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Title: A MARKET STRUCTURE ANALYSIS OF THE SALMON
PROCESSING INDUSTRY

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Richard S. Johnston

This study presents an empirical analysis of the market structure of the salmon processing industry in the United States. The primary finding is that the level of concentration of resource acquisition within the industry is a function of a complex set of variables which include the aggregate catch of all salmon, the biological variability of the several species, the market form of processed salmon, and government policy. Conclusions are supported by tests of projections of concentration ratios and tests of forecasted concentration levels predicated upon changes in the biological composition of aggregate catch statistics.

These findings have implications which are precisely the opposite of perceived conditions with respect to government policy. Traditionally, policy makers have viewed concentration in the aggregate and have concerned themselves with endogenous variables
relative to the fishing industry. The study gives support to the view that both anti-trust and fisheries regulation have been and continue to be tangential forces toward greater levels of concentration and a less competitive salmon market. It is further argued that a strong and stable oligopsony has created benefits for the industry which current policy trends may undo. Such policy measures as the limited entry program and an anti-trust policy based upon reduced levels of concentration may in fact, conflict with each other. Without a comprehensive review of policy measures affecting the salmon industry, performance may diminish rather than improve with the application of diverse policy measures.
A Market Structure Analysis of the Salmon Processing Industry

by

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A MARKET STRUCTURE ANALYSIS OF THE
SALMON PROCESSING INDUSTRY

I. INTRODUCTION

The Pacific salmon industry established a vigorous growth pattern in the first 30 years of its existence. The salmon were abundant and easy to catch, and the market for canned salmon seemed insatiable. The future appeared very bright for this infant industry. In 1890, only 25 years after the first salmon cannery was built on the west coast of the United States, there were estimated to be 110 canneries on the Pacific Coast: 21 on the Columbia River, 8 on the Oregon Coast, 6 in the State of Washington (other than the Columbia River area), 7 in California, 35 in Alaska, and 33 in British Columbia (10, p. 154-171). The annual pack of canned salmon exceeded 1 1/2 million cases and the catch was in excess of 10 million salmon.

The State of Washington was a major participant in this bonanza, and the Puget Sound area of that state was the "mother lode" for the salmon harvest. At its peak in 1913, the Puget Sound area produced a catch of 40 million salmon. These fish were caught by several hundred gear units (predominately net or trap) and processed by 31 canneries which were owned by about two dozen firms (10). In 1971 these same waters produced a catch of about 6-2/3 million salmon. These salmon were caught by about the same number of net units and
six times the number of troll units than in 1913. There were 18 can-
neries to process the 1971 harvest and the largest of these accounted
for 30\% of the total production in that year (29).

Economic theory attempts to uncover the basic relationships of
cause and effect hidden by the diverse surface manifestation of eco-
nomic activity in the marketplace. Abstract models of industry have
been constructed for this purpose but the diversity of organizational
form between industry groups precludes an effective, universal
theory. Market structure analysis consists of isolating those signifi-
cant organizational characteristics of a market which may affect the
behavior of firms participating in that market. These firms organize
the resources for the production of goods and services and the alloca-
tion of those resources. The salmon industry is particularly unique,
both in organizational characteristics and geographic location. It
would, therefore, seem logical that the industry is acted upon by
certain unique forces which require identification and study. If policy
measures are to be formulated for this important fishery they should
be founded upon a sound informational base, including a comprehen-
sive description of the organizational structure and its relevant
variables.

The Pacific salmon fishery has been the subject of evaluation
and discussion on a number of occasions during the past 70 years,
the most recent being Crutchfield and Pontecorvo's study (12). With
the exception of Gregory and Barne's work in 1938 (19) the concept of market structure has received little attention (Rubenstein documented the shift in processor concentration in the State of Alaska through 1967) (30). It is hoped that this study will provide a significant base to replace the paucity of literature currently available.

Objectives of Study

This thesis deals with an area in which abstract theory has apparently made very little satisfactory progress in building a coherent explanatory structure: the functioning of an oligopsonistic industry. It will not attempt to either verify models of market behavior or to apply the methods of value theory in search of deterministic price-quantity solutions. Rather, it will deal with the structural components of an industrial market, the salmon processing industry, in an attempt to discern the foundation for possible patterns of behavior in that market.

It is not necessary to review the essential unreality of the solutions to oligopoly and oligopsony problems; the many attempts to insert realistic institutional assumptions have not provided theoretical models that will circumvent the difficulty of oligopolistic or oligopsonistic interdependence (16). The attempt to come to grips with the circumstances of industrial markets, then, is the foundation of the approach to the problem of industrial behavior. Such an
approach must, of necessity, involve lower theoretical standards than abstract theory, in that precise, deterministic solutions, and the manipulation of variables in a given manner to ascertain the logical implications of various assumptions, are not possible. However, it is possible to study economic behavior in its actual setting, and to make informed conjectures about the determinants found behind the patterns that are discovered. Those determinants, or elements of market structure, for a purely competitive market have been identified as: standardized product; a large number of buyers and a large number of sellers; no barrier to the entry or exit of resources into the industry. J. M. Clark identified a number of "conditioning factors" upon which the "specific character of competition in any given case depends" (9). A more extensive classification has been developed by Joe Bain (1). A synthesis of the elements suggested by these two authors would include:

1. The number and size distribution of sellers
2. The number and size distribution of buyers
3. Technological requirements
4. Flexibility of supply
5. Freedom of entry and ease of exit
6. The nature of the product
   a) Homogeneity
   b) Perishability
7. Geographic distribution of production
8. Scale efficiency in production
9. The legal framework (anti-trust policy)

These elements may not be completely independent of each other. For example, the number of processors (buyers) may depend upon technological requirements, supply, and financing. Freedom of entry may depend upon the same considerations. The empirical approach includes an attempt to define key structural variables outside the control of the firm. This, coupled with the fact that it sidesteps the problem of intra-firm organization and the resultant variations that might be caused in the behavior of market participants, is the major criticism of market structure analysis. This, however, should not weaken the purpose of such a study. That objective was stated succinctly by Joe Bain: "We must ... inquire (1) if certain characteristics of market structure potentially influence the choice of competitive pattern and (2) if these or other such characteristics influence the results which a given pattern may yield (3).

This study concerns itself with the market structure of the salmon processing industry in the State of Washington and emphasizes the influence of selected exogenous variables upon that structure. The reasons for this constrained and atypical market structure analysis are manifold, and it is important for the reader to understand their significance.
During 1969 computer printouts of the aggregate purchases, by specie, for all processors in the State of Washington were made available to researchers at Oregon State University. An initial summation of those purchases gave an indication of substantial industry concentration. In the State of Washington concentration of purchases was as high as 98% of all Albacore tuna by a single processor. Because of its relative importance to the Northwest fishery and because several mergers were anticipated, the salmon processing industry appeared to be a logical candidate for analysis. Also, a market structure analysis of a single specie (salmon) avoids the spector of joint product evaluation.

The State of Washington is the only political entity which makes available the necessary statistical data (Oregon has a limited data collection system; Alaska, British Columbia, and California refuse to make the necessary data available to researchers). With the exception of its limited reef net fishery, however, the State of Washington provides an excellent surrogate for the entire salmon industry. All principal species of salmon are represented in the waters of the state, the processing and catching methods are comparable, and the markets and processed market forms are the same as those of other salmon producing regions.

Given the current levels of concentration and the potential for further horizontal mergers within the salmon processing industry,
the levels of concentration could be safely predicted to increase. Such levels of increasing concentration are believed by many to be detrimental to the goal of efficient resource usage—especially with the exponential increase in the number of catch units. This view is clearly evident in the writings of economists (7, 30); and in the actions of the Federal Trade Commission against the salmon industry. Therefore, it was felt that a thorough market structure analysis of the salmon industry would provide support for a number of the proposals initiated by Crutchfield and Pontecorvo in their fine study of the salmon industry (12) and would provide substance for further government regulation of the salmon industry.

The next printout of salmon purchases was for the year 1970. It was puzzling to find that concentration had actually diminished from the levels in 1968. This circumstance was further complicated because there were fewer processors and more fishing units in 1970 than there were in 1968. It was apparent that the levels of concentration were conditioned by variables which were not clearly evident in the aggregations of available data. Several steps were taken to isolate variables. First, the aggregate data were subjected to a four year moving average; and a clear picture of a long-term cycle became evident. This was followed by an evaluation of the impact of the various species (five) upon the total aggregation of salmon purchases. At this point it became clear that two principal species
dominated the industry—the sockeye (red) salmon and the humpback (pink) salmon. Evaluation then turned to catch method and market form for each specie. As a result of these efforts it became apparent that the level of industry concentration was the result of a complex set of exogenous variables which included the aggregate catch of all salmon, biological eccentricities of the various species, market form preference for the processed product, and government policy.

This study does not propose changing market structure analysis; it does, however, argue that each industry may have unique characteristics and forces which will shape the structure of that industry. These factors may be completely outside of the control of the decision makers within the industry. The traditional approach to market structure analysis is founded upon the assumption that decision makers within an industry have control of their destinies, and our policies are formulated toward that end. This study takes strong exception to that concept. Therefore, the starting point for the study is not a review of theory but a comprehensive coverage of industry characteristics and history. It is intended that the reader be immersed in a background study of the Northwest salmon industry so that the unique factors affecting it are clearly in mind. Then it is possible to approach the market structure analysis within an institutional framework.

It is the thesis of this study that the concentration ratio (level
of concentration) in the salmon industry is a function of the aggregate catch of all salmon, the ratio of total troll salmon to the total of all salmon, the ratio of troll pink salmon to total troll salmon, and government policy relative to both anti-trust regulation and fishery regulation. One measure of the strength of the relevant variables is their ability to force either a stable or a changing structure. Therefore, the following hypotheses will be tested: (1) Given the institutional constraints affecting the salmon industry, ceteris paribus, there will be significant changes in concentration levels relative to changes in the aggregate catch of all salmon; (2) Given the more competitive stance of the troll salmon fishery, substantial changes in the aggregate catch of troll caught salmon will, ceteris paribus, inversely affect the level of concentration; and (3) Given the limited market form alternatives for pink salmon, increases in the relative catch of troll pink salmon to the total troll salmon catch will, ceteris paribus, increase the levels of industry concentration.

A secondary objective follows rather naturally from the primary objective--the identification of systematic patterns of behavior based upon variables relevant to the salmon processing industry. Although no satisfactory deterministic model of industry behavior has yet been advanced, it is possible to identify alternative reward structures that individual firms face in an oligopsonistic market. Experimental evidence has suggested that the reward structure
influences behavior so that a behavioral model can provide a systematic means for gathering information about the effects of market structure variables upon outcomes in oligopsonistic markets (32). The final objective of this study will be to evaluate past as well as potential policy implications relative to industry performance and to the structural and behavioral characteristics identified by this study.

Traditionally, policy makers have viewed concentration in the aggregate and have concerned themselves with endogenous variables relative to the fishing industry. Hence, a concern for limiting the bargaining power of fishermen on the theory that it would create collusive price agreements; or a more current concern that a larger number of fishing units (especially troll) is both inefficient and anti-competitive with respect to the diminishing number of processors. If the thesis of this study is correct, then the level of concentration within the salmon industry can be dramatically altered by a change in specie mix or the passage of time. Should this be the posture of the salmon industry then governmental policy, both anti-trust and fisheries regulation, must be severely modified.

**Procedure**

In order to attain the objectives stated this study is organized as follows:
Chapter II will provide a brief background on the development of the salmon industry. This historical and institutional development will describe the various species of Pacific salmon, and will detail commercial catch techniques and preservation methods as well as processed market forms.

Chapter III details the salmon processing industry in the State of Washington. This material includes information and data about both the supply and production of salmon.

Chapter IV documents the changing technology of the salmon canning process. This information is supplemented by production cost information and sources of capital for the industry.

Chapter V presents a market structure formulation for the salmon processing industry. The principal structural factors include the number and size distribution of business units, conditions of factor supply, and entry and exit conditions in the industry. A test of the previously stated hypotheses will be performed to strengthen the argument.

Chapter VI presents some observations on market conduct and performance in the salmon processing industry. The behavioral factors are evaluated in light of the alternative reward structures facing industry decision makers and performance measures are considered with respect to the aggregate change in industry performance by various structural conditions.
Chapter VII provides a tentative set of conclusions and policy implications. The implications of anti-trust measures and regulatory measures relative to the basic resource are evaluated within the framework of the market structure study and the behavioral and performance conditions.
II. THE DEVELOPMENT OF THE SALMON INDUSTRY

Salmon have a long history of commercial exploitation. As early as 1273, Aberdeen merchants were exporting salmon to England and the European Continent (13). 'Newcastle salmon', highly esteemed in London, were also introduced to the early American colonies:

Mrs. Gardiner's Receipts from 1763, published at Boston, Mass., gives a recipe "To Pickle Salmon the Newcastle Way, according to a Receipt procured from England, as is said by the infamous Governor Sir Francis Bernard.' After scaling, splitting down the back and removing the backbone and washing, it is cut into 'Junks of about four or five inches thick. Put on your Pot of Water, making it sharp with salt, and when it boils put in your Junks of Salmon, and let them boil for twenty-three Minutes. Then take it off the fire and let it cool. Make a Pickle with two ounces of Allspice, two ounces of black Pepper and one Gallon of Vinegar, which boil, and into which, when cold, put a handful of Salt. Place the Salmon in a Keg, and, when the Salt is dissolved, pour the Pickle upon the Salmon. After it has stood one night in this manner, strain off the Oyl that may have arisen on the Top, to prevent its acquiring a strong taste and then head up the Keg (13, p. 86).

When the early settlers came to the Pacific Coast of North America salmon was a principal food of the native Indians (20, 24). Russian and English trading companies were soon shipping substantial quantities of salt and pickled salmon to their mother countries (20, 25). However, it was not until 1864, when Hapgood, Hume, and Company established the first salmon cannery in Yolo County, California, that the salmon processing industry, as we know it, began to take form (10, 19, 20, 25, 26). The short supplies in the
Sacramento River and glowing reports of its abundance in the Oregon Territory caused William Hume to move canning operations north to the Columbia River (10, 18). Subsequently, British Columbia and Alaska began major salmon canning industries (10, 22). Very little has been written about the development of the salmon industry in the Puget Sound area of the State of Washington, but Cobb noted that there were numerous canneries by 1900 and that San Juan Fishing and Packing Company was the first firm to pickle salmon in that area (1901) (10). There is evidence that the fisheries of Puget Sound also attracted processors for the halibut fishery to satisfy the growing eastern demand for that important white fish (5). Since that time Puget Sound has been the dominant salmon producing and processing area for the State of Washington.

**The Pacific Salmon**

It is important to understand that there is not one but six species of salmon in Pacific waters. Five of these species are abundant in the waters of the western United States. All of the Pacific salmon are included in the genus *Oncorhynchus* (meaning hooked nose). Fishermen incorrectly group the steelhead trout, which belongs to the closely related genus *Salmo*. The principal difference between the Pacific and Atlantic (Salmo) salmon is the fact that the latter may spawn more than once, while the Pacific salmon always die after
spawning. Pacific salmon are anadromous, that is, they are hatched in fresh water, move into salt water for their major growth, and return to the fresh water to spawn. The five species of salmon peculiar to the western United States are: (1) chinook—also known as king, spring, tyee or quinnat salmon, (2) chum—also known as fall, dog or keta salmon, (3) pink—also known as humpy salmon, (4) silver—also known as coho or medium red salmon, and (5) sockeye—also known as the red or blueback salmon. The sixth species of Pacific salmon is the rose salmon, which, apparently, is unique to the northern waters of Japan.

**Chinook Salmon**

The chinook salmon is the largest of the salmon. It perhaps averages about 15 pounds but has been known to achieve a size of 100 pounds. It has a flesh which is generally red but has been found in varying shades, including white. Its flesh has a softer texture than the other species, is very rich in oil content, and breaks into large flakes when cooked. Although it was highly prized in its canned form in earlier days it is now marketed, principally, in fresh and frozen form. It has a life span of 4 to 6 years. It may be caught with any form of salmon gear.
Chum Salmon

Because of its low oil content and light color, the chum salmon has been the least desirable of the species. It is also more coarsely textured when cooked. Until recently it had been processed predominantly in the canned form. However, its large size (average weight 9 pounds) has made it a suitable fish for processing into frozen salmon steaks so fewer fish are being canned at the present time. It has a life span of 3 to 5 years. It is caught with net or trap type salmon gear.

Pink Salmon

Although it is the smallest of the species, the pink salmon has accounted for a major portion of the salmon catch each year because of the size of the salmon runs for this specie. It has an average size of about 4 pounds and is noted for its delicate flavor and light color. It has an invariable life cycle of 2 years. At the present time it is processed only in the canned form. It is usually caught with net or trap type salmon gear.

Silver Salmon

The silver salmon is somewhat lighter than the red salmon but much larger in size (average size of about 8 pounds). It has a
very desirable texture and flavor similar to but not as rich as the chinook. Its principal market form is as fresh and frozen salmon. It has a life span of about 3 years and may be caught with any form of salmon gear.

Sockeye Salmon

The sockeye or red salmon is relatively small in size (averaging 5 or 6 pounds) but is highly prized for its dark red color and rich flavor. The texture is firm and it early became the most highly desired type of canned salmon. Young sockeye require from one to two years of life in a fresh water lake before they migrate to the sea to complete a life cycle of 4 to 6 years. The sockeye is marketed only in the canned form and, like the pink salmon, is a dominant factor in the total catch of salmon. The sockeye salmon can only be caught with a trap or net form of salmon gear.

Methods of Catching Salmon

Salmon catching techniques are, for the most part, as old as the industry. With the outlawing of fixed location gear such as fish wheels and fish traps, the principal types of commercial salmon catching gear are the purse seine, the gill net, and trolling gear. Additionally, reef nets and dip nets, adopted from the Indian fishery, may account for five or six percent of the total commercial catch in
the State of Washington.

The Purse Seine

The introduction of fish traps in Alaska and the State of Washington provided the major source of catch method during the major growth phase of the salmon industry at the turn of the century. At that time the purse seine was relatively inefficient because it was restricted to hand or sail power. The advent of the internal combustion engine and the power block made a dramatic change and, with the elimination of salmon traps, purse seines now account for over 40 percent of the total commercial salmon catch.

A seine is a net of varying length, mesh size, and depth which is used for catching schooling-type fish such as the salmon. The purse seine is 200 or 300 fathoms in length and has a depth of 10 to 15 fathoms. It is carried aboard a boat 60 to 90 feet long which is broad-beamed and square sterned. When set in the water the net is supported by floats threaded on a head- or cork-line. The net is let out in almost a straight line, then closed by the boat moving in a circle. By closing the circle, the fish are trapped with the closing of the "purse"--this is accomplished by means of a purse-line strung through large metal rings at the bottom of the net. After this drawing-in or "pursing-up" of the purse line, the fish may be easily brailed out of the enclosure. Once this procedure is completed the net is made
ready for another "set" and the technique is repeated.

**The Gill Net**

Salmon gillnets now account for over 30 percent of the salmon commercially harvested. It is one of the oldest forms of gear used in commercial fisheries on the Pacific Coast. With new handling technology and because the necessary investment is substantially less than the purse seiner, there has been a renewed interest in this method of salmon fishing.

The salmon gillnet is also 200 to 300 fathoms in length. The nets hang to a depth of 14 to 20 feet and are set in the path of the schools of salmon. As its name implies, the gillnet catches fish by entangling their gill covers in the mesh. Now that set nets (having one end stationary on shore) are unlawful the operating gillnets are the drift net variety. These are one or two man boats of up to 40 feet in length. The net is dropped over the stern by a power reel. There are floats on the top of the net and weights on the bottom to hold it down. After the "set" the boat and net drift with the tide for a period, after which the net is hauled in and the fish removed before the next set.

**Trolling**

Trolling is a method of catching fish, particularly salmon,
that consists of dragging a hook and line through the water at a slow speed. The hooks are baited with either fresh herring or with artificial lures. Trolling may be accomplished by almost any sized boat, and commercial vessels range in size from a skiff to a 50 foot troller. The only species of salmon which are consistently caught by this technique are the silver and the chinook. The pink salmon will strike at some of the artificial lures. The modest investment required and the increase of hatchery silver salmon have caused a tripling of the number of these catch units during the past 40 years. Trolling now accounts for about 20 percent of the total commercial salmon catch.

Reef Nets

The reef net has been adopted from the Indian fishery and appears to be unique to the Puget Sound area. Its use was rather limited until the set net fishery was outlawed, but it now accounts for 5 or 6 percent of the total commercial salmon catch.

The reef net consists of two large skiffs anchored about 50 feet apart, with a net 50 feet square rigged between them. One end of the net is floated at water level while the balance of the net sags below the water to form a cup. A lead of cable with rope ties hanging from it is used to direct the school of salmon into the net area. When a lookout spots fish entering the net area he calls for the crew to
draw up the net and fish.

Salmon as a Processed Market Form

Fish is one of the most perishable of all foods. The remote geographic locations of harvest and the susceptibility of the fresh fish to severe enzymatic, oxidative, and bacterial action have had a major influence upon the final market form. Salmon, because it is a schooling fish, accentuates the problem even more—the bulk of the fish are caught within a relatively short period of time so that the type of processing facility capable of handling these massive inputs of fish is rather limited.

Initially, salmon was marketed almost exclusively in the pickled or salted form. The advent of the canning process in the nineteenth century allowed, for the first time, a practicable means for preserving and marketing large quantities of the highly perishable salmon. Although highly developed processing technology and transportation means are beginning to have some impact upon the market form composition of processed salmon, that composition has changed very little over the past 40 years. In 1937 the market form composition of processed salmon was estimated as 77% canned, 19% fresh, 2% cured, and 2% frozen (19). By 1968 the estimate was 77% canned, 10% fresh, 4% cured, and 9% frozen (31). Because changes in the consumption patterns for processed salmon may have a considerable
impact upon the market structure for that industry, it seems advisable to include a brief description of the major market forms.

**Cured Salmon**

The preservation of fish for consumption after the catch season is a very old concept. Drying and smoking processes developed shortly after the discovery of fire (19, 34). Salting dates back to the Stone Age and pickling methods are credited to the Greeks and Romans (13, 34). Modernly, these preservation techniques are referred to as "curing." One hundred years ago curing methods represented the dominant technique for handling salmon. Currently, less than five percent of the catch is processed and marketed in this manner.

Preservation of fish by curing is achieved by retarding the bacterial action through drying and the application of chemicals. The curing processes require large inputs of labor and necessitate longer periods of time than the other processes. Additionally, the flavor characteristics of the fish are altered substantially.

**Fresh Salmon**

"Fresh" implies that the original qualities of the salmon are largely unimpaired and that no storage or preservation has been accomplished (34). Fresh salmon has always been a valuable fish.
However, it did not achieve large-scale distribution until the coming of the railroad in the nineteenth century and the use of ice for storage and distribution in the late eighteenth century (salmon was in fact the first fish on which ice was systematically used for preservation in England at the end of the eighteenth century) (13). In the twentieth century, rapid air transport and refined handling techniques have given even greater flexibility in the use of fresh salmon.

While at sea, salmon tend to increase in size but during their spawning migration back to the fresh water they cease to eat, using their body oils for energy. As a result, the flavor characteristics of salmon differ significantly. Historically, fresh salmon has originated from those species which take a hook (still eat) and the troll fishery, which consists mostly of silvers and chinooks, has dominated this market form (as well as the frozen form). With the continued demand for fresh and frozen salmon, larger quantities of net-caught salmon are being used and such species as the chum salmon are being used in this form with more regularity.

Frozen Salmon

Although the first patents on the freezing of fish were granted in 1869, the most important advance in the artificial refrigeration of fish came with the development and use of ammonia refrigerating machines in 1892 (13, 34, 36). Refrigerating the salmon to 32°F
(0°C) cannot result in actual freezing because of the dissolved salts in the water of the fishes' flesh. Although fish may appear to be frozen quite solidly at temperatures above 15°F (-9.5°C) substantial bacterial action is still taking place (34). Because of the dehydrating action upon the fish the freezing process must be accomplished with either a brine or plate freezing method--both of which are much more costly than the blower freezing used in other food processing industries. Additionally, this dehydration effect forces repetitive glazing during the storage life of the frozen product. Although substantial improvement has been made in the technology of this increasingly important market form, it can still be said that after one hundred years "little is known of the biochemical properties of fishery products and how they influence the suitability of the product for freezing" (34, p. 289).

For the salmon industry the major use of frozen product has been in frozen steaks, both bulk (for institutional use) and packaged retail units. In addition, much salmon is frozen for transport and subsequent processing into another market form (canning and/or curing). Because of the tendency of the oil to go rancid, salmon does not have a satisfactory storage life of much beyond one year in its frozen state.
**Canned Salmon**

The major portion of the commercial salmon catch is processed by canning. This is particularly true of the sockeye and pink salmon which are landed in such large quantities in such a short period of time that canning has been the only practical method of preservation. Because both of these fish are also small, thereby preventing their use as frozen steaks, and because the state of preservation and distribution technology is not far enough advanced, continued domination by the canned form can be predicted for the commercial salmon industry.

The father of the canning process is generally recognized to be Nicolas Appert, a French chef who developed the technique in response to a prize offered by the Napoleonic government in 1795 (11, 24, 30). The process was perfected and the results published in 1810 (13). The process was first used in the United States in 1820 when oysters, lobster, and fruit were packed in glass, but it was not until 1874, when A. K. Shriver introduced the pressure kettle or retort, that the modern canning industry began its dramatic growth (13). It was not until 1900 that the hand-soldered "hole-in-cap" can was replaced by what we know as the "sanitary" or open-top can of today (34). An expert tinsmith could turn out about 60 cans per day of the "hole-in-cap" cans, while the can making industry of today can
process cans at the rate of 1000 cans per minute (34).

The development of the canning industry can be attributed to the design of suitable containers and an economically feasible process. Canning has been defined as "the packing of foods in hermetically sealed containers and obtaining commercial sterility through the use of heat processing" (34, p. 311). Although Crosse and Blackwell are credited with establishing the world's first salmon cannery, the major commercial expansion came in the United States with the heavy demand arising during the civil war (13, 26). It was in 1864 that the brothers Hume and Andrew Hapgood, experienced canners of Maine lobsters and salmon, came west to build the first commercial salmon cannery on the Sacramento River at Washington, Yolo County, California (10). Hapgood, Hume & Company moved north with the discovery of the remarkable salmon runs of the Pacific Northwest and Alaska. With a pack of 2,000 cases of canned salmon in the year 1864 the industry grew to its peak production level of 10 million cases in the war year of 1917. In 1864 there was one salmon cannery on the Pacific Coast (10). It is a sad postscript to note that currently, although canning accounts for better than three-quarters of the total commercial salmon catch, the total pack is less than 40 percent of the 1917 peak and the number of cannery facilities has dwindled to about one-third the number of producing units during the peak period (29).
III. THE SALMON PROCESSING INDUSTRY IN THE STATE OF WASHINGTON

Although it is a significant salmon fishery, the Columbia River is contiguous to both the State of Oregon and the State of Washington; and it is, therefore, treated as a separate and distinct regional fishery. The salmon fishery of the State of Washington has long been centered in the Puget Sound area of that state. This dominant indentation in the coast, with its numerous islands and excellent harbors, has fostered a large and successful fishery. This is particularly true of the salmon fishery because of the numerous rivers and creeks which enter the Sound. Strictly speaking, the designation Puget Sound should be restricted to that long, narrow arm extending south from the Strait of Juan de Fuca, but a practice has developed, and is currently common among fishermen and others, of designating all the great water area in the State of Washington comprising Puget Sound proper, Strait of Juan de Fuca, Rosario Strait, the Gulf of Georgia, and numerous other small straits, bays and sounds, as Puget Sound. Because of these factors and because this designated area produces more than three-quarters of the total salmon production in the State of Washington, this study will limit its analytical foundation to the Puget Sound area. The State of Washington, represented by the Puget Sound area, provides an excellent surrogate for the salmon processing industry--the composition of the catch, the
catch methods (with the exception of the reef net), and the composition of the market form are comparable to the other major salmon producing regions of the Pacific coast.

Both the Northwest Company and Hudson Bay Company developed a large salt salmon production in Puget Sound in the early part of the nineteenth century (10). The first salmon cannery on Puget Sound was built by Jackson, Myers & Co., in 1877, in Mukilteo; and it produced 5,000 cases of salmon in its first season (10). Later at this plant were put up the first pink salmon ever canned. Cobb notes:

In order to divert the minds of purchasers from the fact that the meat of the humpback was much lighter in color than the grades then known to the consuming public, the company printed on its label the legend, 'Warranted not to turn red in the can.' Even with this shrewd sizing up of the weak side of the consuming public the demand for humpback or pink salmon developed very slowly, and it was some years before it became a factor in the markets (10, p. 21).

In one of the peak years, 1917, the pink salmon accounted for one-half of the total Puget Sound canned salmon production (10).

It was the extension of the railroad to Puget Sound that provided the major stimulus for the growth of the fishing industry. By 1889 the first fresh halibut and salmon were shipped to the population centers of the Midwest and East and the number of salmon canneries had increased to 4; and the pack was close to 22,000 cases (10). By 1899 the canning process dominated the salmon fishery--there were
19 canneries producing almost one million cases of canned salmon (10). In the largest packing season in Puget Sound history there were two and one-half million cases of salmon packed by more than 30 canneries (10). Overfishing and the refinements of civilization have insured that this impressive performance is likely never again to be matched. Table 1 and Chart 1 indicate the dramatic reduction in the available supply of salmon from the record catch of almost 40 million fish in 1913 to the recent high in the cycle of less than 7 million salmon in 1971.

As has been previously indicated and is further clearly evident from the data in Table 1, the runs of sockeye and pink salmon dominate the total catch of salmon. These two principal species migrate to the catch grounds in varying cycles--two years for the pink salmon and four, five or six years for the sockeye salmon. These major migration cycles for the different species of salmon create a longer term cycle of 17 to 18 years. This fact is not immediately evident from the raw data, so a four year moving average has been compiled and plotted (Chart 2). In addition to the evidence of a strong, long-term cycle, it can be seen from the smoothed data that the average catch level has diminished over time and that the harmonic range has narrowed substantially during that same period of time. This general trend in what might be described as the biological force affecting the salmon industry gives some indication of stability and
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Table 1. Catch of salmon on Puget Sound, excluding offshore catches (in numbers of fish)
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<th>Pink</th>
<th>Silver</th>
<th>Sockeye</th>
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<td>Silver</td>
<td>Sockeye</td>
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<td>3,063,116</td>
<td>6,623,409</td>
<td>3,574,714</td>
</tr>
<tr>
<td>1972</td>
<td>186,500</td>
<td>788,196</td>
<td>3,446</td>
<td>643,643</td>
<td>1,144,987</td>
<td>2,766,772</td>
<td>3,785,950</td>
</tr>
</tbody>
</table>

Source: 1972 Fisheries Statistical Report, Washington State Department of Fisheries
Chart No. 1. Annual Puget Sound Salmon Catch
Chart No. 2. Puget Sound Salmon Catch (number of fish)
Plotted as a 4-year Moving Average
the resulting average catch levels and cyclical extremities may present substantially less uncertainty for fishermen and processors.

The following tabular format presents a summary of the Puget Sound salmon fishery in terms of these biological forces from the year 1913 to 1969:

<table>
<thead>
<tr>
<th>Period</th>
<th>Maximum</th>
<th>Average</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913-19</td>
<td>39,626,690</td>
<td>13,669,931</td>
<td>3,910,622</td>
<td>35,716,068</td>
</tr>
<tr>
<td>1920-39</td>
<td>11,285,566</td>
<td>5,538,868</td>
<td>1,566,833</td>
<td>9,718,733</td>
</tr>
<tr>
<td>1940-59</td>
<td>10,450,875</td>
<td>4,748,246</td>
<td>1,017,532</td>
<td>9,433,343</td>
</tr>
<tr>
<td>1960-69</td>
<td>7,608,633</td>
<td>3,076,503</td>
<td>1,233,714</td>
<td>6,374,919</td>
</tr>
</tbody>
</table>

Cobb indicates that the salmon catch in 1917 was distributed between the various gear forms in the following manner: traps 50%, purse seines 30%, gill nets 10%, Indian gear 7%, and troll gear 3% (10, pp. 148-149). With the removal of fixed location gear (traps) in the mid-thirties (Washington State Legislature, Initiative 77 of 1934), the distribution of the catch was substantially altered. Table 2 portrays the catch distribution for the years 1937, 1955, and 1967. It can be observed that the great preponderance of catch is taken by the net-type gear, and the dominant species contributing to the total catch are the pink and sockeye salmon. Gregory and Barnes state that the prices paid to fishermen for salmon in the year 1937 were as follows (19):
Table 2. Distribution of salmon catch in the state of Washington (numbers of salmon caught)

<table>
<thead>
<tr>
<th>Year</th>
<th>VESSEL INFORMATION</th>
<th>No. of Licensed Units</th>
<th>Average Catch Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1937</td>
<td>Chinook</td>
<td>Silver</td>
<td>Pink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purse seines</td>
<td>35,467</td>
<td>506,349</td>
<td>4,342,087</td>
</tr>
<tr>
<td>Gill nets</td>
<td>295,291</td>
<td>162,804</td>
<td>461,367</td>
</tr>
<tr>
<td>Other nets¹</td>
<td>62,208</td>
<td>53,076</td>
<td>265,928</td>
</tr>
<tr>
<td>Total net units</td>
<td>392,966</td>
<td>722,229</td>
<td>5,069,382</td>
</tr>
<tr>
<td>Troll gear²</td>
<td>259,432</td>
<td>347,208</td>
<td>16,906</td>
</tr>
<tr>
<td>TOTAL OF ALL GEAR</td>
<td>652,398</td>
<td>1,069,437</td>
<td>5,086,288</td>
</tr>
<tr>
<td>Canned salmon pack (48# cases)</td>
<td>87,849</td>
<td>38,921</td>
<td>326,371</td>
</tr>
<tr>
<td>1955</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purse seines</td>
<td>20,048</td>
<td>243,881</td>
<td>4,141,711</td>
</tr>
<tr>
<td>Gill nets</td>
<td>179,710</td>
<td>231,617</td>
<td>502,539</td>
</tr>
<tr>
<td>Other nets¹</td>
<td>66,768</td>
<td>73,700</td>
<td>453,373</td>
</tr>
<tr>
<td>Total net units</td>
<td>266,526</td>
<td>549,198</td>
<td>5,097,623</td>
</tr>
<tr>
<td>Troll gear²</td>
<td>384,695</td>
<td>493,856</td>
<td>109,925</td>
</tr>
<tr>
<td>TOTAL OF ALL GEAR</td>
<td>651,221</td>
<td>1,043,054</td>
<td>5,207,548</td>
</tr>
<tr>
<td>Canned salmon pack (48# cases)</td>
<td>18,929</td>
<td>50,251</td>
<td>412,159</td>
</tr>
<tr>
<td>1967</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purse seines</td>
<td>48,971</td>
<td>102,306</td>
<td>3,146,174</td>
</tr>
<tr>
<td>Gill nets</td>
<td>97,822</td>
<td>251,386</td>
<td>359,765</td>
</tr>
<tr>
<td>Other nets¹</td>
<td>77,849</td>
<td>80,050</td>
<td>190,727</td>
</tr>
<tr>
<td>Total net units</td>
<td>224,642</td>
<td>433,742</td>
<td>3,696,666</td>
</tr>
<tr>
<td>Troll gear²</td>
<td>131,736</td>
<td>779,417</td>
<td>380,576</td>
</tr>
<tr>
<td>TOTAL OF ALL GEAR</td>
<td>356,378</td>
<td>1,213,159</td>
<td>4,077,242</td>
</tr>
<tr>
<td>Canned salmon pack (48# cases)</td>
<td>6,753</td>
<td>21,104</td>
<td>263,052</td>
</tr>
</tbody>
</table>

¹Includes traps, reef nets, dip nets, fish wheels, set nets and drag seines.

²Denoted as hook and line during 1937.

Sockeye  
---  
$10^{1/2} \text{¢ per lb.}$

Pink  
---  
$2^{1/2} \text{¢ per lb.}$

Silver  
7¢ per lb.  
4¢ per lb.

Chinook  
$13^{1/2} \text{¢ per lb.}$  
$11 \text{¢ per lb.}$

The records of the Washington State Department of Fishery Statistics indicate the following average prices per pound for salmon since 1965:

<table>
<thead>
<tr>
<th>Year</th>
<th>Chinook</th>
<th>Chum</th>
<th>Pink</th>
<th>Silver</th>
<th>Sockeye</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Troll/Net</td>
<td>Troll/Net</td>
<td>Troll/Net</td>
<td>Troll/Net</td>
<td>Troll/Net</td>
</tr>
<tr>
<td>1965</td>
<td>55¢/35¢</td>
<td>19¢/23¢</td>
<td>17¢/131/4¢</td>
<td>37¢/271/4¢</td>
<td>31¢/35¢</td>
</tr>
<tr>
<td>1966</td>
<td>58¢/37¢</td>
<td>28¢/24¢</td>
<td>27¢/13¢</td>
<td>40¢/31¢</td>
<td>46¢/35¢</td>
</tr>
<tr>
<td>1967</td>
<td>62¢/43¢</td>
<td>18¢/30¢</td>
<td>201/2¢/14¢</td>
<td>461/2¢/33¢</td>
<td>31¢/34¢</td>
</tr>
<tr>
<td>1968</td>
<td>67¢/481/2¢</td>
<td>291/2¢/27¢</td>
<td>281/2¢/161/2¢</td>
<td>46¢/35¢</td>
<td>431/2¢/381/2¢</td>
</tr>
<tr>
<td>1969</td>
<td>76¢/56¢</td>
<td>411/2¢/35¢</td>
<td>251/2¢/20¢</td>
<td>481/2¢/401/2¢</td>
<td>50¢/43¢</td>
</tr>
<tr>
<td>1970</td>
<td>841/2¢/60¢</td>
<td>331/2¢/26¢</td>
<td>34¢/19¢</td>
<td>58¢/40¢</td>
<td>531/2¢/431/2¢</td>
</tr>
<tr>
<td>1971</td>
<td>68¢/43¢</td>
<td>29¢/31¢</td>
<td>26¢/19¢</td>
<td>39¢/32¢</td>
<td>45¢/44¢</td>
</tr>
<tr>
<td>1972</td>
<td>84¢/65¢</td>
<td>31¢/42¢</td>
<td>36¢/181/2¢</td>
<td>59¢/64¢</td>
<td>59¢/50¢</td>
</tr>
</tbody>
</table>

Those same statistical records also indicate that there were 3032 licensed salmon-catching units in 1965 (almost evenly divided between troll and net gear) and 102 licensed salmon buyers. Of the total number of salmon buyers 22 purchased the net-caught salmon. During the period 1964-72 the average number of buyers remained fairly stable, as did the number of net-type catch units. However, the number of troll fishing units trebled during this same time period.
It is interesting to note from Table 2 that the catch per unit of net gear also remained fairly stable, while the catch per unit of troll gear was reduced to almost one-half of the 1955 average. With a stabilized yield the average catch per fishing unit is directly related to the intensity (number of units) of the fishing effort.

The Supply of Salmon

"Freshly caught" salmon are necessary inputs for the production of processed salmon. There is an extensive literature on the theory of fisheries supply but an analysis and review of that literature is beyond the scope of this study (6, 11, 41).

The data presented give some indication that the annual harvest of salmon has declined until the mid-1950's. Since that time there is some evidence that the annual harvest of salmon has become relatively stable. For the purposes of the present analysis it is postulated that, at least in recent years, the annual supply function of salmon is relatively inelastic (see discussion in Chapter V). During the past 20 years the average catch for the net fishery has remained relatively stable but the average catch per unit in the troll fishery has declined. The total troll catch has increased but not at the same rate that the number of troll fishing units have increased. It is important that these features of the supply of salmon be differentiated because the net-fishery continues to account for three-quarters of the supply of
all salmon and the buyers for that portion number about 20.

The Production of Salmon

Because the canned form is still dominant in the salmon industry, it would seem obvious that the aggregate pack of canned salmon has declined along with the diminishing schools of fish. This fact is clearly depicted by the production data arrayed in Table 3. During the four decades since 1913, the pack of canned salmon has dropped to about one-fifth of its level in the early years of this century. This decline is plotted in Chart 3, and Chart 4 provides a 4-year moving average of smoothed data for a clearer portrayal of the long-term trend. During this same time period the number of canneries on Puget Sound decreased from 45 to 16 (28). Chart 4 also provides some evidence that, along with the net catch of salmon, the average level of canning pack has stabilized subsequent to the mid-1950's. This trend toward stability is best summarized in the following format:

<table>
<thead>
<tr>
<th>Period</th>
<th>Maximum</th>
<th>Average</th>
<th>Minimum</th>
<th>Range</th>
<th>Number of Canneries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913-19</td>
<td>2,585,065</td>
<td>1,383,970</td>
<td>622,731</td>
<td>1,962,334</td>
<td>34</td>
</tr>
<tr>
<td>1920-39</td>
<td>1,139,351</td>
<td>521,371</td>
<td>122,806</td>
<td>1,106,545</td>
<td>16</td>
</tr>
<tr>
<td>1940-59</td>
<td>793,142</td>
<td>408,733</td>
<td>39,484</td>
<td>753,658</td>
<td>18</td>
</tr>
<tr>
<td>1960-69</td>
<td>514,973</td>
<td>223,500</td>
<td>85,915</td>
<td>428,058</td>
<td>16</td>
</tr>
</tbody>
</table>

Averages can be misleading, and it is worth noting that in 1971 there were 18 canneries reported operating on Puget Sound (28). Of this
<table>
<thead>
<tr>
<th>Year</th>
<th>Chinook</th>
<th>Chum</th>
<th>Pink</th>
<th>Silver</th>
<th>Sockeye</th>
<th>Total</th>
<th>4-Year Moving Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913</td>
<td>1,805</td>
<td>55,786</td>
<td>802,040</td>
<td>62,492</td>
<td>1,662,942</td>
<td>2,585,065</td>
<td></td>
</tr>
<tr>
<td>1914</td>
<td>27,140</td>
<td>290,476</td>
<td>1,016</td>
<td>158,932</td>
<td>339,786</td>
<td>817,350</td>
<td></td>
</tr>
<tr>
<td>1915</td>
<td>28,942</td>
<td>422,728</td>
<td>589,195</td>
<td>185,522</td>
<td>85,430</td>
<td>1,311,816</td>
<td></td>
</tr>
<tr>
<td>1916</td>
<td>26,942</td>
<td>398,445</td>
<td>138,798</td>
<td>148,824</td>
<td>82,349</td>
<td>795,358</td>
<td></td>
</tr>
<tr>
<td>1917</td>
<td>89,048</td>
<td>384,726</td>
<td>1,135,169</td>
<td>176,003</td>
<td>462,852</td>
<td>2,247,802</td>
<td></td>
</tr>
<tr>
<td>1918</td>
<td>62,821</td>
<td>264,922</td>
<td>6,607</td>
<td>235,795</td>
<td>52,587</td>
<td>622,731</td>
<td></td>
</tr>
<tr>
<td>1919</td>
<td>71,190</td>
<td>529,967</td>
<td>437,731</td>
<td>201,696</td>
<td>67,087</td>
<td>1,307,670</td>
<td></td>
</tr>
<tr>
<td>1920</td>
<td>27,482</td>
<td>47,831</td>
<td>4,921</td>
<td>25,321</td>
<td>62,751</td>
<td>168,306</td>
<td></td>
</tr>
<tr>
<td>1921</td>
<td>25,662</td>
<td>27,315</td>
<td>375,900</td>
<td>65,303</td>
<td>95,667</td>
<td>589,847</td>
<td></td>
</tr>
<tr>
<td>1922</td>
<td>21,911</td>
<td>66,746</td>
<td>2,985</td>
<td>115,405</td>
<td>50,235</td>
<td>257,282</td>
<td></td>
</tr>
<tr>
<td>1923</td>
<td>16,103</td>
<td>100,652</td>
<td>469,869</td>
<td>120,908</td>
<td>50,003</td>
<td>757,535</td>
<td></td>
</tr>
<tr>
<td>1924</td>
<td>16,319</td>
<td>143,074</td>
<td>6,699</td>
<td>84,850</td>
<td>70,749</td>
<td>321,691</td>
<td></td>
</tr>
<tr>
<td>1925</td>
<td>29,983</td>
<td>42,715</td>
<td>557,086</td>
<td>172,007</td>
<td>104,973</td>
<td>906,764</td>
<td></td>
</tr>
<tr>
<td>1926</td>
<td>27,780</td>
<td>112,201</td>
<td>2,128</td>
<td>120,950</td>
<td>44,567</td>
<td>307,625</td>
<td></td>
</tr>
<tr>
<td>1927</td>
<td>42,575</td>
<td>41,813</td>
<td>585,869</td>
<td>134,254</td>
<td>103,550</td>
<td>908,060</td>
<td></td>
</tr>
<tr>
<td>1928</td>
<td>24,628</td>
<td>145,735</td>
<td>5,816</td>
<td>92,770</td>
<td>61,044</td>
<td>329,993</td>
<td></td>
</tr>
<tr>
<td>1929</td>
<td>32,776</td>
<td>149,860</td>
<td>737,508</td>
<td>106,825</td>
<td>112,383</td>
<td>1,139,351</td>
<td></td>
</tr>
<tr>
<td>1930</td>
<td>33,073</td>
<td>66,801</td>
<td>3,976</td>
<td>122,592</td>
<td>360,190</td>
<td>586,632</td>
<td></td>
</tr>
<tr>
<td>1931</td>
<td>28,009</td>
<td>55,117</td>
<td>706,288</td>
<td>76,471</td>
<td>87,745</td>
<td>953,630</td>
<td></td>
</tr>
<tr>
<td>1932</td>
<td>20,337</td>
<td>124,833</td>
<td>1,659</td>
<td>60,326</td>
<td>74,605</td>
<td>281,760</td>
<td></td>
</tr>
<tr>
<td>1933</td>
<td>21,490</td>
<td>39,976</td>
<td>540,033</td>
<td>44,515</td>
<td>128,518</td>
<td>774,532</td>
<td></td>
</tr>
<tr>
<td>1934</td>
<td>15,274</td>
<td>69,303</td>
<td>3,887</td>
<td>68,849</td>
<td>349,602</td>
<td>506,815</td>
<td></td>
</tr>
<tr>
<td>1935</td>
<td>9,737</td>
<td>15,319</td>
<td>371,296</td>
<td>71,445</td>
<td>51,146</td>
<td>518,943</td>
<td></td>
</tr>
<tr>
<td>1936</td>
<td>6,029</td>
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<td>1,345</td>
<td>29,191</td>
<td>42,894</td>
<td>122,806</td>
<td></td>
</tr>
<tr>
<td>1937</td>
<td>8,968</td>
<td>17,061</td>
<td>326,371</td>
<td>32,559</td>
<td>60,355</td>
<td>445,314</td>
<td></td>
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<tr>
<td>1938</td>
<td>2,787</td>
<td>7,852</td>
<td>193</td>
<td>9,820</td>
<td>139,173</td>
<td>159,825</td>
<td></td>
</tr>
<tr>
<td>1939</td>
<td>2,439</td>
<td>14,505</td>
<td>275,485</td>
<td>54,773</td>
<td>43,511</td>
<td>390,713</td>
<td></td>
</tr>
<tr>
<td>1940</td>
<td>1,991</td>
<td>21,168</td>
<td>2,732</td>
<td>30,376</td>
<td>59,354</td>
<td>115,621</td>
<td></td>
</tr>
<tr>
<td>1941</td>
<td>4,706</td>
<td>21,170</td>
<td>153,686</td>
<td>45,968</td>
<td>110,605</td>
<td>336,135</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>250,574</td>
</tr>
<tr>
<td>Year</td>
<td>Chinook</td>
<td>Chum</td>
<td>Pink</td>
<td>Silver</td>
<td>Sockeye</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
<td>---------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>1942</td>
<td>1,460</td>
<td>3,932</td>
<td>843</td>
<td>7,032</td>
<td>267,855</td>
<td>281,122</td>
<td></td>
</tr>
<tr>
<td>1943</td>
<td>2,872</td>
<td>224</td>
<td>61,480</td>
<td>26,220</td>
<td>19,117</td>
<td>109,913</td>
<td></td>
</tr>
<tr>
<td>1944</td>
<td>1,178</td>
<td>15</td>
<td>306</td>
<td>476</td>
<td>37,509</td>
<td>39,484</td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td>5,095</td>
<td>1,512</td>
<td>305,213</td>
<td>19,104</td>
<td>53,055</td>
<td>383,979</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>8,367</td>
<td>43,843</td>
<td>92</td>
<td>11,533</td>
<td>268,561</td>
<td>332,386</td>
<td></td>
</tr>
<tr>
<td>1947</td>
<td>18,248</td>
<td>93,749</td>
<td>607,330</td>
<td>65,722</td>
<td>8,119</td>
<td>793,142</td>
<td></td>
</tr>
<tr>
<td>1948</td>
<td>22,387</td>
<td>94,238</td>
<td>1,502</td>
<td>65,744</td>
<td>90,441</td>
<td>274,312</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>5,922</td>
<td>14,904</td>
<td>527,478</td>
<td>57,960</td>
<td>80,547</td>
<td>686,811</td>
<td></td>
</tr>
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<td>6,407</td>
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<td>967</td>
<td>78,360</td>
<td>116,458</td>
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<td>1951</td>
<td>7,570</td>
<td>94,113</td>
<td>438,732</td>
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<td>118,151</td>
<td>735,146</td>
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<td>1952</td>
<td>5,750</td>
<td>126,372</td>
<td>760</td>
<td>108,161</td>
<td>114,638</td>
<td>355,681</td>
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<td>1953</td>
<td>2,965</td>
<td>35,598</td>
<td>443,524</td>
<td>35,705</td>
<td>178,323</td>
<td>696,115</td>
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<tr>
<td>1954</td>
<td>2,799</td>
<td>39,260</td>
<td>25</td>
<td>16,489</td>
<td>501,496</td>
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<tr>
<td>1955</td>
<td>7,117</td>
<td>32,532</td>
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<td>85,136</td>
<td>584,677</td>
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<tr>
<td>1956</td>
<td>2,513</td>
<td>21,831</td>
<td>786</td>
<td>54,528</td>
<td>84,052</td>
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<tr>
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<td>2,928</td>
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<td>221,014</td>
<td>45,218</td>
<td>119,985</td>
<td>399,151</td>
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<td>1,464</td>
<td>68,969</td>
<td>1,570</td>
<td>27,249</td>
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<td>549,318</td>
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<tr>
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<td>36,175</td>
<td>168,322</td>
<td>49,785</td>
<td>135,480</td>
<td>394,357</td>
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<td>2,575</td>
<td>7,159</td>
<td>41</td>
<td>6,363</td>
<td>96,627</td>
<td>112,705</td>
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<tr>
<td>1961</td>
<td>3,819</td>
<td>22,211</td>
<td>73,117</td>
<td>50,092</td>
<td>122,751</td>
<td>271,990</td>
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<tr>
<td>1962</td>
<td>4,447</td>
<td>8,144</td>
<td>232</td>
<td>24,156</td>
<td>71,953</td>
<td>108,932</td>
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<tr>
<td>1963</td>
<td>5,622</td>
<td>6,194</td>
<td>378,515</td>
<td>14,364</td>
<td>110,278</td>
<td>514,973</td>
<td></td>
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<tr>
<td>1964</td>
<td>5,176</td>
<td>9,601</td>
<td>30</td>
<td>22,411</td>
<td>49,697</td>
<td>86,915</td>
<td></td>
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<tr>
<td>1965</td>
<td>3,149</td>
<td>12,760</td>
<td>62,227</td>
<td>30,334</td>
<td>84,059</td>
<td>192,529</td>
<td></td>
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<tr>
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<td>330</td>
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<td>133,006</td>
<td>171,586</td>
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<td>1967</td>
<td>3,396</td>
<td>12,067</td>
<td>260,931</td>
<td>18,891</td>
<td>159,990</td>
<td>455,275</td>
<td></td>
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<tr>
<td>1968</td>
<td>8,352</td>
<td>16,386</td>
<td>--</td>
<td>28,004</td>
<td>71,279</td>
<td>124,021</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>589</td>
<td>2,038</td>
<td>1,142</td>
<td>65,252</td>
<td>102,101</td>
<td>171,122</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** 1972 Fisheries Statistical Report, Washington State Department of Fisheries
Chart No. 3. Annual Puget Sound Salmon Pack
Chart No. 4. Puget Sound Canned Salmon Pack (48-lb. cases)
Plotted as a 4-year Moving Average.
group, 3 packed less than one thousand cases and only 8 packed more than ten thousand cases of canned salmon. The picture presented provides ample confirmation of the Crutchfield and Pontecorvo thesis that the salmon industry is plagued with chronic overcapacity at the processor as well as the catch-unit level (12).

Little has been or will be said concerning the productive capacity for the fresh and frozen salmon. As has been stated by numerous fish processors and wholesalers, "all it takes to get into the fresh fish business is a box of ice and a pickup truck." These small purveyors make up the bulk of the fish buyers for salmon in the State of Washington. Their primary purchases are the troll salmon and they have a significant impact upon the competitive price structure for troll caught chinook and silver salmon. With the units of purchase small and the buyers numbering over one hundred, the troll salmon market appears competitive in its structure. Nevertheless, the same processors who dominate the salmon fishery because of cannery facilities also maintain the necessary freezer facilities to support a well rounded operation. With canned and frozen salmon accounting for more than 85% of the total salmon catch, there is little benefit in studying the market for fresh salmon. However, because of the importance of the effect of alternative forms of some species of salmon it is necessary to understand the price differentials. The following average prices for canned and fresh salmon were taken
from the Pacific Packers Report and the Market News Service of the Bureau of Fisheries:

<table>
<thead>
<tr>
<th>Year</th>
<th>Chinook</th>
<th>Chum</th>
<th>Pink</th>
<th>Sockeye</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>$31</td>
<td>$31</td>
<td>$28</td>
<td>$37</td>
<td>$30</td>
</tr>
<tr>
<td>1966</td>
<td>31</td>
<td>25</td>
<td>28</td>
<td>37</td>
<td>30</td>
</tr>
<tr>
<td>1967</td>
<td>31</td>
<td>27</td>
<td>31</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>1968</td>
<td>34</td>
<td>28</td>
<td>31</td>
<td>42</td>
<td>34</td>
</tr>
<tr>
<td>1969</td>
<td>38</td>
<td>29</td>
<td>33</td>
<td>46</td>
<td>38</td>
</tr>
<tr>
<td>1970</td>
<td>39</td>
<td>30</td>
<td>34</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>1971</td>
<td>39</td>
<td>32</td>
<td>36</td>
<td>46</td>
<td>38</td>
</tr>
<tr>
<td>1972</td>
<td>No quotes</td>
<td>40</td>
<td>45</td>
<td>57</td>
<td>48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Med. Chinook</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>.70/lb</td>
<td>.70/lb</td>
</tr>
<tr>
<td>1966</td>
<td>.75</td>
<td>.70</td>
</tr>
<tr>
<td>1967</td>
<td>.95</td>
<td>.80</td>
</tr>
<tr>
<td>1968</td>
<td>.95</td>
<td>.80</td>
</tr>
<tr>
<td>1969</td>
<td>.95</td>
<td>.90</td>
</tr>
<tr>
<td>1970</td>
<td>1.00</td>
<td>.90</td>
</tr>
<tr>
<td>1971</td>
<td>1.10</td>
<td>.95</td>
</tr>
<tr>
<td>1972</td>
<td>1.20</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Summary of Chapter

The purpose of this chapter was to give the reader some background for the Puget Sound salmon fishery. This includes dynamics of the salmon fishery itself, the production units involved in the processing of the salmon, and the prices received for both
freshly caught and processed salmon. The picture is one of a
diminishing supply of salmon which currently appears to be stable.
At the same time the number of net-catch units appears to be stable
and those units account for more than three-quarters of the entire
catch. The troll units continue to increase and the resulting catch
per unit has decreased (the average cost has increased). Less than
two dozen buyers are available to receive the net fish while over one
hundred buyers bid for the troll caught salmon. This is because only
cannery facilities can handle the net caught salmon and the average
number of canneries on Puget Sound has been less than 20 for over
30 years. The next chapter discusses some possible explanations
for this disparity in numbers of buyers as between net-caught and
troll-caught salmon.
IV. THE PRODUCTION OF CANNED SALMON

Salmon, like other foodstuffs, is canned in order to preserve it for future use by individuals distantly remote from the original catch location. When packs of 5,000 to 15,000 cases were made during the catch seasons in the early history of the salmon canning industry, the bulk of the work was done by hand. Demand increased for the canned product and hand labor was incapable of packing enough salmon during the short summer season. Additionally, there was a substantial increase in labor costs, especially in the large canneries being opened in Alaska during the last decade of the nineteenth century (10, 19). The result was the development of machines of increasing complexity and speed to substitute for the massive amount of labor. Because this transformation from a labor to a capital intensive industry has had a substantial impact upon the structure of the salmon canning industry, a review of the canning process and its development is provided in the current chapter.

The Technological Evolution of Salmon Canning

When salmon canning was in its infancy, a pack of from 150 to 200 cases was considered a normal level of production in a given day (10). Now it is possible for a modern cannery to turn out 9,000 cases per day, if the fish were available (5, 30). The concept of canning
has not changed dramatically since the early days on the Sacramento River, only the production technology. The following excerpts contrasting these changes are provided from accounts of an early salmon canner, R. D. Hume (21), and one of the modern giants of the salmon canning industry, New England Fish Co. (5). Mr. Hume describes the early process of can-making as follows:

The bodies of the cans were first cut to proper size by the squaring shears, a line was then scribed with a gauge about three-sixteenths of an inch from one edge, and they were next formed into cylindrical shape by the rolls. They were then taken to the soldering bench and one edge lapped by the other until the edge met the line that had been scribed and fastened there by being soldered a small part of the length to hold them in place for the further purpose of seaming. They were then placed in either the iron clamp, which had a piece of wood attached to its underside, and held firmly, the clamp being closed by the operation of a treadle, or were slipped on a piece of wood, which was bolted to the bench, while being held in place by the triangular hand seamer, which was pressed down on the lap of the seam by the left hand of the operator. When this had been done a piece of solder, which had been prepared by shaking in a can together with rosin, was placed on the seam and melted and rubbed lengthwise of the seam. After cooling the bodies were ready for the end or bottom, which operation was brought about by first cutting out circular blanks with the rotary shears, and then placing them in the cast-iron die and bringing the handle of the screw press around with a swing with force enough to form up the end or bottom. In this operation there were many difficulties, as the ends or bottoms would many times stick to the upper part of the die and refuse to come off, and finger nails were pretty short in those days. To get the ends out of the lower part of the die was not so bad, as a wooden plunger operated by a treadle knocked them out, but sometimes they were in pretty bad shape. When the bottoms or ends were ready they were slipped on the bodies and the edge of the bottom rolled about in a pan of powdered rosin until the seam was well dusted. A piece of solder similar in size and preparation
as used for the side seam was placed in the can. They were then placed on the smooth side of the cast iron slabs, and the operator, with a hot soldering copper shaped to fit the circle of the can, melted the solder and by turning the can rapidly soldered the full circumference. The output of this can factory was imperfect, as at least one-half of the seams burst, owing to the lack of experience of the manager or want of good judgement (21, pp. 19-20).

By the early eighteen-eighties California Can Company was making cans in San Francisco and shortly after that Pacific Sheet Metal Works built a can making facility at Astoria (10). Both of these operations were ultimately purchased by American Can Company. The first sanitary can packing machinery for the salmon industry was installed at its Astoria facility in 1911 (10). The dramatic development of can making technology permitted the following statement by New England Fish Company in describing the source for its cans in 1953:

Cans are made in the can factory at Portland, Seattle, or Vancouver and are shipped to the cannery with bottoms attached, in bags, or flattened and without bottoms attached, in cartons that will receive the finished product. Both the pound-tall and the half-flat can usually are shipped flat. A regular shipping case that will hold only 48 filled, sealed, tall cans will hold 360 flattened cans. At the cannery, machines round out these flattened can bodies and attach the bottoms, timed to the speed of the filling machines (5, pp. 54-55).

The changes wrought in the processing of canned salmon are no less remarkable. Mr. Hume’s account of the early salmon canning process is as follows:


When the can making was well underway Mr. Hapgood then turned his attention to getting the apparatus for canning on board the houseboat. This in the cooking department consisted of a kettle made of boiler iron about 36 inches in diameter and 5 feet in depth, set in a brick furnace and fired from underneath. Alongside was a round-bottom, cast-iron pot holding about 60 gallons of water and heated in the same manner. These kettles, with a dozen coolers or circular sheet-iron pans with ropes attached and with holes cut in the bottom for drainage, a set of 5-inch blocks and tackle, with a sheet-iron fire pot and a scratch awl, completed the bathroom outfit. The can filling and soldering room was furnished with a table through the center, where cutting the salmon into pieces to suit and the filling of the cans was done. On each side of the room there was a bench running the full length, on the end of one of which the cans were placed to receive the pickle, which was used at that time instead of the small quantity of salt that is placed in the cans during the operations of these later days. After the salmon had been cleaned by removing the entrails and washing them outside the covered portion of the scow, they were brought inside and placed on the table, and a man with a butcher knife in one hand and a stick in the other, which had a mark on it showing the length of the pieces desired, cut gashes on the side of the salmon as a guide and then cut the fish into sections corresponding to the length of the mark on the stick. He then proceeded to cut the sections into pieces to suit the cans. Then three or four operators placed the salmon in the cans and shoved them along the table to where a boy wiped the top edge and passed them along to two others who placed tops which fitted inside the rim. The cans were then taken in wooden trays to the bench opposite the starting point, which was fitted with four sheet-iron pots, and at the one nearest the entrance to the entrance to the house on the scow a man put a soldering flux on the top edge, which was made by adding zinc to muriatic acid, and then with a pointed soldering copper and a stick of solder melted the solder until a small portion could be drawn around the groove formed by the edge of the can and the bevel of the top. From there the cans were taken to the other parts of the bench, where two men finished soldering the head in, and then taken to the third man, who soldered, or, as it was called, buttoned, the end of the seam lap. The cooking department or bathroom, as
it was called, was separated from the filling or soldering room by a partition. The cans were shoved through a hole in the partition.

... When the cans had been soldered and entered the bathroom they were put in the coolers and lowered into the cast-iron pot, one cooler of cans being cooked at a time. The cooler was lowered into the boiling fresh water until the cans were submerged to within one inch of the top ends and left to cook one hour; then they were hoisted out and the vent holes in the center of the top soldered up, after which they were dumped in the boiler-iron kettle, which held a solution of salt and water of density sufficient to produce, when boiling, a heat of 228° to 230°F. They were cooked in this solution for one hour and then taken out of the kettle with an iron scoop shaped like a dip net, with a wooden handle about 6 feet in length. They were dumped into a tank of water on the other side of the partition, receiving many a bump and bruise in the operation. Then they were washed with soap and a rag to remove the dirt and grease, each can being handled separately. When this was done they were piled on the floor of the packing room and in a few days were painted with a mixture of red lead, turpentine, and linseed oil, for at that time buyers would have no canned salmon, no matter how good the quality, unless the cans were painted red (21, pp. 20-21).

Within 30 years the Jensen can filling machine and can topping machines were developed in the Columbia River area; and in 1906 the first "Iron Chink" was used for butchering the freshly caught salmon (26). The 1920's saw the development of high-speed fillers and automatic vacuum sealers while automatic cutters were well developed by the early 1930's. These developments, along with the widespread use of the sanitary can since the turn of the century, have permitted the modernization of the salmon canning industry so aptly described by New England Fish Company in 1953:
Salmon, when they arrive at the cannery by seiner, troller, gill-netter or packer, are removed from the boats by power elevators with the aid of water, counted and segregated in bins according to species and grades.

Modern salmon canning has become a very highly mechanized, straight line production unit. This is necessary to handle large quantities of salmon during a very short production season. Only by speed of handling can quality be preserved. Labor for a short season is very hard to get and very expensive and this is another reason for highly mechanized production lines.

The machine that cleans the salmon, the "Iron-Chink," is a marvelous product of inventive genius. It handles whole fish at the rate of about 75 a minute, removing head, fins, tail, scales and entrails, also washing away the blood along the backbone. From the "Iron Chink" the fish are conveyed to the "slimming" tables where they are thoroughly scrubbed with running fresh water to remove the last traces of blood and slime.

For hand filled cans, the next step is to cut the fish into lengths that properly fit the height of the can. This is done by a series of evenly spaced sharp knives cutting the fish into many pieces of the proper length. These pieces are then ready for hand filling. Cutting for machine filling is done by the same machine that fills the can.

Hand filling is done by women. Automatic filling is accomplished by remarkable machines which take whole, dressed fish and empty cans, fills and salts them at the rate of 240 per minute. Filled cans are checked by an automatic weighing machine which throws out light weight cans. The cans are conveyed in a steady stream, passing, if not already salted, first under a salting machine which adds the correct amount of pure dry salt to each can, then to an automatic weighing machine to separate light weight cans, and next they pass between inspectors who remove off grade cans and those showing defects in workmanship. The latter are repacked, the former are placed in a separate lot. From the inspection tables, the cans pass through closing machines which affix covers on the cans and seal them under high vacuum at the rate of 240 per minute.
From the sealing or closing machines, the cans go into metal trays or "coolers," which are stacked on trucks. These trucks of cans are run into retorts, where they are cooked for an hour and a half with "live" steam at 240 degrees Fahrenheit. This sterilizes the contents of the cans and softens the bones so that they, too, are edible.

After cooking, the "coolers" go through a continuous washer, then a rinsing vat, and again are stacked, this time on pallets. Lift trucks convey the stacks of cans to a cooling room, where they are cooled overnight. The stacks of cooled cans then go to a machine which inverts the "coolers" and places the cans on a mechanism that feeds them in a steady stream to the conveyor to the labeling machine.

From the labeling machine they go to a machine that automatically fills the empty cases. These cases then pass through a case sealing machine and then by conveyor to the warehouse, where they are stacked and later shipped to another warehouse, or to the market (5, pp. 54-57).

In the year 1905 a cannery required at least 300 laborers to produce a pack of 3,000 cases (48/1#) of canned salmon per day (19, 26, 39). By the mid-1920's this same cannery could get along with only 150 laborers (8); and by 1935 a salmon cannery could turn out 3,000 cases per day with only 75 laborers (19). A modern salmon cannery is capable of producing 9,000 cases of canned salmon per day with the help of only 100 laborers (5, 22, 30). Even with a short production season (June 15 through October 15) a modern salmon cannery has the potential annual capacity of over 700,000 cases -- there were less than 500,000 cases of canned salmon packed in Puget Sound canneries in 1971, a peak year. During that year the largest single packer, Whitney-Fidalgo seafoods, Inc., canned only 150,000
cases while the second largest packer, New England Fish Company, canned 75,000 cases (29).

By 1950 technological change had plateaued for the salmon canning industry (30). Not only had the supply of the necessary input for the process, salmon, become obviously scarce; but the capital investment had become substantial. The cost of a salmon canning facility has gone from 100,000 dollars in 1910 to over 3,000,000 dollars in 1974. A brief summary of this transition from a labor to a capital intensive industry is depicted in the following tabular format—source references are bracketed "(  )":

<table>
<thead>
<tr>
<th>Year</th>
<th>Capital Investment (exclusive of site cost &amp; unadjusted for price level)</th>
<th>Maximum Required Daily Labor Hours</th>
<th>Maximum Daily Capacity (48/1# cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>$100,000 (1)</td>
<td>2,400 (8)</td>
<td>3,000 (8)</td>
</tr>
<tr>
<td>1937</td>
<td>250,000 (8)</td>
<td>600 (8)</td>
<td>4,000 (8,14)</td>
</tr>
<tr>
<td>1965</td>
<td>1,000,000 (30)</td>
<td>800 (22)</td>
<td>9,000 (5,22,12)</td>
</tr>
<tr>
<td>1974</td>
<td>3,000,000 (27)</td>
<td>800 (22)</td>
<td>9,000 (5,22,12)</td>
</tr>
</tbody>
</table>

Sources of Capital for the Salmon Canning Industry

Cobb's early study of the salmon industry (10) indicates that, because of the modest capital requirements and high labor usage, it was relatively easy to enter the salmon canning industry in the late nineteenth century. Subsequent to that time the transition from labor to a highly mechanized form of production has required large inputs
of capital. Salmon canning operations have traditionally been too small for the usual sources of capital, stocks and bonds, and have been forced to internal financing and short-term credit sources (10, 19). In 1940 Homer Gregory noted: "Generous credit offered by supply houses and brokers has kept the salmon industry well filled with small-sized packing concerns. Cannery equipment (except the Iron Chink) is rented by operators from machine and can manufacturing companies!" (18, p. 410). This, perhaps, contributed to the long history of business failure within the industry (19).

A major source of capital for the salmon canning industry during this period of growth and development was the can manufacturing company. The extent to which this financing device (leasing equipment) was being used was detailed dramatically in the 1949 anti-trust action against American Can Company (87 F. SUPP. 18). Through the use of the equipment leasing device the can companies were able not only to establish tieing contracts for the sale of their cans but to maintain differential pricing by varying the lease terms for different sized canners. The decision went against American Can Company, and, subsequently, the can manufacturing companies stopped manufacturing and leasing canning equipment. A 20-year source of funds for the salmon canning industry was permanently eliminated by that decision.

Currently a few large firms have resorted to the capital markets.
for their financial requirements (Whitney-Fidalgo, New England Fish Co., and Bumblebee Packing Co.) but the remainder of the industry participants continue to rely heavily upon short-term credit as the major source of operating and capital funds.

The Cost of Processing Salmon

In general, data on salmon processing costs are rather skimpy and inconclusive. Until very recently the industry tended to avoid the use of production costing techniques and joint rather than segregated cost information has been the accounting rule. In his interviews with a number of the early packers, DeLoach found that no production cost information was kept—a factor which may have contributed to the large number of business failures in those years (14). Gregory and Barnes calculated the 1937 operating costs for a case of canned salmon to be (19, p. 193):

<table>
<thead>
<tr>
<th>Raw Salmon</th>
<th>$ 2.80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>.64</td>
</tr>
<tr>
<td>Materials &amp; Overhead</td>
<td>.30</td>
</tr>
<tr>
<td>Total Cost of Packing</td>
<td>$ 3.74</td>
</tr>
</tbody>
</table>

With an average selling price of $5.10 per case this yields a gross margin (sales less cost of goods manufactured/sales price) of approximately 27%. Interviews with a number of processors in 1968 permitted the following cost of processing estimates for canned salmon:
With an average selling price of $42 per case this indicates a gross margin of approximately 24% for the canned product. These same processors also indicated that the average gross margin for the fresh and frozen processed salmon was also approximately 24%. Certain of these large processors indicated that the resulting return on investment was substantially higher for fresh and frozen than for the canned product because of the high opportunity cost for replacement of canning facilities as contrasted to the cost of facilities for fresh and frozen production. However, they also pointed out that decisions are made on the basis of "bottom line" accounting (where one looks only at the accounting net income) and that most canning facilities are fully depreciated (hence no cost assigned for use of the fully depreciated production facilities). Because of the current excess capacity, cannery facilities are viewed as having a zero opportunity cost in terms of their resale value—this fact is supported by the number of canneries which have been abandoned rather than sold.

There is no indication that any new canning facilities are planned and some processors talk of closing facilities and having other processors custom-can their requirements. A new entrant into the salmon
processing industry would have to assign a relevant cost for the capitalized buying rights and any equipment purchased. This provides a stark contrast to the cost base for existing industry decision makers.

Some Concluding Comments

Chapter III was intended to provide some insight into the dynamics of the biological forces which have affected the salmon processing industry while the present chapter addresses itself to the technological changes which have transformed the salmon canning industry. Economists have been less than kind in their evaluation of the current overcapacity which has plagued the industry (12) but change is never even and predictable.

As late as the early nineteen-thirties the industry was not viewed in terms of overcapacity. If anything, it was undercapacity in times of major fish runs which received the attention of government authorities and economists. In a report submitted to the Secretary of Agriculture in 1933, W. G. Campbell, Chief of the Food and Drug Administration, made the following statement:

The salmon pack of 1932 approximated 5,867,590 cases and included some of the worst fish encountered in recent years. The large run experienced was undoubtedly the primary cause; canneries apparently could not handle the volume of fish received (38, p. 6).
DeLoach in his 1939 study of the salmon canning industry pointed out that no cannery at that time had the capacity for the largest possible catch and, yet, few ever used their maximum capacity at that time for more than a two or three days each season (14, p. 49). He cites the Brookings Institution study of the canning industry as an apt analysis of the salmon canning industry (14, p. 49). One passage from that study does seem descriptive of the salmon industry:

The extreme seasonality of the canning industry exposes estimates of practical capacity to the danger of serious error as a result of the necessity for deciding somewhat arbitrarily what number of working days shall be taken as the length of the working year. Furthermore, the perishable character of the product and the importance of weather considerations result in considerable uncertainty as to the length of day which should be used in estimates. Actual operations may drop to a few hours or be extended by night work to practically a double shift basis (14, p. 49).

It is obvious that, up to the mid-fifties, two long-term trends were taking place in the salmon processing industry. One of these was the diminishing availability of the supply of fresh salmon, both in the amplitude of the runs and the average annual catch size. The second was a corresponding growth in production technology. Both of these forces appear to have stabilized, but their impact upon the long-term structure of the industry and the duration that impact will be felt remain indeterminate.
A substantial proportion of the effort devoted to economic analysis concerns itself with the behavior of business firms; for it is the firm which marshals the resources for the production of goods, and the allocation of resources among those sets of firms known as industries is the basic problem of value theory. Competition has been a major factor in the organization of production and the determination of factor prices for those industries, and economists attach a substantial weight to the concept. Although economic theory has had some success in explaining and evaluating competitive markets, it has not met with particular success in applying the same analytical techniques to oligopsonistic and oligopolistic markets. Market structure analysis is an attempt to evaluate the activities of the firm within a defined structure so that observed variations between structures and changes within structures may be more easily associated with the behavior of the firms in a market and the ultimate performance of those firms within the economy. Market structure has been defined as those features of the organization of a market which seem to influence strategically the nature of competition and pricing behavior within a market (1, p. 7). As a further explanation, Bain goes on to point out that the market structure analyst seeks to identify those characteristics which determine the
relationship of sellers in the market to each other, of buyers in the market to each other, of sellers to buyers, and of sellers or buyers established in the market to any potential new entrants which may enter the market (1, pp. 7-8). In this attempt to focus the diverse elements of an industrial market there is bound to be a lowering of theoretical standards from that provided by abstract theory, in that precise, deterministic solutions and the manipulation of variables by the analyst are not possible. The methodology does allow the study of actual economic behavior in its natural setting, and provides a foundation for informed conjectures about the forces standing behind the patterns which are found. The empirical approach of market structure analysis identifies those determinants, with particular reference to those which are external to the firm, which do or will influence the decisions of firms within specified industry groups.

Both the theorist and the market structure analyst agree upon the general conditions for a competitive market. These conditions include homogeneous factors, a large number of buyers and a large number of sellers so that no one firm may noticeably influence market price, and the possibility of rapid entry for new firms into the market and rapid exit for existing firms from the market. If any of these conditions is varied, the resulting change in behavior and performance may be examined for its influence. At this point
the structural taxonomy begins to weaken, for it is necessary to go beyond general statements. What degree of homogeneity is required for a competitive situation, and how do you measure the differences? What number of sellers and what number of buyers will be considered "competitive?" The austerity of the abstract model of perfect competition has motivated market structure analysts to refine conditions into a more realistic concept. A major innovation has been that of J. M. Clark in detailing what he called "workable competition" (9). In his work he identified a number of conditioning factors upon which competition depends. A much more elaborate classification system was later devised by Joe Bain in which extensive sub-classification was detailed for the purpose of evaluating systematic and significant differences between different firms and industries (1). This process of refining the conditions in order to cope with reality has not been without its ambiguities (how close must conditions be to perfect competition for the industry to be workably competitive?), but the ultimate goal of associating various market structures with behavior patterns remains tenable. Bain evaluates the process as follows:

We must . . . inquire (1) if certain characteristics of market structure potentially influence the choice of competitive pattern and (2) if these or other such characteristics influence the results which a given pattern may yield (3, p. 38).
Application of market structure analysis requires a survey of all relevant influences. It is difficult to establish the exact degree of influence that a particular structural condition may have upon industry behavior; these conditions are not fully independent of each other. However, it is possible to distinguish between certain broad tendencies or differences produced by the absence or presence of some structural element. Abstracting Clark's and Bain's taxonomies with respect to the salmon processing industry yields the following structural elements which appear to be crucial to that industry:

1. The number and size distribution of the sellers (fishermen)
2. The number and size distribution of the buyers (processors)
3. Technological developments for the industry
4. Flexibility of factor supply (salmon), including indivisibility
5. Homogeneity and perishability of product
6. Freedom of entry and ease of exit

This study most ultimately concerns itself with the performance of the salmon processing industry. The initial step toward this goal is the determination of the structural relationship between the processors of salmon, the buyers of salmon as a factor input, and the fishermen who catch those salmon, the sellers of the factor. It is assumed that the processors, although few in number, have no monopoly or oligopoly power in the market place. In addition it should be noted that the study contains average annual data for the
period 1964 through 1972. These data range from the highly reliable detailing of the Fisheries Statistics Division of the Washington State Department of Fisheries to the substantially less reliable (often hearsay) information from officials of both government and industry. The assembled data, however inadequate, provide an ample foundation for a structural analysis of the salmon processing industry. Any further elaboration or qualitative enhancement was not considered marginally beneficial given the expense involved.

The Number and Size Distribution of Fishing Units (Sellers)

The commercial salmon fishery has always had the facility to attract a large number of catch units. The ease of entry, the relatively low capital requirements, and the lack of an economic rent accruing to an "owner" of a common property resource have encouraged a substantial and increasing number of these units even in the face of decreasing numbers of fish. The economics of the salmon industry are beyond the scope of this study, but the interested reader is referred to Crutchfield and Pontecorvo's well known study of the Pacific Salmon Fishery (12).

Because of the institutional constraints relative to the catching of salmon (the reader is referred to Chapter II for a discussion of catch methods) it is necessary to differentiate between net and troll
methods of catch in the commercial salmon fishery. The net units are the only form of gear which can catch the pink and sockeye salmon, and these species account for the bulk of the commercial salmon harvest in the State of Washington. Even in a differentiated form the sub-classifications of sellers--purse seine, gill net, and troll--represent substantial numbers; and each class can be considered a competitive selling group. Table 4 arrays data relevant to these three catch classifications. These data include the total catch of salmon by specie for each unit, the number of catch units, and the average catch per unit for the years 1964 through 1970. For the troll fishery the data give evidence of a dramatic increase in the total number of catch units. However, since 1967 the troll catch has decreased from 1 1/4 million fish to less than 1 million fish in 1970--during this same period, as seen on p. 30, the average price for troll salmon has increased from approximately 40 cents per pound to over 70 cents per pound. The net fishery appears to be relatively stable when the salmon cycles are taken into consideration.

The competitive nature of the fisherman-seller is accentuated even more by the fact that government anti-trust policy has kept even fishermens' unions from acting as collective bargaining units when pricing negotiations are attempted with the processor-buyers. The Federal Trade Commission considers the fishermen not as employees, workers, or laborers, but as independent businessmen
Table 4. Catch distribution of licensed commercial salmon units in the state of Washington (in numbers of salmon)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Troll Fishery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinook</td>
<td>163,618</td>
<td>95,855</td>
<td>167,192</td>
<td>131,736</td>
<td>162,787</td>
<td>186,941</td>
<td>214,298</td>
</tr>
<tr>
<td>Chum</td>
<td>171</td>
<td>193</td>
<td>87</td>
<td>393</td>
<td>190</td>
<td>61</td>
<td>212</td>
</tr>
<tr>
<td>Pink</td>
<td>9,768</td>
<td>104,872</td>
<td>29,367</td>
<td>380,576</td>
<td>61</td>
<td>59,395</td>
<td>6,689</td>
</tr>
<tr>
<td>Silver</td>
<td>602,858</td>
<td>966,828</td>
<td>884,908</td>
<td>779,417</td>
<td>713,856</td>
<td>463,838</td>
<td>744,110</td>
</tr>
<tr>
<td>Sockeye</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>776,860</td>
<td>1,167,902</td>
<td>1,081,554</td>
<td>1,292,299</td>
<td>881,884</td>
<td>610,576</td>
<td>965,765</td>
</tr>
<tr>
<td># Units</td>
<td>1,280</td>
<td>1,300</td>
<td>1,392</td>
<td>1,635</td>
<td>2,274</td>
<td>2,808</td>
<td>2,459</td>
</tr>
<tr>
<td>Average catch</td>
<td>607</td>
<td>898</td>
<td>777</td>
<td>790</td>
<td>388</td>
<td>253</td>
<td>392</td>
</tr>
<tr>
<td>Gill Net Fishery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinook</td>
<td>89,497</td>
<td>102,236</td>
<td>91,055</td>
<td>97,822</td>
<td>117,548</td>
<td>119,600</td>
<td>170,851</td>
</tr>
<tr>
<td>Chum</td>
<td>154,994</td>
<td>94,944</td>
<td>177,322</td>
<td>108,833</td>
<td>200,288</td>
<td>108,709</td>
<td>145,511</td>
</tr>
<tr>
<td>Pink</td>
<td>253</td>
<td>93,637</td>
<td>442</td>
<td>359,756</td>
<td>117</td>
<td>92,438</td>
<td>1,050</td>
</tr>
<tr>
<td>Silver</td>
<td>246,161</td>
<td>278,473</td>
<td>442,090</td>
<td>251,386</td>
<td>351,577</td>
<td>266,295</td>
<td>688,604</td>
</tr>
<tr>
<td>Sockeye</td>
<td>179,513</td>
<td>236,290</td>
<td>495,564</td>
<td>603,098</td>
<td>371,394</td>
<td>549,217</td>
<td>511,674</td>
</tr>
<tr>
<td>Total</td>
<td>670,418</td>
<td>805,580</td>
<td>1,206,473</td>
<td>1,420,895</td>
<td>1,040,924</td>
<td>1,136,259</td>
<td>1,517,690</td>
</tr>
<tr>
<td># Units</td>
<td>1,216</td>
<td>1,332</td>
<td>1,240</td>
<td>1,397</td>
<td>1,321</td>
<td>1,466</td>
<td>1,598</td>
</tr>
<tr>
<td>Average catch</td>
<td>551</td>
<td>605</td>
<td>973</td>
<td>1,017</td>
<td>788</td>
<td>775</td>
<td>950</td>
</tr>
<tr>
<td>Purse Seine Fishery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinook</td>
<td>23,794</td>
<td>36,086</td>
<td>37,410</td>
<td>48,971</td>
<td>39,495</td>
<td>38,345</td>
<td>57,271</td>
</tr>
<tr>
<td>Pink</td>
<td>107,261</td>
<td>94,298</td>
<td>205,110</td>
<td>130,220</td>
<td>231,060</td>
<td>55,675</td>
<td>88,732</td>
</tr>
<tr>
<td>Silver</td>
<td>150,418</td>
<td>135,996</td>
<td>223,109</td>
<td>102,306</td>
<td>123,392</td>
<td>121,693</td>
<td>272,580</td>
</tr>
<tr>
<td>Sockeye</td>
<td>284,229</td>
<td>736,229</td>
<td>786,012</td>
<td>1,389,624</td>
<td>465,092</td>
<td>1,004,421</td>
<td>782,119</td>
</tr>
<tr>
<td>Total</td>
<td>565,916</td>
<td>1,431,702</td>
<td>1,251,987</td>
<td>4,817,295</td>
<td>859,202</td>
<td>2,002,908</td>
<td>1,201,364</td>
</tr>
<tr>
<td># Units</td>
<td>292</td>
<td>400</td>
<td>317</td>
<td>340</td>
<td>301</td>
<td>384</td>
<td>319</td>
</tr>
<tr>
<td>Average catch</td>
<td>1,931</td>
<td>3,579</td>
<td>3,949</td>
<td>14,169</td>
<td>2,854</td>
<td>5,216</td>
<td>3,766</td>
</tr>
</tbody>
</table>
engaged in fishing for their own account and profit. The numerous cease-and-desist orders concerning price negotiations among packers and fishermen do not indicate any current change of policy in this matter. This situation is in sharp contrast to the British Columbia processors and fishermen where a strong union is in force for collective bargaining by the fishermen.

Finally, the size distribution among units within the three classifications appears to be comparable. The unit catch will differ from year to year but the average over those years provides no obvious distortions. This picture of an almost complete dispersion of power is the essence of competitive circumstance. It should be understood that this picture of competitive units relates to units within the individual classifications. The problems of product homogeneity and indivisibility will cause differences between the bargaining positions of these classes (this will be discussed in a later section of this chapter) but in no way enhance the market power of the units.

The Number and Size Distribution of Processor Units ( Buyers )

The statistical files of the Department of Fishery Statistics of the Washington State Department of Fisheries indicate that since 1964 there have been about 100 licensed salmon buyers in that state.
Although some changes have taken place during that time period, the constancy of number and composition have been relatively constant. Further, the same file indicates that the largest buyer of this catch purchased 18% of the total, while the four largest buyers acquired 36% and the eight largest buyers accounted for 50%.

Bain has noted that

Concentration as referred to by economists has two possible alternative meanings: (1) control of a large proportion of some aggregate of economic resources or activity by a small proportion of the units which control the aggregate; or (2) control of a large proportion of such an aggregate by a small absolute number of these units (1, p. 78).

To paraphrase Stigler (35, p. 30), the purpose of a measure of concentration is to predict the extent of the departure of price from some competitive level. Hence, inequalities in the purchases of the necessary input to the salmon processing industry, namely freshly caught salmon, provides the measure of a firm's size in this market place. Bain specifies that

The economically most relevant measure of the degree of concentration refers to both (a) the absolute number of units which controls a given economic aggregate, and (b) the size distribution of these units when the size of each is measured by the proportion of the aggregate that it controls (1, p. 79).

With several thousand sellers (and the number appears to be growing over time), a stable but small group of buyers, and diverse degrees of buyer acquisitions as noted above, both of these measures appear
relevant to the salmon processing industry. Because of the relative stability of the absolute number of buying units, the primary focus will be upon the size distribution of the units.

The Development of Concentration in the Salmon Processing Industry

Rubenstein has divided the history of concentration in the salmon industry into five convenient periods (30, p. 49):

1) 1864-1892 Period of initial expansion
2) 1893-1900 Period of monopoly
3) 1901-1919 Period of geographic and specie expansion
4) 1920-1958 Period of weak and unstable oligopoly
5) 1959- Period of strong oligopoly

Because of geographic constraints (which will be discussed at a later point) it appears questionable to define the aggregate salmon processing industry as a monopoly or oligopoly. Each geographic region appears isolated and distinct, and no evidence has ever been presented that the aggregate group of units comprising the salmon processing industry as a whole could be fitted to the above classification system. This is particularly true of the Puget Sound area of the State of Washington which never did experience the period of consolidation and merger seen in Alaska, British Columbia, and the Columbia River area during the late nineteenth century. During
this period those regions saw the growth of the well known salmon packer associations which grew out of the chaotic markets in those growth years (10). This group includes Columbia River Packers Association (now known as Bumblebee Packing Co.), British Columbia Packers Association, and the Alaska Packers Association. There is some possibility that they may have exercised monopsony power in their respective geographic locales during that "period of monopoly." Cobb, in describing the pricing of canned salmon during that period, notes:

The manner of fixing the selling price at which the canner is willing to dispose of his canned product varies slightly in certain regions.

... In the early days of the association (Alaska Packers) the custom grew up amongst the smaller packers of Alaska and Puget Sound of waiting until the association fixed the prices on its own pack, when the others would generally fall into line with the same prices for their packs.

... Occasionally the other packers do not like a certain quotation of the association and make one more nearly in consonance with their own views. This happened in 1913 ... and in 1915 ... 

... Should the buyer dislike the opening price he has the privilege of canceling the order.

... The packers of British Columbia and the United States both sell a considerable portion of their high-grade salmon abroad, and the competition thus engendered compels a fairly close conformity in prices. On salmon sold in the domestic markets, however, the competition is not so keen; hence there is room for a considerable diversity of opinion as to values (10, pp. 175-79).
In order to coordinate the history of the salmon processing industry with the exogenous forces which have stimulated change in its structure, the following classification is proposed for the salmon processing industry of the State of Washington:

1) 1877-1900  Period of discovery and initial development (characterized by high labor inputs, easy entry, and abundant supply of necessary input)

2) 1901-1937  Period of rapid technological change (characterized by transition from labor to capital intensive industry, diminishing supply of necessary factor, and continuation of ease of entry)

3) 1938-1958  Period of maturation for salmon processing industry (characterized by further reduction of supply of necessary input, stabilization of technological growth, and formation of strong barriers to entry)

4) 1959-     Period of consolidation and stability (characterized by a strong oligopsony)

As has been pointed out by Cobb (10), Gregory and Barnes (19), and Rubenstein (30), some degree of concentration existed during this entire panorama of change. Until the beginning of the early 1960's the individual participants, whatever their relative degree of market concentration, had very little opportunity to exercise any perceptible influence in the market because of the dynamics of institutional forces. The ease of entry and the possibility of potential competitors make a study of concentration measured during the earlier period a questionable exercise. Subsequent to that time, events and data indicate that the industry became more cognizant of these exogenous
factors and began a period of consolidation.

Concentration in the Salmon Processing
of the State of Washington

Data from the salmon purchase tickets required by the Department of Fisheries of the State of Washington have been used to compile the concentration ratios for processor firms in that state. The data commence with the year 1964, and the five-year period from 1964 through 1968 are used to portray the industry concentration during the early part of this most recent period of industry development. The data are quite conservative in that many of the licensed buyers are acting as agents for the large salmon processors. Identifying these agency relationships has been a difficult and time-consuming task; and the probability that some were missed is quite high. However, this deters from the import of the study by only a modest degree. The following table arrays the buyer concentration percentages for the salmon processing industry during that period:

Table 5. Percentage of total salmon purchases accounted for by the largest firms, 1964 through 1968

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<tbody>
<tr>
<td>Largest firm</td>
<td>19%</td>
<td>19%</td>
<td>13%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Four largest firms</td>
<td>50</td>
<td>46</td>
<td>40</td>
<td>45</td>
<td>54</td>
</tr>
<tr>
<td>Eight largest firms</td>
<td>64</td>
<td>64</td>
<td>57</td>
<td>63</td>
<td>70</td>
</tr>
<tr>
<td>Twenty largest firms</td>
<td>84</td>
<td>85</td>
<td>83</td>
<td>88</td>
<td>90</td>
</tr>
</tbody>
</table>
The concentration table depicts the cumulative percentages of total available salmon which are controlled (purchased) by the leading firms in the salmon processing industry. These annual data are plotted on Chart No. 5 to give some indication of the trends in industry concentration during those five years. Given the fact that 20 firms account for in excess of 85 percent of all annual purchases of salmon, any further aggregation of data did not appear marginally beneficial for an analysis of the industry's market structure.

The Lorenz curve is a measure of concentration which takes account of the total number of firms in an industry. Chart No. 6 is a Lorenz curve of the salmon processing industry in the State of Washington with respect to the necessary factor input, salmon. An industry composed of firms of identical size would present a curve proximate to the 45 degree diagonal line represented by line 00 in the chart. This represents equal distribution of salmon purchases between all firms in the industry. It should be noted that the Lorenz curve is a relative measure of concentration as between existing firms in the industry, and does not give any indication of absolute dimensions (if there was only one firm in the industry, the curve would indicate equal distribution). Given the fact that there are approximately 100 firms in the industry, the reading of the curve is made somewhat simple in that percentage firms also reflect absolute numbers. The ultimate purpose of measures of industry
Chart No. 5. Percentage of Total Salmon Purchases Accounted for by the Harvest Firms 1964 thru 1968
concentration such as the Lorenz curve is to complement an analysis of market power. The curve for the salmon processing industry indicates the highly skewed curve of an industry where a large percentage of the resource is controlled by a small percentage of the firms within that industry.

Although the supporting data are confidential, the relative positions of the major firms within the salmon processing industry can be arrayed. The relative ranking for the eight largest salmon buyers in the State of Washington for the years 1964 through 1968 are arrayed in the format of Table 6. A few observations are in order after surveying this table and the concentration data. First, the leading firms present a remarkable picture of ranking stability. New England Fish Company, long a giant in the Northwest fishing industry (see Rubenstein (30)), merged with Whiz Fish Company, Eardley Fish Company, and San Juan Fishing and Packing Company during the early part of the 1960's and has been able to establish a dominant position in the salmon processing industry of the State of Washington. The 1967 decision by Nakat Packing Corporation (A & P Tea Co.) to abandon their position in the Northwest salmon industry, and the subsequent decision by Booth Fisheries (Consolidated Foods) in 1968 to drop its buying operation should cause some regrouping within these ranks. The significant consolidation during
Table 6. Relative positions of the eight largest salmon buyers in the state of Washington for the years 1964 through 1968

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<tbody>
<tr>
<td>1</td>
<td>New England Fish Company</td>
<td>New England Fish Company</td>
<td>New England Fish Company</td>
<td>New England Fish Company</td>
<td>New England Fish Company</td>
</tr>
<tr>
<td>2</td>
<td>Seaport Fish Company</td>
<td>Washington Fish &amp; Oyster Co.</td>
<td>Washington Fish &amp; Oyster Co.</td>
<td>Whitney-Fidalgo Seafoods</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Washington Fish &amp; Oyster Co.</td>
<td>Bumble Bee Seafoods</td>
<td>Bumble Bee Seafoods</td>
<td>Seaport Fish Company</td>
<td>Washington Fish &amp; Oyster Co.</td>
</tr>
<tr>
<td>4</td>
<td>Bumble Bee Seafoods</td>
<td>Fidalgo Packing Company</td>
<td>Seaport Fish Company</td>
<td>Bumble Bee Seafoods</td>
<td>Bumble Bee Seafoods</td>
</tr>
<tr>
<td>5</td>
<td>Fidalgo Packing Company</td>
<td>Seaport Fish Company</td>
<td>Booth Fisheries</td>
<td>McCallum-Legaz VITA Foods Products</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fishermen's Packing Co.</td>
<td>Fishermen's Packing Co.</td>
<td>McCallum-Legaz Fidalgo Packing Company</td>
<td>McCallum-Legaz</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Booth Fisheries</td>
<td>Fishermen's Packing Co.</td>
<td>Fishermen's Coop</td>
<td>Fishermen's Packing Co.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sebastian-Stuart Fish Company</td>
<td>Nakat Packing Corporation</td>
<td>Fidalgo Packing Company</td>
<td>Fishermen's Packing Co.</td>
<td>Fishermen's Coop</td>
</tr>
</tbody>
</table>
this period was the merger of Fidalgo Packing Company and Seaport Fish Company in 1968. This, as with the termination of operations, will have long-term consequences in ranking. Secondly, all of the four largest salmon buyers are associated with the canning phase of the salmon processing industry as well as the fresh, frozen, and cured. Of the firms arrayed in the first eight buyers only two, Booth Fisheries and the Fishermen's Coop, have not been actively involved in canning salmon.

The concentration figures arrayed in Table 5 indicate a relative decrease in levels of concentration during the years 1965 and 1966. As has been discussed earlier, the salmon fishery can be classified under two major headings, troll fishery and net fishery. The troll fishery, because of the larger number of buyers, is more competitive than the net fishery. The one exception to this characteristic concerns itself with the pink salmon which can, at times and with varying degrees of success, be taken on a hook and line. The pink salmon is traditionally a canning salmon, and must therefore be sold to the canners. When large troll catches of pink salmon occur, the competitive posture of the troll salmon industry decreases. The concentration tables were developed from salmon buying data on the basis of total poundage purchased. The following array provides the aggregate poundage of troll-caught salmon during the years 1964 through 1968:
<table>
<thead>
<tr>
<th>Year</th>
<th>Chinook</th>
<th>Silver</th>
<th>Pink</th>
<th>Pink as % of Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>2,069,623</td>
<td>4,591,868</td>
<td>42,664</td>
<td>(0.6)</td>
<td>6,704,155</td>
</tr>
<tr>
<td>1965</td>
<td>1,347,495</td>
<td>7,427,825</td>
<td>679,824</td>
<td>(7.0)</td>
<td>9,455,144</td>
</tr>
<tr>
<td>1966</td>
<td>2,001,063</td>
<td>6,135,930</td>
<td>139,970</td>
<td>(1.7)</td>
<td>8,276,963</td>
</tr>
<tr>
<td>1967</td>
<td>1,699,432</td>
<td>6,167,314</td>
<td>1,946,164</td>
<td>(19.0)</td>
<td>9,812,910</td>
</tr>
<tr>
<td>1968</td>
<td>1,869,270</td>
<td>4,543,227</td>
<td>19,669</td>
<td>(0.3)</td>
<td>6,432,166</td>
</tr>
</tbody>
</table>

Source: Fisheries Statistical Report, Washington State Department of Fisheries

The number of troll-caught silver salmon during the years 1965, 1966, and 1967 made a substantial increase in the total poundage for that class of purchases during those years. Because silvers and chinook salmon may be sold to any class of processor, this circumstance by itself should cause the concentration factors to decrease for those years. However, in the years 1965 and 1967 there were substantial numbers of pink salmon caught by hook and line, 7% of the total troll catch in 1965 and 19% of the total 1967 troll catch. While the total catch of silver and chinook salmon were comparable during these three years, the relative increase in cannery fish (pinks) during the odd numbered years caused a substantial difference in the levels of competition in those years as compared to 1966. If the troll fishermen are to sell their catch they must sell that catch to the canners when a substantial proportion of the total is exclusively cannery-type fish. The canners will not buy the catch in segmented form and the
non-canner buyers cannot buy the pink salmon in large quantities.

According to Bain's classification of industry concentration (1, pp. 135-36), the salmon processing industry is in the middle concentration category—the first four firms control between 50 and 74% of the total resources in the industry. Additionally, it should be noted that the largest firm (buyer) in the industry controls as much as 20% of the total production of salmon. It is apparent from the data relative to the salmon processing industry that noticeable levels of concentration exist for that industry, and that they are directly related to the canning sector of the industry.

**Technological Development in the Salmon Processing Industry**

As has been previously discussed in Chapter IV, technological innovation ceased for the salmon processing industry by the late nineteen-fifties. During the 40 years prior to this time there was an almost explosive growth of technology in an attempt to keep stride with the massive catch of salmon during those early years. The termination of this growth period appears to have resulted from two factors: the declining salmon catch and a major anti-trust decision against the can manufacturers which prevented them from using canning equipment as a tying device (with this incentive gone, there was no further purpose in trying to secure customers with
financially accessible, innovative technology). Eugene Singer provides an excellent summary of the theory and market phenomena of tying arrangements (33). The following excerpt from that book provides a simplified description of this common form of market behavior:

Tying arrangements are one of the most elementary market practices whereby a firm operates simultaneously in more than one market for the purpose of increasing its aggregate profit. The practice is, therefore, a useful starting point for analyzing the behavior of multiple product firms. The typical tying arrangement either conditions the sale of one commodity (tying good) on the sale of another (tied good), or conditions the lease of a machine on the use of supplies or services furnished by the lessor. The practice of tying goods together is implicit in other business practices, such as full-line forcing, where a seller presses his complete line of different products on a buyer predominantly interested in only a given product.

The economic motive or rationale for firms employing a tying arrangement is generally that total profits can be increased more by selling the items together than by selling them separately (33, p. 187).

This remarkable burst of technology, however, has left a legacy of overcapacity in an industry which is already suffering the hardship of a declining resource base. Under existing standards of technological advancement, a single cannery could handle the general catch levels of salmon for the State of Washington. With several such canneries in existence, there is very little left to the imagination as to the need for subsequent growth or new entrants.

With respect to the fresh and frozen salmon, very little
technological improvement has taken place for the past 30 years. The same problems concerning perishability and flavor change which have plagued the industry for years continue to exist. Transportation technology in the movement of catch and the marketing of the processed product have made substantial progress during the past ten years, but this has not been sufficient to overcome the market-form forcing characteristics of the salmon (pink and sockeye continue to be canned).

**Flexibility of Factor Supply (Salmon)**

Because salmon is a necessary input for the production of processed salmon in any market form, it is important to consider its availability and the forces which affect that availability. Will an increase in the demand and price for the final product control the availability of the basic factor? This concept of a flexible factor supply is important if an industry is to expand and contract in response to the demands for its goods.

The price series arrayed on page 37 indicate that the prices for both the basic factor and the final product have increased by almost double during the past ten years. However, Table 1 and Charts 1 and 2 indicate the intractible nature of the salmon as a source of supply. During this same period of rising prices the supply of salmon has diminished and then apparently stabilized during the
past ten years. This picture of an inelastic supply function in any given year for the same resource provides some insight into the perceptions of industry participants (among the exogenous variables giving rise to a lack of factor insensitivity to price changes would be biological considerations and government regulations such as duration of fishing seasons) (12). If the annual supply of salmon is inelastic, then any price competition for additional quantities of the factor will cause total industry costs to increase, and the resulting shares of the factor will remain substantially the same (all other buyers will increase their offering price in order to protect their existing market shares). Further, for the same reason, a new entrant would have to use non-price means for securing any share of the factor. Lastly, existing firms with established shares of the aggregate supply of salmon have a market value relative to the capitalization of savings due to size economies in the production process for salmon (see discussion in Chapter IV).

When supply functions are normally evaluated, it is with a view toward a continuous function which is perfectly divisible. Table 2 indicates that the average catch per unit of purse seine was 14,000 fish per season, while the gill net fishery averaged about 1,000 and the trollers less than 800 fish per season. This variation in the size of the catch per unit presents an important structural characteristic for the salmon processing industry. The most efficient catch
units (those which take larger numbers of salmon per catch period) must sell their catch to processors who have the productive capacity to handle large numbers of salmon at any time. The troll fishery can be adapted to small processing units, while the net fishery, especially the purse seines, must limit their transactions to large processing facilities (canning operations). With less than two dozen such operations available for these larger catch units, the chances for a competitive market become more remote.

**Homogeneity and Perishability of Factor**

When a market structure analysis is made of an industry, a major source of concern is the homogeneity of the product offered by the sellers within that industry. If, after all, there was complete homogeneity of the units offered for sale, there could be no reason for different price-quantity relationships in the marketplace. The salmon industry presents some interesting aspects for this structural component.

The average lay reader, when confronted, considers all salmon as a homogeneous product. However, the differences between species and the physiological changes which take place during the spawning migration create substantial, identifiable differences between factor units. The material in Chapter II details this biological taxonomy, but the major points bear reiteration. A small unit size
and very large schooling runs characterize the sockeye and pink salmon. Because of this they adapt well to the canning process.

Size as much as any other factor in modern times has contributed to the desirability of chinook, silver, and chum salmon in the fresh and frozen market form. The larger size gives versatility of use, such as sliced, filleted, or whole. A further differentiable point in the biological make-up is the spawning characteristic. As the fish move closer to the spawning grounds they become less desirable in flavor and texture. Although not very evident in the Puget Sound waters because the fish are not yet ready for their runs up the rivers and streams, it is very pronounced in the river fishery as the salmon move upstream.

In addition to the biological make-up forcing a differentiated factor market, the form of catch method also creates a means for differentiation. Traditionally, the troll-caught salmon have brought a premium over the net-caught salmon, for two reasons. First, the fish are still feeding (willing to strike at a lure) and therefore are of prime quality. Secondly, the skin and flesh of the net-caught fish are often marred by net marks which decrease the appearance and marketable quality. Another point is that, traditionally, troll-caught fish are cleaned when caught and are, therefore, less subject to deterioration than the net fish, which are sold in the round (not cleaned). Because the trolling method only works with chinook,
silver, and pink (to a small degree) salmon, and because pink salmon are only used in the canned market form, the differentiation only relates to the chinook and silver salmon. As a result of these various differences a definite system of differentiation has developed, with troll-caught salmon being considered of higher quality than net-caught fish (and therefore bringing a higher price) and the various species of fish bringing differing prices.

Except for agricultural products, the concept of perishability is seldom of concern in a market structure study. It is, however, a major force within the salmon processing industry. The high degree of perishability requires that processing take place very soon after the salmon is caught. This is particularly true of the net-caught salmon which are in the round, and, therefore, subject to more rapid bacterial action. Because of this, processing facilities have tended to develop in port areas proximate to the major catch grounds. Although this concept has been modified somewhat by the advent of improved transportation, thereby allowing processing facilities more distant from the catch areas, the large processing facilities built 30 and 40 years ago still dominate the industry. In Puget Sound the use of buying stations or powered scows is quite popular, with the salmon being transported daily from the buyer to a cannery or freezing facility within the general area. This high degree of perishability causes the salmon processing industry to be
a highly localized and easily identified industry—the necessary factor
is geographically bounded and has no substitutes in the production
process.

The development of a limited number of processing facilities
near the catch grounds and the high level of perishability have tended
to "Balkanize" the catch units, especially the net units. This limita-
tion of market for the seller is an important characteristic of the
salmon processing industry. Markets are spheres of interaction
between supply and demand forces, while industries are defined
in terms of supply, with reference to comparable production tech-
niques and outputs. In the case of the salmon processing industry,
the observed market for the factor and the industry itself are con-
tiguous. These unique characteristics cannot be lost on the partici-
pants in the market. The buyers (processors) are few in number
and, because of the geographic bounding, know each other well. The
sellers (fishermen) are in large and growing numbers and are not
allowed by law to combine as a collective bargaining unit (the
Federal Trade Commission treats them as independent businessmen
rather than laborers for anti-trust purposes). This legal barrier
has tended to prevent the growth of strong fishermen's unions because
the central goal of a union is deleted. It is true that the troll fisheries
have more selling options available to them because they can sell to
either canners, freezers, or fresh fish wholesalers; and these buyers
number more than five times the available canneries. However, the troll fishermen are forced into canneries when their catch includes substantial numbers of pink salmon, as it does occasionally. Net fishermen must sell to the canners because the large proportion of their catch is represented by the sockeye and pink salmon. Such structural characteristics provide a natural setting for an oligopsonistic industry.

Freedom of Entry and Ease of Exit

When we speak of competition we are concerned with the minimization of power that any single firm might have in the market. An evaluation, therefore, would consider such factors as relative size and numbers because if all firms were the same size then no firm would have greater market power and if there are vast numbers of participants then no firm could account for an appreciable share of the market. To limit a market analysis to only such variables would be to overlook a major determinant of competitive behavior. In addition to the existing firms, there is the threat of potential competition which regulates business activity. That is, when returns for any industry begin to show substantial profits new firms will enter and, conversely, when returns drop then firms will leave the industry. This concept of a "state of potential competition" is evaluated by what Bain terms the "condition of entry":
The advantages of established sellers in an industry over potential entrant sellers, these advantages being reflected in the extent to which established sellers can persistently raise their prices above a competitive level without attracting new firms to enter the industry (1, p. 3).

In the case of the salmon industry it is a concern for attracting new buyers and the existing buyers' ability to hold down prices which is of concern in this analysis. In terms of market conduct its reference is both present and future, for it may affect present as well as future pricing policy, and it may provide support for increased concentration within the industry. The concept might best be described graphically using "easy entry" and "blockaded entry," the two extremes of Bain's classification for condition of entry (1, p. 31). In the case of blockaded entry, the monopsonist can pay a price for the factor of production which will maximize his short run profits and still attract no rival firms. If entry is easy then new firms will enter the industry when such pricing yields greater than normal returns on capital. In Figure 1 below these concepts are elaborated more specifically. If we assume that the processors must sell their product into a competitive market and that raw salmon is the only significant factor of production, then the demand curve facing the firm would be a horizontal line and the marginal revenue product curve can be depicted by line MRP and represents the demand curve for the factor. The marginal cost (MC) and the Average Cost (AC) curves are drawn as straight lines for the purposes of discussion. Contrary to a
competitive market circumstance where the price of the factor equals the marginal revenue product of the factor, the monopsonist (or strong oligopsonist) will purchase units of the factor at a price which will add more to total revenue than it will to total cost. Hence, the price paid for the factor will be at the average cost rather than the marginal cost for the factor (Point A rather than Point B in Figure 1).

![Figure 1](attachment:image.png)

Figure 1

Probably the most significant barrier to entry is the biological constraint which creates an inelastic supply function for the necessary factor of production. With a relatively fixed total supply of salmon, any attempt at price competition by either existing or potential firms would be met with matching prices by existing firms in order to maintain their respective market shares. Any new entrant must
secure a share of the fixed supply of the factor through non-price means if it is to enter the industry. This can sometimes be accomplished by placing a buying or processing facility in a more convenient location or enticing fishermen with boat moorages, generous credit, repair facilities, etc. All of these "non-price" methods, of course, will increase the total cost to the provider. This same problem of inelastic supply can create an additional phenomenon in the industry. Because actual quantities of available salmon diminished over time, the only other alternative method of increasing factor shares has been through consolidation and merger with existing firms.

There are additional disadvantages which a new firm might face as compared to a firm already in the salmon processing industry. One of these arises when firms do not achieve the lowest possible production costs until they occupy a larger proportion of the total market. This concept, known as size economy, is depicted below in Figure 2. It shows the average unit cost curve of any firm in such an industry. As has been described in Chapter IV, the salmon processing industry is subject to high fixed costs and very large technological capacity. This set of characteristics combine to create a production cost picture as depicted in Figure 2. The dilemma facing any new firm entering this industry is that the existing firm(s) can, in fact, bid the factor prices even higher. If he builds a plant of suitable scale to compete against the existing
firms, he must not only entice away a sufficient amount of their existing market share of the factor, but may have to do so under a different and higher set of costing standards. It was noted in Chapter IV that the processing cost for canned salmon (exclusive of the factor input) was estimated to be about $4 per case and that the gross margin on sales of salmon are estimated to be about 24% (p. 57). These calculations are made on the basis of general accounting conventions and "bottom line" appraisal of financial statements. Under these conditions the new entrant faces absolute cost barriers to entry.

Because of excess capacity within the industry, firms view their fully depreciated cannery facilities as having a "zero" opportunity cost and have, in fact, abandoned many such facilities even in recent years (see Rubenstein (30), Gregory & Barnes (19), and Cobb (10).
for descriptions of the same phenomena in earlier years). The new firm must assign relevant costs for its operation and, therefore, must take into consideration the costs of financing and depreciation of the new facility. The distinction between this concept and that of size economies is apparent in Figure 3 below. In the case of absolute cost barriers the new firm faces a cost disadvantage over the existing firms at any level of output it is capable of producing.

This concept of productive facilities with a zero opportunity cost stems from the fact that there is no alternative use for the facilities and that the valuation for the firm relates to the property rights it has acquired in a share of the necessary factor of production. When a facility is abandoned it is because the factor share has either disappeared or has diminished to a point where production is no longer economically feasible. Hence, when facilities are sold they are purchased jointly with the market share property right. This
property right is not a formalized contractual agreement, but it is one which has evolved over time between processors and fishermen. This arrangement includes tacit buy-sell agreements for freshly caught salmon.

The combination of size economies, absolute cost barriers, and the property right phenomenon make any entry decision for the salmon processing industry, at best, extremely hazardous. Additionally, relative to the entry condition of the salmon processing industry one further point should be made. Even if a new firm should be foolhardy enough to face up to the limited factor availability, the size economies, and the absolute cost differences, the availability of capital for such a venture may be somewhat limited. As was pointed out in Chapter IV, the industry is small relative to others in the economy, and the firms within that industry have tended to resort to short term credit devices for all of their capital requirements. With a current cost of almost three million dollars, a new canning facility would be difficult to finance under short term financing conditions. Existing firms had the initial advantage of generous leasing and credit terms from the can manufacturing firms. This major source of capital for the salmon canning industry was terminated by the legal decision in 1949 which forced the can manufacturers to divest themselves of such arrangements in the selling of their cans. Although such tying arrangements did give monopolistic powers to the tin plate
manufacturers, the decision points up the complexity of our economic system. In the process of applying anti-trust measures to one industry in order to reduce monopoly power it has aided another industry in consolidating monopsony power.

Ease of exit from the industry is, after all, an important consideration. Just as resources should be able to flow into an industry, so should they be able to leave when returns diminish below an acceptable point. In the case of the salmon processing industry the major facilities (canning) are viewed as having a zero opportunity cost. Hence leaving the industry means abandoning the facility. Interestingly enough, firms leaving the industry need not leave without some gain, in that they can capitalize the cost benefits that their factor share represents to existing or new firms. In some cases the present value of such factor shares has represented substantial gains to the selling firms. This situation of firms with large processing facilities being sold for substantial sums presents a confusing set of evidence to the uninformed when the processing facilities are immediately scrapped or abandoned by the acquiring buyer.

A Synthesis of Structural Conditions and a Test of Hypotheses Resulting from those Conditions

A cursory review of the structural conditions relative to the salmon processing industry indicate that it is characterized by an
atomistic group of processor-buyers. The substantial concentration of market power at the buying level is not only supported but encouraged by major barriers to entry and an inelastic supply function for the necessary factor of production. The problem of analysis is further complicated by a variety of species which subject the supply function to varying biological eccentricities and by a variety of market forms which apparently result from biological and processing conditions as well as external demand for the final market form.

In proceeding with the structural analysis it became apparent that there were, in fact, two distinguishable markets. These markets relate to the catch taxonomy and can be broadly categorized as the troll-caught (hook & line) and the net-caught salmon fishery. Because the units of sale are small, the troll-caught fishery can bargain with a larger group of buyers than the net-caught fishery. Further, the net-caught fishery is predominantly cannery fish (pink and sockeye) and must sell those fish to a small group of buyers. The market relating to the troll fishery, therefore, meets more conditions for competition than that concerned with the net fishery. The only time that the troll fishermen must sell their catch to canners is when they catch substantial numbers of pink salmon. Sockeye and chum salmon do not take readily to the hook and line method of catch.

If these observations and conclusions about the structure of
the salmon industry are correct, then one should be able to generate and test certain hypotheses from the model. Three such hypotheses will be advanced in this study, and Washington State salmon buying data for the years 1964 through 1972 will be used to develop linear regressions for each of the hypotheses. These hypotheses do not, by any means, exhaust the possibilities; but are intended to substantiate some of the major points made with respect to the structure of the salmon processing industry. Namely, that biological forces, processing technology, and the dominant position of the canned market form regulate the degree of competition (level of buyer concentration) within the industry.

**Hypothesis I:** Given the institutional constraints affecting the salmon processing industry, ceteris paribus, there will be significant changes in concentration levels relative to changes in the aggregate catch of all salmon. The reasoning behind this hypothesis relates as much to the biological eccentricities of the various salmon species as to buyer behavior. As was seen in Chapter II, the various species of salmon have varying life cycles and are available each year in varying numbers. The major forces behind the varying catch levels are the sockeye and pink salmon, the remaining three species being rather constant in availability. With the principal species being cannery fish, the relative buying concentration of the few available canneries should increase during the rising period of the catch level
if no additional firms enter the industry. Given the barriers to entry which characterize the salmon processing industry and the fact that no change in market form preference appears imminent, it seems reasonable to assume that concentration levels should be closely tied to the level of catch.

Hypothesis II: Given the more competitive stance of the troll salmon fishery, substantial changes in the aggregate catch of troll-caught salmon will, ceteris paribus, inversely affect the level of processor concentration. If the troll fishery is more competitive than the net fishery it seems reasonable to assume that any major changes in the amount of troll-caught salmon would reduce the concentration levels within the industry.

Hypothesis III: Given limited processed market form alternatives for pink salmon, increases in the relative catch of troll pink salmon to the total troll salmon catch will, ceteris paribus, increase the level of industry concentration. If pink salmon could only be marketed in the canned form then trollers would be forced to sell their catch to the canners whenever they caught large numbers of pink salmon.

Simple linear regressions were computed for concentration of buying power at both the first four and first eight firm levels. In addition a multiple regression using all three assumptions was computed for both concentration levels. The data utilized and the results
of the regression computations are arrayed in Table 7. It can be seen from the results that, at the five percent level of significance, only the first hypothesis cannot be rejected. The test of that hypothesis does point out the importance of the size of the catch to the level of concentration—the Coefficient of Determination was .41 for the concentration level of the first four firms in the industry and it was .58 for the largest eight firms in the industry.

The second hypothesis, although not established as a significant factor in the level of concentration, indicates that the troll fishery has some positive effect upon the competitive stance of the salmon processing industry. The regression coefficient is negative with respect to the level of concentration at both the eight and four firm levels of aggregation. Additionally, it should be noted that the troll salmon catch is generally less than one-third of the total salmon catch during any season. The third hypothesis was disappointing with respect to the simple linear regression, in that the sign of the regression coefficient was negative rather than positive as hypothesized. However, with the pink salmon comprising only a very modest percentage of the total troll catch—with the exception of the 19% figure in 1967, all other years were 7% or less—this variable could not be expected to show strongly. Furthermore, the multiple regression equation indicates that the regression coefficient for the total troll catch is negative while the
Table 7. Statistical data and regression results for tests of Hypotheses I, II, and III

<table>
<thead>
<tr>
<th>Year</th>
<th>% Concentration First Four Firms</th>
<th>% Concentration First Eight Firms</th>
<th>Total Catch (millions of lbs.)</th>
<th>Total Troll (millions of lbs.)</th>
<th>% of Total Pink to total troll</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>50</td>
<td>64</td>
<td>19.0</td>
<td>6.7</td>
<td>0.6</td>
</tr>
<tr>
<td>1965</td>
<td>46</td>
<td>64</td>
<td>25.0</td>
<td>9.5</td>
<td>7.0</td>
</tr>
<tr>
<td>1966</td>
<td>40</td>
<td>57</td>
<td>27.5</td>
<td>8.3</td>
<td>1.7</td>
</tr>
<tr>
<td>1967</td>
<td>45</td>
<td>63</td>
<td>28.7</td>
<td>9.8</td>
<td>19.0</td>
</tr>
<tr>
<td>1968</td>
<td>54</td>
<td>70</td>
<td>27.2</td>
<td>6.4</td>
<td>0.3</td>
</tr>
<tr>
<td>1969</td>
<td>58</td>
<td>74</td>
<td>33.2</td>
<td>5.9</td>
<td>6.0</td>
</tr>
<tr>
<td>1970</td>
<td>50</td>
<td>69</td>
<td>36.8</td>
<td>8.7</td>
<td>0.4</td>
</tr>
<tr>
<td>1971</td>
<td>62</td>
<td>84</td>
<td>52.1</td>
<td>7.9</td>
<td>1.3</td>
</tr>
<tr>
<td>1972</td>
<td>58</td>
<td>62</td>
<td>34.1</td>
<td>6.0</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Regression of Concentration Levels of First Four Firms $Y(1)$ on Independent Variables

<table>
<thead>
<tr>
<th>Intercept</th>
<th>Regression Coefficient</th>
<th>Coefficient of Determination</th>
<th>Computed t value</th>
<th>Computed F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total catch $X(1)$</td>
<td>36,052</td>
<td>0.46</td>
<td>0.411</td>
<td>2.211</td>
</tr>
<tr>
<td>Total troll $X(2)$</td>
<td>68,131</td>
<td>-2.286</td>
<td>0.258</td>
<td>-1.559</td>
</tr>
<tr>
<td>% Pink troll $X(3)$</td>
<td>51,833</td>
<td>-0.315</td>
<td>0.083</td>
<td>-0.796</td>
</tr>
</tbody>
</table>

Regression of Concentration Levels of First Eight Firms $Y(2)$ on Independent Variables

<table>
<thead>
<tr>
<th>Intercept</th>
<th>Regression Coefficient</th>
<th>Coefficient of Determination</th>
<th>Computed t value</th>
<th>Computed F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total catch $X(1)$</td>
<td>47,050</td>
<td>0.647</td>
<td>0.579</td>
<td>3.105</td>
</tr>
<tr>
<td>Total troll $X(2)$</td>
<td>75,773</td>
<td>-1.083</td>
<td>0.041</td>
<td>-0.549</td>
</tr>
<tr>
<td>% Pink troll $X(3)$</td>
<td>68,344</td>
<td>-0.223</td>
<td>0.029</td>
<td>-0.460</td>
</tr>
</tbody>
</table>

$F(1, 8) = 5.32$  
$F(3, 5) = 5.41$

Multiple Regression Equations for Concentration Levels at the Four Firm Level $Y(1)$ and at the Eight Firm Level $Y(2)$, Using the Three Independent Variables $X(1)$, $X(2)$, and $X(3)$

Four Firm Level  
$y(1) = 55.652 + 0.480X(1) - 2.730X(2) + 0.186X(3) + e(1)$  
$R^2 = 0.688$  
$F(3, 5) = 5.41$  
$Durbin-Watson Statistic = 1.868$

Eight Firm Level  
$y(2) = 56.922 + 0.662X(1) - 1.421X(2) + 0.141X(3) + e(2)$  
$R^2 = 0.628$  
$F(3, 5) = 5.41$  
$Durbin-Watson Statistic = 1.759$
Table 7  (Continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Correlation X vs. Y</th>
<th>Std. Error of Reg. Coef.</th>
<th>Computed t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative to X(1)</td>
<td>X(1)</td>
<td>31.5110</td>
<td>9.37369</td>
<td>0.64119</td>
<td>0.18305</td>
</tr>
<tr>
<td>Relative to X(2)</td>
<td>X(2)</td>
<td>7.68888</td>
<td>1.49452</td>
<td>-0.50768</td>
<td>1.38677</td>
</tr>
<tr>
<td>Relative to Y(1)</td>
<td>X(3)</td>
<td>4.05555</td>
<td>6.15631</td>
<td>-0.28810</td>
<td>0.34119</td>
</tr>
<tr>
<td>Relative to X(1)</td>
<td>X(1)</td>
<td>31.5110</td>
<td>9.37369</td>
<td>0.76117</td>
<td>0.23655</td>
</tr>
<tr>
<td>Relative to X(2)</td>
<td>X(2)</td>
<td>7.68888</td>
<td>1.49452</td>
<td>-0.20310</td>
<td>1.79204</td>
</tr>
<tr>
<td>Relative to Y(2)</td>
<td>X(3)</td>
<td>4.05555</td>
<td>6.15631</td>
<td>-0.17124</td>
<td>0.44091</td>
</tr>
</tbody>
</table>
regression coefficient for the percent of total pink to total troll is positive with respect to the concentration levels. Further, it is obvious from the correlation matrix and the supplementary factor data that some intercorrelation exists between the total troll catch, \( X(2) \), and the % of total pink to total troll, \( X(3) \). This then could obscure the contribution of each in explaining variations in concentration levels.

As has been previously pointed out, the hypotheses do not exhaust the possible assumptions. They are intended to substantiate the importance of unique institutional factors within the industry. These factors have an important role in shaping the structure of the industry and, more often than not, are completely overlooked in economic analyses and public policy decisions. In addition to the above regression analyses, it would be fruitful for any researcher to review the annual variations in relevant industry data.

The annual purchases with respect to the 20 largest firms in the salmon processing industry are arrayed in Table 8. The percentage relationship of the major buyer groupings to the total purchases of salmon within the State of Washington has been arrayed, by year and buyer classification in Table 9. Although, as with the previous years, there is a cyclical influence, it can be seen that the trend in concentration has, on the average, increased. As compared with the period 1964-68 the position of the largest firm
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Salmon Purchases</th>
<th>Largest Buyer</th>
<th>4 Largest Buyers</th>
<th>8 Largest Buyers</th>
<th>20 Largest Buyers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>19,028</td>
<td>3,648</td>
<td>9,375</td>
<td>12,161</td>
<td>15,726</td>
</tr>
<tr>
<td>1965</td>
<td>25,099</td>
<td>4,742</td>
<td>11,488</td>
<td>15,916</td>
<td>21,571</td>
</tr>
<tr>
<td>1966</td>
<td>27,510</td>
<td>3,674</td>
<td>10,694</td>
<td>15,178</td>
<td>22,711</td>
</tr>
<tr>
<td>1967</td>
<td>28,667</td>
<td>4,219</td>
<td>12,162</td>
<td>17,260</td>
<td>24,431</td>
</tr>
<tr>
<td>1968</td>
<td>27,286</td>
<td>5,312</td>
<td>14,130</td>
<td>18,457</td>
<td>23,421</td>
</tr>
<tr>
<td>1969</td>
<td>33,172</td>
<td>6,366</td>
<td>18,685</td>
<td>23,709</td>
<td>29,583</td>
</tr>
<tr>
<td>1970</td>
<td>36,769</td>
<td>5,779</td>
<td>18,202</td>
<td>24,715</td>
<td>32,261</td>
</tr>
<tr>
<td>1971</td>
<td>52,671</td>
<td>9,409</td>
<td>32,066</td>
<td>43,319</td>
<td>48,652</td>
</tr>
<tr>
<td>1972</td>
<td>34,041</td>
<td>5,749</td>
<td>16,821</td>
<td>20,925</td>
<td>27,877</td>
</tr>
</tbody>
</table>
Table 9. Percentage of total salmon purchases in the state of Washington accounted for by the largest firms, 1964 through 1972

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest firm</td>
<td>19</td>
<td>19</td>
<td>13</td>
<td>15</td>
<td>20</td>
<td>19</td>
<td>16</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>Four largest firms</td>
<td>50</td>
<td>46</td>
<td>40</td>
<td>45</td>
<td>54</td>
<td>58</td>
<td>50</td>
<td>62</td>
<td>50</td>
</tr>
<tr>
<td>Eight largest firms</td>
<td>64</td>
<td>64</td>
<td>57</td>
<td>63</td>
<td>70</td>
<td>74</td>
<td>69</td>
<td>-84</td>
<td>62</td>
</tr>
<tr>
<td>Twenty largest firms</td>
<td>84</td>
<td>85</td>
<td>83</td>
<td>88</td>
<td>90</td>
<td>93</td>
<td>88</td>
<td>94</td>
<td>82</td>
</tr>
</tbody>
</table>
remains somewhat constant, but the four largest firms move from a high of 54% to a high of 62%, while the eight largest firms move from a high of 70% to a high of 84% of the total purchases. There is some indication that 1971 may be the peak year in the long term cycle and the subsequent ten year period may be one of decreasing aggregate catches and decreasing concentration. The compilation of percentage control in Table 9 and the trends indicated are graphically portrayed in Chart 7, where suggested trend lines are also drawn.

The nine year period indicates a period of general industry stability, at least among the major buying firms. Although there has been some change in the relative positions of the four largest buyers, the firms remain the same. The array of firms in Table 10 also indicates a lesser degree of stability in the next four largest buyers. Part of this can be attributed to the consolidation of Washington Fish & Oyster Company with McCallum-Legaz in 1971. This combination also caused Washington Fish to move to the first position during the 1972 buying season. An additional factor which caused some change in the concentration tables was the decision of Peter Pan Seafoods, a major salmon processor in Alaska, to expand operations into the Northwest. Their acquisition of the Union Fish Company canning operation in Astoria, Oregon, provided a processing base for buying operations in the states of Washington and Oregon. An
Chart No. 7. Percentage of Total Salmon Purchases Accounted for by the Largest Firms 1964 thru 1972.
Table 10. Relative positions of eight largest salmon buyers in the state of Washington, 1969 through 1972

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Whitney-Fidalgo Seafoods</td>
<td>Whitney-Fidalgo Seafoods</td>
<td>Whitney-Fidalgo Seafoods</td>
<td>Washington Fish &amp; Oyster Company</td>
</tr>
<tr>
<td>2</td>
<td>New England Fish Company</td>
<td>New England Fish Company</td>
<td>Bumble Bee Seafoods</td>
<td>Whitney-Fidalgo Seafoods</td>
</tr>
<tr>
<td>3</td>
<td>Washington Fish &amp; Oyster Company</td>
<td>Washington Fish &amp; Oyster Company</td>
<td>New England Fish Company</td>
<td>New England Fish Company</td>
</tr>
<tr>
<td>4</td>
<td>Bumble Bee Seafoods</td>
<td>Bumble Bee Seafoods</td>
<td>Washington Fish &amp; Oyster Company</td>
<td>Bumble Bee Seafoods</td>
</tr>
<tr>
<td>5</td>
<td>Fishermen's Packing Company</td>
<td>McCallum-Legaz</td>
<td>Fishermen's Packing Company</td>
<td>Peter Pan Seafoods</td>
</tr>
<tr>
<td>6</td>
<td>McCallum-Legaz</td>
<td>Peter Pan Seafoods</td>
<td>Peter Pan Seafoods</td>
<td>VITA Food Products</td>
</tr>
<tr>
<td>7</td>
<td>Peter Pan Seafoods</td>
<td>Roy Strittmatter</td>
<td>Washington Crab Producers</td>
<td>Roy Strittmatter</td>
</tr>
<tr>
<td>8</td>
<td>VITA Food Products</td>
<td>VITA Food Products</td>
<td>VITA Food Products</td>
<td>Middleton Fisheries</td>
</tr>
</tbody>
</table>
interesting, and behaviorally important, fact is that no one firm within this array can be considered a dominant firm. All of the major firms represent substantial buying positions, and all are dependent upon the conduct of the others for the maintenance of those positions and the prices they must pay for the freshly caught salmon.

A major factor in shaping the second and third hypotheses is the fact that only the silver and chinook salmon consistently take to a hook and line, and the major portion of these fish are used in the fresh and frozen market form. The pink salmon also strikes at lures but not as predictably as the other two species. The ceteris paribus condition is very important with respect to the third hypothesis because should the pink salmon begin to be used in the fresh and frozen market forms, then the level of concentration within the industry would be conditioned by the total troll catch without regard to catch composition of species. Statistics for the troll salmon fishery are arrayed in Table 11. These data provide some explanation for the obvious reversals in concentration during the nine year upward trend. For the years 1966 and 1970 the troll catch represented 25 percent or more of the total salmon catch and the number of pink salmon represented in the troll catch for those years was very small. For the year 1972 the precipitous decline in the total salmon catch and the concentration level provides strong evidence of the influence
Table 11. Total poundage of troll-caught salmon in the state of Washington relative to the total salmon catch for the years 1964 through 1972

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Salmon Purchases (millions of lbs.)</th>
<th>Chinook</th>
<th>Silver</th>
<th>Pink</th>
<th>Pinks as a % of Total Troll Catch</th>
<th>Total Troll Catch (millions of lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>19.0</td>
<td>2,069,623</td>
<td>4,591,868</td>
<td>42,664</td>
<td>(0.6)</td>
<td>6.7</td>
</tr>
<tr>
<td>1965</td>
<td>25.0</td>
<td>1,347,495</td>
<td>7,427,825</td>
<td>679,824</td>
<td>(7.0)</td>
<td>9.5</td>
</tr>
<tr>
<td>1966</td>
<td>27.5</td>
<td>2,001,063</td>
<td>6,135,930</td>
<td>139,970</td>
<td>(1.7)</td>
<td>8.3</td>
</tr>
<tr>
<td>1967</td>
<td>28.7</td>
<td>1,669,432</td>
<td>6,167,314</td>
<td>1,946,164</td>
<td>(19.0)</td>
<td>9.8</td>
</tr>
<tr>
<td>1968</td>
<td>27.2</td>
<td>1,869,270</td>
<td>4,543,227</td>
<td>19,669</td>
<td>(0.3)</td>
<td>6.4</td>
</tr>
<tr>
<td>1969</td>
<td>33.2</td>
<td>2,288,592</td>
<td>3,282,101</td>
<td>340,364</td>
<td>(6.0)</td>
<td>5.9</td>
</tr>
<tr>
<td>1970</td>
<td>36.8</td>
<td>2,549,924</td>
<td>6,074,789</td>
<td>35,494</td>
<td>(0.4)</td>
<td>8.7</td>
</tr>
<tr>
<td>1971</td>
<td>52.1</td>
<td>3,106,878</td>
<td>4,681,279</td>
<td>105,068</td>
<td>(1.3)</td>
<td>7.9</td>
</tr>
<tr>
<td>1972</td>
<td>34.0</td>
<td>2,613,775</td>
<td>3,408,854</td>
<td>11,735</td>
<td>(0.2)</td>
<td>6.0</td>
</tr>
</tbody>
</table>
that total catch level has over the competitive posture of the salmon
processing industry.
VI. SOME OBSERVATIONS ON MARKET CONDUCT AND PERFORMANCE

The manner in which firms arrive at factor pricing decisions has important implications. Theoretically, independent action is desirable and collusive action is most likely to lead to monopsonistic pricing. Market conduct refers to the patterns of behavior that business firms follow in adjusting to the markets in which they buy or sell. This conduct would encompass (1) the price policies of firms, whether acting individually or collectively and (2) the process or mechanism of interaction. Cross-adaptation, and coordination of policies of competing buyers in the market (1, p. 9). Market performance refers to the composite end results which firms in any market arrive at by pursuing whatever lines of conduct they espouse (1, p. 10). Relative to the fishing industry these end results would include (1) the buying price for the factor relative to the long-run marginal cost of production, the long-run average cost of production, and the resultant profit margin; (2) the rate of progressiveness of the industry in developing new products and techniques of production; and (3) the size of industry output relative to the largest attainable consistent with the equality of price and long-run marginal cost.

Although in theory we attempt to envisage a three-stage sequence running from market structure to market conduct to market performance, Bain has pointed out "that it is not possible to link a
distinct class of performance with each objectively distinguishable broad class of market conduct" (1, p. 329). Further, "... there does not seem to be any very close association between patterns of interseller coordination and the character of market structure" (1, p. 330). However, linkage considerations aside, it is possible to evaluate relevant dimensions of market conduct as between the complete independence and the complete collusion of participant firms; and it is further possible to evaluate the end results of the strategy decisions of firms within an industry (1, p. 348). These long-term performance tendencies are the basis for evaluating welfare goals within the framework of existing and potential public policy formulation. As Bain has pointed out:

Market structure and conduct patterns are significant only to the extent that they are systematically associated with market performance, and they can be evaluated ultimately only in terms of performance patterns to which they lead. It is thus appropriate that we examine evidence both of the market performance of various industries and of the association of structure and conduct to performance (1, p. 372).

**Market Conduct in the Salmon Processing Industry**

In an atomistic industry each buyer would view the industry-wide buying price of a factor as given and not subject to his influence. He, therefore, produces that output and pays that factor price which will yield a maximum profit. Because of the large number of buyers and their relative size any collective action would be impossible.
However, in an oligopsonistic industry each buyer acquires a large enough share of a factor of production to influence the buying price. Each, therefore, would anticipate the reaction of a rival buyer and would act accordingly. In short, all buyers in an oligopsonistic industry recognize a mutual interdependence of their price-quantity decisions. Oligopsonistic interdependence exists if two or more buyers in an industry have a large enough market share that a small proportional change in his own volume of purchase, made at the expense of others in the industry, will result in a noticeable proportional change in the purchases of the other buyers or in the price paid by others (1, p. 115). As has been seen in Chapter V, this situation is in fact the case of the salmon processing industry.

Although concentration has characterized the salmon processing industry for over 70 years the patterns of behavior have not been consistent (10, 19). Initially, an abundance of production factors and a positively shifting demand curve for the final product diverted decisions to capacity expansion and the acquisition of factor inputs for that expansion process. This type of situation is clearly portrayed in Cobb's early study of the salmon industry (10). Once growth should cease, however, there are definite changes in behavior patterns. The next phase of behavior came during the early part of the twentieth century when the industry was burdened by what appeared to be an excessive supply of salmon followed by
a chronic overcapacity situation as the supply of salmon shifted to lower equilibrium positions (10, 19). Such symptoms tend to breed "destructive competition" and the picture of subnormal profits and numerous business failures begins to emerge (1, pp. 471-473). This condition of chronic industry maladjustment has been documented for the salmon processing industry by both Gregory & Barnes (19) and Rubenstein (30). As the quantity of salmon began to shrink there was price warfare as the oligopsonistic rivals fought to maintain their shares of the diminishing supply. As the supply condition stabilized the industry began to move toward a more mature and stable oligopsony form. Bain has described the pattern of conduct for this type of industry as follows:

From general observation of a scattering of cases, the following impressions emerge. First, with highly concentrated buying, patterns of tacit collusion implemented by buying price leadership by the largest buyer are frequently in evidence. If not, close interdependence in the buying price policies of the principal buyers is found. Performance evidence concerning the height of price relative to supplier's costs or to a hypothetical competitive level of price frequently suggests a lowering of price roughly consistent with the maximization of the joint profits of the buyers, and little independent or competitive action on the part of individual buyers (1, p. 367).

Within the legal framework of anti-trust policy the market conduct of buyers embodies the composite of "acts, practices, and policies" of buyers in arriving at and in some way coordinating their several decisions as to what prices to charge, what outputs to produce, and what product designs to produce (1, p. 303). As such,
market conduct is an extremely complex circumstance, and a minute analysis, if feasible, would not be very rewarding. It does, however, seem worthwhile to synthesize those aspects of conduct within the salmon processing industry which (1) are immediately identifiable and (2) possibly have some impact upon industry performance.

The salmon processors do not determine prices for their inputs of salmon with complete independence. It is obvious from the material presented in Chapter V that a rational businessman would take account all of the possible reactions of rival buyers when making price-quantity decisions. With an inelastic supply function no one can profit from price raising. Further, secret price raising is impossible because the fixed supply characteristics of the industry coupled with limited geographic dispersion of the industry would provide a sensitive notice to the residual buyers. This circumstance is universal to the firms within the industry because small firms as well as large understand that they will lose in any form of price competition. The substantial barriers to entry which exist for the industry are important here because they put all participants on notice that cooperation leading to increased profit levels will not attract new firms into the industry.

The salmon processing industry is not characterized by obvious collusion between the buying firms so much as the parallel action of those firms in their buying decisions. Although there is no express agreement, no buying takes place each year until the prices
are established with the fishermen. This occurs when one of the major firms in the industry (usually acknowledged to be New England Fish Company) agrees to a set of opening prices with its fishing units. It is interesting to note that the same process takes place between troll as well as net fishermen and the salmon buyers—the bargaining strength of the trollers, however, is substantially superior to that of the net units. Subsequent to the established opening price structure, when any firm announces a price change for the salmon the other firms quickly announce a matching price. Although there is no formal agreement between the parties this apparent consensual action of the processors creates a result comparable to tacit collusion. The result is a monopsonistic pricing circumstance. Rather than reverting to the plethora of oligopsony models yielding unique solutions but requiring rather strong conjecture about the behavioral assumptions, it might be rewarding to attempt an explanation of behavior within the context of reward structures. Sherman (32) and other economists have followed the example established by sociologists and social psychologists in evaluating individual behavior within the framework of payoff interdependence. By using the game theoretic setting popularized by Luce and Raiffa (24) they emphasize payoff structure rather than precise decision rules. This approach is depicted for the salmon processors in Figure 4. The two alternative strategies represented by the simple duopsony situation
Figure 4. Prisoner's Dilemma
represent cooperation or non-cooperation. By associating probabilities with the competing buyer's actions the decision maker can roughly perceive the reward structure associated with his own decision process. Should he raise his offering price for salmon in order to acquire a larger proportion of the total he can see that the opposing firm faces two courses of action, raise his price to keep his market share or retain the original price and lose some of his proportionate share. Given the comparability of cost curves within the industry the competing buyer will probably match price raises. Alternatively, the processor may retain the existing price for salmon and, by the same reasoning, the competing buyer will probably not raise his price for the factor. It is obvious that a strategy of avoiding price competition presents the highest payoff structure to all participants. If there were, in fact, substantial cost differences between firms a payoff table could be constructed to reflect these differences (see Sherman (32, pp. 55 to 61)).

One result of a bifurcated (troll and net) factor market with different degrees of competition is the differential pricing of the factors. These differences were not readily apparent when the net and troll salmon serviced different markets (canned and fresh). Now, however, for both net and troll salmon the bulk of all chinook salmon and a major portion of all silver salmon find their way into the fresh or frozen market. With little or no price differential existing in the
final fresh and frozen markets the continuation of differential pricing at the factor level is strong indication of imperfect market conditions. Within the salmon industry the more balkanized the fishery, the greater the spread in the differential pricing. A prime example of this is the Indian net fishery which indicates substantially lower factor prices than the net fishery of Puget Sound.

Two obvious questions must be raised with the structural conditions and patterns of conduct presented for the salmon processing industry. What must a firm do to expand output and how might they compete other than with price policy? As was mentioned in Chapter V, the one feasible method for expanding output is through merger with existing firms. By capitalizing the marginal gain resulting from the property right of another firm, processors are able to determine a value for those firms. As was readily apparent in Chapter IV, estimates of firms' cost functions are inherently difficult and problematical. But, as Sherman has pointed out:

Despite these difficulties, accumulated evidence suggests that a simple linear total cost function will serve as a reasonable approximation for the cost function of firms beyond a so-called minimum efficient size in many manufacturing industries. The function comprises a fixed cost and a variable cost that is the product of output quantity times a constant marginal cost. To be sure, this cost function is a crude approximation to reality. It reflects accounting approximations to economic costs, and it may fail to reflect important differences in cost functions from firm to firm and industry to industry. But empirical analysis has not uncovered those differences and business managers do not believe they exist,
so firm behavior probably is based on the linear total cost function that is so apparent from analysis of accounting data (32, p. 60).

Although the evidence is crude, it has been shown that firms within the industry are pursuing a policy of consolidation and merger and that potential new firms outside the industry face a different accounting cost function than existing firms. The patterns of behavior exhibited by the participants in the market does tend to confirm the hypothesized cost perceptions.

Because of the stringent structural constraints upon price competition a number of interesting forms of non-price competition have developed in the salmon processing industry. The most prevalent of these is the use of credit. Because of the seasonality of the fishery the fishermen require large amounts of credit during off season periods and to replace equipment. As was noted by Gregory & Barnes (19) the use of credit has been a commonplace circumstance for many years. This is particularly true of net units which require a larger investment and higher maintenance costs. Many small processors do not have the financial capabilities to make credit advances but the larger processors consider it an absolute necessity for maintaining their market shares. A cursory review of recent financial statements for some of the larger processors indicates that there has been a substantial increase in credit advances during the past several years. Although the large processors do own some
of their own catch units (particularly in Alaska) they have found it to be far more advantageous to advance credit at the current interest rate rather than be vertically integrated. Given the risks, the rates of return for fishing vessel operation are considered low; and firms are able to maintain their market share of the factor by financing fishing operators who are willing to assume the risk/rate of return combination which characterizes the industry. At least two of the major processors have implemented a policy aimed at eliminating vessel ownership (determined in conversation and substantiated, in part, by evaluation of financial statements.

Non-price competition also has taken a variety of other forms, including convenient boat repair facilities, boat moorage facilities, and elaborate buying facilities with showers and meals made available to the fishermen. An even more ingenious device is particularly popular in the strong ethnic fishing communities--the hiring of a relative or a fellow townsman as an employee. Many times these individuals are employed as buyers and are placed on a commission which is based upon the number of salmon purchased for the processor.

The term market conduct concerns itself with behavior patterns which firms in an industry exhibit in the market where they buy their basic factors of production. In the case of either competitive or purely monopsonistic industries market conduct is not very relevant,
because firms react only to purely impersonal economic forces. In the case of an oligopsonistic industry such as the salmon processing industry, those patterns of behavior are both interesting to the observer and necessary for an understanding of the industry. The diverse patterns of conduct presented as exemplifying the salmon processing industry cannot do complete justice to the totality of industry behavior. It does, however, reflect response to the strong influence of the exogenous forces comprising the industry structure.

**Market Performance in the Salmon Processing Industry**

To quote Bain, "Market performance encompasses the strategic end results of the market conduct of sellers and buyers" (1, p. 372). Market performance is an attempt to evaluate how well the market activity in the industry contributed to social welfare. Because of its multi-dimensional nature a full appraisal of market performance is difficult. Bain has said: "Each industry is in some degree a special or unique case requiring a 'tailor made' appraisal not fully applicable to other industries" (1, p. 372). In the salmon processing industry, for example, we must concern ourselves with the conservation of the basic resource as well as efficiency of industry operation. With this in mind and an eye toward clarity and understanding, this study will direct its attention toward those features of market performance for the salmon processing industry which are both relevant and distinguishable.
Profitability as a Measure of Performance

Under the model of perfect competition if resources are to be allocated in the manner desired by society then prices must equal marginal costs in the short-run. In the long-run, competitive adjustments would drive prices and average costs to the same level. Should excess profits exist in an industry over a long period of time, it is an indication that, at least for a monopsony, the marginal revenue product of the factor has been greater than the price paid for that factor (see Figure 1, p. 90). An additional argument logically concludes that long-run excess profits may mean that the industry is restricting output relative to societal demands. It would thus seem desirable that long-run accounting profits for firms within an industry should approximate a fair return on the owners equity.

Bain places great emphasis on the disparity between long-run selling price and long-run marginal cost (1, p. 375) but restructures the evaluative framework because of data problems:

Because long-run marginal costs are usually not directly measurable, and also because the long-run average cost of production is typically about the same as the long-run marginal cost, the allocative efficiency of an industry is in practice best judged by the relationship of its long-run selling price to its long-run average cost of production. And the most convenient available indicator (if properly interpreted) of this price-average cost relation is the long-run average rate of profit that firms in the industry earn on owners investments (1, p. 375).

With this mandate in mind we can move to an evaluation of the salmon
A perusal of financial statements from selected major firms within the salmon processing industry indicates a substantial increase in accounting profits between the years 1964 and 1974. New England Fish Company, for example, was able to show an operating profit of $535,746 in 1964, while in 1974 that operating profit rose to $5,474,299. Although joint cost and revenue figures preclude the possibility of identifying salmon contributions, the buying records indicate that salmon made a major contribution to processor operations. Does this, however, indicate excessive profits? Firms in a competitive industry would expect to earn at least as much as they could earn elsewhere or they would leave the industry. In 1964, the financial statements of New England Fish Company indicate an owners equity of $10,086,922; or a return on owners equity of 5.3% for that year. In the year 1974 the owners equity valuation was $32,975,706, which gives an indicated rate of return of 16.6% for the year. The rate of return for 1964 was below the average market rate of return for investments of comparable risk (as a matter of fact, it approximates the rate of return on a riskless savings account) while the rate of return in 1974 was only about 5% over the prime rate in 1974. Given the cyclical changes created by the long-term salmon cycle it might be conjectured that the rate of return on the average during the full period of the cycle was in fact
substandard.

In the manufacturing sector the association between firm size or concentration and the rate of profitability has never been shown to be significant and the salmon processing industry shows itself to be no exception to that observation. However, there are certain quantitative and qualitative addenda to profit analysis which may relate to structural conditions. One of these is the differential pricing previously discussed under the heading of market conduct. The differential profit rates between factors originating in the troll and net fisheries does create a disparity between returns on resources and it may create an inequity in the distribution of income. Another item which is qualitative by nature is the relative stability of larger firms as compared to smaller firms within an industry. Although small firms may make as large or even larger profit rates than the largest firms within an industry, their chances for survival during times of cyclical change are far less. The salmon canners are faced with large fixed costs which include labor and operating overhead. Many of these costs are incurred before the annual salmon season commences, and the advent of a low catch period in the salmon cycle can have disastrous consequences upon those firms which have a relatively small share of the total catch. At this point one might conjecture further that as the salmon cycle moves into the decreasing period (1972 to 1982, prox.) the number of small
processors either leaving the industry or merging with larger firms will tend to intensify.

Industry Progressiveness in Marketing and Production

When technological progressiveness is considered in organizational theory it refers to the rate of adoption of new techniques which lower the real cost of producing and distributing goods. The difficulty in establishing a standard for such an evaluation is immediately apparent. Rather than a simple enumeration, Bain feels that "Each industry should be judged relative to what it was possible to do" (1, p. 419). Chapter IV provides us with a picture of an industry which has not had a major change in technological progress for 20 years. However, the circumstances also indicate that substantial overcapacity has been, and continues to be, a structural characteristic in the salmon processing industry. This, it would seem, justifies the lack of technological progress in the production of salmon. It does not, however, justify the rather dismal record of product performance within the industry.

Product performance refers to that optimal balance between buyer satisfaction and the cost of production. It has a number of possible dimensions, such as quality and product design, rate and pattern of product change, and variety among competing products at any time (1, p. 422). It has been made very clear that market
form composition for salmon products has changed very little in alternative forms or in shifts between the existing forms (see page 21). While many food processing industries within the agricultural sector have made substantial progress in initiating such changes, the salmon processing industry has remained in a static position for 40 years. Progress within this classification of product performance could provide some relief for the structural constraints--if either the pink or sockeye salmon began to move into fresh and frozen channels there would be a reduced pressure upon fishermen to bargain with cannery operators. In addition to form, it can be pointed out that the handling of fresh salmon has shown very little improvement. As Stansby pointed out in a discussion of frozen fishery products: "Little is known of the biochemical properties of fishery products and how they influence the suitability of the product for freezing" (34, p. 289). The industry devotes little or no effort to quality control standards, and it has only been through the efforts of the Food and Drug Administration that processors have made some effort to modernize facilities.

Turner and Williamson stress one additional area within the general classification of industry progressiveness (37). Organizational innovation is broadly considered to be "all cost reducing activity that is not attributable to technical developments" (37, p. 133). This would include such diverse elements as improvements
in cost accounting, work scheduling, personnel and collective bargaining procedures and changes in organizational form, (37, p. 133). Although there seemed to be little progress made within this category during the first several decades of the salmon industry, there is considerable evidence that the processors have made gains during the past several years. Modern cost systems are being used for production control and pricing, and efficient production techniques long utilized by other industries are being implemented into the production process. Additionally, some horizontal integration is taking place so that production cost efficiencies can be realized. This latter point tends to be a bit controversial (as does vertical integration for cost savings) because it does intensify the degree of power for the merged firms. However, it must be recognized that there are efficient attributes to such actions. Turner and Williamson conjecture that such a merger direction may have a beneficial impact upon technical innovation and that this circumstance should be considered in any policy decisions, (37, p. 140).

The Size of Industry Output

Certain policy makers seem concerned that an industry achieve an output as large as possible, consistent with the equality of price and long-run marginal cost. It is interesting to note that the salmon processing industry may now face an inelastic supply function for the
necessary factor of production for processed salmon, (12). The level of output is, in fact, contingent upon the biological forces affecting the salmon fishery. The present study has been concerned with factors related to market structure. If it were not for the fact that salmon is a common property resource, any further discussion or analysis could be terminated as irrelevant to an analysis of industry performance. A complete discussion of the welfare implications and public policy changes would have to recognize the open access nature of the fishery resource. This is beyond the scope of the present study but the interested reader is referred to the work of Copes (11), Crutchfield and Pontecorvo (12), and Worcester (41). Indeed, an extension of the present work might incorporate these features into an evaluation of industry performance.

Performance and Economic Welfare

The evaluation of market performance is based upon the development of standards for judging the effectiveness of an industry in producing and distributing goods, services, and incomes. The norms for such standards find their foundation within the conditions imposed by Pareto optimality. However, such analysis does not take into consideration the interdependence between individuals, firms, and industries in a society. The external economies and diseconomies (such as the depletion of the natural resource, salmon)
raise some doubts as to the validity of current performance measures.

As Singer has pointed out:

The presence of interdependence among the various equations in the producer sector and the consumer sector has been the basis for a frontal attack on the marginal analysis used to derive the Paretian optimum. Critics of the 'classical welfare economics' have contended that if there is introduced into a general equilibrium system a constraint which prevents the attainment of one of the Paretian conditions, the remaining Paretian conditions are in general no longer desirable. Thus, in a mixed economy with a number of regulated and unregulated industries not operating under conditions of pure competition, it may be undesirable in terms of economic welfare to attempt to restructure some but not all of these monopolistic industries (33, p. 21).

This point of view finds strong support in the work of Lipsey and Lancaster, who state "... there is no a priori way to judge as between various situations in which some of the Paretian optimum conditions are fulfilled while others are not" (23, pp. 11-12). The authors go on to say:

In particular, it is not true that a situation in which all departures from the optimum conditions are of the same direction and magnitude is necessarily superior to one in which the deviations vary in direction and magnitude. For example, there is no reason to believe that a situation in which there is the same degree of monopoly in all industries will necessarily be in any sense superior to a situation in which the degree of monopoly varies as between industries (23, p. 12).

The theory of the second best should put both the economist and the policy maker on notice that piecemeal analysis and policy
may be not only futile but detrimental. The authors point out: "To apply to only a small part of an economy welfare rules which would lead to a Pareto optimum if they were applied elsewhere, may move the economy away from, not toward, a second best optimum position" (33, p. 17).
VII. CONCLUSIONS AND POLICY IMPLICATIONS

This study furnishes any policy maker or would-be policy maker with some interesting and useful insights into the salmon processing industry. More importantly, it may raise a number of imponderable questions with respect to the entire salmon industry. With the possibility of aggressive anti-trust policy and restrictive limited entry programs for the salmon industry, the circumstances presented importune the decision maker and the economist who rush to implement simplistic analysis.

Unique exogenous forces and historical circumstance have combined to give the modern salmon processing industry form. The stable oligopsony which has emerged is the result of 70 years of resource misuse, questionable anti-trust policy, the biological eccentricities of the salmon, and technological change. Further, there is a strong indication that the industry structure will continue to move toward higher levels of concentration through the consolidation of existing firms. The contrast of a very small number of buyers and the large number of fishing units which characterize the salmon industry is enough to chill the heart of any economist or anti-truster who seeks the benefits of competitive markets as an alternative to monopolistic market evils.

Consider for a moment, however, that rigorous sets of policy
conditions without regard to the unique forces affecting the salmon processing industry apparently are some of the strong causal forces which have helped shape the salmon industry of today. Anti-trust policy has eliminated a major source of capital and processing technology for aspiring new processors and has blocked many attempts by the fishermen-sellers to achieve more market power through collective bargaining. Fishery regulation which eliminated the most efficient forms of catch for the salmon fishery is apparently considering a policy reversal through limited entry programs. If this were to happen the major contributor to a competitive stance for the industry, the troll fishery, might be eliminated. The resulting conflict and confusion present a nightmarish morass for both the researcher and the industry decision maker. A better approach would be to emphasize industry performance in light of possible policy alternatives.

The concept of "workable competition" as first proposed by J. M. Clark (9) tends to vary considerably from author to author. An ideal level of industry performance reflects the ability of firms within that industry to adjust to market circumstances so as to obtain the maximum degree of benefit for overall economic objectives. Workable performance, therefore, refers to a reasonable approximation of those goals. Workable competition as proposed by Bain "is revealed by, and is the result of whatever gives rise
to reasonably satisfactory or workable market performance..." (1, p. 14). In concluding that the salmon processing industry is workably competitive, albeit a strong and stable oligopsony, the author lays no foundation for a more rigorous definition of workable competition. One of the difficulties inherent in any standardized definition is that it must overlook the dynamic forces which shape any industry's development. For the salmon processing industry these include an inherited circumstance of productive overcapacity and a substantially reduced quantity of the necessary factor of production. This has tended to force a diminishing number of processor-buyers as existing firms seek the benefit of scale economies and potential entrants perceive the insurmountable barriers. The troll fishery, although providing a classic picture of fishery overcapacity, appears to be a competitive force within the salmon processing industry; while the net fishery, although substantially more efficient, contributes to the overall level of concentration.

If we are concerned, as we should be, with the concept of workable performance this bifurcated oligopsony (troll market and net market) of the salmon industry is not without its merits. The troll fishery has had the opportunity to affect the level of factor prices for the entire salmon industry. It has, in fact, been a mitigating circumstance for the possibility of severe oligopsony factor pricing. Concurrently, the existence of a strong and stable
Oligopsony has created the possibility of benefits for the salmon fishery. Worcester (41) argues that such an oligopsony acting as a monopsony with leadership could in fact reduce the level of fishing intensity. The argument for limited entry programs in the fisheries is based upon the fact that no rent is attached to a common property resource and that the foregone rent is dissipated in excessive fishing units and the overfishing of the stocks (see Crutchfield and Pontecorvo (12)). If the existence of monopsony power forces a lower factor price than a more competitive model then the number of units entering the industry will be minimized and the level of performance for the industry will achieve a net gain. It should be noted that the situation may raise some questions about the resulting income distribution, but that question has not been seriously considered in the evaluation of limited entry programs.

If policy demands a limited entry program for the salmon fishery it should be implemented with the understanding that there may be higher levels of processor concentration resulting from such a program. Further, the trend toward more efficient catch units may cause an even greater shift in income distribution with the processors absorbing more of the rent from the fishery. This, in turn, will increase the value of the existing participants for the rent absorbed by both the more efficient catch units and the processor firms will be capitalized as future income.
Interestingly enough, the limited entry program must conflict with existing anti-trust policy which contends that increased levels of concentration reduce the competitive stance of an industry. This same anti-trust policy has vigorously rejected any attempt by fishermen to collectively bargain with the processors. This study mandates the conclusion that before there is any further implementation of either anti-trust or limited entry programs for the salmon fishery there must be a comprehensive review of aggregate welfare implications resulting from such programs. By themselves, and under simplistic circumstances, both of these programs may appear meritorious. Together they may prove self-defeating with a net reduction in industry performance. It should also be pointed out that less stringent modifications to the structure could be considered and might accomplish an even higher level of performance for the salmon industry. These would include allowing collective bargaining by the fishermen and taxing the excess profits of the processors.
BIBLIOGRAPHY


