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CHARACTERISTICS OF HAWAII'S WHOLESALE SEAFOOD MARKET

By

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ABSTRACT

Hawaii's wholesale seafood market and its role in the development of the commercial fishing industry are described. The study extends previous analyses of seafood markets in Hawaii by including the market for frozen seafood and the import and export sectors.

Data from a 1980 National Marine Fisheries Service survey are presented on the flow of seafood through the wholesale market and cross tabulation statistics are used to examine economic relationships in the wholesale market.

The study concludes with a brief analysis of the interrelationships between key factors affecting the wholesale market and government policy directed toward commercial fisheries.

INTRODUCTION

This paper presents data and statistical analyses of data compiled by the National Marine Fisheries Service, Southwest Fisheries Center Honolulu Laboratory, on wholesale seafood markets in Hawaii. Historical information on seafood markets in Hawaii and theoretical considerations of competitive markets are also presented. The information from this research was used in another paper analyzing market exchange and competition under conditions of uncertainty.[1] The current paper provides a fuller description of the survey results and the general economic theory of market behavior underlying seafood exchange.

Hawaii's commercial fishing industry (including the fresh fish marketing system) remained virtually stagnant for the 15 years following statehood in 1959. A variety of constraints, including the structure of the fresh fish market, were blamed for the problems of the industry. Local fishers frequently complained about marketing arrangements, and many ways to circumvent these market channels were tried, including producer cooperatives, direct sales to consumers, bilateral negotiation with retailers (especially with restaurants and supermarkets), and forward integration by fishing companies into general seafood wholesaling and retailing. These arrangements have not proven to be adequate to promote sustained growth in the harvesting sector of Hawaii's seafood industry. The impediments to the expansion of local fisheries were outside the structure of the market, although the inertia of old marketing practices may have limited development. Alliances between individual harvesters and wholesale dealers which have broadened the wholesale market network and the growth of the auctions have had a major influence in recent expansion in the harvesting sector.

To understand why the wholesale market has been important to the growth of commercial fishing in Hawaii, one must examine those functions which contribute to industry development. This paper applies a theoretical framework to the characteristics of the wholesale fish marketing system in Hawaii as a means of providing an analytical description of that market.

Seafood Markets

Seafood markets are a particular type of business enterprise often called "intermediate trading agents" (Lim 1981). These enterprises serve a variety of functions in the interchange of products from producer to consumer (Plott and Uhl 1981). Fish dealers (brokers and wholesalers) are quintessential intermediate trading agents, taking on a variety of very specific functions in the diverse hierarchy of transactions in a product market characterized by minimal processing requirements.

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[1]Pooley, S. G. 1983. Competitive markets and bilateral exchange: The wholesale seafood market in Hawaii. Manuscr. in prep. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812.

Seafood markets generally consist of two market forms: auctions for freshly harvested seafood and long-term contractual arrangements between harvester and dealer. Some auctions act to transfer seafood between brokers and wholesale dealers while others are the primary interface between the harvester and the retail sector. Hawaii has two harvester-wholesaler auctions which act as "spot markets," the market form most closely representing the economists' ideal where price is apparently determined in an open, competitive situation of many buyers and sellers.[2]

Two major types of contractual systems dominate bilateral transactions in the fishing industry (Wilson 1980). Reciprocal agreements represent purchases by dockside buyers where the price is offered by the buyer at the point of purchase. Consignment sales exist in markets where the catch is transferred to final markets and price is communicated to the harvester following sale. Reciprocal and consignment agreements represent individual transactions within the overall wholesale market, but these transactions are cut off from direct contact with other market actors, i.e., other commercial seafood harvesters and other dealers. Lacking immediate market information, the bilateral participants require a certain amount of trust upon which both the harvester and the wholesaler can depend. Relatively stable relationships are required for successful bilateral marketing of fresh fish but are difficult to maintain.

Reciprocal agreements are found in Hawaii when fishers bypass the auction either by dealing directly with wholesalers, retailers, restaurants, and supermarkets, or by selling directly to a processor such as the tuna cannery or dried fish companies. Consignment sales are less frequent at the harvester-wholesaler level but exist in the transfer of catch between islands and in the export market. Both the Hilo and Honolulu auctions incorporate aspects of consignment transactions, e.g., ex-post discounts for fish found to be of poor quality.

Whereas the implicit contractual aspect of the bilateral trading arrangements between harvester and marketer reduces individual inefficiencies and inequities which might otherwise arise where information is incomplete, Wilson (1980) found that such bilateral arrangements also tend to suppress the flow of information to the overall market and reduce the market's performance as an allocator of resources. Impediments range from inventory gluts and product wastage to poor quality and broken arrangements. Each impediment can be ascribed to the quality of bilateral exchanges. Wilson found that the "actors" in the New England seafood market respond (or "adapt") to these problems by avoiding "competitive" market behavior, i.e., by minimizing changes in buyer-seller patterns, minimizing price bidding, and maximizing inventory control through selective limitations on fishing effort. Thus, competition (in the economic as opposed to the social sense) is replaced by negotiation.

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[2]The term "market" has two uses. In common terminology, it refers to places where many sellers are located, while for economists, markets denote the universe of exchange transactions at a particular level of aggregation.

Prices, which are the primary market signal available to consumers, become less informative and both harvesters and consumers suffer.

Although these factors are specific to the fresh fish markets studied by Wilson in New England, they are not unique. Similar evidence exists for Hawaii's seafood transactions (Peterson 1973; Garrod and Chong 1978). Adaptations to market imperfections effectively change the assumptions of analysis and might have significant implications for fisheries development in Hawaii.

A wide variety of market studies have emphasized the transactional aspects of exchange relationships (Coase 1937; Stigler 1961; Grossman and Stiglitz 1976; Figlewski 1978; Hirshleifer and Riley 1979). These aspects were frequently neglected by traditional microeconomic analysis of market behavior and prices. Important aspects of market transactions are their information bearing abilities, their risk assignability, and their responsiveness to uncertainty. The acquisition and consolidation of market information within the confines of the wholesale firm provide key avenues for economies of scale. Internal control of information acts as a barrier to other firms, much as do large initial investment costs (Wilson 1975). In seafood markets, fresh fish auctions act to pool price, quantity, and quality information because auction transactions are quasi-public. However, individual wholesale dealers have a strong incentive to obtain additional information and product outside the auction, as they have done in the import and export markets and through local bilateral arrangements. This reduces the risk and uncertainty besetting the firm, and it also limits the public availability of information on the firm's business practices. Thus, in Hawaii, wholesale fish dealers are combining several types of market transactions for specific marketing problems which are outlined in the following section.

Seafood markets contain a wide range of risk and uncertainty, including fluctuating supply, product spoilage, and product quality. Analysis of risk is directly applicable to the problems of inadequate quality premiums cited by Wilson (1980) in the bilateral agreements of the New England fish market. Furthermore, fishery markets regularly exhibit characteristics which strain the credence of the competitive model. Wilson's implication is that every transaction is subject to some form of imperfect competition because of its bilateral character. This pertains particularly to the small number of brokers and wholesalers in seafood markets compared with the many disparate and independent sellers on the other sides of the transactions, i.e., the individual fishers and retailers.

Yet, as will be shown in the concluding section, it is precisely the adaptability of some major wholesalers in Hawaii to imperfect marketing conditions which seems to have played a major role in the expansion of commercial fishing in Hawaii over the past 5 years. To understand this unexpected conclusion it is necessary to examine the theoretical determinants of competitive markets, to compare these with the reality of fish wholesaling in Hawaii, and to indicate how adaptations at the wholesale level have affected the entire commercial fishing industry.

The Theory of Competitive Markets

Markets do not in reality consist of atomistic competitors (i.e., small and totally independent firms), that prices are not abstractly determined by the disinterested interplay of such numerous competitors, and that resources are not solely allocated by reactions to price. Yet, these are the basic assumptions of microeconomic theory and provide the basis for normative prescriptions against monopoly, regulation, and economic planning.[3] Although industrial economics traditionally studied market structure and the degree of competition, most policy analyses in the past 30 years have operated under the norm of relatively perfect competition (Friedman 1962). However, emphasis on other aspects of industrial structure is returning (Williamson 1981).

The structure of a market was thought to matter because of (1) its social welfare implications, (2) the impact of the market on productive efficiency, and (3) its influence on the distribution of income.[4] Previous analysis of Hawaii's seafood market has not included welfare considerations because the lack of a thorough market description has limited an assessment of the impact of market structure on the economic behavior of individual dealers, commercial fishing firms, and seafood consumers. Although several analyses have pointed to possible imperfections in the seafood markets, public policy has generally assumed the salience of local markets ([Hawaii.] Department of Land and Natural Resources 1979).

The degree to which Hawaii's fish markets correspond to the competitive market provides an indication of how the wholesale sector must be analyzed. Basic microeconomic market structure assumptions as applied to Hawaii's seafood markets include:

1. Scarcity: Resources are assumed to be relatively scarce compared with consumer demand. Therefore, choice between alternative patterns of resource allocation is required.

In fish markets there frequently is a situation of abundance, indeed often of gluts, viz long-term price levels. The wholesale fish market serves to mediate these fluctuations in supply, but wide fluctuations in price levels are inadequate market signals for medium-term decision making. Nonetheless, because wholesalers have limited business resources, an additional scarcity problem exists at the marketing level, and this is important in their choice of product, product state, and product source and destination.

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[3]The basic assumptions upon which microeconomic price (and thus market) theory operates are not well supported in any market setting (Franklin 1977).

[4]"Welfare" in the economic sense of overall good to society through competitive resource allocation, not as an income transfer term.

2. Large numbers: No individual market "actor" or small group of producers or buyers can significantly influence product price.

There are 118 wholesale seafood firms in Hawaii, about 100 full-time fishing enterprises, perhaps 2,000 part-time commercial fishers, and hundreds of retail outlets which handle seafood. Only the wholesale sector acts in a "small numbers" environment although harvesting cooperatives and financial consolidation may reduce the effective number of competitive harvesters for some species. One cannery purchases the dominant species (skipjack tuna), and a relatively small number of dealers engage in the majority of fresh and frozen seafood transactions. Therefore, this norm of competitive market theory is challenged.

3. Corporate mobility: Firms may freely enter and leave the industry.

Adams (1981) has documented entry and exit (turnover) in the wholesale fresh fish market in Honolulu and suggested that the industry is competitive when judged on this basis. The extent to which turnover is significant as a market indicator has been challenged (Hudgins 1980a) and ability to reallocate wholesale business resources would seem costly at any time. Furthermore, new firms face an information gap and a learning period in developing their buying and selling practices. Therefore, there may be problems of transition whenever the overall market grows. However, a diversity of firms exist to help maintain this norm.

4. Product homogeneity: All sources of a commodity are said to be interchangeable in the eyes of the consumer, i.e., they are essentially identical.

Agricultural commodity markets are frequently cited as models of competitive behavior because individual farm products appear to be relatively homogeneous. However, the wholesale seafood market discriminates between sources of seafood, i.e., differentiates local full-time commercial harvesters from part-time and transient harvesters. Furthermore, it is certain that the fresh and frozen fish markets are dichotomized precisely because consumers have definite, though possibly shifting, seafood preferences not completely related to price differentials. The product, "fish," is highly differentiated, although substitution among species and product may be relatively frequent. Elasticities of price and cross-elasticities of substitution have not yet been thoroughly calculated for seafood in Hawaii although Hudgins (1980a) made preliminary estimates and found relatively little substitution among major species groups. Thus, competition has an additional source of limitation in product heterogeneity.

5. Complete knowledge: All buyers and sellers have thorough knowledge of the market situation and their alternatives.

Hawaii is a very centralized state and 80% of the population live on one island (Oahu). If market knowledge on the local level is ever to be realized in the seafood industry, it should occur in Hawaii. However, the range of uncertainties which face wholesalers is considerable, even on the

local level. Knowledge about international and U.S. mainland market opportunities is seldom easily available. Institutional impediments to the flow of information through the seafood market may also reduce the knowledgability of market participants. Therefore, there is an information burden to seafood market transactions, particularly at the wholesale level.

6. Rational self-interest: Economic "actors" behave to maximize their returns, i.e., profits or personal utility.

In a competitive market system, failure to act "rationally," to minimize costs and to expand markets, usually leads to business failure. However, subsidiary factors which affect business decisions, such as tradition and kinship, may play important market roles in less competitive industries. The familial nature of the fish business in Hawaii suggests that "non-rational" behavior may exist in the market. Yet, profitability is essential in a private enterprise economy if wholesalers are to undertake risky ventures into new products or harvesting. The rate of turnover identified by Adams (1981) suggests that rational self-interest is essential for maintaining a market share in Hawaii's seafood industry.

7. Private ownership: Economic resources are privately owned and controlled.

The fishing industry in Hawaii operates in an essentially small business environment where corporate ownership and economic control coincide. The wholesale sector is typified by business decisions directly related to seafood markets. However, the cannery and some portions of the retail sector are examples of large corporate hierarchies where marketing decisions are not made solely on the conditions directly affecting the fishing industry. Nonetheless, it may be assumed that most marketing decisions are privately, and locally controlled.

These seven conditions are considered essential for preserving the microeconomic model where atomistic economic units are "harmonized" by competitive markets and exchange transactions force a form of social cooperation, i.e., the private allocation of resources on behalf of society. Microeconomic theory indicates that these conditions enhance private and social productivity and reduce the social power of individual industry participants (Friedman 1962). Failure to meet these and related conditions reduces the efficacy of the microeconomic model (Graff 1954).

The seafood industry in Hawaii meets these basic assumptions well, but not completely, and as such it may at least be termed "contestable" (Baumol 1982). The industry is neither vertically nor horizontally integrated in that harvesting, processing, wholesaling, and retailing operations are usually undertaken by separate firms. Most economic transactions occur in the marketplace, although the key market role of the wholesalers is the variety of marketing functions, such as transportation, insurance, and inventory, which they undertake within their individual firms. The level of transactions within the wholesale sector is quite specific and specialization occurs in product states and in source and destination orientations.

Of the seven basic assumptions of the competitive model, three may be said to be significantly challenged in Hawaii's wholesale markets: large numbers, product homogeneity, and complete knowledge. Such "deviations," however, do not imply monopolistic conditions in the market, nor intentional collusion. However, these deviations may affect market behavior and social welfare. These market characteristics can now be examined and their effect on market dynamics in the commercial fishing in Hawaii assessed.

A Profile of Hawaii's Seafood Market

The overall wholesale seafood market in Hawaii is much more diverse than even the folklore of the fresh fish market would suggest. Although this history has been well described (Peterson 1973; Garrod and Chong 1978; Adams 1981), fresh fish is but one part of Hawaii's seafood marketing system. The production of seafood sold in Hawaii is both an international and a local phenomenon. Markets exist for particular products based on strong cultural preferences and on the expectations of restauranteurs. Frozen seafood is important in domestic and tourist consumption (Hudgins 1980b) and export of locally caught fresh fish is expanding (Cooper and Pooley[5]).

Production in Hawaii's commercial fishery has long been dominated by the tuna fisheries, particularly that for skipjack tuna (aku). Past studies have thus dealt primarily with the pole-and-line fishery for skipjack tuna, the problems in that fishery, and the role of skipjack tuna in the Hawaii fresh fish market. Because there has been little growth in this segment of the market, the Hawaii commercial fishery and the fresh fish market had been described as stagnant.

Despite this, Hawaii's commercial fishery has expanded dramatically in the past 5 years, primarily due to fisheries for bottom fish and large tunas. Previous studies pointed to the lack of capital investment in large, far-ranging skipjack tuna and multipurpose fishing vessels as the "death knell" for Hawaii's commercial fishery. Ironically, it is the growth of a small boat fleet and the dramatic increase in its productivity which have led to recent market expansion. Using relatively simple techniques that require little capital investment, i.e., deep-sea handline methods, a major impediment to commercial fisheries expansion (capital costs) has temporarily been bypassed (Yuen 1979). More vessels are also utilizing fuel-efficient longline gear on a small scale and are fishing around fish aggregating devices (Shomura and Matsumoto 1982). Development of the fishery in the Northwestern Hawaiian Islands evidently is still limited by capital requirements but this fishery has also expanded.

The relatively high demand for the bottom fish and large tunas harvested by deep-sea handline attracts a large number of part-time and

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[5]J. C. Cooper and S. G. Pooley. 1982. Total seafood volume in Hawaii's wholesale fish markets. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812. Admin. Rep. H-82-15. 12 p.

small-scale fishers to this market. A variety of non-traditional marketing arrangements have developed, and the fresh fish auctions have been rejuvenated. The commercial fishery's greatest expansion was not due to technological advances or marketing innovations in the dominant skipjack tuna fishery but due to a return to traditional methods in harvesting other species and the ability of local wholesale dealers to market this product. The effect of this competition within the skipjack tuna fishery has been significant. The frequently used term "tuna industry" in the Hawaii setting is definitely misleading. There is obviously a major difference between the two-tiered bilateral exchange skipjack tuna market where set portions are allocated to the fresh fish market and the cannery, and the ahi market (yellowfin and bigeye tunas) which is a fully competitive high-price fresh fish market. Indeed, the increased competition between aku and ahi in the fresh fish market emphasizes this difference in marketing practices. Increasing levels of substitution among the fresh fish market species is being witnessed. The analysis below reflects this heterogeneity. Further research on the retail market and renewed interest in market structure should provide a clearer indication of trends affecting the commercial fishery in Hawaii.

The Southwest Fisheries Center, Honolulu Laboratory surveyed the Hawaii wholesale fish dealers in 1980[5,6] and again in 1982[7,8] to assess the overall flow of seafood through Hawaii's seafood markets. As opposed to other studies, these surveys took into account not only locally caught fresh fish but also fresh imports and exports, frozen imports, and other forms of processed seafood products.

The 1980 sample frame consisted of 185 seafood marketing firms compiled from telephone directories and supplemented by direct knowledge of the industry. A total of 118 firms were actually engaged in the wholesale seafood business and 105 firms were successfully interviewed in July 1980. Data were collected for the 1979 calendar year. The characteristics of the average wholesale fish dealer and total wholesale seafood volume are outlined in Table 1.

The study emphasized product state (fresh, frozen, canned or bottled, etc.), source (local vessels, auctions, imports, etc.), and destinations (retail, export, processing, etc.) (Tables 2, 3 and Figs. 1, 2).

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[6]U.S. National Marine Fisheries Service. 1982. Preliminary results of a survey of wholesale fish dealers in Hawaii. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, Hawaii, Admin. Rep. H-82-14, 17 p. + append.

[7]SMS Research, Inc. 1982. Survey of monthly prices and quantities of wholesale fish products in Hawaii: Final report, 39 p. + append.

[8]SMS Research Inc. 1983. Survey of the broker and retail fish sectors of the fish markets in Hawaii: Final report. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, Hawaii, Admin. Rept. H-83-10C, 45 p.

Table 1.--Characteristics of Hawaii's wholesale seafood market in 1979 (adapted from Cooper and Pooley, text footnote 5).

Category	Number	
Number identified	118	firms
Number surveyed	105	
Additional types of business		
Retail	63	firms
Processing	27	
Storage	15	
Type of product handled		
Fresh	63	firms
Frozen	63	
Canned and bottled	17	
Salted, dried, and smoked	26	
Fishcake	13	
Percent business which is wholesale (average)	72.9%	
Average starting year	1960	
Employees		
Full-time paid	1,490	employees
Part-time paid	618	
Full-time unpaid	33	
Part-time unpaid	3	

Market volume[1]	Value (million)	Pounds (million)
Total purchases	$55.0	30.4
Fresh	25.7	12.7
Frozen	22.9	17.5
Other	6.4	0.2
Total sales	$77.1	30.6
Fresh	32.7	13.8
Frozen	33.1	12.8
Other	11.3	4.8

[1]These summary figures have been adjusted to replace missing observations. This may account for more pounds sold than purchased and indicates the reason for deviations from other tables.

Table 2.--Purchases by product and source in 1979 (Cooper and Pooley, text footnote 5).

Fresh			
Local			
Fishers[1]	$18,022,008		
Wholesalers	4,325,010		
Not specified	1,931		
Total		$22,348,949	
Imports			
Mainland	$1,546,021		
Foreign	196,911		
Not specified	660,000		
Total		$2,402,932	
Total fresh			$24,751,881
Frozen			
Local			
Fishers[1]	$23,080		
Wholesalers	465,284		
Total		$488,364	
Imports			
Mainland	$13,133,950		
Foreign	8,019,095		
Total		$21,153,045	
Total frozen			$21,641,409
Canned and bottled			$2,992,142
Salted, dried, and smoked			2,078,465
Fishcake			1,152,005
Total purchases[2]			$52,615,902

[1]Includes auction fish.
[2]Totals are based on 99 firms.

Table 3.--Destination of products in 1979
(Cooper and Pooley, text footnote 5).

Local retail		
Fresh	$15,888,322	
Frozen	29,399,144	
Canned and bottled	4,504,577	
Salted, dried, and smoked	2,082,717	
Fishcake	2,239,619	
Total		$54,114,379
Local processor		
Fresh	$725,174	
Frozen	72,291	
Canned and bottled	0	
Salted, dried, and smoked	0	
Fishcake	0	
Total		$797,465
Local wholesale		
Fresh	$9,786,999	
Frozen	2,966,597	
Canned and bottled	73,722	
Salted, dried, and smoked	527,376	
Fishcake	76,400	
Total		$13,431,094
Export		
Fresh	$5,288,697	
Frozen	61,861	
Canned and bottled	239,400	
Salted, dried, and smoked	0	
Fishcake	234,375	
Total		$5,824,333
Total sales[1]		$74,167,271

[1]Totals are based on 102 firms.

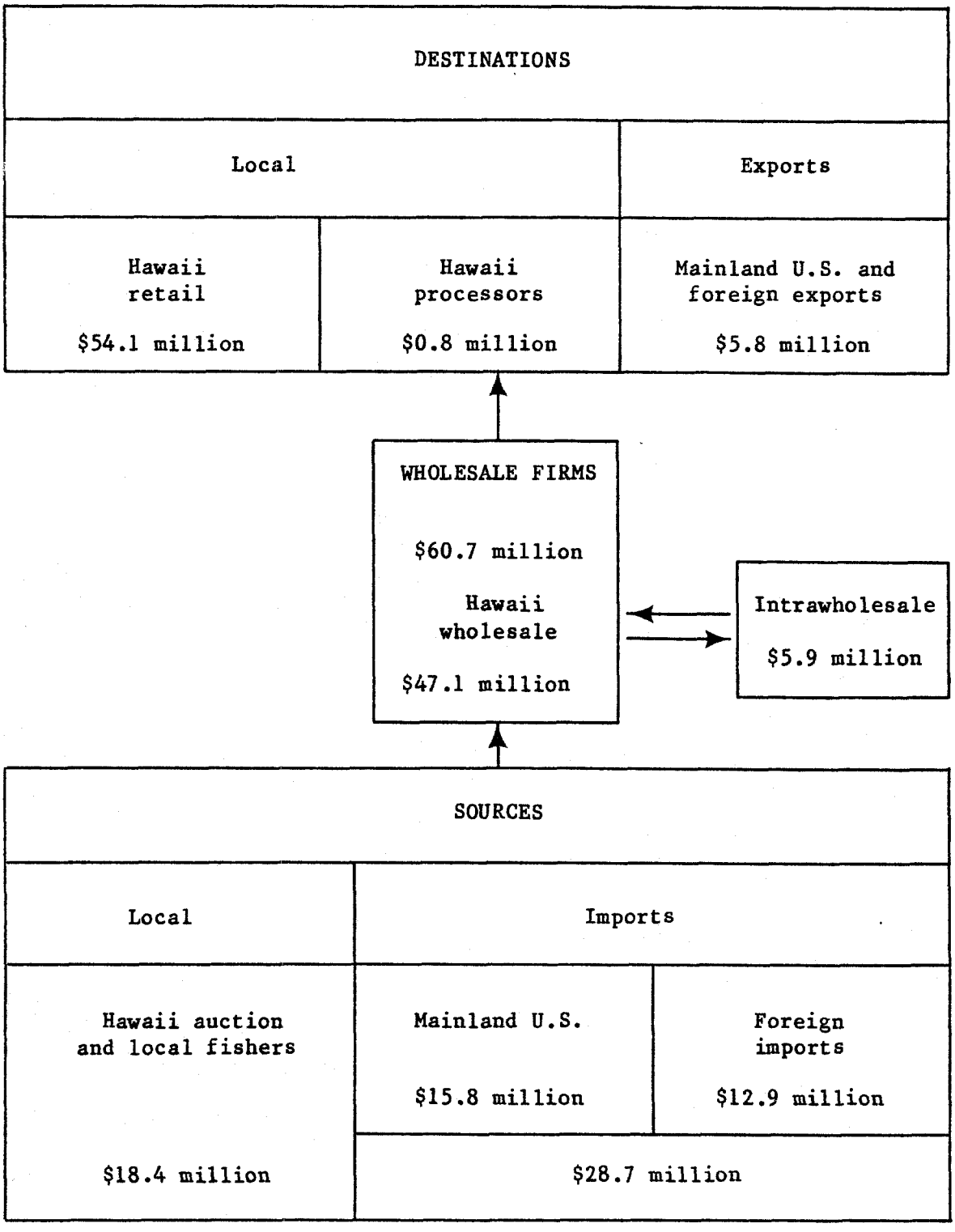

Figure 1.--Diagram of sources and destinations of seafood (data from Cooper and Pooley, text footnote 5).

The wholesale market is fairly evenly divided between fresh and frozen products and most canned seafood products evidently bypass the wholesalers (Fig. 2).

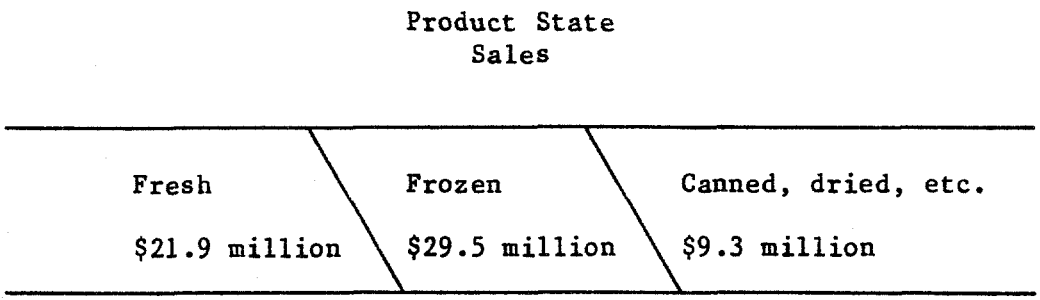

Figure 2.--Hawaii wholesale seafood sales in 1979 by products (data from Cooper and Pooley, text footnote 5).

Utilizing a variety of additional sources, we can make an overall estimate of the seafood market channels in Hawaii for 1979 (Figure 3). Production available for seafood markets was $62.4 million in 1979, including $24.3 million from local commercial fish and imported seafood. This seafood was then handled by wholesalers and local processors, and some was sold directly to retailers. Final retail sales are estimated at $142.4 million, including domestic consumption of $105.4 million (approximately $101 per capita (24 lb)) and $37.0 million in export, mostly processed or transshipped.

We believe that this is the first relatively comprehensive description of Hawaii's seafood marketing channels. Although imprecise and subject to revision as new data become available (especially for the retail sector), this description indicates the relative importance of frozen seafood imported from mainland and foreign sources to the overall supply of seafood in Hawaii, and thus to the behavior of businesses in the wholesale seafood market.

Assessment of Hawaii's Wholesale Seafood Market

Clearly there are a variety of analytical tools available to assess the performance of the wholesale seafood market in Hawaii. The approach we have chosen emphasizes statistical relationships of market structure, market channels, and market adaptation to risk and uncertainty.[9] The first is explored primarily to respond to criticisms of monopolistic behavior in the market. The second is used to provide a coherent description of the

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[9]Other methodologies include price and profit performance, location analysis, bargaining strategy and game theory, and comparative statics. These might be more appropriate for analysis of specific marketing problems, rather than for the overall descriptive and analytical purposes we have in mind.

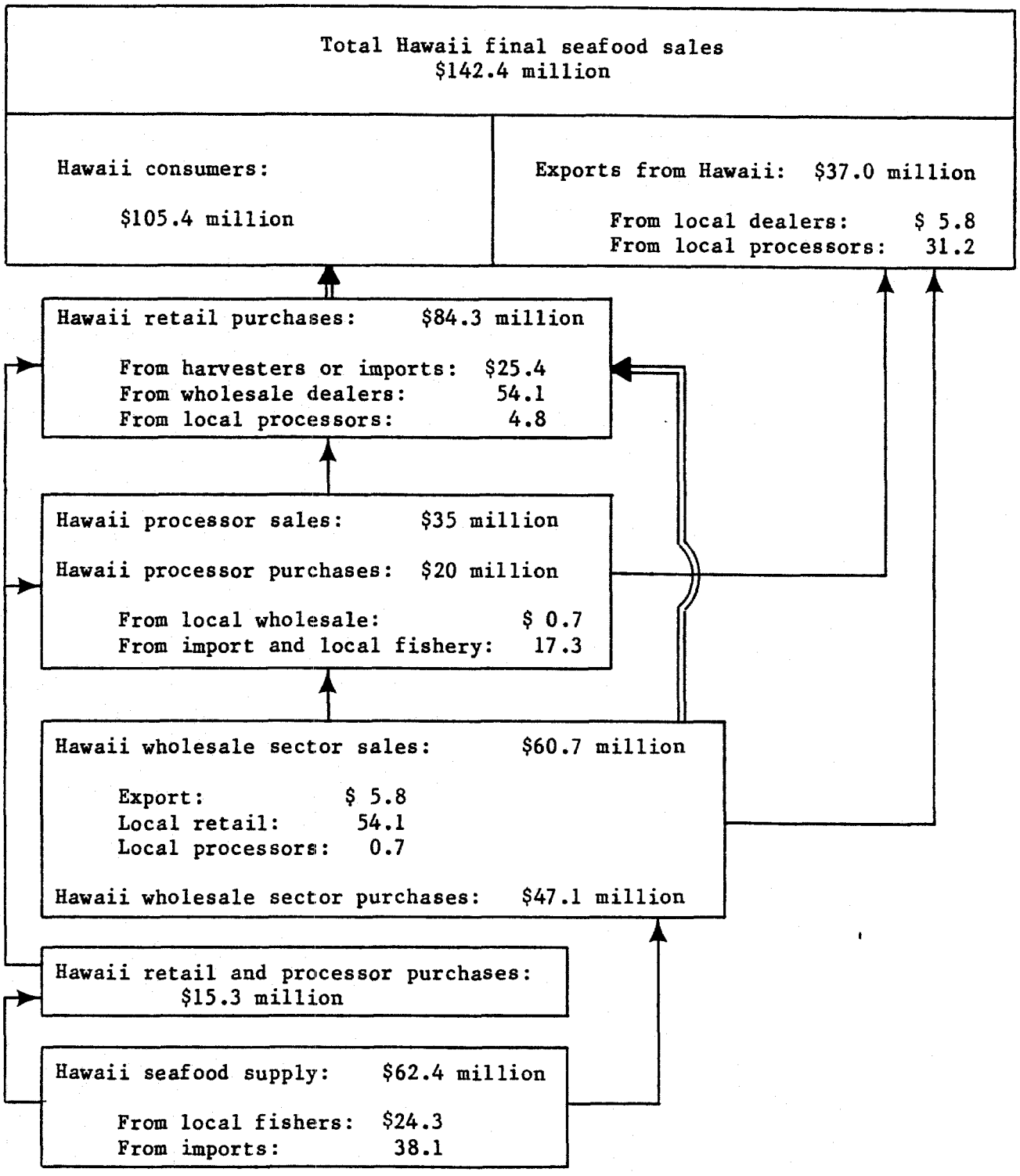

Figure 3.--Diagram on total seafood market flow in Hawaii, 1979 (in millions of dollars). (Sources available upon request.)

market's interrelationships. The third is employed to consider the role the wholesale market has in the development of the harvesting sector.

This section utilizes two-way contingency tables to depict the distribution of values for the major relationships and simple correlations pertaining to wholesale specialization in product state, source, and destination. Variables were stratified to provide a relatively uniform distribution of responses where no clear dichotomy existed for the boundaries in the contingency tables.

Frozen seafood is much more important in the wholesale market in Hawaii than had previously been emphasized. Frozen seafood provides 49% of sales from wholesalers to retailers. Fresh and frozen seafood are found in firms of all sizes, and there is a low correlation between firm size and proportional share of fresh or frozen seafood in a firm's wholesale revenue. The data on revenue from frozen (Table 4) and fresh seafood (Table 5) were stratified into percentages of total wholesale revenue for each firm. The chi-square statistics for these cross tabulations are significant but the simple correlation coefficients are not at a 90% confidence level.[10] Interestingly, a subset of the sample which deletes firms that specialize 100% in frozen seafood provides a stronger positive correlation between firm size and share of revenue from frozen seafood (Table 6).

Because of the extensive frozen fish sales in Hawaii, it is possible to make many comparisons of the fresh and frozen sector which may reveal marketing practices. Previous studies and commentary on Hawaii's fresh fish markets have emphasized market imperfections which serve to limit competition. Economic theory suggests that if monopolistic behavior were a dominant factor in the fresh fish market and not a general market characteristic, price margins would be higher for fresh than frozen seafood. For firms specializing in fresh fish, at least for the larger firms which concentrate on wholesale transactions, this is not true. The margin on frozen seafood is slightly greater on average than that on fresh

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[10]Chi-square indicates the degree which a sample population deviates from a proportional distribution of the values. Whereas the correlation coefficient is a linear relationship, chi-square emphasizes the distribution of values across the clarification variables. Although the variable range is arbitrary, major variables are stratified to maintain a relatively even distribution of total responses while maintaining a heuristically appealing differentiation of responses, dividing 0% and 100% revenue firms from the main sample where possible. The statistical proportions of the chi-square are not significantly affected by this choice. A nearly perfect 1/3-1/3-1/3 division variables across revenue and percentage frozen in Table 4 would give a chi-square of 7.57 ($P = 0.11$). Even stratification along the reference variables would be statistically unjustified and the results would be extremely skewed (95 "small" firms have sales revenue in the lower one-third).

Table 4.--Cross tabulation of firm size with share of revenue from frozen seafood sales.

Share from frozen[2]	Firm size[1]			Total firms ($748,946)
	Small	Medium	Large	
0%	22	15	3	40
1-99%	13	17	10	40
100%	5	12	3	20
Total firms (32.7%)	40	44	16	100
Chi-square: 9.35		df: 4		P: 0.05
Simple correlation: 0.14				P: 0.18

[1]Firm size categories were chosen by total wholesale seafood revenue: small = $1 to $99.999; medium = $100.000 to $999,999; and large = $1 million and over. These size categories are used throughout the paper.
[2]As a percentage of a firm's wholesale revenue.

Table 5.--Cross tabulation of firm size with share of revenue from fresh seafood sales.

Share from fresh[1]	Firm size			Total firms ($748,946)
	Small	Medium	Large	
0%	15	19	7	41
1-99%	8	17	7	32
100%	17	8	2	27
Total firms (49.8%)	40	44	16	100
Chi-square: 9.36		df: 4		P: 0.05
Simple correlation: -0.07				P: 0.47
[2]N = 105				

[1]As a percentage of a firm's wholesale revenue.
[2]Sample size is given for correlation when different from cross tabulation.

Table 6.--Firm size and share of revenue from frozen seafood for firms with less than 100% frozen product sales.

Share from frozen	Firm size: Small	Medium	Large	Total firms ($744,378)
0%	22	15	3	40
1-99%	13	17	10	40
Total firms (15.8%)	35	32	13	80

Chi-square: 6.21 df: 2 P: 0.04
Simple correlation: 0.26 P: 0.02
N = 84

seafood.[11] The overall wholesale margin is 48%, and the wholesale margin for fresh product is 41% and that for frozen product is 45% (Table 7).

There is a weak negative correlation between price margins and firm size and no correlation between overall wholesale margin and percentage of frozen seafood in total revenue (Table 7). The slightly larger frozen seafood margin does not necessarily imply higher profit rates in handling frozen seafood, since a variety of additional costs may be involved. It is not possible to make any inferences about profitability in the absence of cost and yield (loss from preparing seafood for further sale) information.

[11]Margins were calculated by comparing average purchase price and average sales price for a product (fresh, frozen, and processed). Because transfer of product between fresh and frozen can distort these figures, calculations were made by excluding firms which process seafood. Average prices calculated with changes in the form and composition of the product would create an additional source of error.

Table 7.--Fresh, frozen, and total wholesale margins for firms not engaged in processing (N = 79).

Price margins[1]		
Fresh	Frozen	Total wholesale[2]
41.4%	45.5%	48.4%

Simple correlation of price margin with firm size:

Fresh margin	r = -0.19	P = 0.27	N = 36
Frozen margin	r = -0.05	P = 0.78	N = 39
Total wholesale margin[2]	r = -0.09	P = 0.48	

[1] Assumes no transfer between fresh and frozen product state by the wholesaler.

[2] Including trade in canned, dried, fishcake, and other processed products.

Hawaii is one of the few seafood markets in the U.S. which revolves around fresh fish auctions.[12] If manipulation of the auction were a dominant market characteristic, one might expect a positive relationship between firm size and participation in the auction and between participation in the auction and higher fresh fish margins. Again, this is not supported by the data. Although it is clear that small firms do not participate widely in the auction, the simple correlation coefficient between firm size and percentage use of the auctions is insignificant (but positive) (Table 8). Table 9 shows the cross-tabulation of auction participation and fresh fish price margin. There is no statistically significant relationship between these variables, although the simple correlation coefficient is negative. A negative correlation would be expected in the absence of collusion because of the presumed more competitive nature of auction transactions.

Seventy percent of the small firms dealing in fresh fish purchase no fish directly from the auctions, whereas 52% of the medium-sized firms and only 22% of the large firms purchase none of their fresh fish from the auctions. Seventeen percent of the firms buy over 50% of their fresh fish from the auctions, and 62% of auction fish is purchased by 4% of the total number of wholesale firms. However, calculating an "auction purchasing

[12] The auction form of market exchange is generally considered to be highly competitive, although this perception has been challenged for the Hawaii fresh fish market (Peterson 1973).

Table 8.--Firm size and use of auction for firms handling fresh fish.

Use of auction[1]	Firm size			Total firms ($700,666)
	Small	Medium	Large	
0%	18	14	2	34
1-100%	7	11	7	25
Total firms (25.2%)	25	25	9	59
Chi-square: 6.76		df: 2		P: 0.03
Simple correlation: 0.147				P: 0.27

[1]As a percentage of a firm's fresh fish purchases.

Table 9.-- Cross tabulation of use of auction with fresh margin for firms handling fresh fish.

Use of auction	Fresh margin		Total (36.5%)
	<25%	>25%	
0%	14	11	25
1-100%	14	10	24
Total firms (25.2%)	28	21	49
Chi-square: 0.027		df: 7	P: 0.87
Simple correlation: -0.17			P: 0.23

concentration coefficient" which measures purchasing dominance provides an intermediate value, 34.9%.[13] Although medium-sized and larger firms have a relatively larger participation in the auctions as revealed in the chi-square statistic, neither price margin nor auction participation data support a conclusion of market collusion in the fresh fish market.

[13]Concentration coefficients are calculated from industry shares (Table 10). In this case, the shares are each participating firm's share of total auction sales. (Data is from unpublished NMFS sources.)

Table 10.--Concentration ratios.

	Industry-wide		Fresh product firms		Frozen product firms	
	C	N	C	N	C	N
Total sales	22	100	31	56	31	58
Fresh sales	31	58	31	58	45	34
Frozen sales	32	34	70	34	35	34

Industry-wide columns include the entire range of 105 firms. Fresh product columns indicate firms with over 50% of their wholesale revenue from fresh seafood sales. Frozen product columns indicate firms with over 50% of their wholesale revenue from frozen seafood sales.

The concentration ratio is calculated in the following manner:

Let C define the concentration coefficient of a sector of the industry.

Let R define the total wholesale revenue from that sector.

Let r_i define the revenue of the individual firm.

Let N define the number of firms in that sector of the industry.

Then C is calculated:

$$C = 100 \times [(\sum_{i=1}^{N} (r_i/R)^2)]^{1/2} .$$

Overall, industry-wide concentration for the wholesale market, as well as ratios calculated for firms concentrated in fresh and frozen seafood separately, is minimal.[14] Industry concentration is 22% from a possible range of 14-100% with only marginal increases, in most cases, when stratified by product state. This is not to say that the larger firms do not play a large role in the industry: eight wholesale firms account for over 50% of product sales (Table 11). Nonetheless, the issue of "small numbers" does not seem to play a central role in the competitive posture of Hawaii's overall seafood market.

Table 11.--Market shares of largest four and largest eight firms.

	Share	
	Top 4	Top 8
All wholesale	35.5%	53.5%
Fresh firms	52.8%	71.9%
Frozen firms	52.8%	75.4%

We can make a further analysis in this direction by examining the tendency of firms to specialize in particular product groups (species groups). Table 12 reports two types of specialization: within-firm and industry-wide species concentration.

[14]Concentration within industrial structures has been measured in a variety of ways (Rosenbluth 1955; Adelman 1958; Kakwani and Podder 1973). The approach we have taken is to calculate a summary measure of concentration which takes into account all the information available about the firms revenue patterns through use of the Gini-Herfindahl-Hirschman concentration coefficient which is related to the more familiar Lorenz curve approach to measuring income distributions. The measure is computed from the square root of the sum of the squares of the relative shares of each firm in the industry (Table 10). An alternative measure is also presented based on the market share of the largest four and eight firms in each market segment (Table 11).

Table 12.--Species concentration ratios.

Within-firm species concentration ratios (CISPP)

Industry average: 74.4 Standard deviation: 19.8
Theoretical minimum: 28.9 Range: 40.0 to 100.0
N = 103

Industry-wide species concentration ratios (CSP)

N	Species	CSP	Share (%)	N	Species	CSP	Share (%)
44	Tuna	33	27.1	18	Akule	41	1.3
23	Ono	40	1.8	25	Mollusks	42	7.7
40	Bottom fish	40	18.6	16	Billfish	56	3.3
32	Crustaceans	40	11.5	4	Sharks	66	0.1
23	Reef fish	40	1.9	12	Opelu	66	1.2
42	Mahimahi	40	14.3	39	Other	37	11.6

The within-firm species concentration ratios (CISPP) is calculated for each firm analogously to the previous concentration measure (C). It is based on the relative weight of each species group (12 in total) in a particular firm's total wholesale revenue and is calculated for each firm. The industry-wide species concentration ratios (CSP) is calculated by each firm's percentage of that particular species group's share of the firm's total wholesale revenue, calculated over all firms.

The average CISPP indicate a relatively high average level of specialization (as compared with the industry-wide measure of revenue concentration) but a fairly wide range. Sixteen firms specialize totally (CISPP = 100) in one product group alone. Not surprisingly, within the frozen product segment of the industry, fresh fish sales are rather concentrated (indicating that most firms specializing in frozen product are unlikely to carry quantities of fresh product), and the converse is true for fresh product firms (figures not reported). The largest industry-wide participation is in locally important species (tunas, mahimahi, and bottom fish) whereas primarily frozen products such as crustaceans and mollusks have fewer traders than one might anticipate. This situation may be due to direct purchases of these frozen products by major retailers (e.g., supermarkets) from the mainland U.S. and from import brokers bypassing the wholesale sector and this survey.

We would expect larger firms to be more diversified in product groups (smaller CISPP) and cross tabulation of CISPP on firm size verifies this belief (Table 13). The chi-square statistic is significant at the 90% level of confidence, and although the simple correlation coefficient is not significant, the sign is correct.

Table 13.--Species concentration and firm size.

CISPP	Firm size			Total firms ($748,946)
	Small	Medium	Large	
Below average	23	15	10	51
Above average	17	28	6	52
Total firms (74.4%)	40	43	16	103
Chi-square: 6.82		df: 3		P: 0.07
Simple correlation: -0.10				P: 0.29

Questions of monopolistic influences in the fresh fish market can be reexamined in light of product specialization. Domination within the fresh fish market for particular species can be seen by comparing the concentration ratio for auction purchases as a whole with purchases of individual species. Different firms dominate particular species, relating to their specialization in wholesale functions. Adams (1981) reported that eight wholesale buyers purchased 71% of fresh tuna, eight purchased 83% of fresh bottom fish. and eight purchased 67% of all species combined in the fresh fish market on Oahu in 1977.[15] However. 81% of the firms in the Oahu fresh fish market handled tuna and 45% handled bottom fish. When including the frozen sector, only 43% of the firms handled tuna, 41% mahimahi. 39% bottom fish. and on down through the species groups listed in Table 12. Thus the existence of the frozen market suggests a higher level of specialization and a lower degree of concentration than when viewing the market solely from the fresh fish market perspective. There is essentially no difference in the relationship between species concentration ratios (CISPP) for the market as a whole and the fresh fish firms which utilize the auction (Table 14).

[15]These eight firms are not necessarily the same eight for each category.

Table 14.--Species concentration and use of auction for firms handling fresh fish.

CISPP	Use of auction 0%	1-99%	100%	Total (25.2%)
Below average	19	8	3	30
Above average	17	12	3	32
Total firms (76.6%)	36	20	6	62
Chi-square: 0.847		df: 2	P: 0.65	
Simple correlation: -0.059			P: 0.65	

There is a positive relation between firm size and the weight of wholesale trade in a firm's business as might be expected (Table 15). Large fish dealers can specialize in wholesale transactions without resorting to significant retail or processing trade to increase their scope of operations. However, because of the unusual problems of risk and uncertainty in the seafood industry, specialization by wholesale firms might lead to greater chances for catastrophic losses. The uncertainty of supply in fresh fish may be balanced with frozen food imports for major fresh fish dealers. Those firms doing a higher percentage of wholesale trade (as compared with wholesale and retail or processing) have a lower specialization in fresh product (Table 16).

Firm size is also important in intrawholesale trade. In the fresh market over 56% of the small firms sell no fish to other wholesalers compared with 32.4% of the medium and large firms. However no such ready identification can be made in the frozen product market as might also be expected (figures incorporated in Tables 17-19 but not reported). There is a strong positive correlation between fresh market specialization and purchases of seafood from other wholesalers (Table 18) reflecting the role of larger wholesale firms in auctions and direct purchases (bilateral exchange), whereas the reverse is true for frozen product (Table 19). We believe the latter relationship relates to the role of frozen product firms in filling special needs of fresh fish dealers.

Diversification of product source through foreign and mainland U.S. imports is a common practice for local seafood wholesalers. Fifty-five firms purchase from overseas to effectively reduce the uncertainty associated with seafood supply (Table 20). On the other hand, only 12 firms sell seafood abroad and these are strongly correlated with size of firm (Table 21).

Table 15.--Wholesale business and firm size.

Wholesale business[1]	Firm size			Total ($748,916)
	Small	Medium	Large	
1-50%	19	6	0	25
50-99%	13	20	7	40
100%	8	18	9	35
Total firms (72.99%)	40	44	16	100
Chi-square: 20.39		df: 4	P: 0.000	
Simple correlation: 0.275			P: 0.006	

[1]Measured as percentage of a firm's total revenue (including retail and processing).

Table 16.--Wholesale business and share of revenue for fresh seafood.

Wholesale business	Fresh share			Total (49.8%)
	0%	1-99%	100%	
1-50%	3	10	14	27
50-99%	15	14	11	40
100%	24	10	4	38
Total firms (72.9%)	42	34	29	105
Chi-square: 21.248		df: 4	P: 0.000	
Simple correlation: -0.427			P: 0.000	

Table 17.--Firm size and share of purchases from other wholesalers.

Purchases from other wholesalers[1]	Firm size			Total ($748,946)
	Small	Medium	Large	
0%	31	32	7	70
1-10%	1	4	1	6
Over 10%	6	7	5	18
Total firms (8.6%)	38	43	13	94
Chi-square: 5.388		df: 4	P: 0.2497	
Simple correlation: 0.011			P: 0.915	

[1]Given as the percentage of a firm's total wholesale revenue.

Table 18.--Intrawholesale purchases and share of revenue from fresh seafood.

Purchases from other wholesalers	Fresh share			Total (49.8%)
	0%	1-99%	100%	
0%	38	17	16	71
1-10%	1	2	3	6
Over 10%	0	12	6	18
Total firms (8.6%)	39	31	25	95
Chi-square: 20.982		df: 4	P: 0.003	
Simple correlation: 0.339			P: 0.001	

Table 19.--Intrawholesale purchases and share of revenue from frozen seafood.

Purchases from other wholesalers	Frozen share 0%	1-99%	100%	Total (32.7%)
0%	27	26	18	71
1-10%	3	2	1	6
Over 10%	8	10	0	18
Total firms (8.6%)	38	38	19	95
Chi-square: 6.317		df: 4	P: 0.177	
Simple correlation: -0.242			P: 0.018	

Table 20.--Firm size and import share.

Import share[1]	Firm size Small	Medium	Large	Total
0%	14	9	2	25
1-50%	1	10	4	15
51-100%	18	17	6	41
Total firms (50.9%)	33	36	12	81
Chi-square: 10.16		df: 4	P: 0.04	
Simple correlation: 0.02			P: 0.88	
N = 105				

[1]As measured by percentage of a firm's total wholesale purchases.

Table 21.--Firm size and export share.

Export share[1]	Firm size			Total
	Small	Medium	Large	
0%	35	31	8	74
1-100%	0	6	6	12
Total firms (2.8%)	35	37	14	86
Chi-square: 15.58		df: 2	P: 0.00	
Simple correlation: 0.26			P: 0.02	

[1]As measured by percentage of a firm's total wholesale revenue.

The possibility of fisheries development in frozen fillet product lines has been broached for several years in Hawaii, and certainly there is a diversified market for frozen product. Whether domestic frozen bottom fish and groundfish can compete with mainland and foreign fillets is the key marketing question for these fisheries. Market diversity at the level is important for overcoming sales barriers and is a key factor in expanding the "economies of scope" (Panzor and Willig 1981) of wholesale firms. The combination of fresh and frozen product state in larger wholesale firms and the ability of the larger firms to experiment with forms of processing and handling provides diversity in both the wholesale and commercial fishing sectors.

CONCLUSION

This paper attempted to provide a systematic description of the markets for seafood in Hawaii based on an extensive survey of the wholesale sector. We identified three market factors which economic theory could identify as potential barriers to competition and efficient market behavior: small numbers, product heterogeneity, and an inadequate flow of market information. In addition, there are a number of general characteristics which affect Hawaii's seafood market and in which the specific characteristics of individual firms find their place. These general characteristics include:

Consumption: Hawaii's high per capita consumption of seafood estimated at 24 lb per capita and a large tourist industry (10% of de facto population) provide a relatively strong local market for seafood, especially fresh fish.

Domestic market: Despite the high per capita consumption, total demand is limited by population size (1 million residents, 4 million

tourists annually). The domestic market thus places significant constraints on the size of firms operating in Hawaii's seafood market.

Market coherence: Hawaii is an extremely centralized state with ready transportation between most locations (both production and consumption). This provides few economies of scale for the domestic distribution of seafood and makes domestic market information widely available amongst participants.

Location: Hawaii's geographical isolation makes transfers of product from outside sources of supply (imports) and to U.S. and other overseas markets (exports) costly, and information about mainland U.S. suppliers and buyers even more difficult to obtain.

Harvesting sector: Hawaii's commercial fishing fleet is characterized by individually owned, small-scale producing units. The wholesale sector faces a predominately competitive production sector and thus could act as a monopsonist (single buyer). However, in the harvesting sector there are sufficient differences between product specialties such that production of individual species (except tuna) can be affected by a small number of producers, or by producers in just a few locations (in the example of tuna). To a degree, elements of bilateral duopoly exist in the Hawaii market.

Retail sector: Hawaii has nine major supermarket chains which dominate home sales and the restaurant sector is also somewhat concentra-trated (through hotel chains). Thus the importation of frozen seafood in bulk by local seafood wholesalers is necessary for competitiveness in the wholesale sector as it faces the retail sector.

Corporate organization: Most seafood dealers (especially those specializing in fresh fish) and producers in Hawaii are family firms of limited capitalization. Horizontal integration into other food lines and vertical integration into harvesting are limited.

Tradition: Traditional bonds between wholesalers and individual fishers and between wholesalers and individual retailers are important in Hawaii. These long-time relationships can strain the wholesaler's capacity to respond to market conditions (e.g., accounts receivable) during periods of economic stress. However, they also make an important social contribution to the local fishery.

Collectively, these characteristics do not appear to impose significant market imperfections. Although various barriers to entry exist within this seafood market, these are primarily informal and specific to the tasks of wholesalers. The overall market requires that wholesalers act competitively. Transactions and information costs are high for the export market but this is simply Hawaii's comparative disadvantage, not a market failure.

The market analysis provided in the previous section suggests that the problems of limited numbers of dealers and of product heterogeneity are

also insignificant market imperfections. However, the various accounts of market power are not without foundation either, since large wholesalers predominate in most product lines. Thus the market can act to restrict some forms of competition. We would suggest that the market is somewhat oligopsonistic (i.e., limited competition in purchasing) but highly competitive when facing the retail market. This means that a few dealers play a major role in nonprice competition (e.g., preferential access to supply) but that sales price competition is significant. From the consumer's viewpoint, this suggests that day-to-day product availability may be affected by harvesters' attempts to maximize their market power (through limiting supply to increase a fishing trip's market share) but that product price is basically competitive despite occasional seasonal peaks. From the fishers' viewpoint, the market produces relatively good prices, but total revenue is rationed, often through bilateral arrangements and the fear of gluts at the auctions. This latter point is in accord with the findings of Wilson (1980) on the New England seafood markets. Commercial fishers face costs (price and nonprice) whether they participate in the auctions or bypass the auctions by using bilateral arrangements.

In terms of market information and transactions efficiency, the local fresh fish market appears to meet most of the competitive norms and standards. Information on price and quantity is effectively pooled through the auctions and a large number of such transactions are available for public inspection. While the harvesting sector of Hawaii's fishery was relatively stagnant in the 1960's and 1970's, the auctions were blamed for depressing prices. There were rational reasons in believing this but also in believing that the auctions (i.e., the major wholesalers) were simply dampening price fluctuations in the face of uncertainty and low demand. Now with the explosion of handline fisheries for tuna (especially yellowfin and bigeye), and the growth of bilateral trade, the auctions provide important information on the status of the domestic market. With the opening of export channels by some individual fishers (and wholesalers who buy directly from specific fishers) and the growth of the tourism market for fresh fish, the producers are now probably able to gain a relatively high value for their product, while the wholesalers, especially those with limited export capabilities, may be bearing the weight of market uncertainty and risk. This will not completely reduce the perception by the commercial harvesters that major wholesalers still manipulate the market, but problems of market development are significant to the wholesalers and to the harvesters. Because of the public nature of Hawaii's auctions, there appears to be no need for a local "market news" to communicate fresh fish marketing conditions although more timely ex post information might be useful.

There is probably less informational efficiency for frozen product imports and for export opportunities which are based on bilateral agreements. The potential may exist for a cooperative marketing association of harvesters and dealers, as has been promoted for various diversified agricultural and manufactured products in Hawaii. Similarly, because wholesale firms may play a major role in the development of the local commercial fishery, status reports on marketing conditions would be relevant to fisheries management plans and development policy. This way

some of the market information which is generally not viewed as a public commodity could be available for policy determinations.

Finally, in terms of the wholesale market's role in pooling and assessing uncertainty and risk, fishery management or development policy which tends to stabilize supply would tend to reduce wholesale costs, and vice versa. An additional source of supply-related risk in the Hawaii seafood industry is product quality, natural toxicity of some bottom fish and imported shrimp and mahimahi, deterioration of high-priced tuna, and spoilage of canned fish products. Management policy might also be directed toward reducing the chances for naturally occurring toxicity or developing projects to reduce the time required for seafood inspections. Collectively these actions would reduce not only the direct costs of losses by spoiled product, but also reduce the costs associated with "self-insuring" against such risks.

Wholesalers have an information handling burden based on complicated inventory problems. With highly valued product and expansion into the hotel and export sectors, failure to control information could be disastrous for dealers. Unfortunately these small businesses frequently lack the financial and organizational resources for computerized book-keeping and inventory control. A business resource, whether through an industry body or with government cooperation, might be the shared use of microcomputer and telecommunications facilities. This would serve the informational functions of the wholesale firms and improve the informational efficiency of the market. The possibilities for computerized communications and networks are unlimited although notions of antitrust may slow their cooperative deployment.

In conclusion, the general social welfare implications from this largely deductive analysis suggest that Hawaii's wholesale markets are operating efficiently. The availability of fresh seafood seems to be increasing, and high quality fresh seafood is certainly more widely available at the restaurant level. Price fluctuations appear to be dampening although fresh fish prices are still high. New opportunities exist for commercial fisheries development, assisted by the wholesale market sector. Other social problems of the seafood industry (e.g., employment effects) have yet to be analyzed but to do so would raise questions about the overall trajectory of Hawaii's economy. With a declining agricultural sector and a cyclical, and perhaps socially divisive, tourist industry, the seafood marketing industry would appear to be quite responsive to community needs.

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