Do Buyback Programs Make Sense?

Rögnvaldur Hannesson
Center for Fisheries Economics
The Norwegian School of Economics and Business Administration
Helleveien 30
N-5045 Bergen

Phone: +47 95 92 6+
Fax: +47 55 95 95 43
E-mail: rognvaldur.hannesson@nhh.no

March 2004

Buybacks and overcapacity

Overcapacity of fishing fleets is apparently a widespread phenomenon. Its root cause is well known and lies in too easy entry into the fishing industry. Fish stocks are scarce resources the productivity of which is limited by nature. Unless there is some mechanism that takes that limitation adequately into account, people will invest in fishing boats to grab a larger share of the stocks. It may be profitable for the individual investor to buy a new boat even if it adds less to the total catch value than what it costs, once we take into account the long term effect on the fish stock and the catches of other boats, effects that the individual investor has little or no incentives to take into account. The contribution of the additional boat could even be negative while still being profitable for the individual investor. This type of overinvestment happens even if the total catch is limited; if there are no restrictions on entry into the industry, people will invest in order to grab a larger share of the catch, even if they add nothing to the total value generated in the industry.

It goes without saying that a solution to this fundamental problem will never be achieved unless some mechanism is put in place which sufficiently restricts entry into the industry. Purchasing fishing boats for removal from the industry accomplishes nothing in the long run unless it is accompanied by a mechanism which prevents the overcapacity the buyback scheme was meant to remove from developing again. It may be noted that limiting the number of boats is not enough to guarantee a long term success of a buyback program. It is possible to increase the capacity of fishing fleets in ways other than by increasing the number of boats. Boats can be made bigger, provided with more powerful engines and other equipment, and more fishing gear can be applied. Weninger and McConnell (2000) use a formal model to show how buyback programs can be self defeating. Others have also noted this possibility (see discussion and references in Weninger and McConnell [2000]). An analysis by Funk, Griffin, Mjelde and Ward (2003) shows how a successful buyback in one fishery can result in effort expansion in another and related but uncontrolled fishery.

Without some mechanism that prevents excessive investment, buyback programs could actually make things worse. They could do so in two ways. First, they would transfuse money into the industry which could be used for investment in new boats replacing the ones that were bought out. Second, buybacks could be taken as an indication that capital losses in the industry will always be limited. This would reduce the overall risk in the industry, enticing risk averse investors to invest more in fishing boats than they would otherwise have done.

How, then, could buyback programs be justified? Clearly they would have to be supplementary to other, more fundamental remedies. But given that such solutions are in place, buybacks could have a role to play. They could do so in two ways. First, they could be a compensation mechanism for those players in the industry that would otherwise lose out from rebuilding fish stocks and restructuring the industry. Second, they could speed up the desired transition from overexploited stocks and overcapitalized industries to replenished stocks and restructured industries.

Buybacks as compensation mechanism

There are two principal situations where a reduction in fleet capacity is called for. Both arise from open access to the industry. In one case there is no control of the catch so that the fish stock is overexploited. In the other case the total catch is under control so that the fish stock is

not endangered, but there are more boats than needed to take the catch efficiently. In the latter case the number of boats clearly needs to be reduced. In the first case it is not so certain that the number of boats needs to be reduced in the long run. That question is addressed more formally below. But what needs to be done in the short run is reducing the degree of exploitation of the stock, so that the catch will be less than the surplus growth of the stock. This requires a reduction in fishing effort, which can be achieved by using the existing boats at less than full capacity. If in the new situation after the stock has grown to the desired level we would need as many boats as before, or maybe more, it might not be such a great idea to buy out and destroy some of the boats; it could be better to use them for some time at less than full capacity.

Suppose, however, for the sake of the argument, that a reduction in the number of boats is called for, whether it be for achieving stock recovery or simply a more efficient way of taking the total allowable catch. If this is to serve any economic purpose it must lead to greater benefits in the future. But the necessary reduction in the number of boats does not happen by itself, without some intervention. Clearly, since this situation developed in the first place and then persists, it must be the case that the boatowners are better off by continuing fishing than by quitting the fishery. At the same time there is a surplus expected to emerge as a result of reducing the number of boats, whether it be through stock recovery, greater catches and lower costs of fishing, or through fewer boats sharing a catch that is controlled.

The surplus expected to emerge from reducing the number of boats provides incentives for setting up some mechanism for reducing the number of boats and so realize this gain. Initiatives to do so could come from the industry itself, in its own interest. The mechanism necessary to achieve this through voluntary transactions would have to provide appropriate compensation to those who would forsake the expected future benefits and leave the industry. Buying back redundant fishing vessels is clearly one way in which this can be achieved. The government could step in and put up money up front in order to facilitate this. But since the justification for doing so lies in the realization of benefits for those who remain in the industry, it would seem appropriate to put in place some mechanism by which the public outlays are recovered from the increased profitability of the industry. Furthermore, as demonstrated below, if the government puts up the money for buying the redundant boats without a plan to recover that money from the industry, it may well end up spending more money on the buyback than corresponds to the rent ultimately realized.

But there is another way to facilitate this compensation, one that has been traveled by a number of countries over the last 20 - 30 years. This is by individual transferable quotas. In fisheries where individual transferable quotas valid for the long term have been introduced they have typically gained a high market value rather quickly. An important reason for this gain in value is the expectation of higher benefits in the future due to the rebuilding of the fish stocks or less excess fleet capacity. These schemes have led to fleet reduction through the buying of fish quotas, sometimes indirectly through the buying of fishing vessels with quota allocations. In this way voluntary transactions between players in the fishing industry itself have facilitated the necessary reduction in fishing vessels by providing compensation for those who are willing to trade expected future benefits in the fishery for an immediate compensation. It is possible, however, that buyback schemes with government putting up money up front would facilitate capacity reduction more quickly than relying on individual transferable quotas.

Individual transferable quotas are not necessarily applicable under all circumstances; they can be costly to monitor and may lead to undue discarding of fish. But when they can be applied they have the advantage over buyback programs alone of providing incentives to limit investment. They may not achieve a fully optimal investment pattern, however. One reason is the share system that is typically used in the fishing industry instead of a fixed wage rate (Hannesson, 2000). But in any event individual transferable quotas are a major improvement relative to open access. In cases where individual transferable quotas cannot be used, transferable boat licenses could be a good alternative.

Government-financed buybacks--a costly alternative

In a recent paper, Clark, Munro and Sumaila (undated) point out that government buybacks may lead to expectations that make the costs of such schemes exceed the rents to be generated. More generally, it may be stated that the money allocated to buybacks could, under perfect foresight on behalf of industry players, realize a smaller rent than amounts to the said allocation. Viewed from another angle, the government money amounts to a rent coming out of the taxpayers' pockets and which is there for the seeking by the industry, in addition to the rent emerging in a restructured industry. By contrast, industry financed buyback would never generate any deadweight loss like that and would be sufficient to realize the maximum rent.

Consider a simple model where the catch per boat is given and equal to a, with the total allowable catch being constant over time and equal to Q. Let the price be independent of the catch volume, and assume further that the operating cost per unit of fish is independent of the stock size. We may then define a price net of operating cost and choose units so that it is equal to one. Ignoring discounting, the optimal number of boats (N^o) will simply be

$$N^o = Q/a.$$

With the annualized fixed cost per boat being c, the open access equilibrium number of boats (N^*) will be

$$N^* = Q/c.$$

Obviously, $a \geq c$, so that $N^* \geq N^o$. Now let the amount the government allocates to a buyback program be B, and the number of boats bought be M. With perfect foresight, no one will sell out for less than the rent per boat realized after the buyback program has come to an end. This implies

$$\frac{B}{M} = \frac{Q}{N^* - M} - c\ .$$

Multiplying by $N^* - M$ we get on the right hand side the total rent realized after the buyback program has run its course. We see that this will be less than the total budget allocated to the buyback if $N^* - M < M$, i.e., if more boats are bought out of the fishery than remain. Specifically, if a sufficient number of boats is bought to realize the optimal number ($N^* - M = N^o$), we see that the cost of the buyback will exceed the maximum rent if $N^o < M$, i.e., if more than a half of the boats in the open access fishery were redundant. While high, that degree of overcapacity is by no means impossible.

Now consider the industry-financed buyback. The operating profit per boat net of fixed costs is

$$\pi = Q / N .$$

If a marginal boat is eliminated, this profit can be increased by dividing that boat's share in the total profits among the rest of the boats. Treating the number of boats as a continuous variable, for simplicity, we have

$$\frac{d\pi}{dN} = -\frac{Q}{N^2} .$$

and the total gain of the remaining boats from eliminating a marginal boat will be *Q/N*. But a boatowner would be willing to sell out for less, or *Q/N* - *c*, when the time comes to renew the boat and commit to a new round of fixed cost. Hence, the industry will in the long run be able to finance its own rationalization.

Experience with buyback programs

Vessel buyback programs have been applied in several fisheries and countries. A review of some of these programs is provided by Holland et al. (1999). They point out that such programs have invariably arisen from a "crisis", typically a depletion of fish stocks due to open access and the resulting excess fleet capacity and fishing effort. They identify three main goals of such programs; (i) saving boatowners or license holders from losses they would otherwise incur, because of the unavoidable adjustment in a fishery in crisis; (ii) improving the profitability of the rest of the industry, and (iii) rebuild fish stocks. It is not clear that these programs have always had a positive effect on the profits of those who remain in the industry. As stated earlier, if buyback programs are to be successful in the long run there must be some control of investment in the industry or incentives to prevent them from taking place on too large a scale. In some programs the money spent on buybacks apparently leaked back into the industry or removed capacity that was not very important in any case. In some cases the reduction in the number of vessels has been neutralized by increased effort by the remaining vessels (Holland et al., 1999, p. 58). As to resource conservation, these authors point out that all the programs they considered had other measures in place to deal with this problem. The buyback programs therefore seem to have been motivated mainly by the first two of the three said goals.

The European Union has for over twenty years had programs in place giving grants to decommissioning fishing vessels. At the same time the Union has provided grants for construction of new vessels and modernization of existing ones. This kind of policy does not seem logical, at least when both types of grants affect similar types of vessels in the same country or region. It is not unlikely that the decommissioning grants have found their way back into the industry and stimulated investment in new vessels, in which case these grants have in effect become grants to investment. Such "leakage" has been alleged to have taken place in the United Kingdom (Banks, 1999, p. 204). Japan has spent money on upgrading its existing vessels and on retiring old vessels from its tuna fishing fleet, in order to make way for new ones (Weber, undated).

The buyback programs of the European Union have probably had an impact on the size of the European fishing fleet; from 1991 to 1996 it fell from about two million GRT to 1.6 million, and from 8.3 million kW (engine power) to 7.3. The much lesser fall in engine power is by some commentators taken as evidence that the reduction in fishing capacity has been much less than indicated by the fall in GRT; naval architects have been clever in finding ways to reduce a vessel's GRT while maintaining or increasing its fishing power. These measures also ignore technological progress, and it is therefore conceivable that the capacity of the fleet did not fall over this period. Over time the emphasis of the programs has turned from grants for new investment to grants for decommissioning; in 1983-85 111 million ECU were granted for new construction and modernization and only 20.7 for decommissioning, while the expenditures for 1986-93 were 375.4 (construction and modernization) and 496.2 (permanent withdrawals).[1] The emphasis on decommissioning was further increased after 1993 (Hatcher, 1999, pp. 54-55).

The seemingly illogical combination of grants to vessel construction and decommissioning is undoubtedly the outcome of inconsistent political goals. Proposals by the European Commission have been ignored or changed by the Council of Ministers, and the policy itself has been subject to repeated criticism by the European Court of Auditors (Hatcher, 1999, pp. 61-62). Some of this may be due to different views in different member states. Some may be due to the objective of transferring funds to disadvantaged areas, and in areas where the fishing industry is predominant it may seem self-evident to direct any economic support to this industry. Such measures will, however, be short-sighted and self-defeating if they result in excessive fishing capacity eroding the profits of the industry and depleting fish stock.

In Norway, buy-back programs for fishing vessels have been implemented since 1979, except for a brief interlude 1996-97. These programs have been targeted at different types of vessels in different periods. They have involved grants both for scrapping fishing vessels and for selling them for other uses, including to other countries. These buy-backs have been particularly successful in the purse seine fleet where the number of vessels has been substantially reduced and the profitability improved, although this improvement is also due to other factors.[2]

Would stock rebuilding entail a permanent reduction in fishing capacity?

Above it was mentioned that more fleet capacity could be needed to exploit a stock that has recovered to an optimal level than would be required to keep it in an open access equilibrium of overexploitation. In this section I shall demonstrate why this could be the case.

Assume a fish stock that is overexploited and needs to be rebuilt. Assume further that the stock is in a deterministic equilibrium where surplus growth is equal to the catch. Let the production function of the fishery be specified as

$$Y = ES^b \qquad 0 \leq b \leq 1$$

where Y is the catch of fish, S is the stock of fish, E is fishing effort and assumed proportional to the number of vessels if they are fully used, and b is a parameter. In equilibrium this must

[1] Calculated from Hatcher (1999), p 56.
[2] This is discussed further in a separate paper at this workshop.

be equal to the surplus growth of the fish stock, $G(S)$. For illustration I shall use the logistic growth function with a carrying capacity normalized at one:

$$G(S) = rS(1 - S)$$

Setting $Y = G(S)$ makes it possible to find the necessary effort (fleet size) to take the surplus growth produced by the stock deemed to be appropriate:

$$E = rS^{1-b}(1 - S)$$

If b is sufficiently small we could have a situation where two different values of S imply the same E. The cases $b = 0$ and $b = 1$ are easy;

$$E = r(1 - S) \text{ if } b = 1$$

$$E = rS(1 - S) \text{ if } b = 0$$

If $b = 1$ we will always need less effort (fewer boats) the larger the stock is, but if $b = 0$ both a "small" and a "large" stock would necessitate the same level of effort, except for the stock producing the maximum sustainable yield.

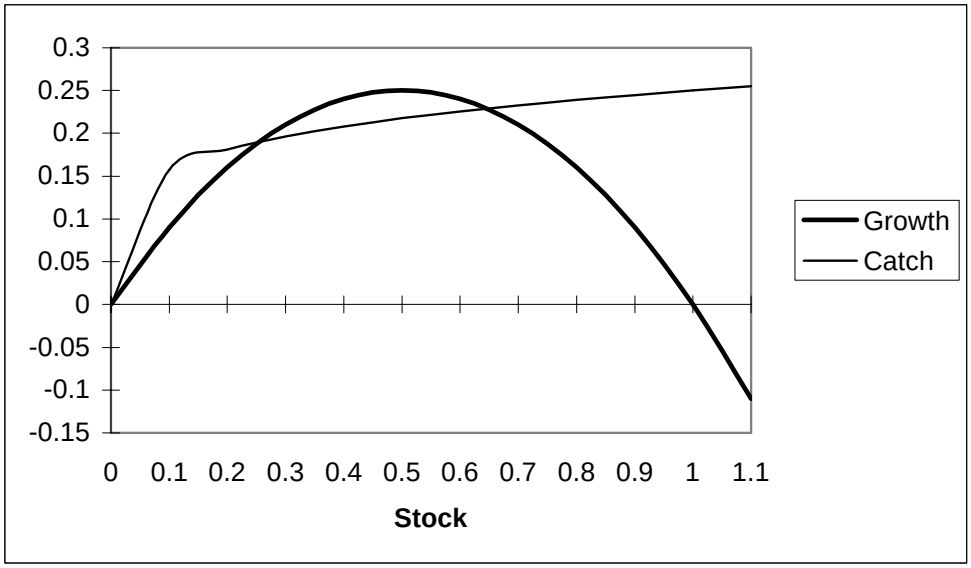

Figure 1: Surplus growth as a function of stock and catch as a function of stock for a given level of effort

In Figure 1 a case with $b = 0.2$ is illustrated. The figure shows the surplus growth function and the production function for a given level of effort. The production function has two points of intersection with the surplus growth curve, so here we have a case where two different stock levels imply the same necessary level of effort. Suppose we start in the equilibrium at the left point of intersection where the stock is below the maximum sustainable yield level. Suppose we want to rebuild the stock to some level between the two points of intersection. Once we have accomplished this we would in fact want more and not fewer boats; in this new equilibrium we would have a new production curve intersecting the surplus growth curve above the first one, but that would imply more boats.

This example is not just of academic interest. The case with a low b is a case where the catch per unit of effort is not very sensitive to the size of the stock. This has been found to be the case for schooling species such as herring and mackerel and is also believed to have played a role in the depletion of the Northern cod of Newfoundland; as the waters of the Grand Banks cooled the stock aggregated in "pockets" of warmer water and became more vulnerable to the fishing fleet, just like schooling fish. On the other hand it could be argued that equilibria where the catch curve intersects the surplus growth curve from above are not very interesting, because they are unstable. Being in the neighborhood of such an equilibrium would be bad news for the fishery, because the fish stock could be driven to extinction.

How quickly we might need to start rebuilding a fleet we had cut down in order to replenish the stock would depend on how quickly the stock recovers, which in turn would depend on its growth rate and how much the fishing effort is reduced. The paradox of first reducing and then increasing the fishing fleet as a part of a stock-rebuilding program does not appear to have been much noticed in the literature. It is true that it would only occur with a certain constellation of parameters and in the unrealistic setting of a deterministic model. Environmentally-driven fluctuations of fish stock generate their own problems with respect to fleet capacity.

Stock fluctuations and capacity

It has already been stated that buyback programs will not provide any long term solution unless they are combined with limiting the number of vessels, or, more appropriately, *adequate incentives to invest*. I emphasize the latter, because some commentators appear to believe that controlling the capacity of fishing fleets will be sufficient to control the exploitation of fish stocks in an appropriate way. This is generally not true; the growth of most fish stocks is influenced by environmental fluctuations which are imperfectly understood and certainly beyond human control (the El Niño is an example). Because stock fluctuations lead to fluctuations in the catch that it is advisable to take, we may expect overcapacity of fishing fleets in some periods and insufficient capacity in other periods. What is needed, therefore, is an incentive system that entices the industry to (i) invest optimally in fleet capacity and (ii) use the available capacity in an optimal way. It is highly unlikely that a public fisheries management agency will be able to accomplish this with a "hands-on" approach; for one thing it would not possess all the relevant information about the costs of fishing. Such information resides in the fishing firms themselves.

Consider a fish stock for which the total allowable catch fluctuates randomly. Suppose that one boat can always catch the same amount of fish when it is fully used. If $F(Q)$ is the cumulative probability distribution of the total allowable catch (Q), the expected net contribution of a marginal boat would be $v(1 - F(Q^*))$, where v is the value net of operating costs of the catch taken by a boat that is fully used and Q^* is the total catch that the fleet is able to take. The optimal fleet size would be where this expression is equal to the capital cost of the boat. Obviously the optimal fleet size would depend on the level of the capital cost, the value of the catch per boat, and the probability distribution of the total allowable catch. It is possible that individual transferable quotas would give incentives to the industry to trade in quota allocations so that both of the above objectives would be realized; (i) the fleet would be of an optima size, and (ii) it would be optimally used in periods when all of its capacity is not needed. As already stated, the share system is one factor which is likely to lead to some overinvestment in fishing boats under individual transferable quotas, although that regime

would be far better than open access. The advantage of a system like this is that the responsibility for investment and fleet capacity would rest with the industry itself.

Conclusion

Buyback programs alone are not the solution to the overinvestment problem in the fishing industry. They would bring some relief in the short term, but if nothing is done about the underlying incentives to overinvest they might actually make the problem worse by strengthening these incentives. Combined with adequate controls on investment buyback programs could be helpful; they would facilitate the necessary reduction in fleet capacity, and they could lead to a more rapid adjustment towards the desired long-run solution. Since the justification of buyback programs lies in the realization of expected future benefits it seems reasonable to require that buybacks should ultimately be funded by those who remain in the industry and enjoy the said benefits once they are realized, even if the general taxpayers' money is used to initially finance the buyback. Furthermore, without such industry funding the cost of the buyback could exceed the rent generated by the buybacks, and even the maximum rent that could be obtained in the fishery.

Literature cited

Banks, R. (1999): Subsidizing EU Fleets: Capacity Reduction or Capital Subsidization? *in* Hatcher and Robinson (Eds.): Overcapacity, Overcapitalization and Subsidies in European Fisheries. *CEMARE Misc. Publication* No. 44, 1999, University of Portsmouth, pp. 200-211.

Clark, C.W., G.R. Munro and U.R. Sumaila (undated): *Subsidies, Buybacks and Sustainable Fisheries*. Fisheries Centre, University of British Columbia.

Funk, R.D, W.L. Griffin, J.W. Mjelde and J.M. Ward (2003): A Simulation Model of License Buyback in the Texas Bay Shrimp Fishery. *Marine Resource Economics*, Vol. 18, pp. 33-53.

Hannesson, R. (2000): A Note on ITQs and Optimal Investment. *Journal of Environmental Economics and Management*, Vol 40, pp. 181 – 188.

Hatcher, A. (1999): The European Community's Structural Policy for the Fishing Industry, in Hatcher and Robinson (Eds.): Overcapacity, Overcapitalization and Subsidies in European Fisheries. *CEMARE Misc. Publication* No. 44, 1999, University of Portsmouth, pp. 50-68.

Holland, D., E. Guðmundsson and J. Gates (1999): Do Fishing Vessel Buyback Programs Work? A Survey of the Evidence. *Marine Policy*, Vol. 23, pp. 47-69, pp. 47-69.

Weber, M.L. (undated): Effects of Japanese Government Subsidies of Distant Water Tuna Fleets, in *Subsidies and Depletion of World Fisheries*, World Wildlife Fund, pp. 119-135.

Weninger, Q. and K.E. McConnell (2000): Buyback Programs in Commercial Fisheries: Efficiency versus Transfers. *Canadian Journal of Economics*, Vol. 33, pp. 394-412.