Regression Analysis of Alaska Halibut and Sablefish QS Prices, 1995-1998

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Abstract

The quota shares issued to fishermen under the individual fisherman's quota programs started in the halibut and sablefish fixed gear fisheries off of Alaska in 1995 were permanently transferable. This report uses ordinary least squares regression to study some of the determinants of the prices for permanent transfers of quota share under these programs. The impacts on quota share prices of the vessel category for the quota share, whether or not the quota share are blocked, the numbers of quota share in blocked and unblocked transfers, the pounds of individual quota per quota share, and time are all examined.

Executive Summary

Permanent quota share (QS) transferability was an important part of the individual fisherman's quota (IFQ) programs which were introduced into the halibut and sablefish fixed gear fisheries off of Alaska in 1995 by the North Pacific Fisheries Management Council (NPFMC).

Transferability of permanent QS helped the NPFMC accomplish several program objectives. Fishermen were able to structure their operations in an efficient manner, consolidation of QS led to a reduction in the number of fishing operations, and QS holders were able to pass on QS within their families and preserve family traditions of commercial fishing.

Nevertheless, the NPFMC sought to constrain the QS markets in various ways to protect pre-existing social characteristics of the fishery. Separate QS were defined for different management areas and vessel classes. QS leasing was restricted. The block program which required some smaller packages of QS to be transferred as a single unit was introduced. Other limitations on transferability were introduced as well.

The QS price impacts of different factors, including some of these limitations on QS markets, were examined by using ordinary least squares (OLS) to regress QS prices in dollars per QS unit on a variety of explanatory variables. These explanatory variables included dummy variables for vessel classes, the natural logs of the numbers of blocked and unblocked QS transferred, a dummy variable indicating whether or not the QS were blocked, a variable for the ratio of pounds of IFQ to QS for the area and year of the observation ("standard" IFQ), a variable for the ratio of "the difference between the standard and actual IFQ for the transaction" to "the actual quota share units in the transaction," and quarterly dummy variables. Separate OLS regressions were run for halibut and sablefish transfer observations.

The regressions appeared to show that vessel class had little impact on QS price. Block status of QS did appear to be statistically significant; blocked QS sold for a lower price than unblocked QS. The number of QS in the package of QS being transferred also appeared to affect the QS price. Larger blocks commanded higher average QS prices. Interestingly, larger packages of unblocked QS also appeared to command higher average QS prices. The "package size" impact was smaller for unblocked QS than it was for blocked QS. The regressions indicated that the more pounds of IFQ that were associated with a given QS, the higher the average price for QS would be. QS prices appeared to vary by quarter. These results held for both halibut and sablefish QS.

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1.0 Introduction[1]

1.1 Purpose of this research

Permanent quota share (QS) transferability was an important part of the individual fisherman's quota (IFQ) programs which were introduced into the halibut and sablefish fixed gear fisheries off of Alaska in 1995 by the North Pacific Fisheries Management Council (NPFMC). QS holders were free to permanently transfer all or part of their holdings (subject to the "blocking" restrictions discussed below).[2]

The right to transfer QS led to active QS markets and to QS prices. This report uses "ordinary least squares" (OLS) regression models to study the factors causing variation in halibut and sablefish QS prices across QS types. The study of QS prices is important for several reasons:

> QS is valuable. The cost of QS is an important part of the cost of access to the fishery. It is an important capital asset for those who hold it.
>
> The IFQ program "blocked" a large part of the QS. This program rule, which i described below, was meant to reduce the price of some QS to make it easier for less highly capitalized, part-time fishermen to enter the fishery. The first step in determining if these rules worked is learning if blocked QS had lower prices per QS unit than unblocked QS.
>
> QS are differentiated by vessel category. The intent of the rule was to help maintain the pre-existing fleet configuration. If the vessel category rules are binding and QS in an area is being prevented from flowing from vessels of one category to vessels of another, the prices per unit of QS in the area may differ depending on the vessel class of the QS. This analysis can shed light on how prices for QS units vary depending on the vessel category of the QS.
>
> QS has been divided among a large number of management areas and vessel class categories. There are eight halibut management areas and four vessel classes and there are six sablefish management areas and three vessel classes.[3] Each management area and vessel class combination has a different type of QS.

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[1] Kurt Schelle, Manager of Research and Planning at the Alaska Commercial Fisheries Entry Commission, provided many helpful suggestions during the preparation of this report. He is not, however, responsible for any errors in it.

[2] Leasing of QS was also permitted during the first three years of the program under certain conditions. However, this report only examines prices generated in permanent QS sales.

[3] QS were only issued for 30 of the 32 halibut area and vessel class combinations.

However, the markets for some QS types are thin making it hard to report QS prices for some management area and vessel category combinations. A model of QS price determination may make it possible to fill in some of the gaps in reported average prices.[4]

1.2 *Transferability rules*

Transferability helped accomplish a number of the NPFMC's objectives for the IFQ program. The ability to transfer QS gave fishermen flexibility to structure their operations the way they wanted. QS holders could pass their QS on to their children or other family members who wanted a fishing career. The use of private contracting to reallocate QS through time also reduced the administrative burdens that might otherwise have been imposed on the program.

Perhaps most important, the reduction in the number of QS holders through the permanent transfer of QS and consolidation of QS holdings was seen as an important way to meet the goals of the program. Effort would be reduced by private contracting. Market forces would move QS to the hands of the persons who could use it most effectively.

However, while the NPFMC wanted to reduce and rationalize fishing capacity and effort, it also wanted to constrain the consolidation and protect important pre-IFQ characteristics of these fisheries. This led the NPFMC to add restrictions on the transferability of QS under the program. Restrictions were added to prevent excessive consolidation of QS, to keep prices on some QS relatively low to preserve opportunities for part-time fishermen, to promote an owner-operated fishery, and to help maintain the preexisting distribution of landings among vessels of different classes.

In one of the most important of these restrictions, separate QS were issued in each of eight halibut management areas and six sablefish management areas. The QS issued for one management area could not be used for fishing in another management area. The halibut and sablefish management areas used for the division of the total allowable catch (TAC) among areas were the areas that had been used before the start of the IFQ program. Use of these areas meant that the harvest of halibut would remain distributed along the coast of Alaska and could not become concentrated regionally under individual quotas.

Vessel classes were another important restriction. Within the different management areas QS was assigned to different vessel classes. There were four halibut vessel

[4] The regressions reported in this paper were used for this purpose in the reports on the halibut and sablefish QS programs in 1995-98 prepared by the Alaska Commercial Fisheries Entry Commission in 1999. See Dinneford, *et al.* (Halibut) and Dinneford *et al.* (Sablefish).

classes: harvester-processor vessels, catcher vessels over 60 feet long, catcher vessels from 36 to 60 feet long, and catcher vessels 35 feet and under. There were three sablefish vessel classes: harvester-processor vessels, catcher vessels over 60 feet, and catcher vessels less than or equal to 60 feet.

QS issued for one of these vessel categories could not generally be fished in one of the other vessel categories within the management area. There were exceptions to this. In some areas "CDQ compensation" QS was issued to compensate some QS holders for reductions in available TACs in other areas[5] . When a person was issued catcher vessel "CDQ compensation" QS in an area where the person had not fished before, that QS could be fished in any catcher vessel class and it was permanently assigned to a catcher vessel class on its first transfer. Also, in August 1996 a "fish-down" rule became effective which allowed persons with QS for larger catcher vessels to fish it from smaller catcher vessels in certain situations.[6]

The programs also created non-severable "blocks" of QS that constrain QS aggregation. Persons received their QS in a block at initial allocation if their QS would have resulted in less than 20,000 pounds of halibut or sablefish IFQ given 1994 TACs for these species and the total QS in the area as of October 17, 1994. Blocks can't be broken up for sale, meaning all the QS in a block has to be sold as a single unit. A person can hold no more than two blocks in an area, and a person with two blocks cannot hold any unblocked QS for the area. During 1995 and most of 1996 the regulations allowed persons to combine, or "sweep-up," more than two blocks if their combined total was less than 1,000 pounds of halibut or 3,000 pounds of sablefish. These limits were changed to 3,000 pounds of halibut and 5,000 pounds of sablefish in December, 1996.[7]

Not everyone can buy catcher vessel QS. Only persons who were originally issued catcher vessel QS or those who qualify as IFQ crew members by working for 150 days on the harvesting crew in any U.S. fishery may buy catcher vessel QS. Purchases of harvester-processor vessel QS are not restricted in this way. [8]

The only corporations or partnerships that may purchase more catcher vessel QS are those that were initial QS recipients, except in halibut Area 2C and the Southeast sablefish area, where corporations and partnerships may only use QS that they were initially issued. An exception to these rules occurs when an individual transfers his/her own QS to his/her solely owned corporation. [9]

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[5] In some halibut and sablefish areas parts of the TAC were set aside for Community Development Quotas (CDQs). These parts of the TAC were unavailable for division between quota share holders in those areas. In order to share the burden of the CDQs among all of the persons with QS, persons in areas with CDQs were given compensatory QS in management areas without CDQs.

[6] Dinneford, *et al.*, (Halibut), pages 18-19; Dinneford, *et al.*, (Sablefish), pages 18-19.

[7] Dinneford, *et al.*, (Halibut,) page 18, and Dinneford, *et al.*, (Sablefish), page 18.

[8] Dinneford, *et al.*, (Halibut,)page 17, and Dinneford, *et al.*, (Sablefish), page 17.

[9] Dinneford, *et al.*, (Halibut, p)age 18, and Dinneford, *et al.*, (Sablefish), page 17-18.

In 1995 and 1996, persons could not use, individually or collectively, more than 1% of the QS in halibut Area 2C, more than a half a percent of the QS in halibut Areas 2C, 3A, 3B, combined, or more than half a percent of the QS in halibut areas 4A, 4B, 4C, 4D, and 4E combined. In March 1997 changes became effective that lifted the 4A, 4B, 4C, 4D and 4E cap to 1.5% and which converted the caps from percentages to numbers of QS. Similarly, persons could not use more than 1% of the sablefish QS in the Southeast area, or more than 1% of all the sablefish QS in all areas. The rules allowed some initial allocations to some initial issuees to exceed some of these restrictions, but these persons were prevented from accumulating more QS. [10]

2.0 Research Methodology

Ordinary least squares (OLS) linear regression was used to estimate the parameters of a linear equation relating a set of explanatory variables to the price of a QS unit, measured in dollars per unit of QS.[11] Separate models were estimated for halibut and for sablefish. The signs, magnitudes, statistical properties of the parameter estimates, and the statistical properties of the regression equation as a whole, were then examined. The results from these regressions were incorporated into the analyses in the reports on the IFQ programs.[12]

The halibut regression was run using observations from Areas 2C, 3A, 3B, and 4A. Since there were relatively few observations available from Areas 4B, 4C, 4D, and 4E, these latter areas were not used in the regression analysis. Similarly, the sablefish regression was run on observations from the Southeast, West Yakutat, Central Gulf, and Western Gulf Areas. Observations from the Aleutian Islands and Bering Sea Areas were not used for the same reason that observations from Areas 4B to 4E were not used in the halibut regression.

The explanatory variables included variables representing each vessel class, a variable indicating whether or not the QS was blocked, variables indicating the size of blocks and the amounts of unblocked QS included in the transfer, variables indicating the current year pounds of IFQ included per QS unit, and variables indicating within which of the sixteen quarters during the four years the transfer took place. As noted, separate sablefish and halibut models were run using observations from four separate management areas. This approach may have missed possibly important area-specific

[10] Dinneford, *et al.*, (Halibut), page 18; Dinneford, *et al.*, (Sablefish), page 18. Some exceptions to the caps were made for initial issuees.

[11] The SAS "Reg" procedure was used for this analysis.

[12] See Dinneford, *et al.*, (Halibut), pages 43-51; Dinneford, *et al.*, (Sablefish), pages 50-60.

differences in coefficient estimates on some variables. The vessel class variables and the quarterly variables are most likely to have been affected by this.[13]

The following Section 2.1 describes the variables used in the analysis, while Section 2.2 describes the nature of the observations. Chapters 3 and 4 discuss the results of the halibut and sablefish price regressions.

2.1 *Variables used to explain QS prices*

Price of QS

The dependent variables in the halibut and sablefish regressions are the prices per unit of halibut and sablefish QS in dollars per QS unit. These were constructed from the data set using information on the gross value of the transfer and the amount of QS units transferred.

Vessel classes

The vessel class of the QS could affect the price of a QS unit. Harvester-processor and catcher vessels may produce different products. Catcher vessels of different sizes may produce in different volumes for different markets or different marketing channels. Catcher vessel size could also affect operating behavior, including ability to operate in different weather conditions, fixed costs, variable material costs, and vessel, skipper, and other crew shares. It was unclear, before the regression analysis, how these considerations would affect the relative prices of QS.

The catcher vessel size categories may have been designed to preserve the initial allocation of QS among the categories. If large catcher vessels could make better use of QS, the absence of vessel classes would have meant that the QS fished by small vessels could have been gradually transferred to the larger vessels. The use of catcher vessel size classes limits the extent to which QS may be transferred to the larger catcher vessels. If the size classes are preventing transfers that would take place in their absence, larger vessel classes should have higher QS prices.

Dummy variables were used extensively in this regression analysis. A dummy variable is a variable that takes a value of one if a condition holds, and a value of zero if that condition does not hold.

The influence of vessel class on QS prices was examined with dummy variables. There were four halibut vessel classes and three sablefish vessel classes. When several mutually exclusive factors are represented by dummy variables, one of them is left out.

[13] This approach was used because it simplified the modeling of quarterly prices.

This is necessary to prevent perfect collinearity between explanatory variables. In each management area, the harvester-processor vessel class dummy variable was left out. The influence of this dummy is reflected in the intercept terms. The coefficient estimates on the remaining vessel class coefficients show the difference in average price between harvester-processor vessels and different catcher vessel classes.

Blocks

As noted earlier, the halibut and sablefish individual quota programs contained "blocking" features. All initial allocations of QS that translated into less than 20,000 pounds of hypothetical IFQ for an area were placed into a single block. Under the program rules, blocked halibut QS must be sold as a unit and, even when catcher vessel blocked QS could be leased, leases were often impossible because of the 10% leasing restriction.[14] In addition, a person is only allowed to hold two blocks of QS in an area. If a person holds any unblocked QS in the area, then the person is only allowed to hold one block of QS.

The purpose of the blocking provision was to make a portion of the QS relatively unattractive to persons who wanted to put together more full-time operations. It was hoped that the block provisions would ensure there would always be QS available to a part-time fleet of small operators. Proponents felt this would help maintain some of the diversity of the fleet that existed under open access and thereby make the IFQ program less disruptive to isolated Alaska fishing communities. Proponents also predicted that the blocked QS would sell for a lower price per QS unit and hence would be more affordable for a fleet of small part-time operators, as well as new entrants to the fishery.

QS blocking was captured by a dummy variable that took a value of one if the observation is from blocked QS and zero otherwise.

Block size

Larger blocks with more QS can provide potential economies of scale to fishing operations. It has generally been expected that larger blocks would have a higher average price per QS unit.

It was hypothesized that the amount of QS in a block and the price of the average QS would have a natural logarithmic, rather than a linear, relationship. In the logarithmic relationship the price is assumed to increase at a decreasing rate as the amount of QS

[14] Although this restriction was less of a concern after September 1996 when rules were introduced to allow leasing of IFQ separately from QS. These new rules were introduced explicitly to address this problem. *Federal Register* 61(155):41523-41526. August 9, 1996. The leasing provisions of the IFQ program expired at the end of 1997, and have not been renewed. See Dinneford, *et al.*, (Halibut), page 61; Dinneford, *et al.*, (Sablefish), page 53.

increases. With the linear relationship the average price of a QS continues to increase at the same rate as each additional QS unit is added. If the linear relationship is adopted, as each additional QS unit is added it increases the value of each QS in the package by the same amount. As the amount of QS gets larger, the total additional value associated with each additional QS will also continue to get larger.[15] The logarithmic assumption offsets this since each additional QS increases average QS values by a smaller amount. While each additional QS increases the value of the package, at some point the increase in value would come very close to zero.[16]

The size of the block was represented by a variable that took the value of the natural logarithm of the amount of QS in the block if the QS was blocked, and zero otherwise.

Size of unblocked transfer

Buyers may also be willing to pay a premium for unblocked QS, sold as part of a larger package of QS, than for unblocked QS sold as part of a smaller package. Since units of unblocked QS can be bought and sold independently of each other, there is not a clear operational reason for higher average QS prices in larger transfers. However, including a larger amount of QS in any given transaction may reduce the transaction costs per QS unit. These lower transaction costs may be reflected in larger average QS prices.

The natural logarithmic relationship used for testing the effect of block size on average QS price was also used for this variable for the same reasons. The size of the package of unblocked QS was represented by a variable that took the value of the natural log of the amount of QS in the package if the QS was unblocked, and zero otherwise.

Standard pounds of IFQ per QS unit

The pounds of IFQ per unit of QS in a transfer could differ for two reasons. First, the standard pounds of IFQ per QS unit varied by management area and by year. In each area and year there was a given standard ratio of pounds of IFQ per QS unit that held for all persons with QS in that area and year. Second, there are factors that might affect each individual transaction separately, so that the actual pounds of IFQ per QS unit transferred in two transactions in the same area and year (and with the same standard allocation) might still differ.

The standard pounds of IFQ per QS unit differ between areas and years. The data for this variable from the areas used in the regression analysis may be found in Table 4 in the appendix. Table 4 shows the extent of the variation. For example, in the halibut fishery, the pounds of IFQ per unit of QS ranged from a low of 0.068 in Area 3B in 1995 and 1996 to a high of 0.241 in Area 4A in 1998. In the sablefish fishery the

[15] The "marginal value" of each additional QS would be increasing.

[16] Since QS holders have the option of "free disposal" of excess QS (by not fishing them) it was not expected that "too many" QS would actually reduce the value of the package.

pounds of IFQ per unit of QS ranged from a low of 0.090 in the West Yakutat and Western Gulf areas in 1998 to a high of 0.19 in the Southeast area in 1995.[17]

Prices per QS unit were expected to be positively related to the pounds of IFQ transferred because the current year IFQ generate the current year's income from holding the QS. Moreover, the pounds of current-year IFQ per QS unit enter into expectations of the value of a QS unit in pounds of IFQ for future years.

Deviation from standard pounds per QS unit

Each individual observation could deviate from the standard pounds of IFQ per unit of QS for the area and year. There were two reasons for this.

First, starting in 1996, the pounds of IFQ were adjusted for each QS holder to reflect overages and underages during the previous year. If a fisherman exceeded his IFQ by 10% or less, the overage would be deducted from his IFQ allotment for the following year. Persons could also fail to harvest up to 10% of a year's IFQ and would see that underage carried over as an increase in their IFQ allotment the following year. These underages and overages followed the QS when it was transferred.[18]

Second, fishermen may sell their QS with only part (or none) of the current year IFQ associated with that QS. For example, they may fish their current year IFQ and then sell the QS with no current year IFQ.

This "individual observation" effect was captured with a variable that was the ratio of "the difference between the standard pounds of IFQ and the actual pounds of IFQ transferred" to "QS units transferred." An under harvest transferred from the prior year could cause the actual pounds to be greater than the standard. This would produce a negative value in the numerator, but would be associated with a relatively high QS price. Similarly, if fewer pounds were transferred than the standard, the numerator would be positive, but the QS price would be relatively lower. These considerations imply a negative relationship between this variable and QS price.

Year and quarter

Any number of events could cause QS prices to rise or fall between 1995 to 1998. Halibut and sablefish prices could change due to changes in world demand, or information about future area TACs could change.

Dummy variables were used to indicate the quarter within which each transaction took place. Dummy variables were introduced for each quarter from the 2nd through the 16th. The first quarter was reflected in the value of the intercept. The coefficient

[17] Dinneford, *et al.*, (Halibut), page 6; Dinneford, *et al.*, (Sablefish), page 6.
[18] Dinneford, *et al.*, (Halibut,) page 202; Dinneford, *et al.*, (Sablefish), page 183.

estimates for these quarterly dummy variables showed the difference in average price between the first quarter and each of the other quarters.

2.2 *Data set*

The data set consisted of observations on priced permanent QS transfers from 1995 through 1998. A transfer observation contains information on a single transfer of QS between a single transferee and a single transferor. If one QS holder sold QS to two or more buyers in a single, complicated, transaction, each sale would appear as a separate transaction (or observation).

Each observation contained information on the date of the transaction, the amount of QS transferred, and the amount of IFQ transferred with the QS. Additional information included the value paid for the QS, the relationship between the persons selling and buying the QS, how they located each other, and sources of financing.

Permanent transfer observations were only selected for the analysis if they were priced. There are many reasons why a permanent transaction record might not have price information. The QS might not have been priced because it was received as a gift or in a trade. Prices might have been too complicated to calculate if the QS was involved in a package sale with a vessel and gear, or the QS was exchanged in return for a claim on an operation's revenues or profits.

Observations were only used from four (2C, 3A, 3B, and 4A) of the eight management areas for which halibut QS was issued, and from only four (Southeast, West Yakutat, Central Gulf, and Western Gulf) of the six areas for which sablefish QS was issued.

In addition, observations with prices below $0.05 per QS unit and above $3.00 per QS unit were excluded from the analyses. This was done to eliminate certain outliers. This rule eliminated 17 halibut observations, leaving 3,486, and eliminated 15 sablefish observations, leaving 953.

3.0 Halibut regression results

The regression results are outlined in Table 2. Table 1 contains summary descriptions of the variables.

The regression had an adjusted coefficient of determination (adjusted R squared) of 0.56, meaning that it accounted for 56% of the variation in the price of a unit of halibut QS. The F statistic was very large indicating that the regression, taken as a

whole, was statistically significant. Many of the explanatory variables were statistically significant - some strongly so. Variables had the signs expected of them.

None of the dummy variables for the three catcher vessel classes were statistically significant; one of the coefficients had a negative sign while the other two were positive. Thus there was little indication that the prices for catcher vessel QS differed from those for freezer vessel QS.

The variable indicating whether or not QS was blocked had the expected sign and was statistically significant. Blocked QS sold for a smaller amount per QS.

The variable showing, for blocked QS, the amount of QS in the block, had a strongly statistically significant, positive value: as expected. This indicates that the price per QS unit in a block is strongly related to the size of the block itself.

The coefficient of the variable showing, for unblocked QS, the amount of QS included in the unblocked transfer also had a positive sign. This coefficient had a smaller magnitude than the coefficient on the block size variable and was not as strongly statistically significant. This indicates that the effect was weaker than it was for the blocked QS. This makes sense since, as noted earlier, small amounts of unblocked QS can be bought to make up any desired holdings size. The higher price per QS unit for larger transactions may reflect lower transactions costs associated with the purchase and sale of QS units in larger amounts.

The variable showing the standard pounds of IFQ per QS unit had a positive sign and was strongly statistically significant. QS units had a higher value in areas where the pounds of IFQ per QS unit were higher and a higher value in years when the pounds of IFQ per QS unit were higher. The more current poundage conveyed by a QS unit the greater its value.

The coefficient on the variable "deviation from standard pounds per QS" had the expected negative sign and was statistically significant. This tended to confirm the result from the coefficient on the previous variable: the more current poundage of IFQ conveyed by a QS unit, the greater its value.

The quarterly dummy variables suggest that, abstracting from the factors dealt with above, in 1995 prices began to drop from the first quarter to the third, and thereafter began to rise through the fourth quarter of 1996. Prices fell in the first quarter of 1997, rose through the end of 1997, and then fell during each quarter in 1998.

Table 1. Summary of Variables Used in the Regression Analyses

Variable Name	Variable Title	Brief Description
PRICEQS	QS price	This is the price of QS in dollars per QS unit. This is the dependent variable.
BB, CC, DD	dummy variable for vessel class	These variables had different meanings for halibut and sablefish since there were different vessel classifications in these fisheries. For halibut, BB was a dummy variable for catcher vessels over 60 feet, CC was for catcher vessels from 35 feet to 60 feet, and DD was for catcher vessels up to and including 35 feet. For sablefish, BB were for catcher vessels over 60 feet, and CC were for catcher vessels up to an including 60 feet. There was no sablefish DD catcher vessel class.
LOG_QS_B	the natural log of the amount of blocked QS transferred	Prices were hypothesized to be higher for QS in larger blocks. This variable was assigned a value of zero for unblocked QS
LOG_QS_U	the natural log of the amount of unblocked QS transferred	Prices were also hypothesized to be larger for QS in larger unblocked transactions. This variable was assigned a value of zero for blocked QS
BLOCK	a dummy variable indicating whether or not QS was blocked	QS in blocks were assumed to have lower prices, all other things equal. This dummy variable took on a value of one if the QS in the transaction was blocked, and a value of zero if it was not.
SWGT_QS	standard pounds of IFQ per QS unit	This is the ratio of pounds of IFQ per QS unit for the area and year. This is the inverse of the standard ratios published by NMFS-RAM. This variable has the same value for all transactions in an area during a year. Information about this variable is in Table 4 in the Appendix.
XWGT_QS	ratio of "the difference between the standard pounds of IFQ and the actual number of pounds of IFQ transferred" to "QS units transferred"	The numerator of this ratio is the difference between the standard IFQ associated with the QS being transferred in the transaction, and the actual pounds of IFQ being transferred in the transaction. The denominator is the number of units of QS being transferred in the transaction.
Q_95_2, Q_95_3....Q_98_4	separate dummy variables for the 2nd through the 16th quarters of the four-year time period	Dummy variables were introduced for each quarter except the first. These variables were intended to capture quarterly price changes due to changes in market conditions relative to the first quarter of 1995.

Table 2. Halibut QS Price Model. SAS OLS Results

Dependent Variable: PRICEQS

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	366.10844	15.91776	193.939	0.0001
Error	3462	284.14816	0.08208		
C Total	3485	650.25660			

Root MSE	0.28649	R-square	0.5630
Dep Mean	1.04273	Adj R-sq	0.5601
C.V.	27.47491		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-0.207648	0.07425158	-2.797	0.0052
BB	1	-0.022493	0.04719804	-0.477	0.6337
CC	1	0.066605	0.04620825	1.441	0.1496
DD	1	0.016011	0.04716367	0.339	0.7343
LOG_QS_B	1	0.082536	0.00478698	17.242	0.0001
LOG_QS_U	1	0.038889	0.00461253	8.431	0.0001
BLOCK	1	-0.682220	0.06382191	-10.689	0.0001
SWGT_QS	1	7.093652	0.18607190	38.123	0.0001
XWGT_QS	1	-0.440733	0.10459385	-4.214	0.0001
Q_95_2	1	-0.031481	0.03095620	-1.017	0.3092
Q_95_3	1	-0.053070	0.03351428	-1.584	0.1134
Q_95_4	1	-0.009119	0.03501867	-0.260	0.7946
Q_96_1	1	-0.012660	0.03306062	-0.383	0.7018
Q_96_2	1	0.053804	0.03050450	1.764	0.0779
Q_96_3	1	0.108996	0.03308485	3.294	0.0010
Q_96_4	1	0.196553	0.03621192	5.428	0.0001
Q_97_1	1	0.066671	0.03304263	2.018	0.0437
Q_97_2	1	0.228481	0.03202509	7.134	0.0001
Q_97_3	1	0.302770	0.03514808	8.614	0.0001
Q_97_4	1	0.402318	0.03560879	11.298	0.0001
Q_98_1	1	0.360638	0.03672406	9.820	0.0001
Q_98_2	1	0.103660	0.03649466	2.840	0.0045
Q_98_3	1	0.025288	0.04965457	0.509	0.6106
Q_98_4	1	-0.160063	0.04407973	-3.631	0.0003

4.0 Sablefish regression results

The sablefish regression results are outlined in Table 3. The variables themselves are defined in Table 1.

The regression had an adjusted coefficient of determination (adjusted R squared) of 0.40, meaning that it accounted for 40% of the variation in the price of sablefish QS. The F statistic was large indicating that the regression, taken as a whole, was statistically significant. Many of the explanatory variables were statistically significant - some strongly so. Variables had the signs expected of them.

Neither of the catcher vessel coefficients was statistically significant; one had a positive sign while the other had a negative sign. Thus the results did not indicate any significant difference between the price for freezer vessel QS and the prices for catcher vessel QS.

The variable indicating whether or not QS was blocked had the expected sign and was statistically significant. Blocked QS sold for a smaller amount per QS.

The coefficient of the variable showing, for a block transfer, the amount of QS in the block, had a statistically significant, positive value. This indicates that the price per unit of QS in a block is strongly related to the size of the block itself.

The coefficient of the variable showing, for an unblocked transfer, the amount of QS included in the unblocked transfer, also had a positive sign. This coefficient had a smaller magnitude than the coefficient on the block size variable and was not as strongly statistically significant. This indicates that the effect was weaker than it was for the blocked QS. This makes sense since, as noted earlier, small amounts of unblocked QS can be bought to make up any desired holdings size. The higher price per QS unit for larger transactions may reflect lower transactions costs associated with the purchase and sale of QS units in larger amounts.

The variable showing the standard pounds of IFQ per QS unit had a positive sign and was strongly statistically significant. QS units had a higher value in areas where the pounds of IFQ per QS unit were higher and a higher value in years when the pounds of IFQ per QS unit were higher. The more current pounds of IFQ conveyed by a QS the greater its value.

The coefficient on the variable "deviation from standard pounds per QS" had the expected negative sign. Unlike the corresponding coefficient in the halibut model, this coefficient was not statistically significant.

The quarterly dummy variables suggest that, abstracting from the factors dealt with above, prices rose in the first quarter of 1995 and then fell for the next two quarters. Prices then appear to have risen through the third quarter of 1997. Prices fell in the fourth quarter of 1997, recovered in the first quarter of 1998, but then fell during the following three quarters.

Table 3. Sablefish QS Price Model. SAS OLS Results

Dependent Variable: PRICES

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	22	47.45575	2.15708	29.848	0.0001
Error	930	67.21005	0.07227		
C Total	952	114.66580			

Root MSE	0.26883	R-square	0.4139
Dep Mean	0.93253	Adj R-sq	0.4000
C.V.	28.82780		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-0.889792	0.11964908	-7.437	0.0001
BB	1	-0.015542	0.03785917	-0.411	0.6815
CC	1	0.060899	0.03584858	1.699	0.0897
LOG_QS_B	1	0.056702	0.00785955	7.214	0.0001
LOG_QS_U	1	0.022964	0.00542397	4.234	0.0001
BLOCK	1	-0.476664	0.09254191	-5.151	0.0001
SWGT_QS	1	9.678396	0.50957822	18.993	0.0001
XWGT_QS	1	-0.220475	0.21273531	-1.036	0.3003
Q_95_2	1	0.137353	0.05295723	2.594	0.0096
Q_95_3	1	0.093024	0.06034301	1.542	0.1235
Q_95_4	1	-0.065403	0.08118331	-0.806	0.4207
Q_96_1	1	0.359454	0.06406049	5.611	0.0001
Q_96_2	1	0.363520	0.05691225	6.387	0.0001
Q_96_3	1	0.404011	0.06392965	6.320	0.0001
Q_96_4	1	0.404429	0.07666205	5.275	0.0001
Q_97_1	1	0.502303	0.06539622	7.681	0.0001
Q_97_2	1	0.606892	0.06308056	9.621	0.0001
Q_97_3	1	0.837017	0.06650216	12.586	0.0001
Q_97_4	1	0.774390	0.06866414	11.278	0.0001
Q_98_1	1	0.857139	0.06876020	12.466	0.0001
Q_98_2	1	0.661885	0.07211050	9.179	0.0001
Q_98_3	1	0.476553	0.09998659	4.766	0.0001
Q_98_4	1	0.376982	0.09392799	4.014	0.0001

5.0 Sources

Dinneford, Elaine, Kurt Iverson, Ben Muse and Kurt Schelle. *Changes Under Alaska's Halibut IFQ Program, 1995 to 1998* Alaska Commercial Fisheries Entry Commission. Juneau: November, 1999.

Dinneford, Elaine, Kurt Iverson, Ben Muse and Kurt Schelle. *Changes Under Alaska's Sablefish IFQ Program, 1995 to 1998* Alaska Commercial Fisheries Entry Commission. Juneau: November, 1999.

6.0 Appendix, data on pounds of IFQ per QS unit

Table 4, below, contains data on the pounds of IFQ per QS unit for each management area and year. IFQ per QS, taken to six significant digits, are used in the regression models as "standard pounds of IFQ per QS unit" or SWGT_QS. As noted in Table 1, this variable is the inverse of the standard ratio of QS units per pound of IFQ published each year by the National Marine Fisheries Service, Restricted Access Management (NMFS-RAM). The NMFS-RAM data on QS units per pound of IFQ were taken from CFEC reports on the operations of the individual quota programs in the halibut and sablefish fisheries.[19]

Table 4. Pounds of IFQ per QS Unit by Area and Year

Species	Area	Year	QS per IFQ	IFQ per QS
Halibut	2C	95	6.650	0.150
		96	6.664	0.150
		97	5.910	0.169
		98	5.672	0.176
	3A	95	9.291	0.108
		96	9.304	0.107
		97	7.397	0.135
		98	7.112	0.141
	3B	95	14.712	0.068
		96	14.731	0.068
		97	5.990	0.167
		98	4.900	0.204
	4A	95	7.622	0.131
		96	7.649	0.131
		97	4.933	0.203
		98	4.144	0.241
Sablefish	Southeast	95	5.277	0.190
		96	6.654	0.150
		97	8.202	0.122
		98	8.578	0.117
	West Yakutat	95	6.431	0.155
		96	8.678	0.115
		97	10.536	0.095
		98	11.100	0.090
	Central Gulf	95	7.309	0.137
		96	9.211	0.109
		97	9.800	0.102
		98	9.960	0.100
	Western Gulf	95	8.138	0.123
		96	9.682	0.103
		97	10.949	0.091
		98	11.103	0.090

[19] Dinneford, *et al.*, (Halibut), page 6; Dinneford *et al.* (Sablefish), page 6.