Thalassoroma

The Value of Individual Processing Quota in the Alaska Red King Crab Fishery: A Preliminary Analysis

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Abstract Preliminary estimates of the value of individual processing quota in the Bristol Bay red king crab fishery are presented. Implications for processor participation in the benefits of crab rationalization are examined.

Key words Crab rationalization, IPQ value.

JEL Classification Codes Q22, Q28, D61.

Introduction

Matulich (2008) estimated the extent of pure efficiency benefits derived by Alaska red king crab harvesters (initial quota recipients). An integer, nonlinear optimization model that incorporated an empirically estimated, nonlinear catch per unit effort function was developed to measure imputed individual fishing quota (IFQ) values based solely on harvesting efficiency, absent individual processing quota (IPQ) or potential wealth redistribution between sectors. Annual net benefits to harvesters based solely on efficiency gains totaled $9.2 million. The empirical IFQ market, however, revealed that harvesters benefitted in addition to the efficiency gains; net IFQ value held by catcher vessel (CV) owners exceeded $17 million per year. While the capitalized net benefits to CVs were estimated in excess of $400 million in this one of several rationalized BSAI crab fisheries, gross quota value exceeded $436 million.1 Absent from the analysis was any estimate of benefits obtained by processors. Until recently, there has been inadequate data to estimate the value of IPQs. This paper fills that void.

Even though IPQ trading data is not observable, like IFQ, the gross value of IPQ is easily derived from a central policy feature that distinguishes the type and unit value of IFQ. After deducting 10% of the catch for Alaska native community development quota (CDQ) and 4.3% for the catcher/processor allocation, the remaining CV harvest is allocated as three types of IFQ: A-shares, B-shares, and C-shares. Ten percent of the

1 All estimates are exclusive of economic benefits that derive from the one-third increase in TAC that occurred two of the three years following program implementation.
non-CDQ CV catch is deducted as B-shares and allocated to vessel owners; 3% is allocated to crew (skippers) as C-shares; the remaining 87% is allocated to vessel owners as A-share quota. Processors are allocated IPQ equivalent to A-shares (87% of the non-CDQ processing history). B- and C-shares have no processor linkages, i.e., may be delivered to any processor, including new entrants. The Magnuson-Stevens Act § 313(j)(2) explicitly prevents recipients of IPQ from linking A-share and B/C-share markets. “If the Secretary determines that a processor has leveraged its Individual Processor Quota shares to acquire a harvester’s open-delivery ‘B-shares,’ the processor’s Individual Processor Quota shares shall be forfeited” (Magnuson-Stevens Fishery Conservation and Management Act § 313(j)(2) and 16 U.S.C.S. § 1862(j) (2) (Supp. IV 2004)).

**Analysis and Results**

The distinction among the three types of IFQ is central to IPQ valuation. Economic theory suggests B- and C-shares should, *ceterus paribus*, capture maximum ex-vessel price, as processors price marginal crab at variable costs in order to use excess processing capacity and to compete with new entrants. Stated differently, harvesters should capture maximum ex-vessel price as processors compete for the marginal B- and C-share crabs. A-shares may be delivered to any processor owning or leasing an equivalent or larger amount of IPQ. Accordingly, A-shares reflect ex-vessel pricing associated with restricted deliveries. Processors will earn a positive quasi rent, though the exact amount is determined by negotiation in much the same way price indeterminacy is resolved in bilateral monopoly. Harvesters (vessel owners and skippers) form limited anti-trust exempt, monopolistic bargaining associations in order to exert countervailing market power over the heterogeneous, oligopsonistic processing sector. The following elementary graph of a processor’s per unit non-fish processing costs and revenues illustrates the IPQ valuation analytics (figure 1).

![Non-Fish Processing Costs and Revenues by Quota Share-Type](image)

**Figure 1.** Non-Fish Processing Costs and Revenues by Quota Share-Type

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2 Much of the policy discussion and rubric of crab rationalization continues to center on somewhat misleading language that refers to the differential share allocations as “90:10,” referring to A-shares and B-shares, rather than A-, B-, and C-shares. This 90:10 vs. 87:13 distinction is due to sequential policy development; the A/B differential was negotiated prior to C-share development.
Define:

\[ P - \alpha X_P^A = MR_A \]

Wholesale price (P) net of A-share raw crab ex-vessel prices (\( XP_A \)), adjusted by the reciprocal of the recovery rate (\( \alpha \)).

\[ P - \alpha X_P^B/C = MR^B/C \]

Wholesale price (P) net of B-share raw crab ex-vessel price (\( XP_B \)), adjusted by the reciprocal of the recovery rate (\( \alpha \)).

\[ \bar{ac} \]

Unit quasi rent with IPQ, \( MR_A - AVC(A) \).

\[ \bar{ab} \]

B-share minus A-share ex-vessel price differential, given variable cost pricing of B-shares. Note: \( ab = MR^B/C - AVC(A + B/C) \).

\[
\frac{bc}{(Q_{A+B/C} - Q_A)}
\]

Average per-unit variable non-fish processing cost per B/C-share purchased.

Marginal cost (\( MC_A \)) is perfectly inelastic at the A-share quota level and again at the B/C-share quota level (\( MC_{B/C} \)). The profit maximizing processor prices raw A-share crab at point “a” and B/C-share crab at point “d.” Accordingly, the unit quasi rent earned by processors on A-share crab is \( \bar{ac} \); B-share crabs generate zero unit quasi rents. It follows that the per-unit value of IPQ is the B/C-share minus A-share price differential (\( \bar{ab} \)), plus the small average variable, non-fish processing costs per unit of B/C-share crabs purchased, \[
\frac{bc}{(Q_{A+B/C} - Q_A)}.
\]

In essence, the ex-vessel price spread between B/C-shares and A-shares accurately measures the per-unit value of IPQ.

The empirical spread between B/C-shares and A-shares is shown in table 1, along with the estimated IPQ value per pound. Most data in this table are not publicly available yet from the Alaska Department of Fish and Game fish tickets or the National Marine Fisheries Service. Share price and quantity data presented in table 1 were obtained from most of the North Pacific Crab Association of processors and collectively represent 88%-91% of A-share processing and 33%-86% of the B/C-share processing, depending upon year. The B/C-share minus A-share price differential, \( i.e. \), the per pound IPQ value, ranged from $0.03-$0.07.\(^{4} \)

These data should be regarded preliminary until fish ticket data become available.

The estimated annual and capitalized gross IPQ values for the entire Bristol Bay red king crab processing sector are presented in table 2. Given the unverifiable/proprietary source of the NPCA pricing data, annual and capitalized IPQ gross value estimates presented in table 2 are based on the maximum B-share minus A-share price differential ($0.07/ lb.), rather than the annual differential shown in table 1. This substitution errs toward the highest IPQ valuation over the three-year period, 2005-2007. Consistent with the analysis of harvesting sector benefits (Matulich 2008), capitalization assumes a 35-year life and a real interest rate of 2.25% (Federal Reserve Board of San Francisco 2005). The average annual IPQ value over the three-year period (2005-2007) is $946,061. Sector-wide capitalized IPQ gross value is $22,610,856 for the entire Bristol Bay red king crab fishery.

\(^{3}\) The average variable, non-fish processing costs per unit of B/C share purchased \[
\frac{bc}{(Q_{A+B/C} - Q_A)}
\] is approximately zero. Efficient processing under elongated, rationalized fishing seasons occurs by replicating optimal daily processing rates; \( bc \) is small. More importantly, the denominator, the number of B/C share purchased, typically is large for acquisitive firms.

\(^{4}\) Some processors pay a single price, regardless of share-type and are able to acquire B/C-shares.
Table 1
Estimated IPQ Value per Pound Based on North Pacific Crab Association (NPCA)\(^1\)

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-CDQ CV Catch(^2)</th>
<th>A-Share</th>
<th>B/C-Share</th>
<th>IPQ Value per lb.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catch</td>
<td>%</td>
<td>Price</td>
<td>Catch</td>
</tr>
<tr>
<td>2005</td>
<td>15.769</td>
<td>12.444</td>
<td>91 $4.50</td>
<td>1.757</td>
</tr>
<tr>
<td>2006</td>
<td>13.295</td>
<td>10.322</td>
<td>89 $3.92</td>
<td>1.293</td>
</tr>
<tr>
<td>2007</td>
<td>17.540</td>
<td>13.464</td>
<td>88 $4.44</td>
<td>0.762</td>
</tr>
</tbody>
</table>

\(^1\) Data was unavailable from some NPCA members.
\(^2\) Bowers et al. 2008.

Note: Catch (M lbs.), percent of annual non-CDQ catcher vessel harvest (M lbs.), and ex-vessel price per lb., by share-type.

Anecdotal information suggests one non-NPCA buyer, a new entrant with no A-shares, paid as much as $0.20/lb. for B/C-shares. While this much larger price premium seems unnecessary to attract B- and C-share crab from NPCA members, it is still useful to consider the maximum impact of this purported ex-vessel price premium on IPQ valuation. For this purpose, actual NPCA shares are valued at their maximum price of $0.07/lb.; all residual B/C-share crab not purchased by NPCA participants are assumed to be purchased at a $0.20/lb. premium every year.

Average annual IPQ values increase 5% to $995,127; the sector-wide capitalized IPQ gross value increases to $23,783,547 for the entire Bristol Bay red king crab fishery.

Table 2
2005-2007 Non-CDQ CV Catch, Estimated Annual Gross Value, and Capitalized Value of IPQs in the Bristol Bay Red King Crab Fishery, Assuming Maximum IPQ Value of $0.07/lb. for all B/C-Share Crab

<table>
<thead>
<tr>
<th>Year</th>
<th>87% of Non-CDQ CV Catch</th>
<th>Annual Gross Value @ $0.07/lb.(^1)</th>
<th>Capitalized IPQ Values n=35; i=2.25%(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>13,719,418</td>
<td>$960,359</td>
<td>$22,952,586</td>
</tr>
<tr>
<td>2006</td>
<td>11,566,340</td>
<td>$809,644</td>
<td>$19,350,487</td>
</tr>
<tr>
<td>2007</td>
<td>15,259,710</td>
<td>$1,068,180</td>
<td>$25,529,494</td>
</tr>
</tbody>
</table>

Average Annual IPQ Value @ $0.09/lb. $946,061
Capitalized Avg. IPQ Value (n=35; i=2.25%) $22,610,856

\(^1\) NPCA maximum three-year IPQ value estimate is $0.07/lb.
Discussion

In January 2004, the U.S. Congress amended section 313(j) of the Magnuson-Stevens Act, enacting the BSAI crab rationalization program into law through the Consolidated Appropriations Act of 2004 (Pub. L. No. 108–199, section 801, 2004). The program was enacted with the proviso that “As amended, section 313(j)(1) requires the Secretary to approve and implement the Program, as it was approved by the North Pacific Fishery Management Council (Council) between June 2002 and April 2003, and all trailing amendments …” (70 FR 10992, 2005). Not only was the program to benefit harvesters, processors, and communities (Duffy 2002), the benefits were to be distributed “equitably” among harvesters and processors. The BSAI Crab Rationalization Problem Statement from the consolidated Council motion states: “Any such [rationalization] system should seek to achieve equity between the harvesting and processing sectors, …” (Amendment 18, 2003). Neither objective has been realized.

Matulich (2008) estimates the net benefit of IFQ to vessel owners, exclusive of any IPQ considerations or A/B-share issues, ranges from $399 to $415 million in the Bristol Bay red king crab fishery alone. The gross value of red king crab IFQ, based on observable market data, is $436 million. Clearly harvesters participated in program benefits. Processors, however, did not participate in program benefits—let alone “equitably”—though such a term is, at best, ambiguous. The processing sector captured just 5% of the gross value earned by harvesters ($22.6-$23.8 million gross IPQ value, including the post-implementation catch increase, compared to $436 million gross IFQ value, excluding the catch increase). While the analysis presented in this article cannot be used to estimate net benefits to the processing sector, doubling or even tripling the Bristol Bay red king crab IPQ value (one of two economically important BSAI crab fisheries) is unlikely to cover sector-wide, pre-rationalization crab processing asset values.

Insight into why the policy disadvantaged processors and greatly advantaged harvesters when so many presumed the opposite, can be gleaned from closer examination of two redundant policy elements: the A:B split and binding arbitration. Impetus for the A:B split was concern or perception that IPQs would transfer ex ante bargaining power to processors and limit new entry (National Marine Fisheries Service 2004). Unrestricted delivery of B-shares was intended to recapture or rebalance downward pressure on A-share ex-vessel price due to lost market power presumed to arise from IPQs. Throughout program development, this line of reasoning was regarded by many as self-evident and, as such, it was never analyzed or discussed in the context of other policy elements. The points below indicate why the presumptive reasoning is faulty and why the B-share minus A-share price differential is so small.

The A:B split, as a means of restoring bargaining power, was never conceptualized or analyzed in the context of binding arbitration, which by regulation, assures harvesters receive their historical share of the first wholesale price on all A-shares. John Sackton (Formula Price Arbitrator) has pursued this regulatory standard by releasing pre-season price formula models that attempt to statistically measure the historical distribution of price over the period specified in the regulation, 1990-2004. Harvesters have been paid at or above the formula price each year. The presumptive transfer of bargaining power to processors that underpins the A:B split never could have occurred; the binding arbitration regulatory standard precludes loss of market power. Accordingly, the A:B split—given binding arbitration—serves only to redistribute wealth from processors to harvesters. The unrestricted delivery aspect of C-shares likewise redistributes wealth from processors to skippers. It, too, was not subjected to comprehensive policy analysis.

Redundancy is not the only reason processors failed to participate in rationalization benefits. The pre-season formula price models have taken on importance never envisioned

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5 Amendment 18 is the consolidated Council motion referred to here.
by the Council; they are used in final arbitrations as “true-up lines,” originally without confidence intervals. The generally poor-quality statistical analysis of these formula price models is probably distorting the historical distribution of first wholesale price.

In 2008, the Formula Price Arbitrator hired independent, outside statistical support with no prior connection to the Alaska seafood industry. Professors Richard Adams and Junjie Wu (Oregon State University) were asked to review prior price formulas and develop an appropriate econometric model, but only for the opilio fishery. A central feature of their model and a controversy in prior arbitration concerns the legitimacy of differential pricing due to the regionalization policy element. Adams and Wu (2008) developed a simple seemingly unrelated regression statistical model, with exceptional goodness of fit statistics, i.e., best available science, given the data. The Formula Price Arbitrator did not use their analysis and clearly did not understand its statistical properties, instead relegating it to an appendix. The statistical accuracy of price formula models for all species remains suspect.

A confounding effect is the application of binding arbitration differs from council intent. Binding arbitration, which may be invoked only by harvesters, was conceived as an event of last resort, though it has not been implemented this way. The Council anticipated pre-season arbitrations “… to resolve failed price and delivery negotiations efficiently in a short period before [emphasis added] the opening of the season” (Amendment 18, 2003). It even anticipated the possibility of mid-season arbitration due to changing market conditions that could arise over the course of elongated seasons that rationalization promotes. “… an IPQ holder and an IFQ holder (or group of IFQ holders) may agree to revise the entire time schedule … and could agree to arbitration(s) during the season” [emphasis added] (Amendment 18, 2003). The in-season spirit of this provision was lost in the Final Rule (70 FR 10174 No. 40, 2005). The Final Rule links lengthy season arbitration to “crab fishing years” that end June 30, even though all crab fishing seasons close earlier. The Bristol Bay fishery closes eight months earlier.

Seven price arbitrations have occurred since policy implementation (all crab fisheries); none occurred prior to the season or during the season—all were won by harvesters. Binding arbitration has become a post-season price discovery mechanism, which leads to maximum rent extraction when coupled with a formula price model that serves as a true-up line/interval. Harvesters no longer negotiate ex-vessel price prior to the season and no longer share market risk with processors, as was done prior to rationalization.

Policy redundancy, weak statistical analysis, and post-season application of binding arbitration all help to explain John Sackton’s April 2007 testimony to the Council that binding arbitration decisions have raised the A-share price above the historic average. All else equal, the B- minus A-share price spread narrows, redistributing wealth from processors to harvesters. Regardless, it seems unlikely IPQs would allow the processing sector to benefit as much from rationalization as harvesters. Despite widespread IPQ leasing, the diversified processing sector has not consolidated as much as the fleet, which is less than a third its pre-rationalization size.

References


6 Data deficiencies abound. The Council has directed industry to resolve the issues.


Duffy, K. 2002. Council Speech after Making the Crab Plan Motion (June 8) and Immediately Prior to Passage of the Motion (June 10). Dutch Harbor, Alaska.


Magnuson-Stevens Fishery Conservation and Management Act § 313(j)(2).


