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Efficiency and Equity Choices in Fishery Rationalization Policy Design:

An Examination of the North Pacific Halibut and Sablefish IFQ Policy Impacts on Processors

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Principal Investigator
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FINAL REPORT
01/24/02

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AUTHORS

Scott C. Matulich is a Professor of Agricultural Economics at Washington State University, Pullman, WA 99164-6210. Michael Clark was a graduate research assistant.

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Gratitude is owed the many nameless individuals and companies that made this research possible. Jeff Hartman, Earl Krygier, Peggy Murphy, and Herman Savikko deserve special thanks. Our colleague, Phil Wandschneider, offered many invaluable suggestions and thought-provoking discussions. As always, any errors or omissions are solely the responsibility of the authors. This report was jointly written with Michael Clark, both as partial fulfillment of his M.S. degree requirements and as the project completion under terms of the grant.

Copies of this report are available from Jeff Hartman, ADF&G project coordinator; Economist, Commercial Fisheries Division, P.O. Box 25526, Juneau, AK, 99802, (907) 465-6155.

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ABSTRACT

This study examines the efficiency and distributional components of welfare economics that can arise from fishery rationalization policy design. The analysis focuses on how the largest individual transferable fishing quota (IFQ) policy in the United States impacted halibut and sablefish processors, but is intended to provide insight into policy choices concerning future rationalization designs of other fisheries, including fishery cooperatives. It is shown that the policy design choice centers on policy "intent," i.e., whether policy makers intend to benefit one sector to the detriment of another, or whether they intend to recognize the prior economic interests of both sectors by allowing both to benefit from the rationalization policy.

The change in economic welfare emanating from the switch to IFQs is measured as the change in quasi rents retained by processors, i.e., the change in revenues in excess of all variable processing costs. This welfare measure allows one to evaluate whether the policy was Pareto safe, such that processors were left no worse off and possibly better off, or whether they were left worse off.

Recent theoretical developments in the ITQ literature argue that a harvester-only allocation of resource rights is detrimental to the co-dependent processing sector. Following the implementation of the Alaska IFQ policy in 1995, there has been no empirical investigation of the economic impacts of the policy upon either the harvesting or processing sectors. Harvesters are assumed to be better off due to efficiency gains from fleet decapitalization and consolidation through fully compensated quota trading. Unlike the harvesters, however, the policy did not allow for processors to be compensated for industry-wide decapitalization.

Welfare changes that occurred in the halibut and sablefish processing sectors are estimated for the pre- and post-IFQ periods of 1992-1993 and 1999-2000. A combination of statewide buying data and a cost of production survey were used to provide information regarding changes in market shares, unit quasi rents shares and ultimately, sector-wide welfare. It is estimated that more than 82% of the halibut processing sector and 97% of the sablefish processing sector (raw fish weight) lost revenues in excess of variable costs relative to the pre-IFQ period. The IFQ policy design was not win-win. It did not allow the processing sectors to participate in the policy benefits. Nor was the policy Pareto safe because most processors were left worse off in both nominal and real dollars relative to historic levels. These detrimental outcomes appear to be unintended and avoidable.

1. INTRODUCTION

Background

The North Pacific halibut fishery could be considered the poster child for rights-based fishing. It was a textbook illustration of H. Scott Gordon's (1954) seminal paper on common property fishery losses and open access externalities. Vessels entered the halibut fishery to the point that, immediately prior to introducing individual fishing quotas (IFQs), more than 5,119 boats harvested 49.5 million pounds of halibut in "three or four short one- or two-day openings each year (North Pacific Fishery Management Council 1997)." Sablefish followed a similar, though less dramatic script. In the late 1980s, the North Pacific Fisheries Management Council (NPFMC) began debating alternative management methods to decapitalize the halibut and sablefish fisheries. The NPFMC chose IFQs as the preferred management method in December 1991. The final IFQ policy design was implemented for halibut and sablefish in 1995 (North Pacific Fishery Management Council 1997).

Six years after switching to IFQs, there has been little evaluation of the economic impacts the policy had upon the industry. There are four exceptions. Knapp (1999 a, b) surveyed 249 halibut captains who fished pre- and post-IFQ, and 200 IFQ permit holders who fished in 1997. The surveys indicated an increase in safety and resource conservation following IFQ implementation; both are attributable to season elongation. Two extensive reports were recently published describing changes that arose from the Alaska IFQ program, but only with respect to quota shareholders (Dinneford *et al* 1999 a, b). These reports provided detailed descriptions of fleet consolidation due to the IFQ programs and how the pool of quota shareholders changed over the years following the introduction of IFQs. However, the reports are silent on both efficiency and distributional components of social welfare. Moreover, contrary to their titles, "Changes Under Alaska's Halibut [Sablefish] IFQ Program, 1995 to 1998," neither report addressed any impacts on the processing sector, despite the fact that an overcapitalized fleet begets an overcapitalized processing sector. The two sectors are inseparable elements of the open access externality that transferable quota policy intends to eliminate (Matulich, Mittelhammer and Reberte 1996 and Matulich and Sever 1999). What happened to the processing sector as a result of IFQs remains unclear.

This omission poses an important unanswered policy question. The NPFMC expressed no legislative intent for the IFQ policies to advantage or disadvantage processors, in either an absolute or relative sense.

> The Council hoped that the halibut [sablefish] program would spread out the season, would allow fishermen to harvest their individual quotas at times opportune to them, and would lead to improved ex-vessel prices and economic profits. They also hoped that the IFQ program would reduce safety problems, congestion on the grounds, gear loss, and wastage of resources (Dinneford *et al* 1999 a, b).

Yet, both empirical and theoretical literature shows that a quota allocation only to harvesters damages co-dependent processors. Lindner, Campbell and Bevin (1992) first raised this issue concerning unintentional redistribution during the transition to an IFQ system as an empirical observation related the New Zealand individual transferable quota (ITQ) fisheries. Matulich, Mittelhammer and Reberte (1996) developed the theoretical framework explaining why a harvester-only IFQ unintentionally transfers wealth from processors to harvesters. Fleet consolidation reduces the harvest rate, which in turn creates excess daily processing capacity and therefore, excess demand for raw fish. Processors will bid up exvessel price to utilize the policy-induced excess capacity, transferring wealth to harvesters. Gardner Brown (2000), citing both studies in his survey on modern renewable resource economics literature, distilled the central policy issue concerning ITQ management. "The rule for allocating ITQs is the crux issue and may be a stumbling block to adoption (p. 895)."

Other than the paper by Matulich and Sever (1999), there has been neither thorough nor rigorous analysis of alternative initial allocation designs or past designs. This observation is surprising, since "Advancement of rights based fishing is stymied by industry and congressional concern over distributional issues arising out of traditional ITQ design (Matulich and Sever 1999, p. 203)." In fact, distributional issues arising out of fisheries rationalization policy seem to be the cornerstone of the recently enacted American Fisheries Act (AFA). For example, Senators Stevens and Gorton clarified the legislative intent of AFA in a letter to the Honorable Janet Reno, U.S. Attorney General.

> The purpose of the legislation was to rationalize, Americanize and decapitalize the Bering Sea pollock fishery. The cooperatives established in the AFA were designed to ensure that **both** [emphasis added] harvesters and processors benefited from the rationalization (Stevens and Gorton 1999).

Fishery rationalization is evolving beyond the simple economic story that assigning transferable property rights to harvesters assures gains from trade. Indeed, quota trading among vessels results in fleet consolidation that promotes efficiency within the harvesting sector. Moreover, no harvester can be made worse off because all trades are fully compensated. But what about the co-dependent processing sector that was capitalized to process the glut of fish that hit the docks following the derby-style open access fisheries? Who benefited, who lost and how much are all elements of the rationalization goal of improved social welfare. To date there is no evidence measuring this broader scope of fisheries welfare economics—certainly none pertaining to the two largest IFQ fisheries in the United States, halibut and sablefish.

There is an additional reason why distributional issues are important to address for policy makers. What is often pejoratively referred to as "rent-seeking" behavior can actually enhance efficiency. Assessing policy alternatives according to their distributional or fairness impact can help promulgate an efficient policy (Milgrom and Roberts 1990). Thus, understanding the existence and magnitude of windfall gains and losses that may have accrued to different halibut and sablefish industry sectors could allow policy makers to avoid unintended distributive effects in future fishery rationalization policies. This, in turn, could enhance the likelihood that a political consensus can form around the adoption of future rationalization policies, whether based on transferable quotas or fishery cooperatives.

Research Objectives

The objective of this study is to examine the changes in economic welfare that occurred in the Alaska halibut and sablefish processing sectors following the introduction of IFQs. In particular, the study is conducted to determine if the IFQ policy design was win-win for both harvesters and processors. Like the transferable quota literature in general, this study assumes quota trading guarantees the harvesting sector becomes efficient and that distributional issues do not arise within the sector because all trades are fully compensated. It does not, however, begin with the supposition that these two facts are adequate welfare measures. The extent to which co-dependent processors were made better or worse off, both relatively and absolutely, is also an important welfare element. Accordingly, this research shall also investigate, to the extent possible, how the share of processing sector benefits differed in the two policy periods and whether the policy was Pareto safe.

Analysis of IFQ impacts on both halibut and sablefish processing sectors provides important policy juxtaposition. Homans and Wilen (2001) argue that the principal advantage of IFQs is the potential to change product forms to capture gains arising from the market side.

> While some capacity reduction generally takes place, and some inputs are reconfigured eventually, it is more often the case that revenues rise immediately in response to changes in fishing practices that deliver higher valued raw products to new market niches previously under-served under open access (Homans and Wilen 2001).

In the case of Alaska halibut, for example, IFQs enabled the industry to shift from a predominantly (83%) low-valued frozen product to a predominantly (59%) high-valued fresh product. There can be little doubt gains were made from both the market side and efficient fleet consolidation. Sablefish, in contrast, remained in the same frozen product forms before and after IFQs. Differential impacts on processors presumably would reflect the ability of the industry to take advantage of new market opportunities. The analysis should be able to confirm this expectation.

Casey *et al*. (1995) reported on how the British Columbia halibut industry restructured following introduction of individual vessel quotas (IVQs). While little emphasis was given to processor impacts, they did indicate impacts seemed relatively minor. The two exceptions concerned market domination by a single firm and entry by numerous, small processors. A by-product of this research is to evaluate the robustness of the Casey *et al*. conclusions.

Report Organization

The next section provides an overview of the analytical framework used in this study. Section 3 contains discussion of data used in the analysis. It is organized into sub-sections related to market share data and then, cost of production survey data. The analytical results are presented in Section 4, first with respect to halibut and then, sablefish. The summary and conclusions may be found in the final section.

2. ANALYTICAL FRAMEWORK

This section contains a brief overview of the analytical framework used to assess the economic welfare implications of IFQs on halibut and sablefish processors. Specific details concerning methods are explained in the context of the Data and Results sections.

The essence of policy design choice and evaluation of policy outcomes are conceptualized in Figure 2.1. This figure illustrates both the efficiency and distributional components of welfare economics that can arise from different rationalization policy designs. The vertical axis measures net benefits to harvesters as quasi rents (QR_H), i.e., revenues in excess of variable costs, while the horizontal axis measures net benefits to processors (QR_P). Let point A be the initial distribution of net benefits between the two sectors under a long-run, open access equilibrium. The downward sloped, 45-degree line passing through A, therefore, defines how the level of open access efficiency (joint benefit) is divided between harvesters and processors. Every point on the 45-degree line represents the same level of joint quasi rents and thus, the same level of overall efficiency. At point A, harvesters earn QR_H^A and processors earn QR_P^A. Any other point along that line indicates a different distribution of the same initial total welfare, $QR_H^A + QR_P^A$.[1]

An outward shift of the downward sloping 45-degree line represents the efficiency gain due to rationalization. If both sectors share in the rationalization benefits in the same relative proportions as under open access (QR_H^A/QR_P^A), then, efficiency gains would occur on the ray out of the origin through point A. Point B represents such an outcome, where $QR_H^A/QR_P^A = QR_H^B/QR_P^B$.

Two other aspects of this diagram are important to understanding the welfare implications of rationalization policy design. The vertical and horizontal lines emanating from point A define the Pareto safe boundaries for processors and harvesters, respectively. Along these boundaries, efficiency gains accrue only to one of the sectors without adversely impacting the other sector. Such Pareto safe boundary points are win-no-lose. For example, point C indicates all of the efficiency gains accrue to harvesters without changing the net benefits retained by processors. Point D reverses the policy beneficiaries; processors capture all efficiency gains from rationalization, while harvesters are left no worse off. The area north and east of the Pareto safe boundaries defines the win-win policy space, where the economic well being of both sectors is improved by the rationalization policy, i.e., both sectors benefit from rationalization. Conversely, any outcome in the crosshatched area leaves one or both sectors worse off. All points left of the vertical Pareto safe line leave processors absolutely worse off, earning lower net benefits than they did under open access. All points below the horizontal line leave harvesters worse off. All points below the initial 45-degree line are inefficient (lower joint quasi rents) and leave one or both sectors worse off.

[1] In welfare theoretic terms, this figure represents the monetized version of a utility possibility curve. It assumes that the industry is in long-run equilibrium, and the marginal utility of money is constant and identical for all agents (i.e., a dollar is a dollar to whomever it accrues). Thus, net income represents utility to both parties at a fixed point of output in production space.

Figure 2.1 focuses the policy design choice on "intent," i.e., whether policy makers intend to benefit one sector to the detriment of the other, or whether they intend to recognize the prior economic interests of both sectors by allowing both to benefit from the rationalization policy. A related design issue concerns political economy. If either sector has political veto power over detrimental policies (the crosshatched area), passage of a particular rationalization policy is at risk. Absent explicit intent to leave one sector worse off, it follows that the default policy designs lead to outcomes in the area, north and east of the Pareto safe boundaries—win-win fishery rationalization policy. Efficiency would be maximized, subject to other social objectives, and both sectors would participate in the benefits anywhere between points C and D. Only at point B would the relative share of joint policy benefits be distributed in precisely the proportion fishery benefits were shared under open access.

This conceptual framework guides the analysis of how the IFQ policy impacted halibut and sablefish processors. The change in economic welfare emanating from the switch to IFQs is measured as the change in quasi rents retained by processors, i.e., the change in revenues in excess of all variable processing costs. This welfare measure allows one to evaluate whether the policy was Pareto safe such that processors were left no worse off and possibly better off, or whether they were left worse off. A second aspect of economic welfare considered in this study is whether processors participated in post-IFQ benefits to the same relative degree they participated in the pre-IFQ fishery benefits. Both welfare measures can be decomposed into two parts: market share changes and unit quasi rent share changes relative to the pre-IFQ policy state. A firm that gained (lost) market share may have gained or lost absolute or relative economic well-being depending upon the degree to which it gained or lost unit quasi rent share.

Measuring market share changes is relatively easy because state and federal fishery regulations require all legal buyers of fish landed in Alaska to report annual buying, production, and price information. Measuring changes in the quasi rent share, however, requires knowledge of variable processing costs. There is no requirement to report such cost data. Nor is there any cost of production study or economic model to estimate variable processing costs across heterogeneous plants and firms and across two distinct policy periods. It follows that an analysis of changing economic welfare among processors must involve a cost of production survey, which then must be integrated with the market share data to determine whether processors were winners or losers from the policy. Details concerning both the market share data and the survey data are discussed in the following data section.

Market Share

Introduction of IFQs changed the structure and operating behavior of the halibut and sablefish processing sectors. Changes in market share distribution among firms provide preliminary but partial insight into the how the industry restructured. The market share analysis starts by categorizing processing firms according to the policy periods in which they operated (pre-IFQ versus post-IFQ) and their relative market shares before and after IFQs. This process yields three categories: surviving firms, exiting firms and new entrants. Surviving firms are those firms who operated in both pre- and post-IFQ periods. Exiting firms only operated prior to IFQs and new entrants started operations after IFQs. The category of surviving firms was further divided into surviving winners and surviving losers, depending upon whether market share increased or

decreased. Only new entrants are assuredly winners in the sense of being financially better off and only exiting firms are assuredly financial losers.

Quasi Rent Share

Whether and to what degree surviving market-share winners or losers participated in the economic benefits of IFQs required knowledge of how the wholesale prices or revenues were partitioned between raw fish cost, variable processing costs and residual unit quasi rents retained by processors. These data were obtained from an industry wide survey covering two-years prior to IFQs (1992 and 1993) and two-years following IFQs (1999 and 2000). Unlike the market share data, which reflect the entire processing industry, the survey data is a sample. Accordingly, it is assumed that the survey data is representative of the entire sector. This survey data was used to examine quasi rents per pound of fish as a share of the wholesale price. Reporting on a share basis helped normalize for unequal wholesale prices pre- and post-IFQ. It also provided a reference point to help judge the relative distribution of pre- and post-IFQ quasi rents.

The change in quasi rent share per pound indicates if processors gained or lost relative to the pre-IFQ per pound quasi rent share. This information is the economic analog to the market share information. It is informative with respect to whether processors participated in post-IFQ benefits **per pound** to the same degree they participated in the pre-IFQ fishery. Market share considerations potentially reverse or amplify any conclusions drawn solely from changes in unit quasi rent share. Measuring either absolute or relative well-being requires combining the change in **retained** market share with the per pound change in **retained** unit quasi rent share. The result of this product estimates the extent to which processors maintained their pre-IFQ share of composite or joint quasi rents. Pre- and post-IFQ total quasi rents were then examined to determine whether or not the policy was Pareto safe. If firms were able to increase or maintain their retained quasi rents after IFQs, then the policy could be considered as win-win or at the least, win-no lose.

All results are reported in nominal dollars, primarily to promote effective conveyance of information to the reader. In those circumstances where critical qualitative conclusions can differ due to using nominal instead of real prices, such as Pareto safety, results are also reported in real dollars. The Producer Price Index for all commodities (U.S. Department of Labor, Undated) is used to convert nominal to real dollars, in these circumstances.

Pre- and post-IFQ comparisons made on a percentage change or percentage share basis normalize any effects due to inflation/deflation. There are no analytical implications from using nominal prices providing total revenues did not shrink in either fishery following the introduction of IFQs. Unfortunately, while both fisheries experienced dramatic wholesale price increases following IFQs, total revenues shrank in the sablefish fishery.

Table 2.1 shows the 1992-2000 total halibut and sablefish pounds purchased in Alaska. Total purchased pounds of halibut increased modestly over this nine-year period, whereas sablefish landings plummeted 43%. Halibut purchases grew slightly from 41.4 million pounds in 1993 to 49.7 million pound in 2000, peaking at 53.7 million pounds in 1999. Sablefish landings in Alaska, on the other hand, experienced a steady decline from the 1992 high of 29.7 million

pounds to the 1999 low of 16.0 million pounds. The wholesale price increase for sablefish did not fully offset the supply loss. Total sablefish revenues decreased in spite of the introduction of IFQs, not because of the policy change. Accordingly, meaningful welfare implications require removing the supply effect on total revenue, so that the "before and after" analysis conforms to the "with and without" policy requirements of welfare economics.

Table 2.1 Alaska Purchased Pounds of Halibut and Sablefish, 1992-2000.

Year	Halibut Raw Pounds Purchased	Sablefish Raw Pounds Purchased
1992	45,697,356	29,680,307
1993	41,441,483	29,107,101
1994	34,912,177	24,071,117
1995	28,549,964	24,914,234
1996	31,829,507	20,917,727
1997	47,559,291	19,942,041
1998	48,081,875	18,399,386
1999	53,688,101	16,048,115
2000	49,667,031	18,510,795

The 1999-2000 sablefish purchases by survey firms were adjusted upward to reflect 1992-1993 statewide purchases. Firm-specific wholesale prices were adjusted downward to reflect 1992-1993 average levels. Since the post-IFQ price increase is presumed not to be policy induced, the unit quasi rent shares were held constant at the actual 1999-2000 levels. No supply adjustment was made for halibut because the small increase in supply was largely mitigated by an offsetting price effect.

This analysis assumed the two-year period, 1992-1993, represents an open access long-run equilibrium, consistent with the fisheries economic literature. As such, it is regarded as a reasonable proxy for both a "before" and "without" scenario in a before and after, with and without policy analysis.

3. DATA

COAR Data

Market share and firm size data were obtained from the Alaska Department of Fish and Game, Division of Commercial Fisheries, Commercial Operators Annual Report (COAR). The report contains plant-specific, confidential data regarding buying and processing activities of seafood processors/buyers operating in the State of Alaska. The buying information includes data about the location where a particular species was purchased, harvest gear used, form of raw product at the time of delivery, total pounds purchased, and price paid to the harvester. The production information includes data about where the fish was processed, finished processed product forms, total finished pounds and the value of the finished products. For the purposes of this study,

information relating to total pounds (raw and finished) and value (exvessel and finished) were examined. COAR data were also used as a partial check on the veracity of the survey data. See below.

Since COAR data is plant-specific, the data were aggregated across plants to provide firm-level data. While most plants were associated with a specific firm, this was not always the case. Plant-firm adjustments were based on first-hand knowledge of the industry gained through this study, and may be incomplete. These adjustments were essential because COAR plant identification codes and firm names were not always consistent across time. For example, a plant that existed in 1992 and 1993 may seem to disappear by 1999, when in fact, only the identifying code was changed to that of the parent company code. Because of this, COAR contains imperfect and sometimes inconsistent plant-firm identifiers. Corrections were made for those firms known to be part of larger parent companies so as to avoid overstating both the number of exiting firms and the number of firms that grew in size.

Market share and size distribution data fail to reflect changes in the processor functions following IFQs, especially in halibut, which is now sold primarily as a fresh product. The COAR data reflect in-state raw fish purchases, as reported on Alaska Fish Tickets at the time of landing. It includes all fish legally landed in Alaska and thus, primary buying/processing, but not necessarily processing through the first point of wholesale. This fact was of minor consequence prior to IFQs because the large capital investment required to process a mostly frozen product was a natural barrier to entry. Most primary buyers/processors of halibut or sablefish also provided all marketing functions through the first point of wholesale prior to IFQs. However, IFQs stimulated the conversion of halibut from a mostly (83%) frozen to mostly (59%) fresh product. Product conversion provided an opportunity for new entrants because of the much smaller capital investment requirements of moving fresh product through the marketing chain to the first point of wholesale. Some new entrants are not included in the COAR data set. These omitted firms are broker/reprocessors who are not the primary processor-of-record that initially receive the fish.

Broker/reprocessors utilize primary processing firms that operate as custom processors.[2] Many negotiate exvessel price directly with vessel owners, including the use of auction services, and arrange for vessels to deliver to particular primary processors, who are represented in the COAR data. The primary buyer/processor-of-record is paid a custom processing fee (sometimes referred to as a tariff) for purchasing and offloading the fish and/or providing an auction service, icing/packing fresh fish in fiber totes for shipping, or freezing the fish before shipping.[3]

All quasi-rents reported in this study are measured through the first point of wholesale. Custom processing is one component of the total revenues and variable costs.

COAR data were used to identify firms that participated in the pre- and post-IFQ periods. This information was then compiled into three categories: firms that participated only in the pre-IFQ

[2] COAR data show the amount of fish purchased. It does not identify whether the purchased fish was for "own" use or if it was "custom processed" for someone else.

[3] There is very little or no custom processing preformed for sablefish, which has not changed product form as a consequence of IFQs.

period (exiters), firms that participated in both periods (survivors), and firms that participated only in the post-IFQ period (new entrants).

Survey Data

Initially, very little was known about industry structure or conduct. A focus group consisting of several industry participants was formed. The purpose of this focus group was three-fold. It provided an essential overview of industry structure; it helped refine initial survey designs into a minimal data request that served the analytical needs of this study without being unnecessarily burdensome for industry; and it was used to introduce all potential participants to the study.

A total of 53 halibut buyers/processors-of-record and 46 sablefish buyers/processors-of-record were asked to participate in the survey. These firms collectively accounted for 88% to 96% of all fish purchased during the four years, 1992-1993 and 1999-2000.[4] Additionally, broker/reprocessor new entrants who were not buyers/processors-of-record were asked to participate.

Survey Design

The revenue and cost of production survey asked respondents to structure their data hierarchically. They were asked to first distinguish between fish purchased/processed for their own marketing activity and fish custom processed for another firm. Within these two categories, participants were asked to segregate data according to fresh and frozen product forms. Ultimately this product distinction was dropped from subsequent analysis because several firms were unable to accurately separate costs and revenues for fresh and frozen products. Firms were then asked to provide confidential information pertaining to total raw pounds, total revenue, raw fish cost, raw fish tax, and variable processing costs. An outline of the requested data and supplementary definitions for each category were included in the information packet provided to each firm. Data concerning total raw pounds purchased, total revenue and raw fish cost were included for purposes of verifying survey data against COAR data.

Detailed definitions for the variable cost category were provided to assure uniformity across participants because this information was not available from any other source. The variable cost category identified only direct costs of production, overhead, plant costs and salaries were to be excluded. Variable costs included: custom processing fees paid (if any), direct processing labor, other costs related to direct labor, direct housing expenses and food, packaging, freight south, and cold storage fees.

The Appendix contains a copy of a sample packet sent to potential participants. The packet consists of three items: a cover letter, a copy of the ADF&G Work Statement, and the formal data request. In addition to the packet, most, participants were contacted by phone to discuss their participation and to clarify any aspect of the survey request or the overall project. Data confidentiality was assured.

[4] Most processing firms invited to participate purchased in excess of 100,000 lb of fish per year prior to the introduction of IFQs.

Data Collection Problems

Data collection problems fell into two basic categories, both of which required participating firms to be excluded. The first problem involved data aggregation and the second concerned firms' inability to access historical financial records. Data aggregation problems arose whenever a firm was unable to accurately attribute costs of production to halibut or sablefish. For example, it was not uncommon for internal firm accounting practices to lump all fish species and/or product forms together (including non-target species like salmon, herring, etc.), such that species-specific disaggregation was not possible. This issue is easily illustrated in the context of transportation costs. Fish are transported from Alaska using one of three modes: trucking, ocean shipping or airfreight. Some firms recorded all transportation costs in a single aggregate category, without accounting for the pounds or percentage of halibut or sablefish (or other species) transported by each mode. Such accounting practices prevented isolating total transportation costs for halibut and for sablefish, and thus, prevented accurately measuring variable processing costs.

Inability to access historical data was a barrier for some firms. In some cases, firms updated their accounting system without converting old electronic data files into the new format. Other cases involved irretrievable physical records placed into a long-term storage facility.

Authentication and Verification

Authentication of the survey data and verification of its accuracy was a high priority because data had been requested for up to 10-year-old financial data and because there existed a possibility for individual firms to strategically misrepresent financial facts surrounding the switch to IFQs.

There were three basic approaches to data authentication and verification. The first method of verification involved comparing pounds and values reported in the survey with the COAR data. Few discrepancies were found, but these precipitated discussions with ADF&G and the particular firms to reconcile or eliminate the deviant survey data. In one case, an error in the COAR data set was discovered. The only other problematic discrepancies arose because of an inconsistency in the way inventories were handled.

COAR does not collect specific information related to inventories. Instead, the COAR inventory protocol assumes all year-of-landing production is sold in the same year. If a firm holds inventory into the next year, COAR reports finished product values based on an average year-of-landing sales price applied to the entire year-of-landing production. This inventory protocol deviates from source documents used to compile the survey data. Historic internal company financial reports, general ledgers, sales/production summaries and/or invoices that had been used to compile the survey data typically reported actual costs, revenues and even pounds in the year of their occurrence. These differences became a source of inconsistency between COAR and some surveys.

Ultimately, inventory carry-forward was not a significant problem. Most participating firms—even those with inventory carry-forward—reported all pounds purchased, sold and associated

actual production costs and revenues in the year of acquisition, i.e., similar to the methods described above for COAR, except all monetary values reported in the survey were actual. Differences in revenues were small and easily explained. Survey data containing inventories that were reported on a year-of-sales basis, however, were more problematic. Fortunately, the few instances where participants followed this inventory protocol represented less than 0.5% of the total fish accounted for in the survey. Accordingly, no adjustment was made to their data.

The second method of verification involved checking for outliers. One would not expect to find large differences in costs or quasi-rents across the industry. Firms identified as outliers in one or more years (usually by exhibiting higher than average quasi rents) were contacted and asked to explain/clarify their data. Unexplained deviance resulted in either eliminating the firm from the analysis or on occasion, substituting a particular data element with the corresponding survey average.

The third and final step in authentication and verification involved comparing source documents with the reported data. This verification audit was done for most of the participating firms that provided summary reports. Some of the survey data were compiled in person from original, historic source documents (i.e., original invoices, sales/production summaries, and general ledgers). Data that were provided in summary form were authenticated and verified as accurate by an *ex post* audit of historic internal accounting documents and financial reports, including audited reports. Verification coverage totaled between 78% and 93% of the retained survey data (measured in pounds of fish) across the four years, 1992-1993 and 1999-2000. In the few instances that internal financial documents were not made available to authenticate/verify the summary data, ordinarily with small firms that did not have staff time to divert from daily business activities, verification relied on outlier examination.

Missing Data

Perhaps the greatest weakness in the survey concerns the linkages between custom processors and broker/reprocessors. Some data at both levels did not have corresponding information for the initial stage (custom processor) or the following stage (broker/reprocessor). Two pieces of information were constructed to fill these data gaps based on the assumption that all halibut was being delivered into a relatively similar market and that the processing costs incurred at each stage were similar across firms.

When primary custom processing information was absent for brokered/reprocessed fish, an average of the custom processing tariff and the variable custom processing costs were estimated from the available survey data. When survey data were available from the primary custom processor but not from the downstream broker/reprocessor, a similar procedure was followed. Survey data were used to calculate an average finished product sales price. The known custom processing fee was treated as part of the variable costs incurred by the broker/reprocessor. An additional $0.15/lb was added to the average custom processing fee to account for transportation costs. COAR information was then used to provide an average raw fish cost whenever the broker/reprocessor purchased the fish directly from the harvesters **and** the custom processor failed to report raw fish costs in its survey response.

This approach to approximating absent upstream or downstream costs should have no qualitative impact on the study's findings. Most of the custom processed fish entered the fresh market; variable processing costs for fresh fish are a very small fraction of the wholesale price.

There was one additional case of missing data. One traditional processing firm was unable to provide 10-year-old exvessel price information. The COAR buying data specific to that firm was used to replace the missing exvessel price and total raw fish cost data for this firm.

Coverage

Retained survey data accounts for 52% and 61% of landed halibut in the pre- and post-IFQ periods, respectively. Survey coverage of landed sablefish averaged 54% and 59% during the same periods. All participating firms were either surviving or new entrant firms. No exiting firms were able to participate because of the lack of retained financial data regarding their ceased operations.

4. RESULTS

IFQs had two prominent effects on the processing sector. The policy contributed to market share changes among firms and to changes in retained revenues in excess of variable costs. The combination of these two changes yields the total economic change, which allows one to evaluate welfare gains or losses among processors following introduction of IFQs. Attention is focused on halibut processing first, followed by sablefish processing. The elements of welfare change are discussed for both species, beginning with changes in market share. Changes in quasi rent share are discussed next. Insights into composite welfare effects end each species-specific section.

Halibut

Market Share

Changes in market share before and after IFQs provide preliminary insight into the impact IFQs had on primary halibut processors/buyers.[5] Firms that increased their share of purchased fish are designated market share winners; firms that lost market share are labeled market-share losers. Plant-specific data regarding the amount of fish purchased each year were obtained from the ADF&G Commercial Operators Annual Report (COAR).

Figure 4.1 shows the size and market share distribution of firms that purchased halibut in the 1992-1993 base period. A total of 104 firms purchased halibut in the 1992-1993 period.

Twelve of these firms were large (≥1M lbs. per year) and accounted for more than 71% of the fish purchased in Alaska. The remaining 92 smaller firms (<1M lbs. per year) accounted for 29% of the halibut. The post IFQ period (1999-2000), shown in Figure 4.2, reveals a somewhat more

[5] The focus on primary processing/buying in this section is done for a variety of reasons. Perhaps the most important reason is that this focus facilitates more meaningful insight into the consequences of IFQs relative to the benchmark years.

concentrated industry but with similar size and market share distribution. The total number of firms decreased from 104 to 83. Four additional firms (16 in total) were large in size, representing 78% of the 1999-2000 fish. The number of smaller firms decreased by a third--from 92 firms in the pre-IFQ period to 67 firms in the post-IFQ period. The smaller firms in 1999-2000 represented a total of 22% of the 1999-2000 halibut.

This simplistic comparison of firm number/size/market share distribution misrepresents how the sector restructured. Like the findings of Casey *et al*. (1995), it seems to suggest there was a relatively minor impact from IFQs on the processing sector. However, simply comparing the firm number/size/market share distribution in the pre- and post-IFQ periods fails to reveal how few firms actually survived and how the industry restructured. A better way of demonstrating how the processing sector restructured following IFQs is to portray the 1992-1993 firms as "surviving" or as "exiting" by 1999-2000. Figures 4.3 and 4.4 capture a more complete portrayal of what happened to firms that purchased halibut during the pre-IFQ period. Less than one-third of the 104, 1992-1993 firms operated in both the pre- and post-policy periods. Those 31 surviving firms represented 80% of the 1992-1993 fish. Nine of the surviving firms were large, accounting for 63% of the 1992-1993 fish; 22 survivors were small, accounting for 17% market share. As a whole, the survivors saw a reduction in their aggregate market share from 80% in 1992-1993, to 65% in 1999-2000. The remaining 73 firms exited the industry and did not operate in 1999-2000. Those that exited represented 20% of the total fish in 1992-1993.[6]

This more through comparison still lacks the detail required to accurately portray market share changes because it fails to describe the changes that occurred among the surviving firms. Some firms increased their share of the market (the surviving market-share winners), while others lost market share (the surviving market-share losers). Moreover, some firms dropped from the large to small size category, while others moved up a size category. Figure 4.5 shows the distribution of 31 surviving firms by size category and associated market share in both 1992-1993 and 1999-2000. Only half (15) of the 31 firms that were survivors in the post-IFQ period can be considered winners in the sense of increased market share.[7] These 15-surviving winners doubled their aggregate market share from 18% to 37%. In reality, however, market share gains were concentrated in only half of these 15 surviving winners--seven firms captured 90% of the market share gain. The 16-surviving losers lost more than half their aggregate market share (down from 62% in 1992-1993 to 28% in 1999-2000). Half of the surviving losers incurred 91% of the aggregate market share loss, while 11 of the 16 surviving losers lost more than half of their pre-IFQ market share.

To this point, the analysis has focused on market share changes among processors and buyers that comprised the pre-IFQ industry. It is instructive to also view the industry from the post-IFQ perspective, as in Figure 4.6. While 72% of the pre-IFQ industry exited, mostly small firms, the policy also provided entry opportunities. There were 51 new entrants (additional winners) that operated in 1999-2000 but not in 1992-1993. These new entrants comprise nearly two-thirds of the total number of post-IFQ halibut processors/buyers. Four of these new entrants are large firms, while 47 are small. It is striking to note that these four, large new entrants captured nearly

[6] Confidentiality restrictions prevent detailing the exiting firms by large and small size categories.
[7] Confidentiality restrictions prevent detailing the surviving winners by large and small size categories.

one-quarter (22%) of the entire post-IFQ market. The 47 smaller new entrants represented 12% of the 1999-2000 fish.

This portrayal of how the primary processing/buying sector restructured with the introduction of IFQs is punctuated by a fact that is not apparent in the COAR data. The COAR data only capture information at the exvessel or raw fish buying level. It does not reflect the structural change under which many of the surviving firms and new entrants may now operate. That structural change was a movement away from traditional processing towards custom processing. Insight into this structural change will be discussed later along with the cost of production and revenue survey results.

Quasi Rent Share

Changes in market share provide, at best, a partial glimpse of potential economic impacts IFQs had on the processing sector. A more comprehensive understanding of how IFQs contributed to a change in sector well-being is developed in this section by examining financial implications derived from the survey data. The basic element of this analysis involves measuring the returns to fixed factors, i.e., quasi rent or gross operating margin. This concept is nothing more than measuring revenues in excess of all variable processing costs, including both raw fish costs and non-fish variable costs.

Two approaches were used to report the financial information obtained from survey data because wholesale price increased more than 62% following the introduction of IFQs. This price change manifests a variety of factors, including a shift in the product mix toward higher value fresh products, probably a shift in demand, and also a supply shift due to an increase in the total allowable catch (TAC). It follows that the dollar change in unit quasi rent per pound (UQR) provides a potentially misleading depiction of financial impacts that IFQs had on the processing sector.[8] A more complete measure of impact that better reflects the wholesale price change requires normalizing UQR by the wholesale price. That is, UQR may be expressed as a share of the wholesale price, hereafter referred to as unit quasi rent share (UQRS). One aspect of a firm's change in economic welfare, then, can be measured by combining the UQRS changes with the market share changes from the COAR data. This combination allows one to investigate the combined (net) effects of market share and unit quasi rent share changes.

Discussion of the halibut survey results is separated into two sections. Initially, "traditional" processing, i.e., processing functions from initial purchase through first point of wholesale, is discussed. This type of firm comprised virtually all of the pre-IFQ buyers/processors. "Custom" processing is subsequently discussed.

[8] Recall that no supply adjustment was made for halibut because the small increase in supply was largely mitigated by an offsetting price effect.

Traditional Processing

The 1992-1993 survey data accounts for 52% of total halibut pounds purchased. None of the pre–IFQ survey data represents exiting firms or custom processing.[9] The 1999-2000 survey data, in contrast, accounts for 61% of total halibut pounds purchased. Traditional processing represents somewhat more of the 1999-2000 survey pounds than custom processing. The average wholesale price for halibut moving through traditional processing increased from $1.82/lb in 1992-1993 to $2.96/lb in 1999-2000--an increase of 62.6% from the pre-IFQ period.

Figure 4.7 shows how the 1992-1993 average wholesale price of $1.82/lb was distributed between raw fish cost (exvessel price), variable processing costs and the retained UQRS. The average exvessel price of $1.12/lb was 61.4% of the wholesale price, variable processing costs accounted for 19.0%, and the retained UQRS was 19.6% ($0.36/lb).

Figure 4.8 shows the allocation of raw fish cost, variable processing costs and UQR as a share of the $2.96/lb average wholesale price in 1999-2000. Exvessel price more than doubled to $2.29/lb, allowing harvesters to capture 77.4% of the higher wholesale price. In other words, harvesters realized a 26.1% share increase relative to 1992-1993. This $1.17/lb exvessel price increase captured more than the entire $1.14/lb increase in the wholesale price. Variable processing costs as a share of wholesale price dropped from 19.0% to 13.7%, despite a $0.06 per pound rise in processing cost.[10] Traditional processors retained $.26/lb, for an average UQRS of 8.9%. This post-IFQ decline in UQRS means that surviving traditional processors lost more than half (54.6%) of their pre-IFQ UQRS (19.6% to 8.9%). This loss of share came about despite the fact that variable processing costs, as a percentage of wholesale price, also declined. It follows that losses in UQRS are attributable solely to a redistribution of wealth from processors to harvesters in the form of exvessel price concessions. The 26.1% overall share increase captured by harvesters represents a policy-induced redistribution from traditional processors to the fleet.

Custom Processing

IFQs spawned custom processing in the halibut industry, which led to an even more striking distributional change than occurred with traditional processing. The introduction of IFQs enabled new entrants with little capital to purchase, process and market fish, primarily in a fresh product form. But IFQs also converted many traditional firms to custom processors of both fresh and frozen halibut.

Custom processing involves two distinct stages in the marketing chain. Both stages are included in this analysis. The first stage involves primary (custom) processors, where the initial processing/handling occurs. The second stage involves broker/reprocessors that facilitate the movement of product through the remainder of the marketing chain to the first point of wholesale. The broker/reprocessor coordinates primary processing, transportation, reprocessing (if any), storage, and marketing activities. Custom processors usually post a flat fee or tariff per pound for their services.

[9] Firms that exited following IFQs no longer exist or did not retain data from ceased halibut operations. Custom processing was uncommon prior to IFQs.
[10] Post-IFQ variable processing costs rose 17.1%, from $.35/lb to $.41/lb.

Some of the participating firms behaved only as custom processors, others acted as custom processors on a subset of their fish and as traditional processors on the remainder. Custom processors realized a UQRS of 29% of their tariff. This return to capital would be attractive for a new entrant with little investment capital but it is problematic for surviving firms that were traditional processors prior to IFQs; the custom UQR is a fraction of the traditional UQR. Unless the decrease in UQR retained by custom processors was offset by an adequate gain in market share, these surviving firms were left financially worse off.

Figure 4.9 shows the allocation of variable costs and UQR as shares of the 1999-2000 average wholesale price for custom processed fish ($3.07/lb).[11] This figure reflects the sum of both stages included in custom processing, i.e., from initial purchase through first point of wholesale. Harvesters captured 72.9% ($2.29/lb) of the wholesale price or 90% of the wholesale price increase. Variable processing costs, including both primary processing and all subsequent variable costs incurred by brokers/reprocessors averaged 17.2% of the wholesale price. The composite UQRS totaled 9.9%, slightly more than that of traditional processors. New entrants that custom processed, either as primary processors or as broker/reprocessors gained quasi rents. The weighted average retained UQRS for all surviving processors, i.e., excluding new entrants, was 34.1% of their pre-IFQ share.[12]

Combined Market Share and Unit Quasi Rent Share Changes

The analytical results discussed above, first addressed changes in market share and then, changes in unit quasi rent share. These two components are now combined to measure the composite distributional impact of IFQs on the halibut processing sector. Initially, the actual quasi rents earned in 1999-2000 by the pre-IFQ processing sector are measured relative to the proportion of composite quasi rents retained by those same processors prior to IFQs.

$$\text{Retained QRS} = (1+\Delta MS) * (1+\Delta UQRS),$$

where $(1+\Delta MS)$ and $(1+\Delta UQRS)$ are the post-IFQ retained market share and retained unit quasi rent share, respectively. Retained QRS = 100% implies processors retain the same **share** of composite quasi rents after IFQs as they did before. That is, QRS = 100% is analogous to point B on Figure 2.1. Deviations from 100%, measured along the 45-degree line, indicate the degree to which processors gained or lost relative to their pre-IFQ **share** of joint benefits, i.e., relative to point B where both processors and harvesters maintain a constant share of total revenues before and after the policy change. Next, the Pareto safety properties of the IFQ policy are evaluated. The notion of surviving winners and losers, which previously referred only to market share, is expanded to differentiate between surviving market-share winners and losers and surviving financial winners and losers.

[11] The $0.11/lb greater wholesale price for custom processed fish is due primarily to a greater portion of the halibut entering the fresh market. Location considerations dominate market allocation choices of firms.

[12] The weighted average was calculated as the retained percentage of pre-IFQ unit quasi rent share for traditional processors times the corresponding percent of the 1999-2000 survey pounds, plus the retained percentage of pre-IFQ unit quasi rent share for custom processors times the corresponding percent of the 1999-2000 survey pounds.

Table 4.1 summarizes the composite changes impacting surviving firms, firms that exited and to a lesser extent, new entrants. First, the retained total QRS for surviving firms was calculated by applying the 34.1% weighted average retained UQRS to the retained market shares for surviving market-share winners, losers and all surviving firms. The average retained QRS of 27.8% was calculated for all 31-surviving firms, yielding an average total quasi rent share loss of 72.2% (1-27.8%). Additionally, the 73 firms that exited lost 100% of their pre-IFQ earnings on a 19.8% market share loss. By incorporating the losses incurred by the surviving and exiting firms, the pre-IFQ halibut processing sector, as a whole, lost an average estimated 77.7% of their pre-IFQ **share** of joint benefits. Fifty-one new entrants captured 34.4% of the post-IFQ fish. These firms, by definition, were financial winners.

The prior focus on changes in market share and UQRS raises the question whether surviving firms were left financially worse off, in absolute dollars, i.e., whether they earned less total quasi rents after IFQs? This is an important policy question because it focuses on the notion of Pareto safety, which is essential for a policy to be win-win or at least win-no-lose for both sectors.

While the pre-IFQ processing sector lost market share and also incurred a UQRS loss relative to the open access policy state, both statewide halibut purchases and wholesale price rose sufficiently to nearly double gross revenues (up 96%). Surviving processors may have retained an equal or greater amount of total revenues in excess of total variable processing costs (QR_P). Such firms would be no worse off, if not better off, despite the fact they did not participate in the post-IFQ fishery benefits to the extent they did under the license limited, open access policy. Exiting firms, of course, were unequivocal financial losers. The purpose of this section is to assess whether the processing sector, as a whole, was left financially worse off (left of point C on the 45-degree line in Figure 2.1), no worse off (at point C) or better off (between points C and D, where both sectors are better off). Point B serves only as a reference to the pre-IFQ share of joint benefits.

The final column of Table 4.1 indicates some of the 15-surviving winners identified by COAR data, in fact, were financial winners in the sense of earning more total quasi rents after the IFQ policy. A subset of the surviving market-share winners that participated in the survey gained sufficient market share of a greater quantity to offset UQRS losses on a greater wholesale price, or they gained both market share and UQRS. These firms were financial winners in the sense of being left better off in both nominal and real dollars. Other surviving market-share winners that participated in the survey were made financially worse off, because UQRS dropped more than market share increased. These surviving market-share winners were, in fact, financial losers that experienced a drop in total quasi rents between the pre- and post-IFQ periods. All surviving market-share losers that participated in the survey were financial losers. Market share losses were accentuated by UQRS losses such that total retained earnings dropped in every case. Likewise, exiting firms were financial losers because they lost all retained earnings. The COAR

Table 4.1 Retained Quasi Rent Shares (QRS) and Relative Market Shares for 1992-1993 and 1999-2000 Halibut Processing Firms[a]

Firm Categories	No. Firms	(a) 1992-1993 Market Share (%)	(b) 1999-00 Market Share (%)	(c) Retained Market Share	(d) Retained QRS	(e) Total QRS Percentage Gain or Loss	Pareto Safe?
Surviving Winners	15	18.0%	37.2%	206.1%	70.2%	-29.8%	Yes/No
Surviving Losers	16	62.2%	28.2%	45.7%	15.6%	-84.4%	No
1992-1993 Total Surviving Firms	31	80.2%	65.4%	81.5%	27.8%	72.2%	Yes/No
Exiters	73	19.8%	0.0%	0.0%	0.0%	-100.0%	No
Sector-Wide Gain/Loss	n/a	100%	65.4%	65.4%	22.3%	-77.7%	Yes/No
New Entrants	51	n/a	34.4%	n/a	n/a	100.0% [b]	n/a

[a] Columns c, d and e are defined as follows:
c=b/a
d=c*0.341, where the weighted average Retained UQRS = 0.341
e=d-1

[b] The 51-new entrants gained 100%, by definition.

data indicate that surviving market-share losers accounted for almost two thirds of the pre-IFQ fish and exiting firms accounted for the remaining 18%**.** Thus, financial losers following the IFQ policy comprised **more** than 82% of the industry (raw fish weight).[13] Surviving and exiting processors, as a group, lost 56.1% of their pre-IFQ quasi rents. That is, the typical processor retained slightly more than 40% of its pre-IFQ net benefits. Referring to Figure 2.1, the pre-IFQ processing sector was left 56.1% to the left of point C.

The IFQ policy was not win-win. It did not allow the processing sector to participate in the policy benefits. Nor was the policy Pareto safe; most processors were left worse off in both nominal and real dollars relative to historic levels.

Sablefish

Market Share

IFQs allowed halibut to change product form from a primarily frozen to a primarily fresh product. IFQs were no such stimulus in the sablefish markets. Instead, sablefish remains a frozen product destined primarily for Asian markets. Nevertheless, changes in market share and size distribution of primary processors were very similar to what occurred in the halibut industry. Market share data for sablefish were also obtained from the ADF&G, Commercial Operators Annual Report (COAR).

Figure 4.10 shows the size and market share distribution of firms that purchased sablefish in the 1992-1993 pre-IFQ period. The total number of firms was significantly less than in the halibut industry. There were a total of 67 firms purchasing sablefish in 1992-1993, but the division between large and small firms is similar to that of halibut. Nine (13%) of these firms were large ($\geq$1 million lb per year), accounting for 68% of the fish purchased. The remaining 58 smaller sablefish processors (<1 million lb per year) purchased 32% of the sablefish. This firm size/market share distribution was almost identical to that found in the halibut industry, though there were fewer sablefish processors. (Recall that 12% of the 104 halibut firms were large, accounting for 71% of the total fish purchased).

The post-IFQ period, shown in Figure 4.11, reveals a somewhat more concentrated, but similarly structured industry relative to the pre-IFQ period. The total number of firms decreased 25% from 67 to 50. However, the aggregate market shares held by large and small firms were unchanged. Three fewer firms, six in total, were large in size, representing 68% of the 1999-2000 fish. The number of smaller firms decreased from 58 to 44. This pre-and post-IFQ comparison is similar to what occurred in the halibut processing sector; the amount of sablefish processed by the pre-IFQ firms decreased by 25%, compared to the 20% reduction in halibut.

Just as the simplistic comparison of firm size/market share distribution misrepresented how the halibut industry restructured, it too misrepresents what occurred with sablefish processing. What appears to be a relatively minor impact on the processing sector, in fact, was a dramatic restructuring. Figures 4.12, 4.13 and 4.14 capture a more complete portrayal of what happened

[13] A reliable estimate of market-share winners that were financial losers is not possible from the survey data.

to firms that purchased sablefish during the 1992-1993 fisheries. Only 25 (37%) of the 67 pre-IFQ firms survived the policy change, and most of those firms lost market share.

Figures 4.12 and 4.13 reveal that the 25-surviving firms represent 78% of the 1992-1993 fish. Eight of these survivors were large, accounting for 64% of the 1992-1993 fish; 17 survivors were small, accounting for 14% of the fish. Nearly two-thirds of the pre-IFQ processors (42 firms) exited the industry. These exiting firms accounted for 22% of the 1992-1993 fish. Surviving firms, in aggregate, gained an additional 10% share of the market following IFQs. This market share gain differs from what occurred in halibut, where the surviving halibut processors lost 14% of the pre-IFQ market share.

Figure 4.14 illustrates how surviving firms restructured. Four firms dropped from the large to small size category; two moved up a size category. Of the 25 surviving firms, less than half (11 firms) can be considered "winners" in the sense of increased market share. These 11 surviving winners nearly doubled their aggregate market share from 33% in 1992-1993 to 64% in 1999-2000. In fact, only five of these 11 surviving winners captured most of this market share increase (27% of the 31% aggregate market share gain). The 14 surviving losers, in contrast, lost almost half their market share (down from 45% to 24%). Half (7) of those surviving losers accounted for virtually all of the loss in aggregate market share (20% of the total 21% market share loss). These structural changes among surviving winners and losers in the sablefish industry closely parallel the experiences of halibut processors.

Figure 4.15 offers a glance at the post-IFQ industry. While two thirds of the pre-IFQ processors exited, the policy also provided entry opportunities; 25 new entrants operated in 1999-2000. These new entrants—all small firms—comprised half of the total number of post-IFQ primary processors/buyers but represented 12% of the sablefish. It is instructive to contrast the relative importance of new entrants in sablefish as opposed to halibut. Halibut new entrants comprised a greater portion of the post-IFQ processors/buyers (60% versus half for sablefish). New entrants into halibut processing/buying also represent a greater share of the post-IFQ market vis-à-vis sablefish (34% versus 12%). Additionally, broker/reprocessors became an important source of new entry in halibut processing that did not occur with sablefish. These structural differences are due, in part, to the shift from largely frozen to largely fresh halibut; entry into a largely fresh market is easier because it requires a much smaller capital investment.[14]

Quasi Rent Share

A strikingly similar economic picture to that of halibut characterizes pre- and post-IFQ sablefish processing, despite the fact that sablefish did not change product form. The 1992-1993 survey data represented 54% of the total purchased sablefish in the pre-IFQ period. The 1999-2000 survey data accounted for 59% of the fish. All survey firms were traditional processors of sablefish pre- and post-IFQ. There was no custom processing, primarily because the product form did not change. Like halibut, sablefish also experienced an increase in the average wholesale price after IFQs. The average price increased 46.1%, from $2.84/lb in the pre-IFQ

[14] The 43% drop in the sablefish total allowable catch may partially explain why there were so few new entrants into sablefish processing.

period to $4.15/lb after IFQs. However, this sharp rise in price appears to be supply driven; TAC dropped from 29.7 to 16.0 million pounds.

Figure 4.16 shows how the pre-IFQ wholesale price of $2.84/lb was allocated between exvessel price, variable processing costs and UQRS. The average exvessel price was $1.81/lb, or 63.5% of the wholesale price. Variable processing costs were $0.34/lb (12.3%) of the wholesale price. The UQR captured the remaining 24.2% share ($0.69/lb).

Figure 4.17 shows the allocation of the 1999-2000 wholesale price between exvessel price, variable processing costs and UQR. Harvesters captured 85.0% share of the $4.15 wholesale price ($3.52/lb), a gain of 33.9% over their pre-IFQ share. This share increase translates into a $1.72/lb increase above the 1992/93 exvessel price of $1.82/lb—a 95% increase in the exvessel price. Sablefish processors, in contrast, lost nearly three-quarters of their pre-IFQ UQRS (down from 24.2% to 6.9% following IFQs). Variable per-pound processing costs remained stable at $0.34/lb, but the increase in wholesale price caused the variable processing cost share to decrease to 8.1%. The remaining 6.9% ($0.29/lb) was retained processing UQRS. The stable variable processing costs and the near doubling of exvessel price imply that the decrease in UQRS experienced by the processors was attributable to a policy-induced redistribution from the processing sector to the fleet.

Combined Market Share and Unit Quasi Rent Share Changes

The combined effect of market share changes and UQRS changes are now investigated following the same approach used for halibut. Initially, the actual quasi rents earned in 1999-2000 by the pre-IFQ processing sector are measured relative to the proportion of composite quasi rents retained by those same processors prior to IFQs. Then, Pareto safety is investigated.

Table 4.2 summarizes the composite changes impacting surviving firms, firms that exited and to a lesser extent, new entrants. First, the retained QRS for surviving winners and losers was calculated by multiplying the 28.5% retained UQRS times the retained market shares for surviving market-share winners, losers and all surviving firms. Next, an average retained QRS of 32.1% was calculated for all 25-surviving firms. Thus, surviving firms lost, on average, 67.9% (1-32.1%) of their pre-IFQ total quasi rent share.[15] Interestingly, this loss is nearly the same as that which occurred with surviving halibut processors (72.2% loss). Additionally, the 42 firms that exited lost 100% of their pre-IFQ earnings.

Surviving and exiting firms, together, yield a sector-wide loss estimate. The sablefish-processing sector, as a whole, lost an estimated 75.0% of its pre-IFQ share of joint benefits. Twenty-five new entrants captured 12.4% of the post-IFQ fish. These firms, by definition, were financial winners.

[15] The 11-surviving market-share winners identified by COAR lost an estimated 44.5%of their pre-IFQ QRS, while the 14-surviving market-share losers lost 85.0%.

Table 4.2 Retained Quasi Rent Shares (QRS) and Relative Market Shares for 1992-1992 and 1999-2000 Sablefish Processing Firms[a]

Firm Categories	No. Firms	(a) 1992-1993 Market Share (%)	(b) 1999-00 Market Share (%)	(c) Retained Market Share	(d) Retained QRS	(e) Total QRS Percentage Gain or Loss	Pareto Safe?
Surviving Winners	11	32.8%	63.9%	194.8%	55.5%	-44.5%	Yes/No
Surviving Losers	14	44.9%	23.7%	52.8%	15.0%	-85.0%	N
1992-1993 Total Surviving Firms	25	77.7%	87.6%	112.7%	32.1%	67.9%	Yes/No
Exiters	42	22.3%	0.0%	0.0%	0.0%	-100.0%	N
Sector-wide Gain/Loss	n/a	100%	87.6%	87.6%	25.0%	-75.0%	Yes/No
New Entrants	25	n/a	12.4%	n/a	n/a	100.0% [b]	n/a

[a] Columns c, d and e are defined as follows:
c=b/a
d=c*0.285, where Retained UQRS = 0.285
e=d-1.

[b] The 25-new entrants gained 100%, by definition.

An examination of Pareto safety requires adjusting for the drop in industry-wide revenue, which arguably is due to failing fish stocks and not the IFQ policy. The adjustment is done so as to have no impact on the actual 1999-2000 unit quasi rent shares, which are presumed to be a consequence of the policy change.

Since sablefish did not change product form after the introduction of IFQs, it is assumed the 46% increase in wholesale price ($2.84/lb to $4.15/lb) is due solely to the lower TAC.[16] Industry-wide total revenue was adjusted back to the 1992-1993 average level. The 1999-2000 sablefish purchases reported by survey firms were adjusted upward by 70.1% (to the 1992-1993 level) to mitigate the 41.2% reduction in statewide purchases. Firm-specific wholesale prices were adjusted downward to the 1992-1993 levels, i.e., the adjustment factor ($2.84/$4.15) was multiplied times the firm-specific wholesale prices reported in the survey. Whether the policy was Pareto safe is determined by comparing the actual 1992-1993 quasi rent with the adjusted 1999-2000 quasi rent for each of the survey firms

The final column in Table 4.2 indicates some surviving winners were better off, or at least no worse off, following IFQs. While surviving market share winners accounted for one-third of the total 1992-1993 fish, less than 2% of the survey pounds earned greater quasi rents (nominal and real dollars), i.e., were financial winners in the sense of being left better off in both nominal and real dollars. The remaining survey participants—representing 97% of the pre-IFQ sablefish processing sector—were financial losers, even after adjusting for the lower TAC and lower total revenues. The pre-IFQ processing sector lost, on average, 75.0% of their 1992-1993 quasi rents.[17]

Like halibut, the sablefish IFQ policy was not win-win. It did not allow the processing sector to participate in the policy benefits. Nor was the policy Pareto safe; most processors were left worse off in both nominal and real dollars relative to historic levels.

5. SUMMARY, CONCLUSIONS AND LIMITATIONS

Summary

The switch from open access to individual transferable quota management is generally regarded a resounding success because efficiency losses emanating from open access externalities are recaptured. But past analyses of transferable quota polices stop there. There has been little theoretical work and no empirical analysis of who wins, who loses and how much. Yet, these combined efficiency and distributional elements of welfare economics are essential to advancing rationalization policies, whether based on individual transferable quotas or fishery cooperatives. Policy design that creates a well-defined class of losers risks jeopardizing passage of future rationalization policies, regardless of the efficiency merits.

[16] The wholesale price increase may be partially policy-induced. Season elongation allowed the finished product flow to better reflect "just-in-time" supply. Inventory/storage costs in Asian markets may have dropped accordingly. It follows that some small portion of the 46% wholesale price increase may be attributable to the IFQ policy.

[17] A sensitivity analysis on the sablefish adjustment factor was undertaken to allow for the possibility that up to 10% of the wholesale price increase was policy-induced. This had no impact upon the qualitative findings.

Recent theoretical literature argues this is precisely what is likely to occur from a traditional rationalization policy design in which all rights are given only to vessels. Most processors capitalized for the open access derby will experience policy-induced wealth losses (Matulich, Mittelhammer and Reberte 1996 and Matulich and Sever 1999). However, that literature has not been examined empirically. The two largest transferable quota fisheries in the United States, the Alaska halibut and sablefish IFQ fisheries, provide an excellent test of the theory. Six years after implementation, no empirical analysis measures efficiency gains, let alone distributional implications of the IFQ programs.

The objective of this study was to estimate the economic welfare impacts of IFQs on Alaska halibut and sablefish processors. This task involved measuring the change in quasi rents before and after IFQs and also measuring the relative share of pre-and post-policy benefits. The two-years 1992 and 1993 were chosen to represent the pre-IFQ period; the two-years 1999 and 2000 represented the post-IFQ period.

Introduction of IFQs changed the structure and operating behavior of the halibut and sablefish processing sectors. Changes in market share among firms provided preliminary but partial insight into processing sector impacts. A firm that gained (lost) market share may have gained or lost absolute or relative economic well-being depending upon the degree to which it gained or lost per unit quasi rent share. Thus, a cost of production survey was conducted to estimate how the wholesale price was partitioned between raw fish cost, variable processing costs and residual unit quasi rent share retained by processors. Changes in unit quasi rents as a share of wholesale price were estimated, along with changes in total quasi rents.

Conclusions

The empirical evidence provided in this study supports the theoretical arguments that a harvester-only allocation of quota transfers wealth from processors to harvesters. The IFQ policy design was not win-win. The harvester-only allocation guaranteed harvesters would benefit from efficiency gains intended by the rationalization policy. But the quota allocation only to harvesters also assured they would benefit at the expense of the processors. This policy design redistributed the pre-IFQ share of joint economic benefits to such an extent that the policy was not Pareto safe.

Both halibut and sablefish processors were impacted in strikingly similar ways, despite the fact that IFQs liberated higher valued, fresh market opportunities for halibut, but not for sablefish. The similar outcomes derive from the fact that fleet consolidation under a harvester-only quota allocation creates excess processing capacity and therefore, excess demand for raw fish. The exvessel price concessions required to eliminate excess processing capacity redistribute wealth from processors to harvesters, regardless of product form.

It is estimated that more than 82% of the halibut processing sector (raw fish weight) lost revenues in excess of variable costs relative to the pre-IFQ period. Despite the 96% increase in total revenues[18] to the entire industry, the pre-IFQ processing sector is estimated to have lost, on average, 56.1% of its pre-IFQ revenues in excess of variable costs. Similarly, most of the sablefish processing sector lost revenues in excess of variable costs, though a precise estimate is

[18] The halibut wholesale price rose roughly 66% and total poundage rose just under 19%.

somewhat more tenuous because the 46% increase in wholesale price did not fully mitigate the 12.1 million pound (41%) decrease in landings. Adjusting for this supply-side effect by holding the wholesale price and purchases at 1992-1993 levels, approximately 97% of the entire sablefish industry (raw fish weight) were financial losers. The processing sector lost, on average, 75% of their pre-IFQ revenues in excess of variable costs.

Market share impacts were dramatic in both fisheries. Less than one-third (30%) of the halibut processing firms and slightly more than one-third (37%) of the sablefish processing firms survived IFQs. Half of these surviving halibut processors doubled their aggregate market share from 18% to 37%, while the surviving losers lost more than half of their pre-IFQ market share (down from 68% to 28% of the market). Overall, surviving halibut processors lost 14% of their pre-IFQ market share. Surviving sablefish processors, in contrast, gained an additional 10% share of the market. Surviving winners nearly doubled their aggregate sablefish market share (up from 33% to 64%). Surviving losers lost almost half their sablefish market share (down from 45% to 24%).

Unit quasi rent shares (UQRS) dropped dramatically for processors in both fisheries. Halibut processors lost, on average, nearly two-thirds of their pre-IFQ unit quasi rent share of the wholesale price; some surviving winners gained sufficient market share to remain Pareto safe, but participated in joint benefits at a rate less than their pre-IFQ share. Prior to IFQs, halibut processors retained a 19.6% share of the wholesale price. Following IFQs, UQRS for traditional processed halibut dropped to 8.9% of the wholesale price; UQRS for custom processed fish was 9.9%. Sablefish processors lost nearly three-quarters of their pre-IFQ share of the wholesale price. Surviving sablefish processors lost, on average, slightly more than two-thirds of their pre-IFQ quasi rent share; few surviving winners gained sufficient market share to remain Pareto safe. Surviving sablefish processors retained 6.9% of the wholesale price after IFQs were introduced, down from a UQRS of 24.2% prior to IFQs.

Both fisheries experienced policy-induced wealth redistribution from processors to harvesters. Exvessel revenues grew as a share of wholesale price, while processing UQRS dropped. The ratio of exvessel price to wholesale price grew 26.1% for halibut and 33.9% for sablefish. Although changes in harvesting quasi rents were not measured, gains from quota trading and season elongation imply variable harvesting costs per pound dropped.[19] Harvesters, unlike most processors, were left better off in both fisheries. Those that exited did so at least fully compensated. Those that remained increased their share of the wholesale revenue, they decreased variable harvesting costs and thus, they increased total retained quasi rents.

IFQs encouraged significant entry of both primary processors and broker/reprocessors. These new entrants tend to be innovative, low cost (efficient) firms that have an operational advantage in not having to invest much, if any, permanent capital, or to service the associated debt. The product form change in halibut enabled new entrants, including broker/reprocessors, with little capital to purchase, process and market fish. These new entrants were not responsible for the product form change. All firms faced the same profit incentive to switch toward the higher valued fresh product. The average wholesale price for halibut rose roughly 65% as the dominant product form shifted from frozen to fresh, while processing costs remained roughly the same

[19] An exception to this inference concerns added cost of longer running distances to fresh market ports.

between the two policy periods and between the two product forms. Pre-IFQ firms located near the limited Alaska road system or where alternative shipping modes support the fresh market faced similar, if not identical incentives. Remote firms were less able to take advantage of the fresh market. This fact was accentuated by season elongation, which allowed vessels to travel to fresh buyers, redistributing landings toward ports that can support the fresh market.

Fifty-one new firms became primary processors/buyers of halibut, capturing one-third of the halibut market. Four of these new entrants were large firms (≥ 1 million pounds) that captured nearly one quarter of the post-IFQ market. Entry also occurred through brokers/reprocessors, though these firms are not reflected in the COAR data. Entry was less important in the sablefish fishery, presumably because capital cost requirements remained high. Still, twenty-five new entrants, all small firms, collectively captured 12% of the market. Broker/reprocessors remain relatively unimportant in the sablefish fishery.

Overall, this study helps clarify the policy choice among future rationalization designs by providing empirical evidence that the initial quota allocation has dramatic welfare ramifications. A harvester-only IFQ allocation (in any manifestation) does not recognize the prior economic interests of both harvesting and processing sectors. It does not allow both sectors to benefit from rationalization. Instead, an IFQ policy benefits harvesters to the detriment of processors. If the rationalization policy is intended to benefit both harvesters and processors, a different initial allocation—one that acknowledges prior economic interests of both sectors—is required. Preserving the opportunity for new entry in both the harvesting and processing sectors will enhance the efficiency gains from future fishery rationalization.

Limitations/Caveats

There are three important limitations/caveats to this study. First, examination of pre- and post-IFQ impacts on the processing sector does not necessarily imply causality. This analysis assumed the two-year period 1992-1993 represents an open access long-run equilibrium, consistent with the fisheries economic literature. As such, it is regarded as a reasonable proxy for both a "before" and "without" scenario in a before and after, with and without policy analysis. Nevertheless, the way in which industry restructured may be partially dependent on things other than the switch from license-limited open access to IFQ management.

Second, empirical economic analysis of fisheries policies, particularly retrospective analysis, often is problematic in U. S. fisheries because costs of production data are not collected. This study is no exception. While the changes in market share reflected all halibut and sablefish landed in Alaska, the economic component was based on an industry cost of production survey that required participants to access 10-year-old data. All primary processors that purchased at least 100,000 pounds of fish were asked to participate (88% to 96% of all fish purchased during the four years, 1992-1993 and 1999-2000). Additionally, new entrant, broker/reprocessors who were not buyers/processors-of-record were asked to participate. The retained survey data from firms that agreed to participate represent 52% and 61% of landed halibut in the pre- and post-IFQ periods, respectively. Survey coverage of landed sablefish averaged 54% and 59% during the same periods. Inferences drawn in this study assume the survey data are representative of the entire processing sector.

Third, policy inferences from this study are intended to guide the design of **future** rationalization programs in other fisheries. No aspect of this study is intended for the purpose of revisiting/changing the policy designs of these two Alaska IFQ programs. Rather, this study is premised on the principle that once the rules of an IFQ program are established and individuals make investments based on those rules, changing the rules in fundamental ways can strand assets and create losers in much the same way as an initial allocation of quota only to harvesters damaged processors.

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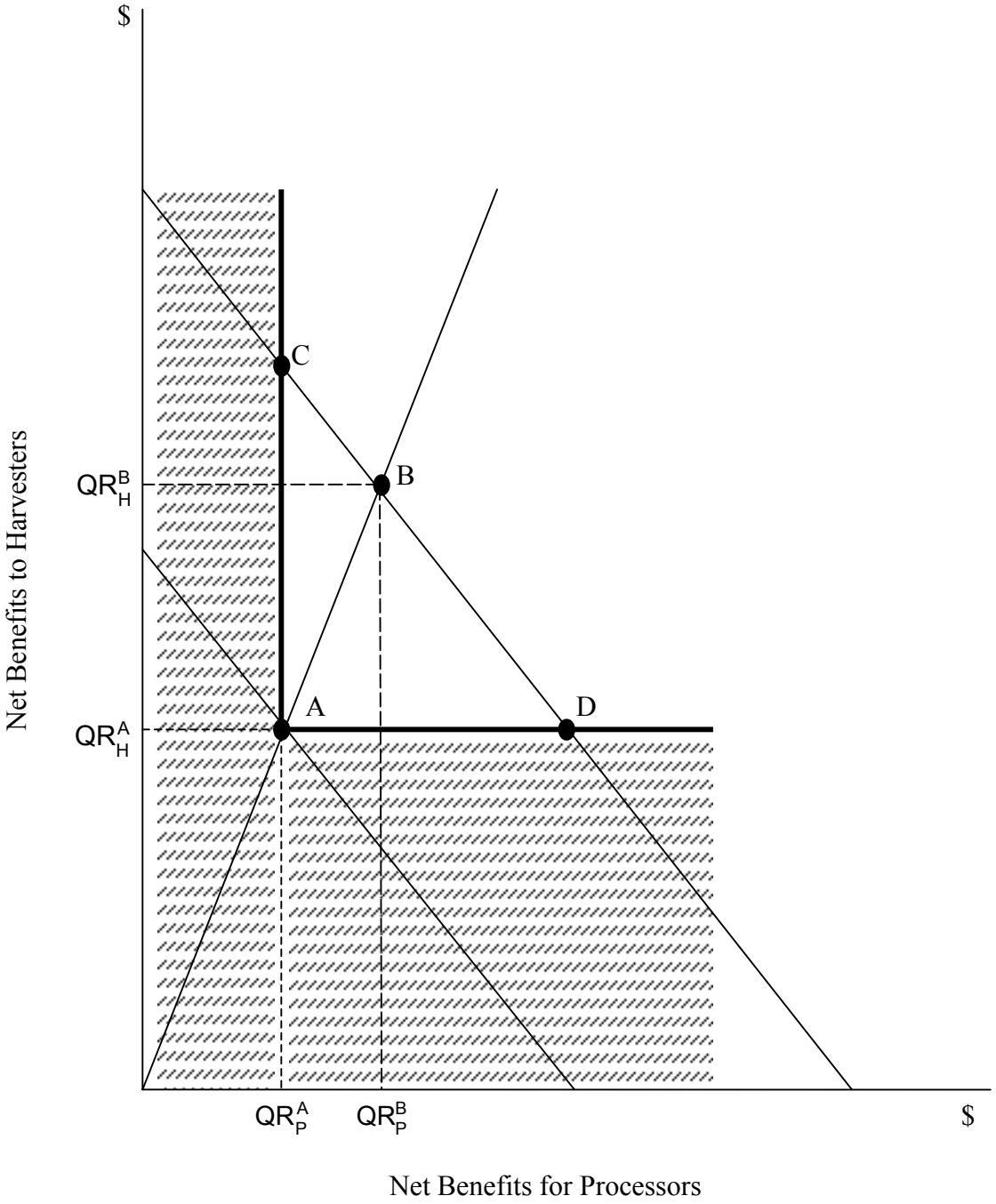

Figure 2.1 Potential efficiency and distributional impacts of rationalization policy design.

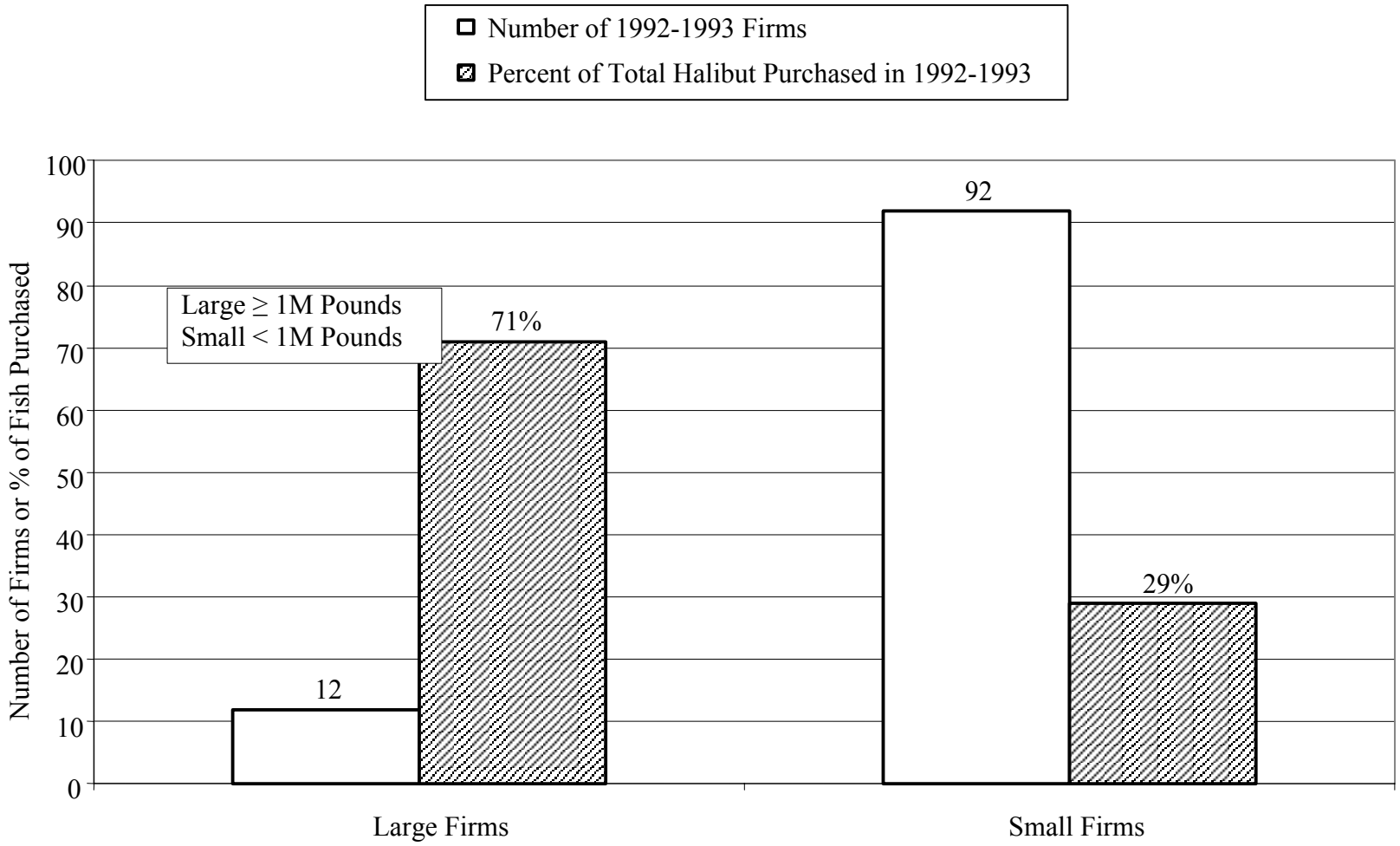

Figure 4.1 1992-1993 market share of halibut processing firms, by firm size.

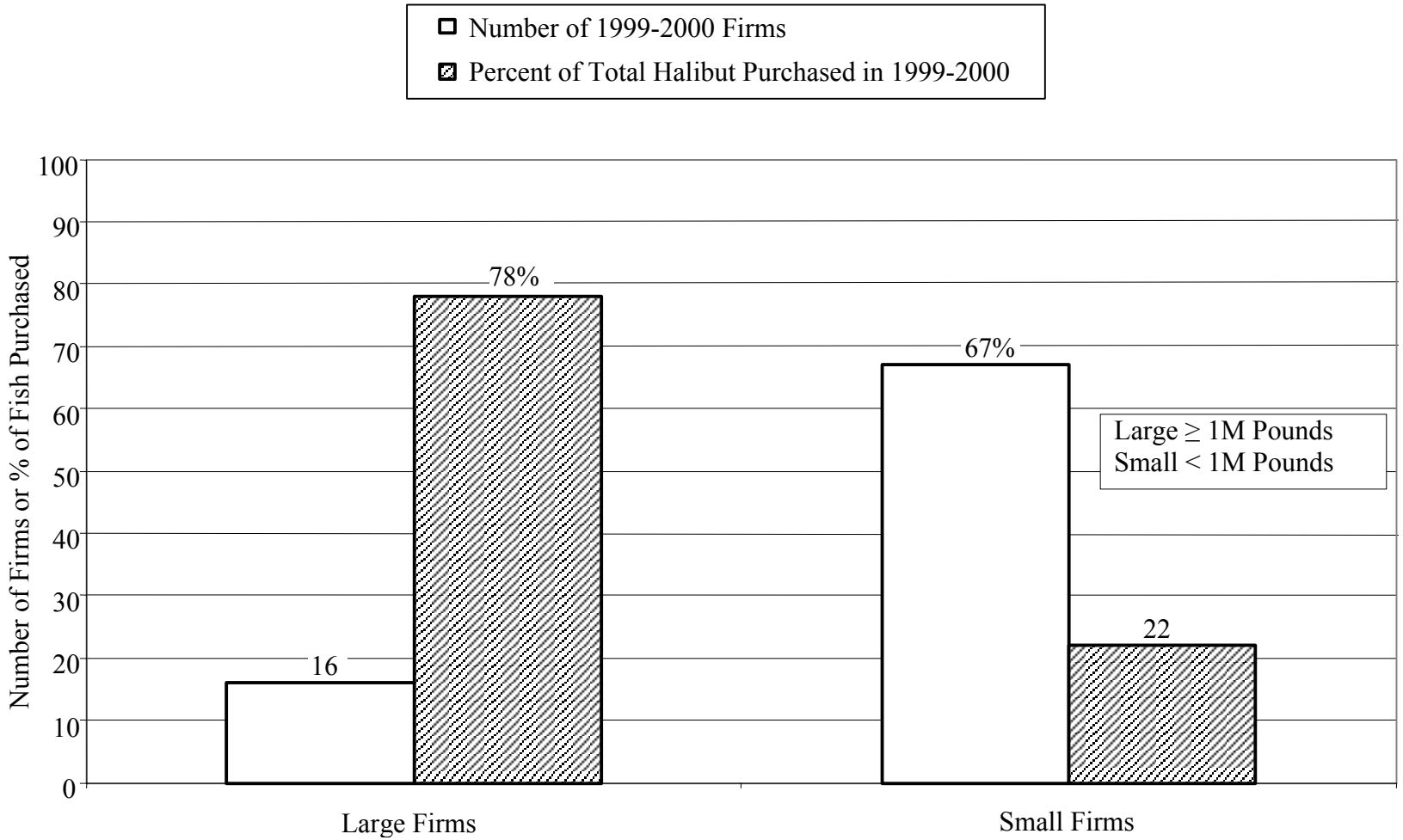

Figure 4.2 1999-2000 market share of halibut processing firms, by firm size.

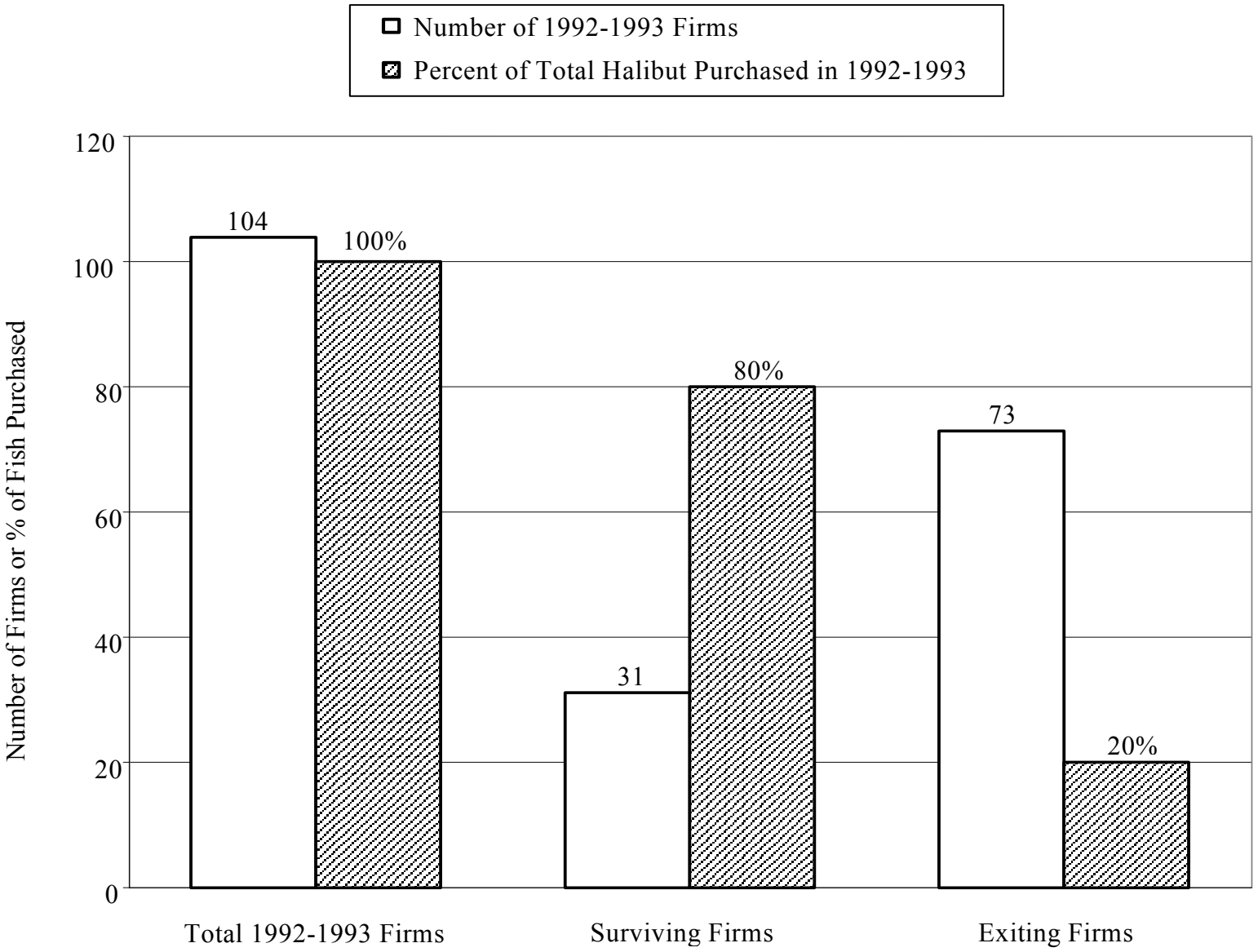

Figure 4.3 1992-1993 market share of surviving and exiting halibut processing firms.

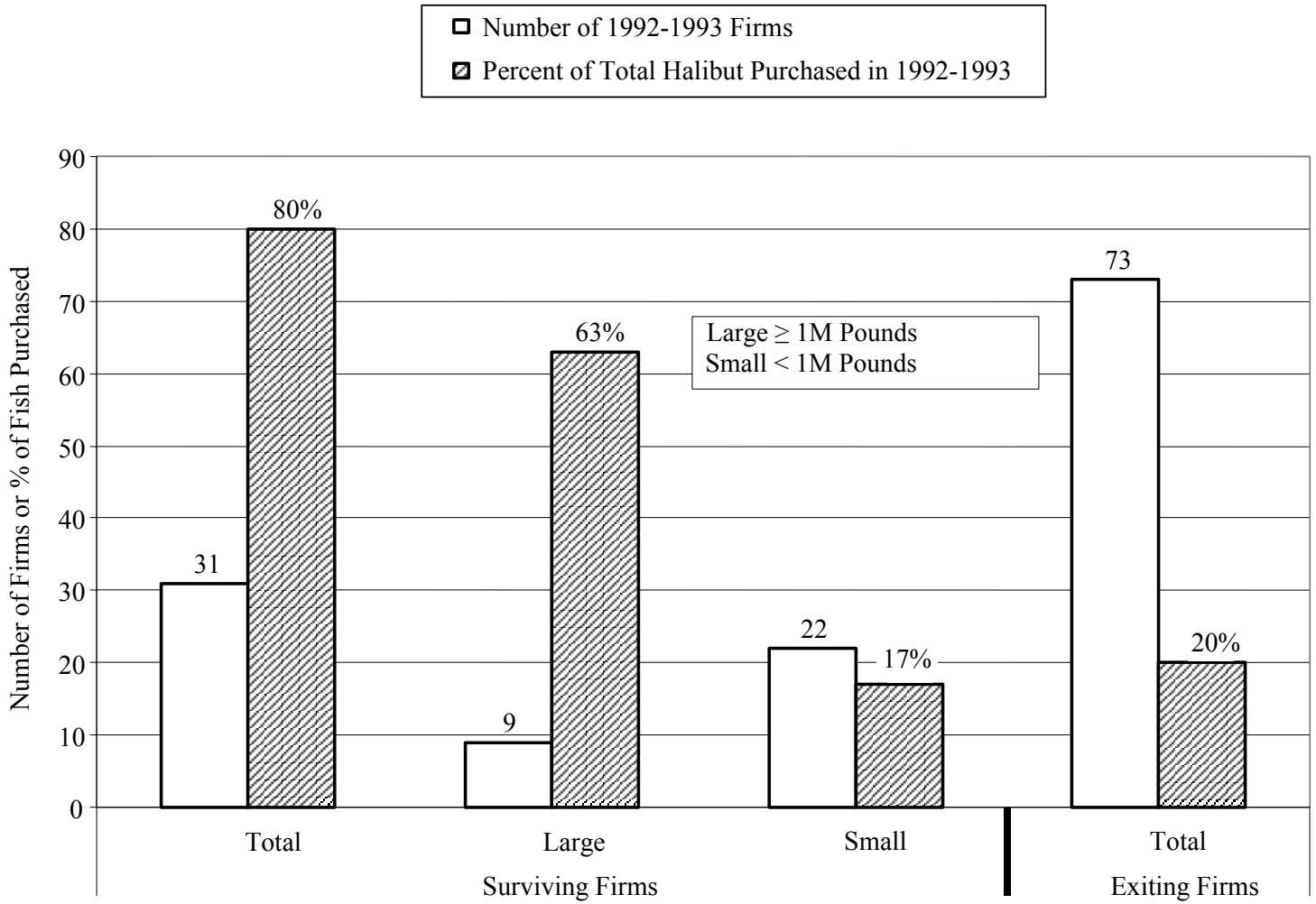

Figure 4.4 1992-1993 market share of surviving and exiting halibut processing firms, by size category.

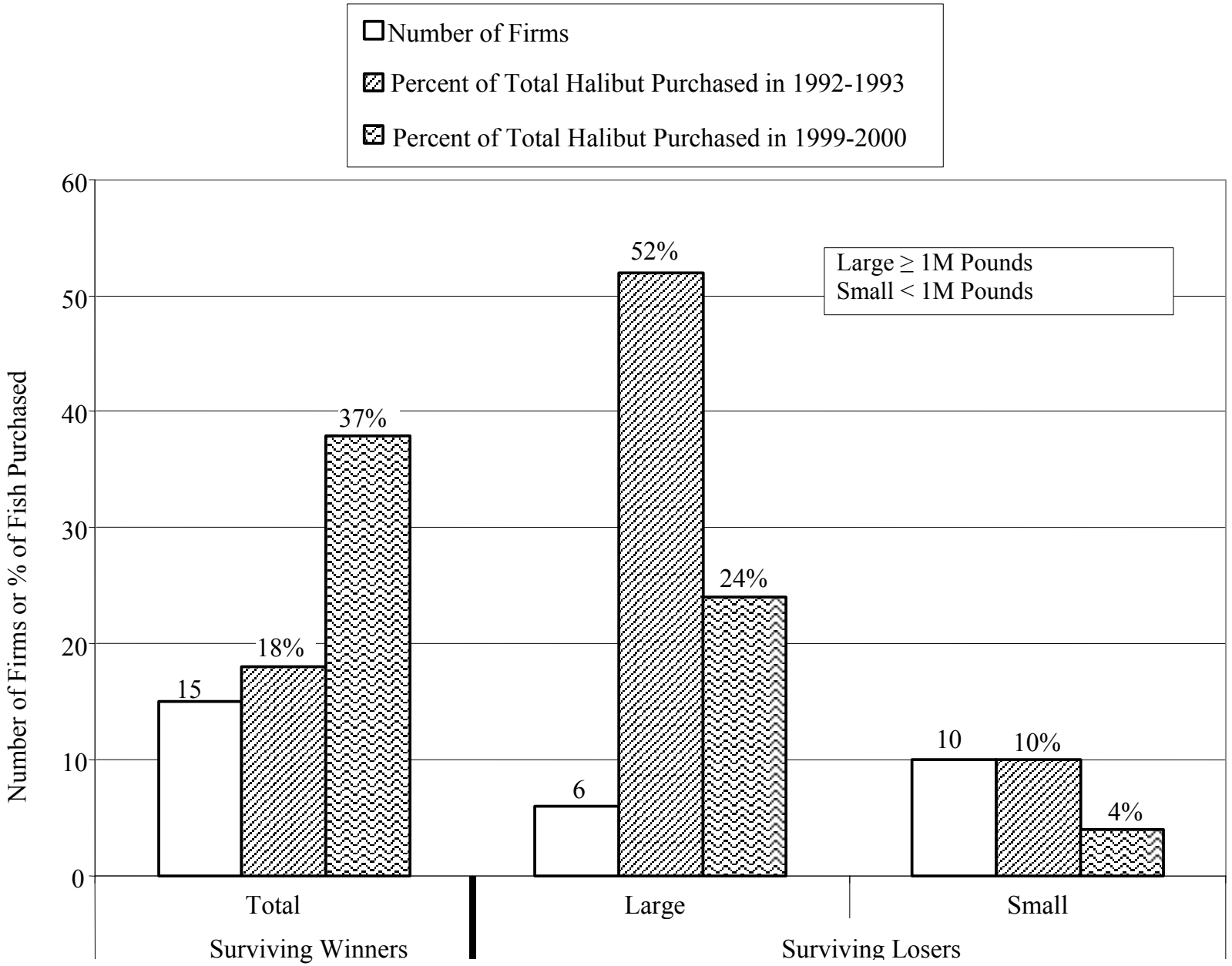

Figure 4.5 Market share changes for surviving halibut processing firms: market share winners and losers, by size category.

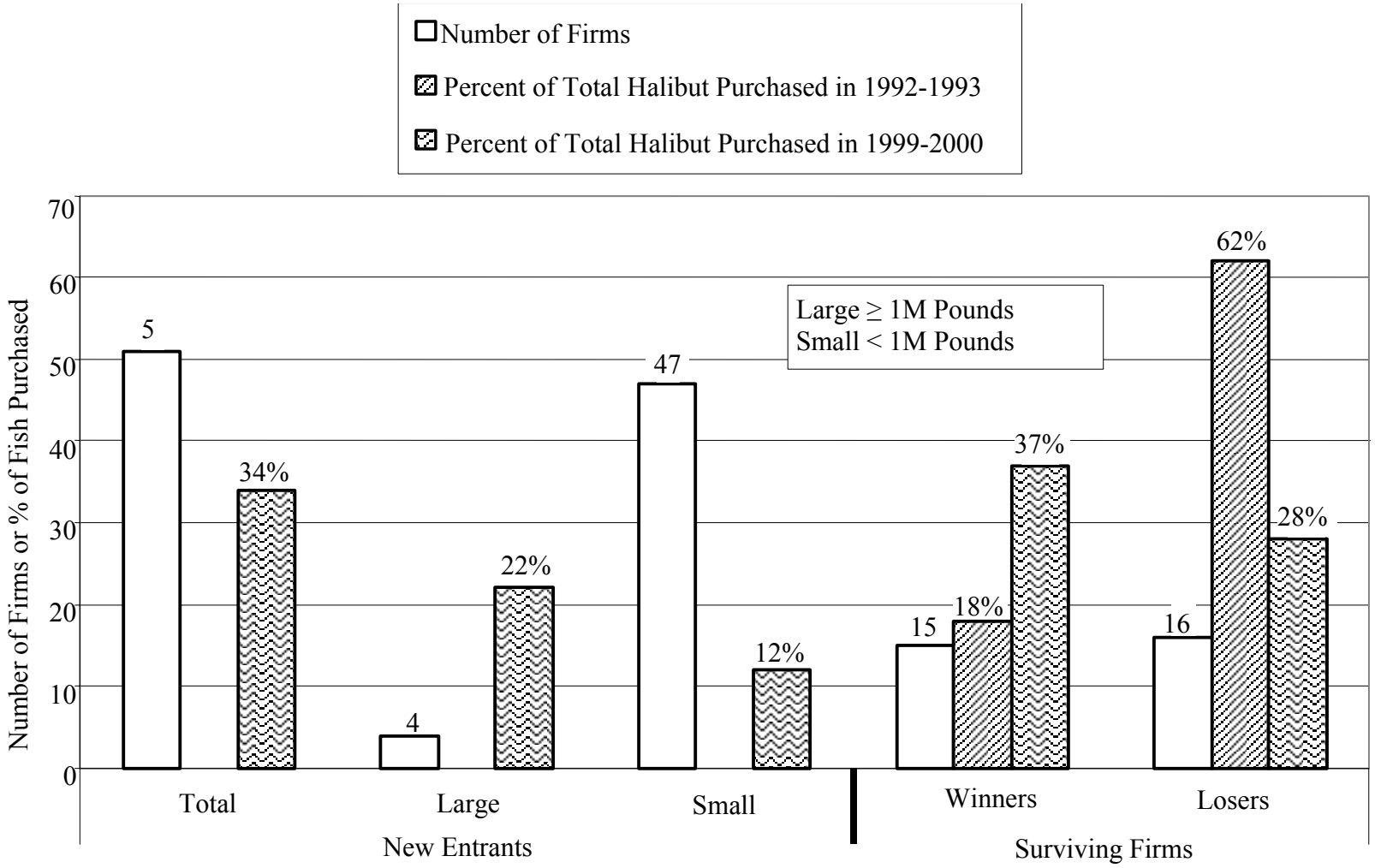

Figure 4.6 Composite market share changes in the halibut processing sector by 1999-2000: new entrants, winners and losers, by size category.

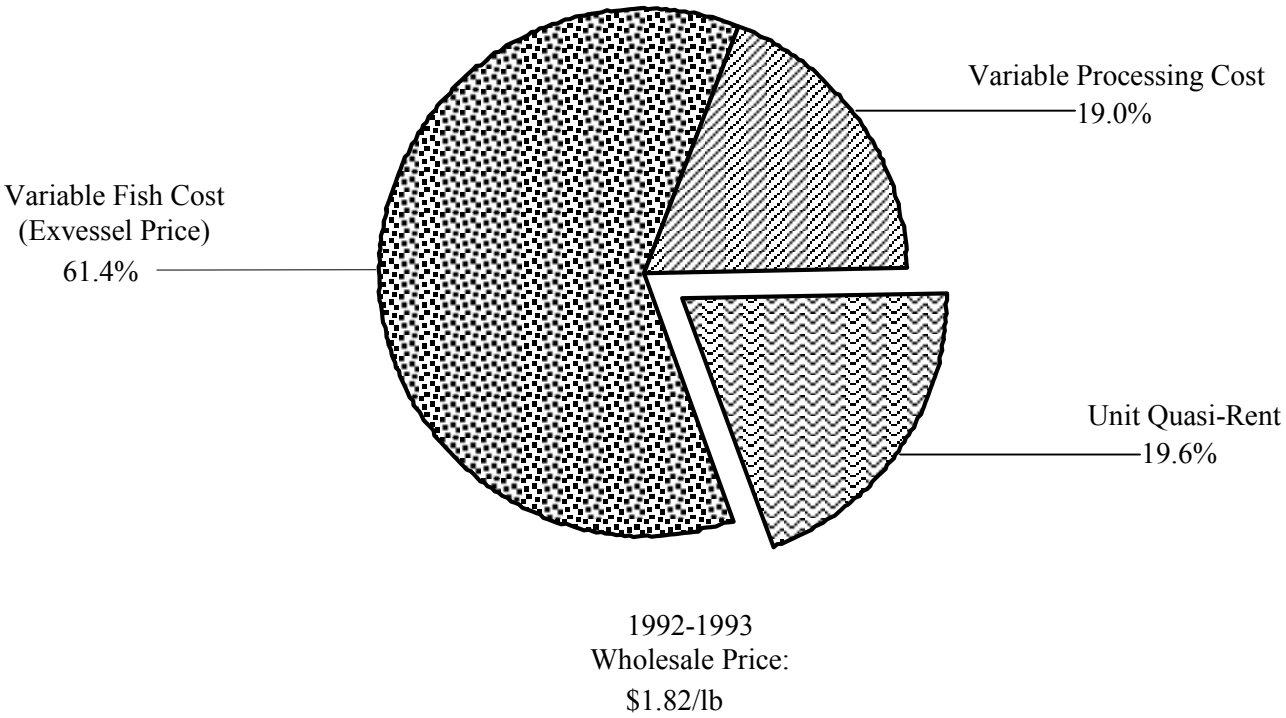

Figure 4.7 Raw fish cost, variable processing costs and unit quasi rents as shares of the 1992-1993 average wholesale price for traditional processed halibut.

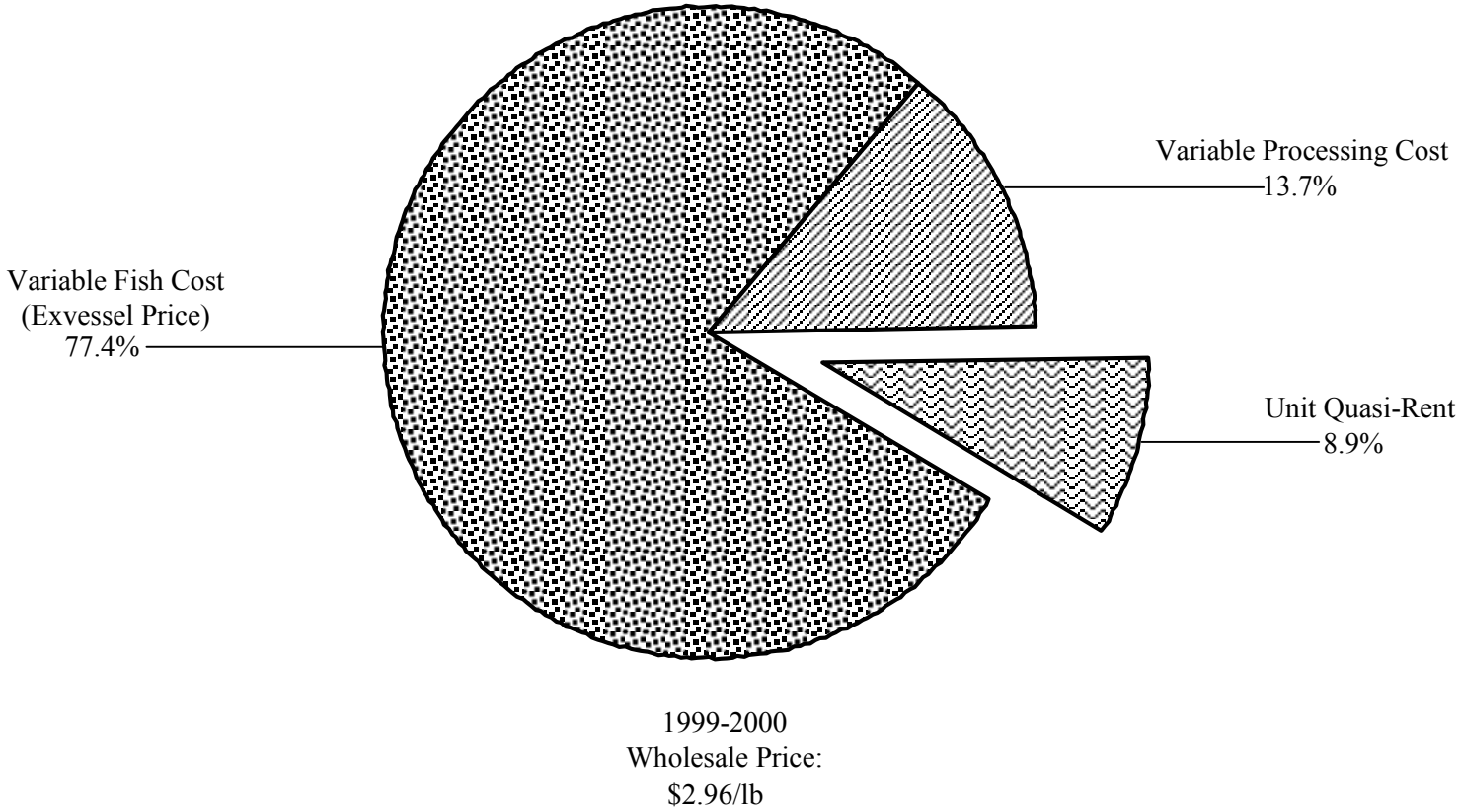

Figure 4.8 Raw fish cost, variable processing costs and unit quasi rents as shares of the 1999-2000 average wholesale price for traditional processed halibut.

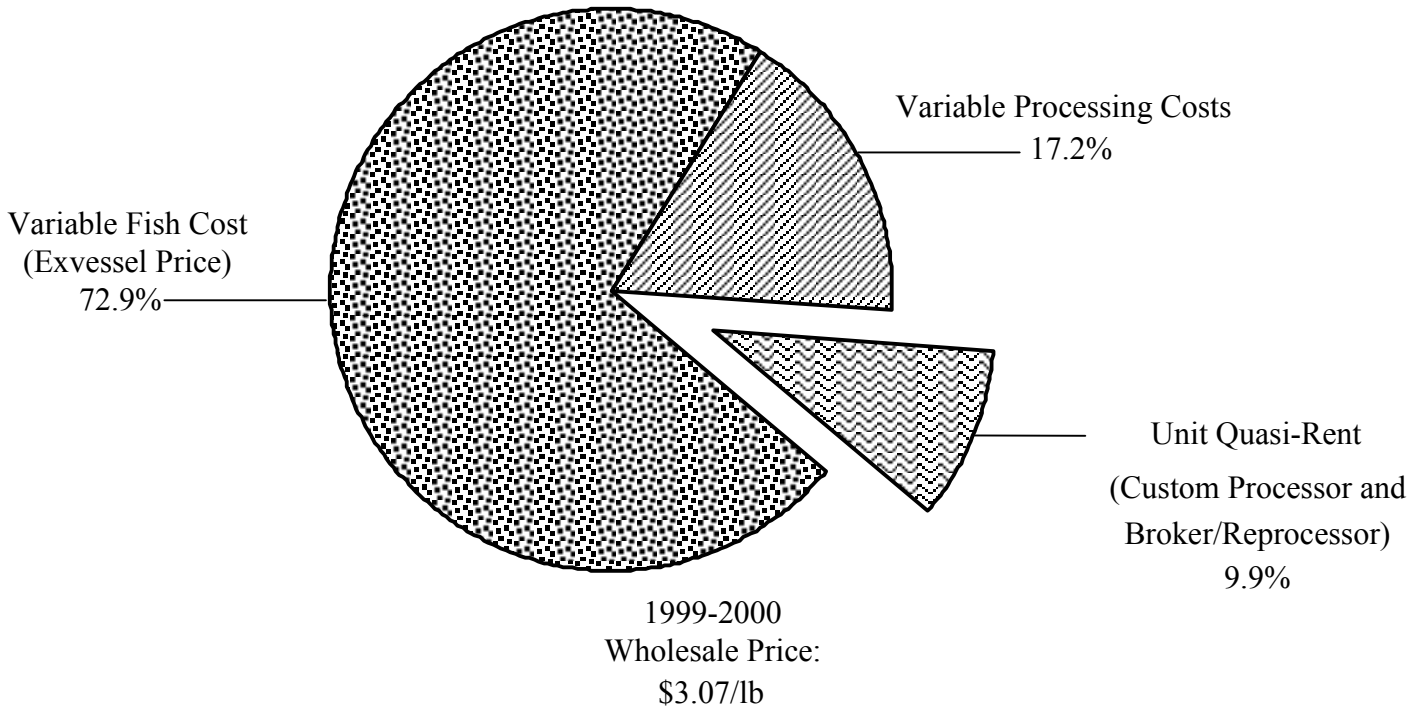

Figure 4.9 Raw fish cost, variable processing costs and unit quasi rents as shares of the 1999-2000 average wholesale price for custom processed halibut.

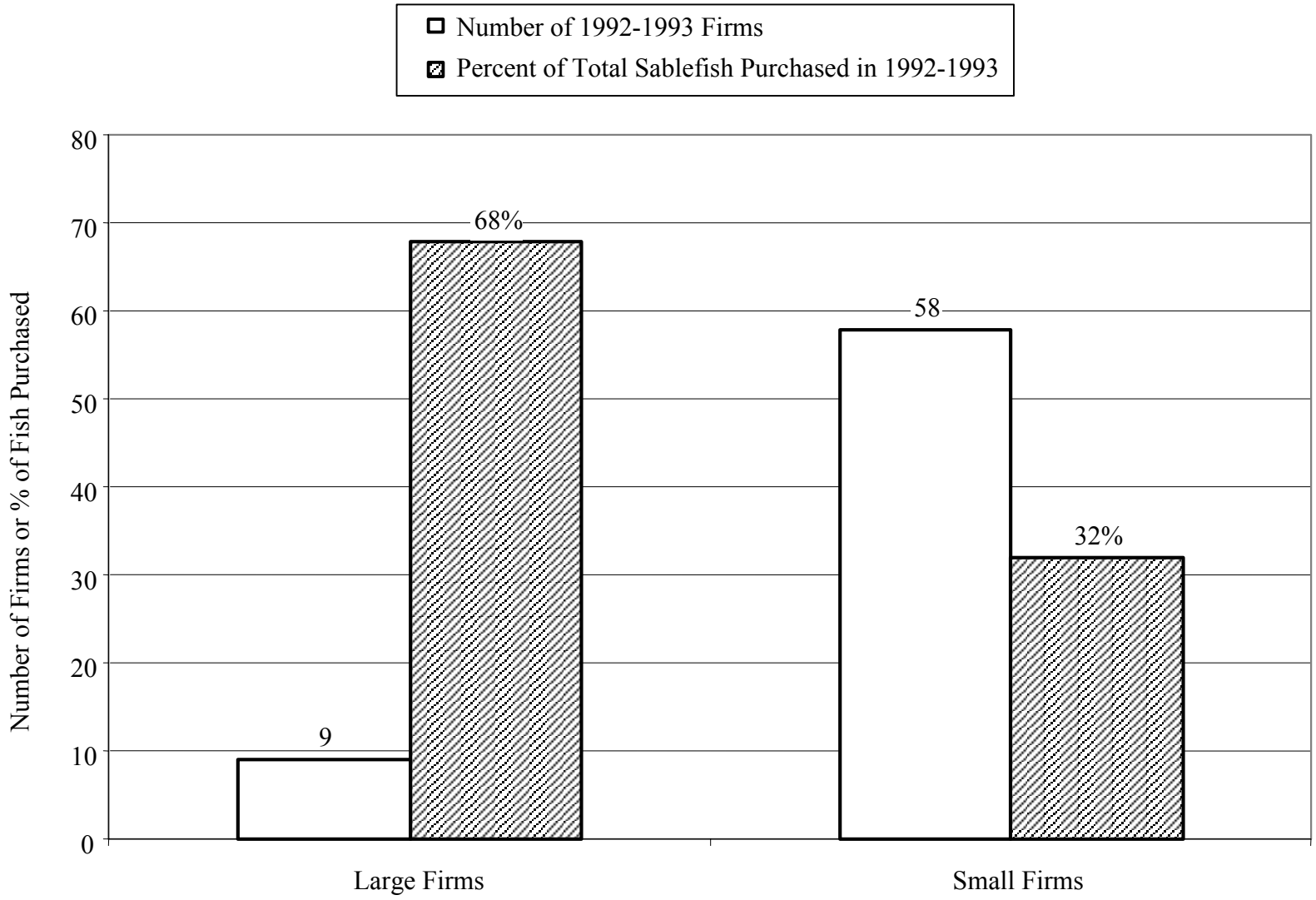

Figure 4.10 1992-1993 market share of sablefish processing firms, by firm size.

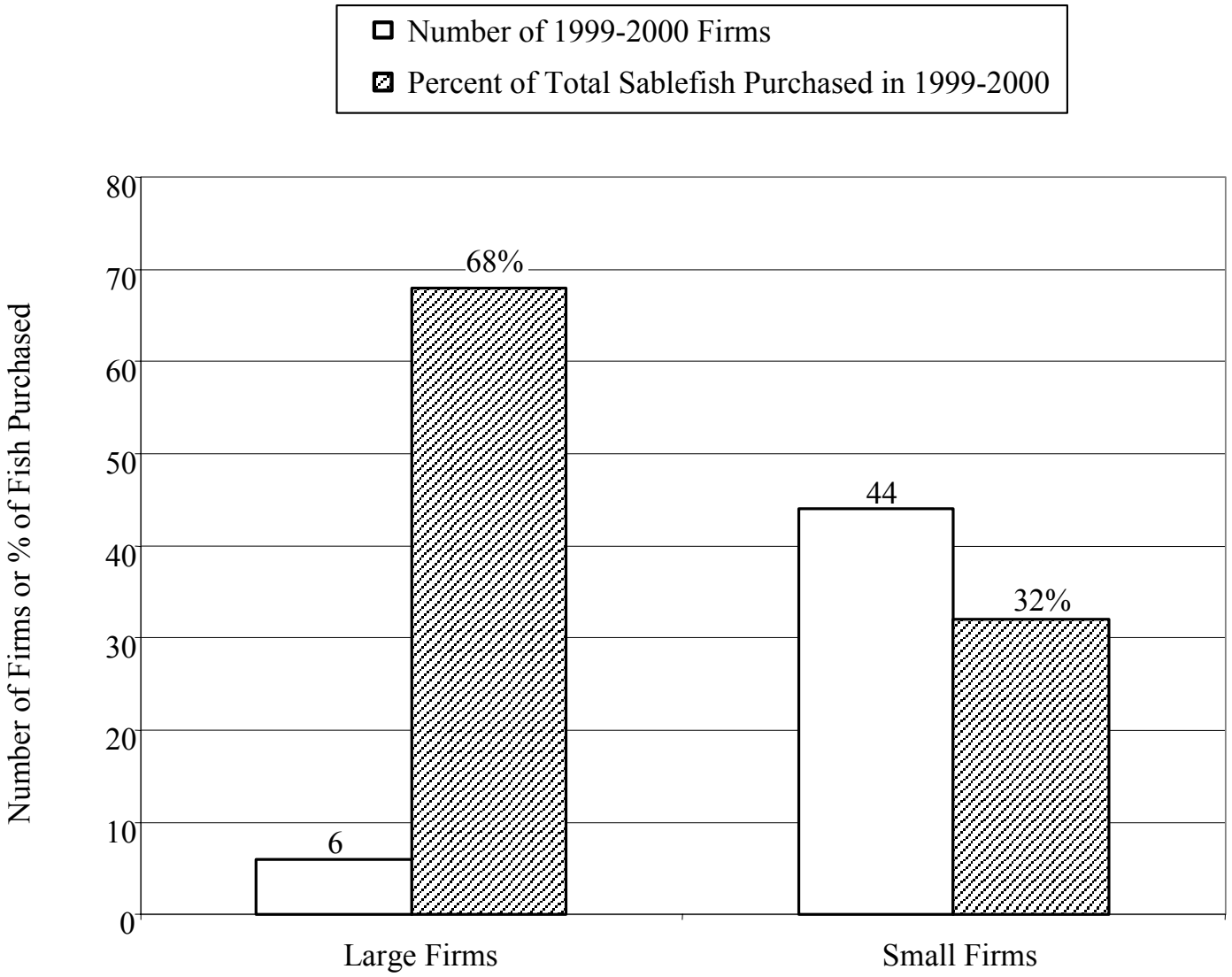

Figure 4.11 1999-2000 market share of sablefish processing firms, by firm size.

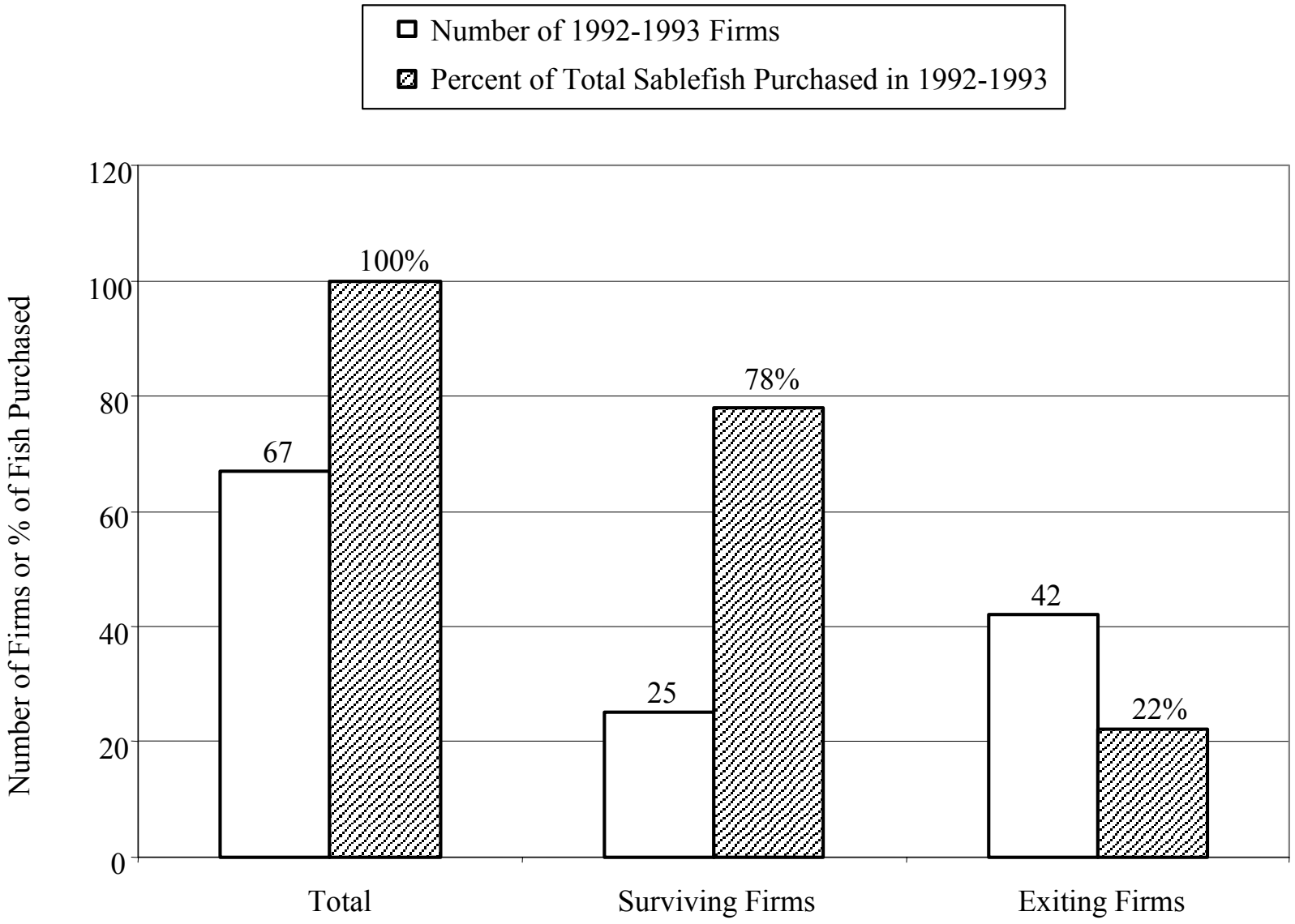

Figure 4.12 1992-1993 market share of surviving and exiting sablefish processing firms.

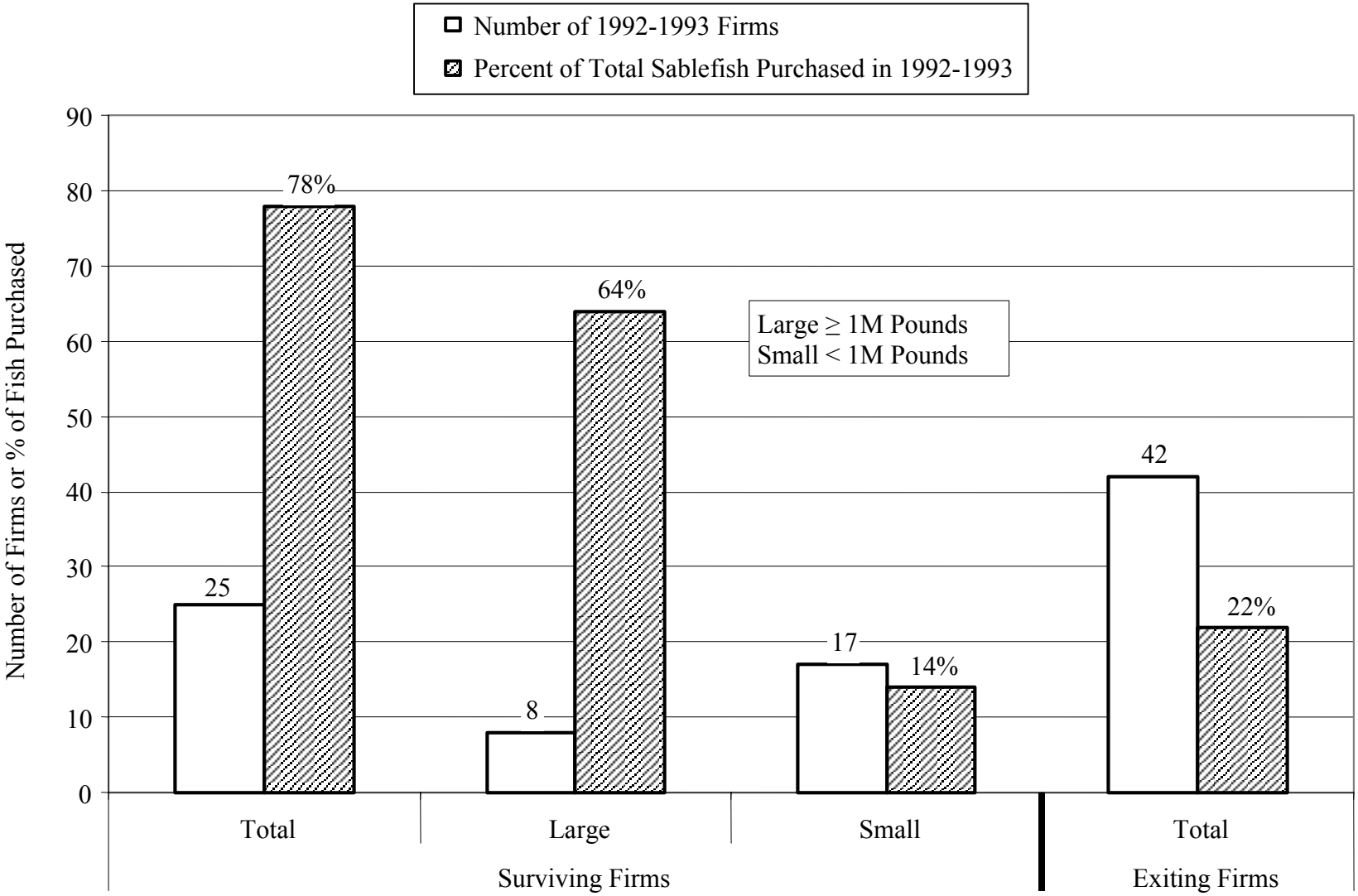

Figure 4.13 1992-1993 market share of surviving and exiting sablefish processing firms, by size category.

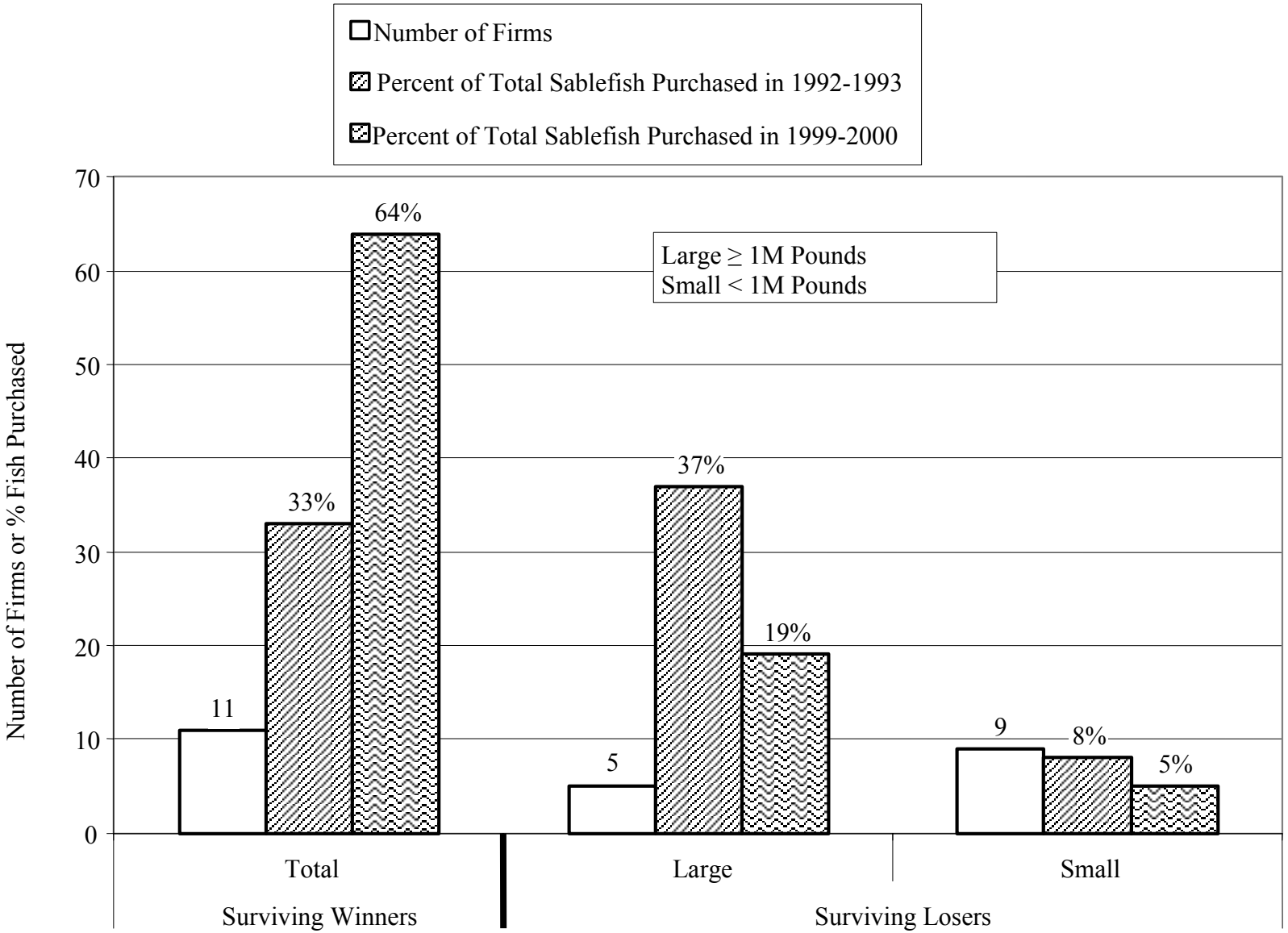

Figure 4.14 Market share changes for surviving sablefish processing firms: market share winners and losers, by size category.

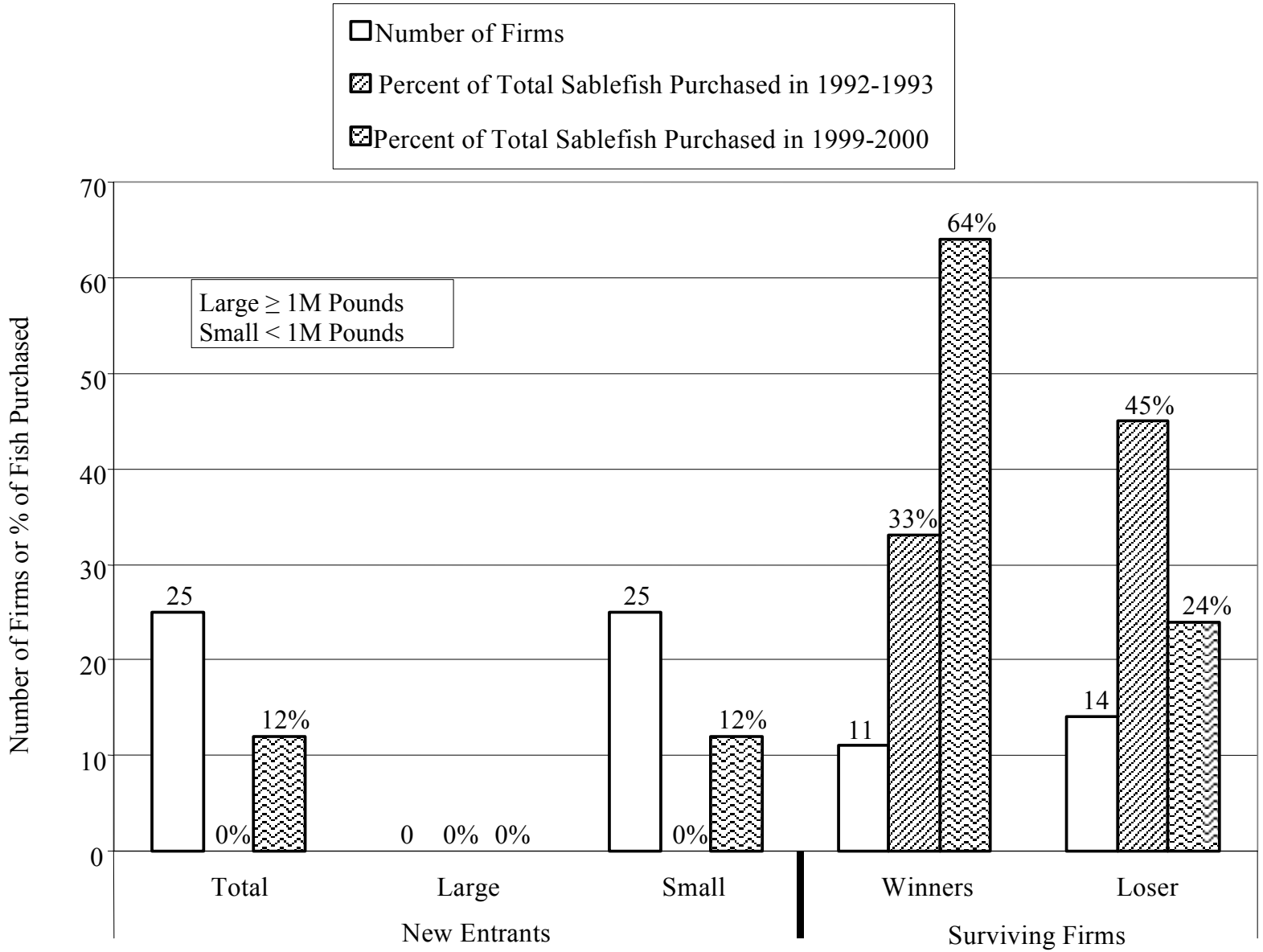

Figure 4.15 Composite market share changes in the sablefish processing sector by 1999-2000: new entrants, winners and losers, by size category.

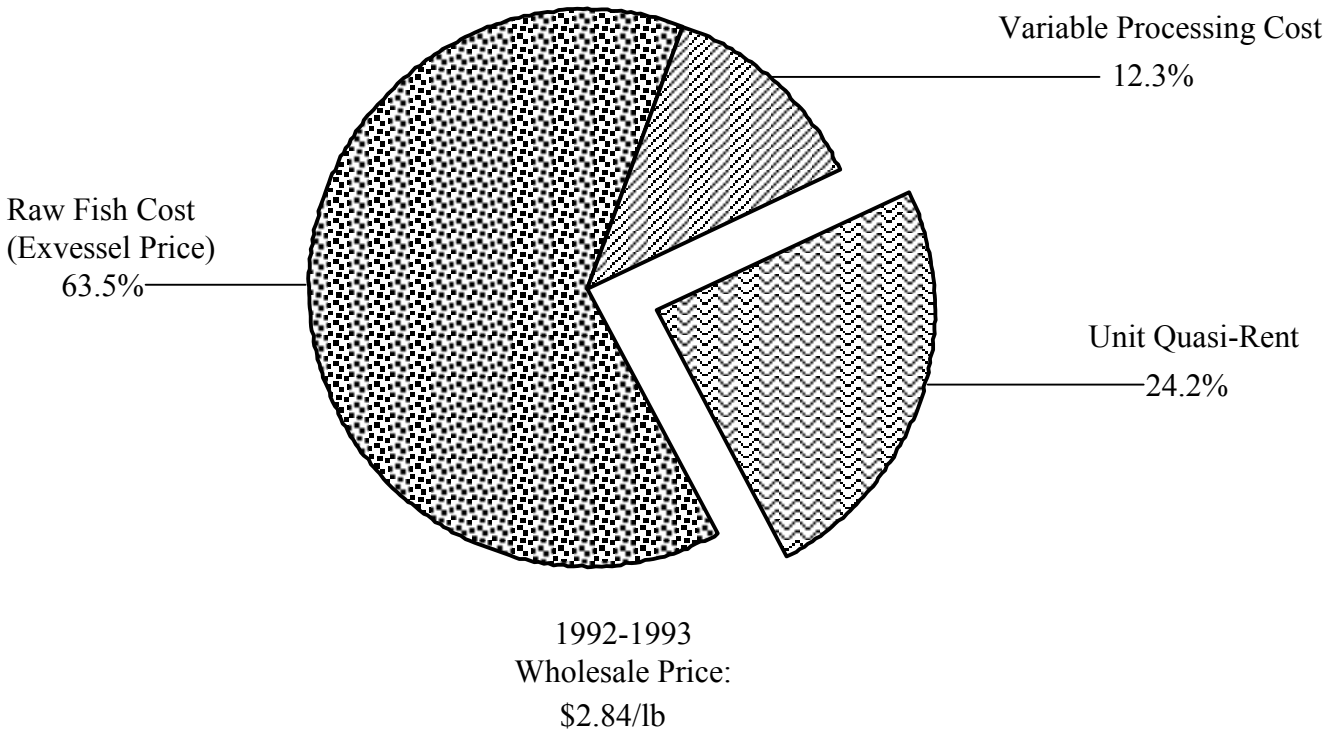

Figure 4.16 Raw fish cost, variable processing costs and unit quasi rents as shares of the 1992-1993 average wholesale price for traditional processed sablefish.

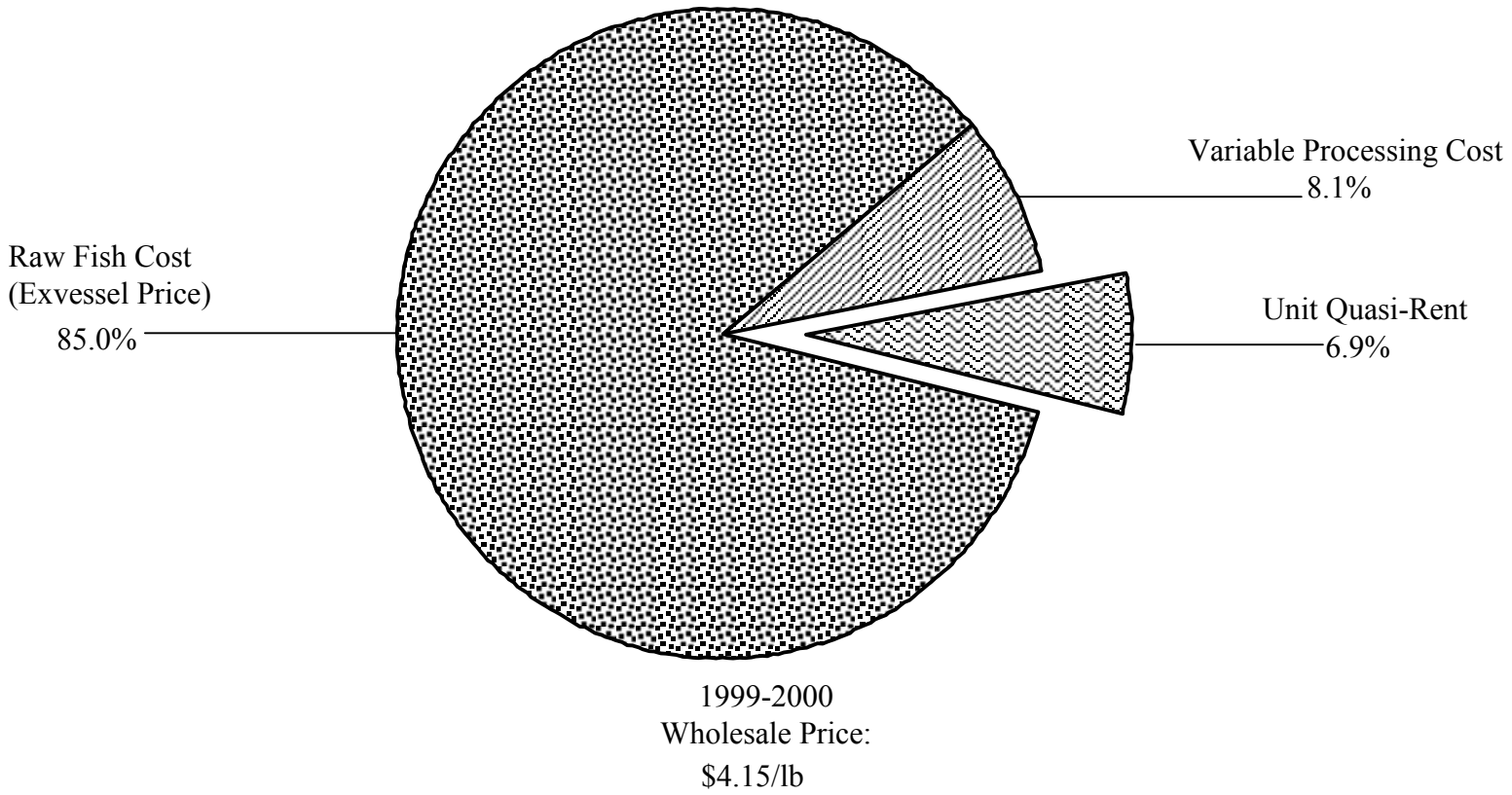

Figure 4.17 Raw fish cost, variable processing costs and unit quasi rents as shares of the 1999-2000 average wholesale price for traditional processed sablefish.

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APPENDIX

PACKET PROVIDED TO POTENTIAL SURVEY PARTICIPANTS

December 11, 2000
Dear Halibut or Sablefish Processor

The Alaska Department of Fish and Game entered into an inter-governmental agreement with Washington State University to conduct an economic analysis of the behavioral and distributional effects of halibut and sablefish IFQ policies. The research is intended to assist the State of Alaska and the North Pacific Fisheries Management Council design ***future*** IFQ programs or other rationalization programs (like AFA). No aspect of this study is for the purpose of revisiting/changing the current halibut and sablefish IFQ programs. More complete details concerning the project are provided in the first enclosure (ADFG Work Statement).

Your participation is critical to this research. **All** processors/buyers who acquired more than 100,000 pounds of raw fish are being asked to provide confidential financial information pertaining to their halibut and sablefish business, before and after the implementation of IFQs. The large number of smaller processors/buyers requires us to contact only a representative sample. Essentially, we need you to provide Annual Total Revenue and Total Variable Costs according to two categories—fish processed for OWN distribution and fish CUSTOM PROCESSED for others. The specific data you are asked to provide are listed in the second enclosure, which includes detailed definitions. Please provide the financial data separately for halibut and sablefish, if you processed/bought both. All data will be kept strictly confidential, even from ADFG. Confidentiality will be maintained in accordance to Washington law and all project results to be reported shall be aggregated in accordance with state and federal confidentiality guidelines. You will, of course, receive a copy of the report.

Please provide the annual data for 1992 and 1993 (pre-IFQ years) and for 1998, 1999 and 2000 (post-IFQ years). Yes, this is a large request. But it is essential if this research is to provide a comparative economic analysis of the policy change. If you are unable to provide every year of data, please provide data for the years you can. **Please complete the task by February 1, 2001**.

If you have any questions, please feel free to contact me or my Graduate Research Assistant, Michael Clark. Our e-mail addresses are given below.

Sincerely,

Scott C. Matulich **matulich@wsu.edu**
Professor (509) 335-1607

Michael Clark mlclark@wsu.edu
Graduate Research Assistant

encl.: 1) ADFG Work Statement, 2) Annual Total Revenue and Total Variable Processing Costs

Work Statement

Behavioral and Distributional Effects
Of Halibut and Sablefish IFQ Policy

Principal Investigator: Scott C. Matulich, Professor
Agricultural Economics
Washington State University
Pullman, WA 99164-6210

PROBLEM:

Five years after implementing individual fishing quotas (IFQs) in the Alaska halibut and sablefish fisheries, there has not been an economic analysis of the behavioral and distributional effects of the IFQ policy. This information should assist policymakers design future IFQ programs or other rationalization programs (like AFA-style cooperatives) in other fisheries. Two issues of particular importance to evaluating policy success are quantifying the economic efficiency gains of the IFQ programs and the distribution of benefits that derive from the program, i.e., who benefited or lost and how much. This insight is sought for the sole purpose of guiding the design of future IFQ or cooperative rationalization programs in Alaska. No aspect of this project is intended to revisit these two IFQ programs for the purpose changing their prior design. Rather, this study is premised on the principle that once the rules of an IFQ program are established and individuals make investments based on those rules, changing the rules can strand assets and create losers.

DISCUSSION:

Individual transferable quota management of fisheries has long been advocated by economists as the solution to eliminating open access externalities and recouping efficiency losses that persist in open access fisheries. Despite the stated goal of improved economic efficiency, little or no literature exists that tests for changes in efficiency following introduction of rights-based fishing. Decapitalization and season elongation, combined with diminished political pressure for policy makers to change the management system are *de facto* evidence of policy success.

Commonly collected commercial fisheries data typically do not permit empirical estimation of efficiency gains, which is why most *ex post* analyses are descriptive of the kinds of fleet reorganization and other non-economic benefits that derive from rationalization. Several excellent examples of qualitative analyses are Knapp (1999 a, b, c) and ADFG-CFEC (1999). Knapp surveyed 249 halibut captains who fished pre- and post-IFQ, and also 200 IFQ permit holders who fished in 1997. The surveys indicated an increase in safety and resource conservation following IFQ implementation attributable to season elongation. An extensive report by ADFG-CFEC examined fleet consolidation due to the IFQ program and how the pool of quota shareholders changed over the period

of 1995-1998. While the report contained quota share sales and lease price data, no economic analysis was conducted. Neither the Knapp nor ADFG-CFEC reports addressed distributional impacts on the processing sector, which has become a contentious issue in other fishery rationalization contexts.

Ironically, policy makers often attach considerably more importance to the distributional impacts of the policy they adopt than they do to the efficiency issues. This would certainly seem to be the case with the Alaska IFQ experience, where departure from so-called "optimal" textbook design was induced by numerous political and social constraints. It follows that potential efficiency gains-from-trade advocated by economists were constrained by many efficiency-equity tradeoffs in actual policy design and implementation. Without an *ex post* empirical examination of the economic impacts of the policy, policy makers cannot determine whether intended tradeoffs were realized or desirable. *De facto* evidence of welfare gains simply may be insufficient to promulgate new rationalization policies, particularly if those gains came at the expense of unanticipated losses or rent redistribution in one or more segments of the industry. The possibility of redistribution is likely to induce expenditure of valuable private resources to block future rationalization policies or to detract from their performance, even when there are no social benefits from this activity. However, as Milgrom and Roberts (*AER* 1990) note, that which often is pejoratively referred to as "rent-seeking" behavior can actually enhance efficiency. They show that assessing policy alternatives according to their distributional or fairness impact can help promulgate an efficient policy. Thus, understanding the existence and magnitude of windfall gains and losses that may have accrued to different halibut and sablefish industry sectors would allow policy makers to avoid unintended distributive effects. This, in turn, enhances the likelihood that a political consensus can form around the adoption of future IFQ or AFA-style cooperative rationalization policies.

It seems inevitable that distributional concerns over rationalization policy design will accentuate as future North Pacific fisheries are considered for rationalization. On the one hand, recent economic theory articles argue that the crux issue is to design a rationalization system in which the initial allocation of quota assures fully compensated trades (Matulich and Sever 1999). A harvester-only quota allocation, like that of halibut and sablefish, according to theory, transfers wealth from processors to harvesters (Matulich *et al*. 1996). On the other hand, there has never been an empirical investigation as to the veracity of the theory. The Alaska halibut and sablefish IFQ programs provide a near-ideal laboratory to evaluate the theory.

Insight into the mechanisms through which IFQ policy works to correct the open access externality can be obtained only by looking at the behavioral responses of economic agents to the policy initiatives. Quantifying the efficiency and distributional consequences of the halibut and sablefish IFQ programs theoretically involves measuring the changes in profitability of affected participants and it requires measuring the changes in management costs. Both changes refer to the *ex ante* and *ex post* policy states. In

sum, the efficiency benefits of IFQs require measuring changes in the three components of efficiency:

1) technical efficiency (reduction in overall input utilization),
2) allocative efficiency (optimal input mixes, given factor prices),
3) scale efficiency (optimal size of operations).

The first two efficiency components are important to evaluating halibut and sablefish IFQs. However, scale efficiency is probably unimportant because the social aspects of the policy intentionally prevented consolidation to the most efficient scale. Distributional concerns, in contrast, address who won or lost and how much, regardless of overall changes in efficiency. It requires looking at financial impacts beyond the harvesting sector—the traditional focus of IFQ analysis. If one broadly defines the policy-impacted sectors as harvesting and processing, measuring the distributional impacts requires measuring changes in processing quasi rents (total revenue minus variable processing costs) and the changes in harvesting quasi rents. Thus, one must have detailed individual operator data for inputs, outputs, costs of production and output prices, or a sample of such data. This data challenge often is problematic in U. S. fisheries where costs of production are not collected.

Absent detailed cost of production data, accurate measurement of allocative efficiency is not possible using either the mathematical programming technique of Data Envelopment Analysis (DEA) or econometric approaches to estimating a stochastic frontier (Grafton *et al*. 2000). Insight into distributional issues may be somewhat easier to evaluate because fishery rationalization in one sector begets concomitant rationalization in all sectors (through product stabilization), regardless of who is the initial fishing quota share recipient. Ex-wholesale and ex-vessel revenue functions (and production functions) might be estimable from fish ticket and COAR data, which would enable one to measure technical efficiency in both fishing and processing. The relatively small number of halibut and sablefish buyers/processors makes direct interviewing feasible in order to obtain estimates of changes in processing costs and thus, net returns to processing. Surveying the fleets is not an equally viable approach for collection of cost data suitable for econometric analysis; the fleets are far too large and heterogeneous.

Two alternatives exist to measure distributional effects. First, a focus group of vessels within the IFQ vessel class definitions could be formed to provide cost of production information for so-called representative vessels. An estimate of changes in quasi rents would be forthcoming. Absent that, measuring changes in the share of gross revenue provides evidence of distributional effects between the two sectors. Moreover, since fleet consolidation was fully compensated through quota trading, surviving vessels are presumably both the most efficient, given the IFQ quota trading restrictions, and they earn quasi rents in excess of that earned during license limited open access. If the vessels' share of wholesale revenues increased, given per unit vessel costs decreased, it is likely the rationalization policy redistributed wealth between sectors. Estimating *ex ante* and *ex post* quasi rents of fish buyers, thus, is critical to determining the extent to which

the IFQ policy may have redistributed wealth between sectors or whether all participants in both sectors benefited.

APPROACH:

Phase One. The initial phase of this project will focus on analyzing distributional consequences of the halibut (and probably the sablefish) IFQ program.

1) Use 1990-1999 fish ticket, COAR and other pertinent data from ADFG, CFEC, IPHC and NMFS to estimate changes in vessel-specific (possibly permit holder-specific) and plant-specific revenues due to the introduction of IFQs in halibut and possibly sablefish. ADFG is required to provide all pertinent data to the PI in a timely fashion. Processor and harvester data confidentiality shall be maintained in accordance to ADFG standards.
2) Interview/survey processors concerning changes in markets and production costs. Processor data confidentiality shall be maintained in accordance to ADFG standards.
3) Estimate changes in processing quasi rents.
4) Attempt to form focus groups of harvesters to develop fishing cost of production data corresponding to vessel size classes delineated in the IFQ policy.
5) If item #4 is not feasible, evaluate any redistribution using items 1-3.

A report shall be prepared for ADFG that details the analysis and results. This report shall be delivered to ADFG one-year after signing this Work Statement.

Phase Two. The second phase of the study is conditional on acquisition/development of harvesting cost data and will be conducted only after mutual consent of PI and ADFG. The PI shall prepare a formal proposal to extend the analysis into the second phase of this project in which IFQ efficiency gains are to be estimated. It is conceivable that the fish ticket data provide sufficient insight into implied costs that a very simple survey of vessels could provide adequate variable cost data to estimate pre- and post-IFQ allocative efficiency changes. Variable costs are few (mainly bait, fuel and maintenance). Changes in crew numbers and crew shares also need to be determined.

1) Estimate change in technical efficiency.
2) Conduct vessel cost survey if this seems feasible.
3) Use a DEA or frontier estimation process, as described by Grafton *et al*. (2000) to estimate changes in allocative efficiency.
4) If data permits, an efficiency analysis may be possible that measures maximum possible efficiency gains from unconstrained quota trading. The difference between status quo post efficiency and efficiency without the various social constraints imposed by the Council design measures the opportunity cost the specific IFQ design.

A report shall be prepared for ADFG that details the analysis and results by the mutually agreed upon date specified in the phase two proposal.

I. Annual Total Revenue and Total Variable Processing Costs for Halibut and Separately for Sablefish: 1992, 1993, 1998, 1999, and 2000.

1. OWN PROCESSING: (Total Pounds as reported on AK Fish Ticket)

a. Shipped Fresh From Alaska: (Total Pounds as reported on AK Fish Ticket)

i. Total Revenue
ii. Total Raw Fish Cost
iii. State/Federal Fish Tax
iv. Total Variable Processing Cost (including any Custom Processing Fees paid to others)—see category definition below

b. Shipped Frozen From Alaska: (Total Pounds as reported on AK Fish Ticket)

i. Total Revenue
ii. Total Raw Fish Cost
iii. State/Federal Fish Tax
iv. Total Variable Processing Cost (including any Custom Processing Fees paid to others)—see category definition below

2. CUSTOM PROCESSING for another company: (Total Pounds as reported on AK Fish Ticket) *Please itemize pounds, all revenues and costs, by the buyer of your custom processed fish.*

a. Shipped Fresh From Alaska: (Total Pounds as reported on AK Fish Ticket)

i. Total Revenue (meaning the Custom Processing Fee charged)
ii. Total Raw Fish Cost (if you paid for the fish)
iii. State/Federal Fish Tax (if you paid the fish tax)
iv. Total Variable Processing Cost—see category definition below

b. Shipped Frozen From Alaska: (Total Pounds as reported on AK Fish Ticket)

i. Total Revenue (meaning the Custom Processing Fee charged)
ii. Total Raw Fish Cost (if you paid for the fish)
iii. State/Federal Fish Tax (if you paid the fish tax)
iv. Total Variable Processing Cost—see category definition below

II. Descriptions of Each Data Section:

General: Please follow the guidelines below for **each** plant location/ADFG buyer number, if appropriate. Be sure to identify firm name, location (port or at-sea) and buyer number, e.g., XYZ Inlet, #FXXXX. If for some reason you are unable to provide the data by plant/buyer number, please aggregate for your entire firm.

Data Section 1: OWN PROCESSING

Please report the total number of pounds processed into either fresh or frozen product forms *for your own finished product wholesale markets.* All quantities should be reported as the number of pounds recorded on the AK fish ticket.

Section 1.a and 1.b: Shipped Fresh/Frozen from Alaska
Sections 1.a and 1.b will require you to report the total amount of raw fish processed into fresh/frozen product forms. Please report all weights in terms of pounds recorded on the State of Alaska fish ticket.

Section 1.a.i and 1.b.i: Total Revenue
Please provide the total revenue (not per pound) from all products processed into fresh/frozen product forms, for your own markets.

Section 1.a.ii and 1.b.ii: Total Raw Fish Cost
Please report the total raw fish cost for the product processed into fresh/frozen product forms for your own use. Only the company whose name is on the fish ticket should report the Raw Fish Cost.

For example: If you purchase fish directly from a fisherman (even if they are offloading to someone who will custom process for you) and you use your fish ticket number to record the landing, then you would report the Raw Fish Cost to us. If you arrange to have product custom processed for you and the other company pays the fisherman and uses their fish ticket to record the landing, then you would not report the Raw Fish Cost to us.

Section 1.a.iii and 1.b.iii: State/Federal Fish Taxes
Report all state and federal fish taxes paid for fish purchased to be processed into fresh/frozen product forms for your own use, **IF** you used your fish ticket number to record the landing and purchase of the fish.

Section 1.a.iv and 1.b.iv: Total Variable Processing Costs
Please aggregate all variable processing costs incurred while processing raw fish into fresh/frozen product forms for your own use. Refer below for specific data to be included in this category. Remember, if you paid others a Custom Processing Fee, include the name of custom processor(s) and total raw fish weight as recorded on the fish ticket for each custom processor.

Data Section 2: CUSTOM PROCESSING for Another Company

Please report the total number of pounds processed into either a fresh or frozen product form *for fish that you **Custom Processed** for others.* Please identify each buyer and the associated total fish ticket pounds. Also, we ask that you identify each buyer and associated pounds as recorded on the AK fish ticket for each category below.

Section 2.a and 2.b: Shipped Fresh/Frozen from Alaska

Sections 2.a and 2.b ask you to report the total amount of raw fish processed into fresh/frozen product forms, by buyer. Please report all weights in terms of the pounds recorded on the AK fish ticket.

Section 2.a.i and 2.b.i: Total Revenue (Total Custom Fee)

Please report total revenue (not per pound) from all products Custom Processed into fresh/frozen product forms, by buyer.

Section 2.a.ii and 2.b.ii: Total Raw Fish Cost

For each buyer, please report the total cost of raw fish Custom Processed into a fresh/frozen product form. Only the company whose name is on the fish ticket should report the raw fish cost.

For Example: If you purchased the fish to be Custom Processed for someone else and use your fish ticket number, you would report the Total Raw Fish Cost to us. If you custom process fish for someone else that was reported using a fish ticket besides your own, then you would NOT report the Total Raw Fish Cost to us.

Section 2a.iii and 2.b.iii: State/Federal Fish Taxes

Report all state and federal fish taxes paid for fish purchased to be Custom Processed for others, **IF** you used your fish ticket number to record the landing and purchase of the fish. Please list by buyer name.

Section 2.a.iv and 2.b.iv: Total Variable Processing Costs

For each buyer, please aggregate all variable processing costs incurred while Custom Processing raw fish into fresh/frozen product forms for others. Please refer below for the information to be included in this category.

III. Definition of Total Variable Processing/Handling Costs to be Aggregated into a Single Value:

- **Custom Processing Fees Paid to Others:** Please include the name of the custom processor and total raw fish weight processed, as reported on the AK fish ticket.

- **Direct Processing/Handling Labor:** This includes wages, all employer taxes, all employer insurance contributions, and all retirement (401K) contributions by the employer). ***Do not include any management or salaried labor costs.***

- **Housing, Transportation, Food and Miscellaneous Costs for Direct Labor:** This category includes all employee expenses charged to the employer that are not covered under Direct Labor.

- **Packaging:** This includes "fiber", banding or strapping material, shrink-wrap, pallets, labels or anything else associated with the materials to enclose or ship finished product, including all freight north to the plant.

- **Freight Costs South or to Customer:** This category includes the cost of freight for the product only. Plants incur no freight costs on FOB sales.

- **Storage, Warehousing and Handling Costs:** Costs associated with storage of product away from a plant before sale.

DO NOT INCLUDE ANY FIXED/OVERHEAD COSTS IN THE AGGREGATED TOTAL VARIABLE COST CATEGORY. TOTAL VARIABLE PROCESSING COSTS INCREASE WITH POUNDS PROCESSED/SOLD.