $6 million to the Texas economy annually, is not addressed here. However, bait landings do enter into the data stream, and are most noticeable between January and April when the coastal bay complex is closed to production of food shrimp but not bait.*
2. *By comparison, the U.S. tuna market accounts for 1.25 billion pounds, but with a value of approximately $950 million, tuna is roughly 43 percent of overall shrimp market value ($2.15 billion).*
3. *The market grew rapidly over the last 11 years, registering a 70 percent increase between 1980 and 1990.*
4. *Only bait shrimping is allowed in the Laguna Madre.*
5. *Other reports that cite a larger tonnage figure utilize round weights (i.e., 100 percent of body weight) as opposed to the shell-on, headless equivalent that is 60 percent of round weight.*
6. *These conditions include bay salinity, water temperature in the Spring, and nutrient availability.*
7. *Computing averages for time periods corresponding to decades is somewhat arbitrary. However, collapsing annual data in this regard does provide an estimate of what happens when annual variability is removed.*
8. *Despite the first four months being out of season for production of food shrimp, bait shrimp may be landed during this time, thus accounting for some bay shrimp production during what appears to be a closed season.*
9. *Offshore landings continue during the closure because numerous vessels move eastward off Louisiana to harvest shrimp outside the closed gulf area, but return to Texas ports to offload. With many gulf vessels equipped with immersion freezing and frozen storage capacity, shrimp can be preserved at the peak of quality. This capability allows vessels to "commute" between productive, open fishing grounds and their port of origin. Likewise, vessels that rely on ice for preserving shrimp quality also fish in Gulf waters off Louisiana during the Texas Closure.*
10. *In contrast to the abundance of cross-sectional time series data available to track and evaluate the production sector, very little public information is available about shrimp processing since, with few exceptions, most establishments are privately held corporations. Financial data pertaining to those processing companies that are subsidiaries of publicly traded firms are generally lost since consolidated financial statements are issued. Additionally, economic impact information such as sales, payroll expenditures, etc., collected by the Bureau of Labor Statistics and categorized by Standard Industrial Classification (SIC) code are confounded since categories are neither product nor process specific. For example, SIC category 2092, "Prepared Fresh or Frozen Fish and Seafoods," contains 15 different types of seafood processing operations including fresh and frozen shrimp.*
11. *Shrimp are classified mechanically using a system of sloping, diverging roller bars that sort shrimp by the diameter of the tail, not length. Smaller shrimp drop through the spaces between the rollers first.*
12. *The months of July and August typically account for about 40 percent of annual Texas landings. Therefore, processors who rely on domestic shrimp must accumulate it during the third quarter.*
13. *Historically, most shrimp were consumed in away-from-home settings. This dependence on food service created a cyclical variation in demand, with periods of economic recovery and expansion accounting for significant sales gains for food service establishments and, thus, the shrimp industry. However, the converse has also been true. Today, shrimp processors are balancing their account base better between food service and the retail food sector. This is a prudent strategy for managing cyclical risk and will partially insulate sales and earnings from uncontrollable macroeconomic conditions.*
14. *Gulf brown shrimp prices used in this section are those reported twice weekly in* ***Seafood Price Current****, published by Urner Barry, Inc. Importantly, reported shrimp prices are* ***not*** *analogous to "arm's length" securities transaction prices reported in the financial pages of daily periodicals. Rather, they are systematically collected quotes from long-standing, reputable firms engaged in shrimp processing and marketing. In this regard, shrimp prices are similar in nature to cash quotes collected from first handlers of agricultural commodities such as cotton and grain. Because there is no one price that clears the market, all shrimp prices reported in* ***Seafood Price Current*** *are expressed as ranges, reflective of individual processors' current sales as opposed to a centralized exchange. Generally, the spread in reported prices for each count size and type of shrimp (i.e., country of origin that suggests species, and to some extent, pack style) is 10 cents per pound. In the interest of conservatism, all shrimp prices are recorded at the lower reported price for that day.*
15. *Prices for the other four count sizes (26-30 through 41-50) also trended downward as the year progressed, but the drop (both in dollar and percentage terms) was much less pronounced in the smaller sizes since the further removed from the specific count size in question, the less impacted by abrupt supply changes.*
16. *The only market form that is categorized by count size is the shell-on headless variety. Roughly half of total imports (converting product weight to a shell on headless basis) were market forms other than shell-on headless, and thus were not classified by individual count size.*
17. *Customs reports count sizes as 31-40, but most countries segment that interval into two classes: 31-35 and 36-40.*
18. *These prices are simple averages, and are not weighted by quantities on the market.*
19. *The residual component is actually comprised of: a) the cyclical component of the time series; b) interaction between the trend and seasonal components; and c) random variation.*
20. *Forecasting using time series analysis*

is fallible since recent history may not repeat itself in quite the same manner. This is particularly true since the market has grown significantly in the past 11 years. The econometric (deterministic) approach to price forecasting requires timely data on currency exchange rates, disposable income, supplies of particular sizes, expectations of future supplies, etc. Aside from the data requirements, many of the historic determinants of demand (i.e., per capita disposable income) are giving way as more shrimp enters the retail food sector, thereby making the product's own price changes and the prices of substitute items a more important demand determinant.

21. *Several background comments are in order before describing how the effects of price changes were estimated. It is practically impossible to pinpoint the quantitative effect of price changes on inventory value in a general sense. The effect of price changes can only be computed on a firm-by-firm basis and require knowledge of the exact quantity and mix of product forms in current inventory, as well as purchases and quantities sold on a daily basis. However, the impact of price changes can be estimated using published price data.*
22. *Theoretically, inventory turnover should be computed using cost information. Inventory is carried at cost, so to be consistent, cost of goods sold should be used in the numerator. However, as Rao points out, sales figures are often used since they are easier to obtain (Rao, 1987). Thus, when sales figures are used to compute inventory turnover, the market form bought and sold affects the impact of price changes on exposure.*
23. *This reduction in unit cost would reduce the effect of price declines on the percentage change in inventory value. Under conditions of an increasing price over time, a lower unit cost would improve the percentage gain.*

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The Texas Marine Advisory Service is a cooperative effort of the Texas A&M University Sea Grant College Program, the Texas Agricultural Extension Service and commissioners' courts in participating counties. Seafood marketing functions are in cooperation with the Texas Parks and Wildlife Department.

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TAMU-SG-92-501
2.5M July 1992
NA16RG0457-01
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