Regression Analysis of Alaska Halibut and Sablefish QS Prices, 1995-1997

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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 is 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 is being prevented from flowing from vessels of one category to another, the prices per unit of QS in an 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. However, the markets for some QS types are thin making it hard to report QS prices for some management area and vessel category

[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.

combinations. A model of QS price determination may make it possible to fill in some of the gaps in reported average prices with estimated 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 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

[4] The regressions reported in this paper were used for this purpose in the reports on the halibut and sablefish QS programs in 1995-97 prepared by the Alaska Commercial Fisheries Entry Commission in 1998. See Dinneford, *et al.* (Halibut) and Dinneford *et al.* (Sablefish).

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 new "buy-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.

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. 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. There were relatively few observations available from Areas 4B, 4C, 4D, and 4E. These latter areas were not used in the regression analysis since the objective was to use the regression results to estimate prices for Areas 2C to 4A. 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 reasons 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 twelve quarters during the three years the transfer took place. As noted, both the sablefish and halibut models were run using observations from four separate management areas. This approach may have missed possibly important area-specific 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]

[10] Dinneford, *et al.*, (Halibut), page 18; Dinneford, *et al.*, (Sablefish), page 18.
[11] The SAS "Reg" procedure was used for this analysis.
[12] See Dinneford, *et al.*, (Halibut), pages 48-56; Dinneford, *et al.*, (Sablefish), pages 43-51.
[13] This approach was used because it simplified the modeling of quarterly prices - the ultimate goal of the regression analysis.

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. Typically when several mutually exclusive factors are represented by dummy variables, one of them is left out. 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. They hoped 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 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

[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 57; Dinneford, *et al.*, (Sablefish), page 53.

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 transactions 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 0.203 in Area 4A in 1997. 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 0.091 in the Western Gulf area in 1997 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. If he exceeded his IFQ by more than 10%, his allotment for the following year would be reduced by an amount equal to 10% of his previous year's IFQ (the balance of the harvest would have been confiscated the previous 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 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 this 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 from 1995 to 1997. Halibut and sablefish prices could change due to changes in world demand, or information about the future area TACs could change.

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[17] Dinneford, *et al.*, (Halibut), page 6; Dinneford, *et al.*, (Sablefish), page 6.
[18] Dinneford, *et al.*, (Halibut,) page 192; Dinneford, *et al.*, (Sablefish), page 175.

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 12th. The first quarter was reflected in the value of the intercept. The coefficient 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 during 1995, 1996, and 1997. 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 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 15 halibut observations, leaving 3,028, and eliminated 11 sablefish observations, leaving 818.

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 (R squared) of 0.58, meaning that it accounted for 58% 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.

The dummy variables for the three catcher vessel classes were all positive, but only one, that for catcher vessels from 36 to 60 feet, was statistically significant. Thus there is some indication that QS prices were higher for catcher vessels, but this is only a strong indication in the case of the catcher vessels from 36 to 60 feet.

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 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 and then rose in each period after that. Overall, price rises were more frequent than drops, and of a higher aggregate magnitude, so that prices ended the three year period higher than they were when they started.

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. The observations for this variable are in the Appendix in Table 4.
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 begin 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_97_4	separate dummy variables for the 2nd through the 12th quarters of the three-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	19	304.27635	16.01454	219.391	0.0001
Error	3008	219.57023	0.07300		
C Total	3027	523.84658			

Root MSE	0.27018	R-square	0.5809
Dep Mean	1.00293	Adj R-sq	0.5782
C.V.	26.93876		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-0.176873	0.07373576	-2.399	0.0165
BB	1	0.031612	0.04649991	0.680	0.4967
CC	1	0.090903	0.04538783	2.003	0.0453
DD	1	0.051487	0.04635243	1.111	0.2668
LOG_QS_B	1	0.084875	0.00489434	17.341	0.0001
LOG_QS_U	1	0.025620	0.00473992	5.405	0.0001
BLOCK	1	-0.835958	0.06601968	-12.662	0.0001
SWGT_QS	1	7.677650	0.19613477	39.145	0.0001
XWGT_QS	1	-0.406147	0.11010110	-3.689	0.0002
Q_95_2	1	-0.033104	0.02920663	-1.133	0.2571
Q_95_3	1	-0.054834	0.03163841	-1.733	0.0832
Q_95_4	1	-0.038208	0.03338926	-1.144	0.2526
Q_96_1	1	-0.013854	0.03125577	-0.443	0.6576
Q_96_2	1	0.044998	0.02884765	1.560	0.1189
Q_96_3	1	0.110072	0.03124873	3.522	0.0004
Q_96_4	1	0.198550	0.03427891	5.792	0.0001
Q_97_1	1	0.045711	0.03135759	1.458	0.1450
Q_97_2	1	0.203976	0.03041042	6.707	0.0001
Q_97_3	1	0.281682	0.03330947	8.457	0.0001
Q_97_4	1	0.375546	0.03396970	11.055	0.0001

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 (R squared) of 0.41, meaning that it accounted for 41 % 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.

The price for the large catcher vessel QS was not distinguishable from that for harvester-processor vessel QS. The magnitude of the coefficient on the dummy variable was very small, and the coefficient estimate was not statistically significant. The coefficient on the small catcher vessel QS was positive and statistically significant, suggested that small catcher vessel QS was selling at a higher price than harvester-processor vessel QS or large catcher vessel QS. This was not expected.

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 to have 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 prices rose in the first quarter of 1995 and then fell for the next two quarters. In 1996 and 1997 prices appear to have risen in the first three quarters and then fallen slightly in the fourth quarter. On balance, price increases were more frequent than declines, and of a higher aggregate magnitude, so that prices ended the three year period higher than they were when they started.

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	18	39.66114	2.20340	31.896	0.0001
Error	799	55.19612	0.06908		
C Total	817	94.85726			

Root MSE	0.26283	R-square	0.4181
Dep Mean	0.92976	Adj R-sq	0.4050
C.V.	28.26909		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-0.925210	0.12362929	-7.484	0.0001
BB	1	0.004944	0.03976908	0.124	0.9011
CC	1	0.079232	0.03766984	2.103	0.0357
LOG_QS_B	1	0.054033	0.00847447	6.376	0.0001
LOG_QS_U	1	0.027399	0.00592457	4.625	0.0001
BLOCK	1	-0.394471	0.10044490	-3.927	0.0001
SWGT_QS	1	9.479480	0.51137351	18.537	0.0001
XWGT_QS	1	-0.128828	0.22081190	-0.583	0.5598
Q_95_2	1	0.132021	0.05181966	2.548	0.0110
Q_95_3	1	0.089727	0.05909212	1.518	0.1293
Q_95_4	1	-0.072958	0.07995203	-0.913	0.3618
Q_96_1	1	0.343893	0.06309421	5.450	0.0001
Q_96_2	1	0.354900	0.05589466	6.349	0.0001
Q_96_3	1	0.392414	0.06286094	6.243	0.0001
Q_96_4	1	0.388209	0.07542076	5.147	0.0001
Q_97_1	1	0.484758	0.06446083	7.520	0.0001
Q_97_2	1	0.594289	0.06218620	9.557	0.0001
Q_97_3	1	0.829863	0.06587538	12.597	0.0001
Q_97_4	1	0.759397	0.06785593	11.191	0.0001

5.0 Sources

Dinneford, Elaine, Kurt Iverson, Ben Muse and Kurt Schelle. *Changes Under Alaska's Halibut IFQ Program, 1995-1997.* Alaska Commercial Fisheries Entry Commission. Juneau: November , 1998.

Dinneford, Elaine, Kurt Iverson, Ben Muse and Kurt Schelle. *Changes Under Alaska's Sablefish IFQ Program, 1995-1997.* Alaska Commercial Fisheries Entry Commission. Juneau: November , 1998.

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. These data 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
	3A	95	9.291	0.108
		96	9.304	0.107
		97	7.397	0.135
	3B	95	14.712	0.068
		96	14.731	0.068
		97	5.990	0.167
	4A	95	7.622	0.131
		96	7.649	0.131
		97	4.933	0.203
Sablefish	Southeast	95	5.277	0.190
		96	6.654	0.150
		97	8.202	0.122
	West Yakutat	95	6.431	0.155
		96	8.678	0.115
		97	10.536	0.095
	Central Gulf	95	7.309	0.137
		96	9.211	0.109
		97	9.800	0.102
	Western Gulf	95	8.138	0.123
		96	9.682	0.103
		97	10.949	0.091

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