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The Control of Market Power in ITQ Fisheries

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Abstract *The notion of restricting the amount of quota shares that can be owned by a single entity (sometimes called excessive share limits or ownership caps) is almost universal in fisheries managed with ITQs. While there is no general agreement on exactly what this means, the focus is normally on monopoly power and the attainment of management objectives or equity goals. This paper addresses the monopoly power issue and derives a formula for determining the maximum percentage any one entity can control before incentives to withhold production become operative. Implications for general and specific policy analysis are provided.*

Key words ITQ, excessive share, monopoly.

JEL Classification Codes Q21, Q22, Q28.

Introduction

The 2006 revision to the Magnuson-Stevenson Act (MSA) stipulates that any Individual Transferable Quota (ITQ)[1] program developed under its auspices must:

> Ensure that limited access privilege holders do not acquire an excessive share of the total limited access privileges in the program by—(*i*) establishing a maximum share, expressed as a percentage of the total limited access privileges, that a limited access privilege holder is permitted to hold, acquire, or use; and (*ii*) establishing any other limitations or measures necessary to prevent an inequitable concentration of limited access privileges; [Section 303A(c)(50(D))].

In a study of the previous version of the act, the General Accounting Office has directed NOAA Fisheries to provide guidance to the Councils on what factors to consider when determining what constitutes an excessive share in ITQ fisheries (GAO 2002).

The concept of an "excessive share," sometimes with a different name, is found in almost all ITQ programs. The exact meaning of excessive share is not clear and it is not defined in the MSA. However, as evidenced by points (*i*) and (*ii*) above, there are two different interpretations of what it means.

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[1] While ITQ is the general term in the economics literature, the term used in the revised MSA is Limited Access Privilege, LAP.

The first has to do with monopoly issues. This has been called output price manipulation [OPM] in the literature (Anderson 1991).

> The transferability of quota may lead to concentration of quota in fewer hands. Several countries have therefore imposed ..a maximum holding restriction to protect against monopolistic tendencies. However, such restrictions will impair the desirable transferability effect of optimizing the fleet structure in economic terms as the most efficient operators will be unable to acquire further quota beyond a set limit (Frost and Lindebo 2003:29).

The second has to do with management objectives or equity concerns. For example:

> If, on the other hand, important objectives include maintaining owner operated fisheries and fishery-dependent coastal communities, transferability may have to be constrained and greater attention given to equity considerations in setting upper limits on accumulation, boundaries to transfer of quota share among communities, and other restrictions (NRC 1999:209).

While there may be more interest in the equity issue, other than noting that there is likely a trade-off between tighter share limits and the efficiency of harvesting and marketing, there is little that formal economic analysis can contribute to the discussion. However, the issue of excessive share as it relates to OPM is amenable to rigorous economic analysis, and this will be the focus of this paper.

At the outset, it is useful to delineate two types of market power. Traditional market power comes from the ability to control the production of a significant proportion of the output of a product with limited substitutes. Ease of entry of potential competitors and other issues are also related, but for purposes here, it is sufficient to focus on the control of capacity to produce. Call this capacity-based market power.

With ITQs and other government-based permit systems, such as agricultural production control programs, the market power control originates from the restricted *permission* to produce a product with limited substitutes rather than the *ability* to produce. Call this permit-based market power.

While it may not be apparent, it is easier to address monopoly problems with permit-based market power, such as an ITQ fishery, than it is with capacity-based market power. In the latter case, there is always the potential for extra output. The question is whether more output will be produced if demand and cost conditions warrant it. There are rules of thumb, such as the Herfindahl-Hirschman Index, to help judge whether a particular industry structure will likely have the power and incentives to withhold production. However, it is possible to be more precise in ITQ fisheries because the total allowable catch (TAC) limits total annual output. The issue is more subtle than how much will be produced. The question is, given a fixed level of output, will it be beneficial for an individual quota holder to withhold production in order to engage in output price manipulation? An entity can withhold production by choosing not to use a portion of its existing quota share. It can also purchase quota shares for the purpose of restricting production. The solution is straightforward in the pure-permit based market power case. It is possible to derive a formula to calculate the maximum percentage of the TAC, call it s^*, that any one entity can hold without conveying the ability to benefit from OPM. This is exactly what the MSA mandates.

The paper will proceed as follows. The first section will derive and generalize the formula for s^* with permit-based market power. The second section shows how the analysis is altered when ITQ programs are instituted in cases where capacity-based market power already exists. Except for the sole producer case, it is difficult to make general conclusions. The final section provides general comments on the practical use of the s^* formula.

General Derivation of s^* with Permit-based Market Power

The purpose of this section is to provide a formal analysis of the determination of s^*, the maximum percentage of the quota that can be held by a single entity such that there will be no incentives to restrict output below the TAC for the purpose of OPM. Assume a fishery is subject to an ITQ program, and quota shares (QS), denominated in terms of percentages of the TAC, have been distributed to industry participants. Each year, annual harvesting privileges (AHP), denominated in units of fish, are distributed among the participants based on their ownership of quota shares. By definition, the amount of AHP will always equal the TAC. The discussion will cover both the market for fish and the market for AHP.

Assume a perfectly competitive market for the fish for a particular fishery. Put in terms of the above discussion, this means that no one firm has a significant share of the productive capacity. Let the inverse aggregate market demand curve be:

$$P_D = P_D(Q). \tag{1}$$

The total revenue for any price and cost combination on the demand curve is:

$$TR(Q) = [P_D(Q)]Q. \tag{2}$$

The marginal revenue curve for this demand curve is therefore:

$$MR(Q) = \partial TR/\partial Q = P_D(Q) + [\partial P_D(Q)/\partial Q]Q. \tag{3}$$

For purposes of the analysis, it is necessary to know the marginal revenue of a single entity that only controls a portion of the TAC. Let Q_1, represent the amount of AHP that is controlled by other owners, which means that the single entity controls TAC–Q_1 units. Assuming that Q_1 will be produced each year by the other AHP owners, the residual demand curve facing the single entity can be represented as:

$$P_D = P_D(Q_1 + q), \tag{4}$$

where q is the production by the single entity beyond Q_1. It can range from zero to $\{\text{TAC}–Q_1\}$. By analogy, the MR for this portion of the overall market demand curve is:

$$MR'(Q_1 + q) = P_D(Q_1 + q) + [\partial P_D(Q_1 + q)/\partial q]q. \tag{5}$$

The difference between equations (3) and (5) is that the former shows the marginal revenue taking into account the reduction in price on total market output, while the latter only considers the effect of the change in price on q, the amount produced by the single entity.

Let the inverse total supply curve be:

$$P_S = P_S(Q). \tag{6}$$

If a single entity is given a large portion of the total AHP, it has two options. It can hire other boats to catch fish for the portion of its AHP that it cannot use given its productive capacity, or it can sell the extra AHP to other producers. Under current assumptions, the result will be the same. Assume, for the moment, that the single entity whose own output capacity is small relative to the total output of the other firms, chooses to hire others to catch the extra fish beyond its own capacity to produce. The total industry supply curve represents the price it must pay for a particular amount. The total cost of obtaining fish is, therefore, equal to:

$$TC(Q) = [P_S(Q)]Q.$$

The marginal pecuniary cost of obtaining fish will be:

$$MC(Q) = \partial TC/\partial Q = P_S(Q) + [\partial P_S(Q)/\partial Q]Q. \tag{7}$$

If the single entity does not control all the AHP, it will be buying fish on the market after the other producers have produced an amount equal to their AHP. Again, Q_1 is the amount of AHP held by others. The price per unit of fish the single entity must pay is:

$$P_S = P_S(Q_1 + q), \tag{8}$$

where q is the amount purchased. By analogy, the marginal pecuniary cost to the single entity is:

$$MC'(Q_1 + q) = P_S(Q_1 + q) + [\partial P_S(Q_1 + q)/\partial q]q. \tag{9}$$

Consider first the extreme case where all of the AHP is given to a single entity. Given the demand and supply curves and their associated marginal revenue and marginal cost curves shown in figure 1, the single entity with control over output and that also acts as a monopsonist in purchasing product to put on the market, all else equal, will choose to operate at Q, where marginal revenue (MR) equals marginal cost (MC). The important policy issue is the size of the TAC relative to the profit maximizing level of output. If the TAC is less than Q, then a single owner of all of the AHP will have incentives to produce the full amount. There will be no output restriction. On the other hand, if the TAC is greater than Q, as pictured in figure 1, the single entity will have incentives to withhold production. The policy-relevant question is how much of the TAC must be given to others such that the modified MR($Q_1 + q$) and MC($Q_1 + q$) curves intersect at the TAC line as pictured in figure 2.

The solution can be derived by equating the expressions for MR'($Q_1 + q$) and MC'($Q_1 + q$):

$$P_D(Q_1 + q) + q * \partial P_D(Q_1 + q)/\partial q = P_S(Q_1 + q) + q * \partial P_S(Q_1 + q)/\partial q. \tag{10}$$

Since the desired level of $Q_1 + q$ is the TAC, this becomes:

$$P_D(TAC) + q * \partial P_D/\partial Q = P_S(TAC) + q * \partial P_S/\partial Q.$$

Both $\partial P_D/\partial Q$ and $\partial P_S/\partial Q$ must be evaluated at the TAC level of output. Solving this for q and the taking the ratio of q to TAC, after considerable manipulation, leads to:

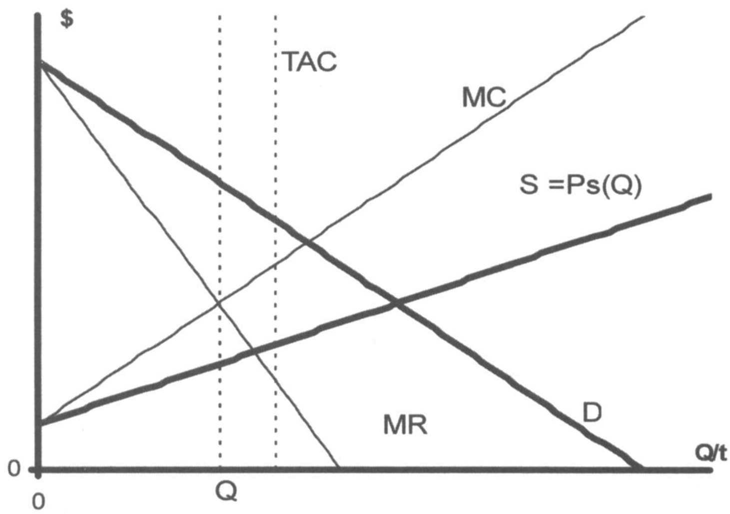

Figure 1. Comparison of Output of Single Entity Controlling 100% of TAC

Note: The full TAC will not be produced.

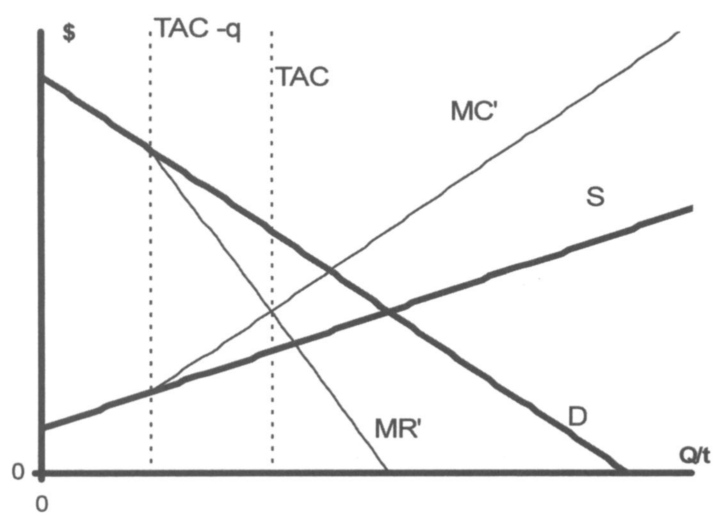

Figure 2. The Operational Demand, MR, and MC Curves when a Single Entity is given just enough Quota such that the Total TAC will be Produced

$$s^* = -\frac{1 - \dfrac{P_S(TAC)}{P_D(TAC)}}{\dfrac{1}{e_D} - \dfrac{P_S(TAC)/P_D(TAC)}{e_S}}. \tag{11}$$

The terms e_D and e_S represent the elasticity of demand and supply, respectively, evaluated using equations (1) and (6) where output equals the TAC.[2,3]

Since e_D is negative, s^* will be positive. As the difference between the demand and the supply price increases, s^* will increase. That is, all else equal, the greater the difference between what would otherwise be the short-run market equilibrium level of output and the TAC, the higher will be the value of s^* and the less will be the concern about potential market power. Likewise, as e_D and e_S get larger, s^* will increase. The calculated value can be greater than 1, which means that given the parameters' values, the MR and MC curves for 100% of the AHP intersect at an output lower than the TAC.

Now consider the case where the single entity wishes to sell AHP rather than hire people to catch fish. The entity will have to decide how many units to sell. Producers will be willing to pay an amount equal to $P_D - P_S$ to purchase a unit of AHP, which is to say that:

$$P_{AHP} = P_D(Q) - P_S(Q). \tag{12}$$

Therefore, the revenue a single entity will receive for selling some or all of its allotted AHP will be:

$$TR_{AHP} = \left[P_D(Q_1 + q) - P_S(Q_1 + q)\right]q. \tag{13}$$

The profit maximizing level of AHP sales occurs where MR_{AHP} equals zero. It can easily be seen that the first derivative of the TR_{AHP} function with respect to output is simply the condition that MR equals MC in the market for fish. See equation (10) above. Therefore, the s^* that is effective for controlling OPM in the market for fish will also accomplish the same thing in the market for AHP.

The analysis is different for the case where the single entity receives an allotment of AHP equal to a relatively small portion of the total TAC. Here there is the

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[2] This implicitly assumes that the other producer(s) will always put their (TAC – q) amount of output on the market, which seems to ignore the possibility of any Cournot duopoly action. Operationally, however, this is of no concern, because with the TAC and the s^* policy Cournot actions are ruled out. For example, if using the assumption, s^* turns out to be 10%, then the smallest number of participants is 10, which effectively rules out duopoly. On the other hand, if s^* is 50%, then there can only be two participants, but from the definition of s^*, neither would have any incentive to restrict output on their own. I thank Ted Groves and Marty Smith for raising the possibility of a Cournot problem.

[3] A reviewer has correctly pointed out that a complete analysis would require the consideration of a Nash equilibrium, where each entity makes its decision on how much production to withhold based on its estimate of what other firms will do. This is an important difference, because it means that there would have to be tighter restrictions because of the implicit collusion. If all firms hold back on the assumption that others will do the same, they can take advantage of the price increase by the total reduction in output. This means that the s^* value obtained under current assumptions may not be low enough. However, given that the correct solution will require information on how many firms will likely be in the game and their individual supply elasticities, and that this information will likely not be available, the use of the current formula, knowing that it will be an overestimate, is likely the best that can be done.

potential to engage in OPM by buying extra units of AHP in order to restrict output and raise the value of its originally allocated AHP either in terms of production of fish or the sale of harvesting privileges. Let q_r equal the reduction in output that results from buying one unit of AHP. If q is the originally allocated amount of AHP, its value can be represented as:

$$V = \left[P_D(Q_1 + q - q_r) - P_S(Q_1 + q - q_r)\right]q. \tag{14}$$

The change in value of the q units due to the purchase of AHP to reduce market output is:

$$\partial V/\partial q_r = P_D - (\partial P_D/\partial q_r)q - P_S + (\partial P_S/\partial q_r)q. \tag{15}$$

In this case the relevant policy question is: What is the largest amount of q where the value of equation (15) can never be positive? Setting (15) equal to zero and solving for q will obtain that value of q.[4]

Since $\partial P_D/\partial q = -\partial P_D/\partial q_r$ and $\partial P_S/\partial q = -\partial P_S/\partial q_r$, the equation formed by setting equation (15) equal to zero is equivalent to (10). This means that the s^* equation that applies in the previous two cases, applies here as well.

In summary, in the perfectly competitive case, equation (11) holds regardless of whether the single entity will be a seller of AHP because it is given a relatively large portion of the TAC or whether it is given a relatively small portion of the TAC and it can buy extra AHP in order to raise output price. The policy implication of the s^* share limit is that no one entity should be allowed to control more than that percentage of the AHP through initial allocation or through purchase of QS or AHP on the open market.

Although equation (11) is a rather convoluted formula, looking at the two extreme cases can make interpretation somewhat simpler. If the demand curve is horizontal, so e_D is equal to infinity, the equation reduces to:

$$s^* = -\left[P_D/P_S(TAC) - 1\right]e_S. \tag{16}$$

If the supply curve is horizontal, so the P_S equals the constant MC of production, the elasticity of supply is infinite and the s^* equation becomes:

$$s^* = -\left[1 - MC/P_D(TAC)\right]e_D. \tag{17}$$

In the above expression, the critical limit is proportional to the elasticity of demand and the ratio of proportionality will always be less than one.[5] The higher the elastic-

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[4] In my earlier paper (Anderson 1991), I considered this problem in a more restricted manner and showed that if a single entity received no AHP in the initial allocation, it would not make sense to buy more simply for the purpose of withholding production and raising price. If q equals zero, both equations (14) and (15) will be equal to 0. Unfortunately, I generalized from that specific case and concluded that it would never make sense to engage in OPM by purchasing AHP. As the analysis in the text shows, the profitability of OPM by buying AHP will depend, upon other things, on the amount AHP the individual holds. The point of the above discussion is to keep that amount small enough that OPM will never be profitable.

[5] While commenting on an earlier version of this paper, Ron Felthoven pointed out that this form of the s^* equation is similar to the Lerner Index, which is a measure of monopoly power (Lerner 1934). The index, which follows directly from the monopoly profit maximization first-order condition is usually expressed as $(P - MC)/P = -1/e_D$. The higher the value (*i.e.*, the greater the difference between P and MC), the greater the monopoly power. The above formulation can easily be transformed to $= -(1 - MC/P)e_D$.

ity of demand and the lower MC relative to price, the higher will be the value of s^* and the less concern there will be for the possibility of OPM. A more detailed discussion of this is provided in the final section of the paper.

A Further Look at the Market for AHP

Previous research has shown that when there is a dominant firm in the market for permits, the equilibrium allocation of permits across firms that results from market trading will not result in productive efficiency because the marginal cost of production will not be equal across firms. This is true for both ITQs and pollution permits, even though the former are permits to produce the marketable product while the latter are permits to produce waste products that are jointly produced with market products (Hahn 1984; Misiolek and Elder 1989; and Anderson 1991). These results are consistent with the above. This can be seen by taking a closer look at equation (7), above. The marginal pecuniary cost to the hypothetical single entity when buying fish to match AHP permits takes into account the change in the price of fish that results from the extra purchases. In order to minimize the total pecuniary cost of obtaining fish, it will equate its MC with the marginal pecuniary cost of procuring fish, which means that the TAC will not be produced as efficiently as possible because its MC will be higher that the MC of the rest of the fleet. This type of market failure cannot be cured by setting an excessive share limit.

It is important to realize that dominance in the market for permits is related to the relative productive capacity of the firms involved, but it is not necessarily related to market power over the price of the marketable output. The most obvious case is pollution rights. Competitors for pollution permits may not even be operating in the same output market. Sulfur oxides can be by-products of many dissimilar products. With fisheries, the output of an ITQ fishery could go into a more general "white fish" market, the price of which is not affected by the amount produced in the ITQ fishery. In either case, a single firm's productive capacity relative to its allocated amount of permits may be such that it can affect the price of permits when it buys or sells them on the open market.

Excessive Share Limits with Capacity-based Market Power

In the above analysis, it was assumed that there are many producers, all of whose production capacity is small relative to the total. Any market power is due to the control of a significant portion of the harvest privileges, but not to the amount of productive capacity *per se*. In traditional market power analysis, it is the relative balance of productive capacity that provides for monopoly power. How is the above analysis changed if an entity has market power both because of productive capacity and because of control of AHP?

The extreme case of a fishery with a single producer is quite straightforward. If one entity controls all of the available productive capacity, it will operate where the market MR curve intersects its MC curve. Call this output level Q_m. What will happen if an ITQ program is instituted in this fishery? If the TAC is less than Q_m, there will be no problem with output restrictions. The single producer will want to produce the full TAC. On the other hand, if the TAC is greater than Q_m, all of it will not be produced. Both statements are true no matter how the AHP is allocated. If it all goes to the monopolist, there will be no incentive to change production. If it all goes to other parties, the monopolist will have to purchase units of AHP for each unit of output it produces. But it will have no incentive to produce more than Q_m units of output, so it will only purchase enough AHP to produce that amount. Technically, this means that demand for AHP will be less than supply at a zero price, so the equilibrium price will be zero. In reality, the monopolist will likely have to pay a positive amount to obtain AHP, and the actual price will depend upon relative bargaining power. Not giving the AHP to the monopolist will not change the output level, but it can change the distribution of the monopoly profits.

If there is an excessive share policy with allocation limits and restrictions on transferability, the conclusions are different. For the sake of discussion, assume an excessive share limit of 20% is instituted, so the single producer receives that percentage of the AHP. The rest is distributed to others and cannot be sold or leased to the sole producer.[6] If the sole producer really controls all of the productive capacity in the fishery, this would mean that in the short-run at least, only 20% of the TAC would be produced. A policy to ensure full production would instead, at the theoretical limit, curb it. However, over time the owners of the remaining AHP may obtain the necessary productive capacity. This could happen relatively fast, and with only minor and transitory efficiency losses, if the sole producer owned a fleet of boats, some of which could be sold. This assumes that the other participants have access to the necessary human capital. On the other hand, it could take much more time, and there would be more significant efficiency effects if new and duplicative productive capacity must be built.

Exactly how this would work with different levels of capacity-based market power and varying degrees of ease of entry will depend upon the specifics of the particular situation. A full analysis is beyond the scope of this paper. However, even at this level of abstraction, it is possible to conclude the following. If there is no excessive share policy and the initial allocation is based on historical catches, implementing an ITQ program in a fishery with a significant amount of capacity market power will actually solidify that power. The market power which comes from capacity to produce can be transitory, but with ITQs it will be backed up with permit market power. On the other hand, if the ITQ program is instituted with an excessive share policy, there is the potential to reduce or eliminate the capacity-based market power, at least in the long run. In those instances, it will be necessary to resort to traditional industrial organization analysis to address the problem. The s^* formula will be of little direct relevance. The calculation of s^* requires data from ongoing market conditions.

Practical Applications

While the s^* equation is rather complex, its value can be calculated using three parameters: the elasticities of demand and supply and the ratio of marginal cost to price, all evaluated at the TAC level of output. Nonetheless, it may be difficult to obtain estimates of these parameters for practical policy analysis. The problem is made even more difficult because while the decision on an excessive share value will likely be made before an ITQ program is implemented, the introduction of the program will likely change demand and supply conditions through changes in product quality, harvesting and processing technology, and perhaps stock size.

Perhaps the potential inability to obtain accurate estimates of the necessary parameters may not always pose a problem. Consider table 1, which shows the value of s^* for a range of P_S/P_D and of elasticities of supply when the elasticity of demand

[6] Since most initial allocation formulae include catch histories, one might wonder on what basis the other 80% would be distributed.

is equal to –2. Except for the top left-hand corner of the table, the values are quite large even for this moderate value for the elasticity of demand. Further, as the fixed value for the elasticity of demand is increased, this becomes more pronounced. See table 2, where the elasticity of demand is set at –10. In the lower right-hand part of the tables, the s^* values are listed as being equal to 1, because the calculated value is greater than 1. This means that no share limit is required to prevent output reduction.

While the elasticity of demand for a particular fishery is an empirical question, it is safe to assume that it will generally be elastic. There are many substitutes for most fish products, including the flesh of other types of fish and sources of protein from other animals. Further, it should be remembered that the demand curve under consideration is the one facing the producers in the particular fishery under ITQ management. That is, there may be an ITQ program for "green fish" in one region but there may be other sources of the identical fish from other regions. One could assume that the demand curve facing the producers in the ITQ fishery would be quite elastic, perhaps even perfectly elastic.

Note that while the left-hand column of the table is the ratio of supply price (P_s which is the MC of production) to demand price, for practical purposes the demand

Table 1
Comparative Values of s^* when the Elasticity of Demand is – 2

Ps/Pd			$e_D = -2$								
0.9	0.06	0.07	0.07	0.09	0.11	0.12	0.13	0.13	0.14	0.14	0.15
0.8	0.13	0.14	0.15	0.19	0.22	0.24	0.26	0.27	0.29	0.30	0.30
0.7	0.21	0.23	0.25	0.31	0.35	0.38	0.41	0.43	0.44	0.46	0.47
0.6	0.31	0.34	0.36	0.44	0.50	0.54	0.57	0.60	0.62	0.63	0.65
0.5	0.43	0.47	0.50	0.60	0.67	0.71	0.75	0.78	0.80	0.82	0.83
0.4	0.58	0.64	0.67	0.78	0.86	0.91	0.95	0.98	1.00	1.00	1.00
0.3	0.78	0.84	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
e_s	0.75	0.90	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00

Table 2
Comparative Values of s^* when the Elasticity of Demand is –10

Ps/Pd			$e_D = -10$								
0.9	0.08	0.09	0.10	0.14	0.18	0.22	0.25	0.28	0.31	0.33	0.36
0.8	0.17	0.20	0.22	0.32	0.40	0.48	0.55	0.61	0.67	0.72	0.77
0.7	0.29	0.34	0.38	0.53	0.67	0.79	0.90	1.00	1.00	1.00	1.00
0.6	0.44	0.52	0.57	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.5	0.65	0.76	0.83	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.4	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
e_s	0.75	0.90	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00

price at the TAC level of output will likely be known. The issue will be the size of the MC because the excessive share limit increases with MC. The reasoning is as follows. The benefits of withholding production are the higher prices for the remaining output and the cost savings from the reduction in output. Therefore, all else equal, firms with higher costs will have higher benefits from restricting output and will require tighter excessive share limits.

Again, while the ratio of MC to price in any ITQ fishery is an empirical question, given the ratio of fixed to variable costs in many fisheries, there are reasons to believe it will not be excessively high and perhaps that it might be quite low. To make a long story short, it depends upon the vertical difference between the post ITQ demand curve and the long-run efficient supply curve at the TAC level of output (see figure 2). The larger that difference, the lower will be the MC/P ratio.

From a casual perusal of the two tables and the understanding that the elasticity of demand will *tend* to be high and the MC/P ratio will *tend* to be low, it does not appear that monopoly restrictions of output will be very likely in ITQ fisheries. It is an indication that the concern over monopolistic excessive share may be ill founded. Put another way, the excessive share limits that have been set in real-world fisheries (20% in New Zealand and less than 1% in the Alaska halibut fishery) will likely prevent any monopoly problems whatever the reason for their implementation.

The above analysis suggests that in the absence of the required parameters, a useful approach to determining an s^* for a real-world fishery would be to come up with the best estimate of the elasticity of demand and use it to construct a table similar to those in the text. Unless there is reason to believe that the parameters that apply to this fishery are in the range where the s^* value is less than 1, there is no need to set a monopoly excessive share limit. In the opposite case, try to come up with the best rough estimate of the other two parameters and set the s^* accordingly using a conservative approach.

Finally, it should be stressed that the analysis here has focused solely on monopoly power excessive share limits. Share limits which address fishery management objectives or equity concerns have not been considered.

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