



Design principles for individual transferable quotas

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Abstract

Individual transferable quota (ITQ) institutions should be designed to minimize two types of transaction costs. First, to minimize the costs of transferring ITQ rights among rights-holders and users, rights should be separated into three components: a permanent entitlement share, an annual catch allocation, and a license to fish. Second, ITQ rights can reduce the transactions costs for development of self-governance by owners both by specifying a non-unanimous voting rule (preferably one-share/one-vote) and also by delineating clear standards for devolution of responsibility from government. These same two principles for reduction of transactions costs can be applied, with slight variation, to individual transferable input systems.

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1. Introduction

Scott suggested the “sole owner” as a metaphor for the advantages of property rights in fisheries management [1]. Economists initially proposed limitations on entry into the fishery that would create a “right to fish” [2]. But the defects of limited entry, including the incentives to increase fishing effort per license (i.e., “capital stuffing”), became apparent during the 1960s and 1970s (see [3]). Christy proposed that a limit be placed on the number of fish that each harvester could take [4]. This concept evolved into individual transferable quotas (ITQs). The incentives under ITQs are to maximize the difference between the value of the harvested fish and the costs of catching those fish. Among other advantages, ITQs end the incentives to race to catch fish. A relatively large number of economic

studies have documented the value of the rights created under ITQs and the reduction in the costs of fishing (see [5]). Economic analysis has tended to treat the exact definition of ITQ rights as an administrative detail, to be worked out in the context of the specific situation. Now that experience with ITQs has accumulated, economic analysis of transactions costs can examine the implications of different administrative arrangements.

Rent generation in fisheries has multiple dimensions. Economic analysis had predicted that efficient use of fisheries would increase productivity and profits by reducing harvesting costs and allowing stocks to recover. But experience indicates that opportunities to increase product value may be at least as important as the opportunities to increase productivity (see [6]). The condensed season under a race to capture an open access total allowable catch (TAC) may significantly lower the value per kilo of fish. Quality of landed product may suffer during the race, prices are depressed by seasonal gluts, and higher value markets often require a consistent supply that short seasons cannot meet. For example, in the Canadian Pacific halibut fishery, the introduction of ITQs moved product from a

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short-season frozen fish market to a year-round fresh fish market. The value per pound increased about 40% [7]. And in the Australian bluefin tuna fishery, the introduction of ITQs moved the product from low-value canned markets into high-value sashimi markets, and an aquaculture industry developed to fatten wild-caught tuna [8]. Anderson further argues that stronger rights for harvesters can create opportunities to increase rents by application of aquaculture technologies [9]. The seeding and rotation programs implemented by the New Zealand Challenger Scallop Enhancement Company, discussed below, illustrate the opportunities to apply aquaculture technology in “wild” fisheries.

Alternative ITQ institutions will affect the ability of participants to realize these various opportunities to increase the value of the resource. As Coase argued, transactions costs limit the ability of private agents to bargain to achieve welfare-improving contracts [10]. Using the case of fisheries, Cheung argued that the absence of property rights raises the transactions costs of negotiating contracts for efficient use of resources [11]. Alternative definitions of rights will affect the transactions costs of negotiating and implementing various contracts for efficient resource use. Better definitions of property rights will reduce transactions costs. Lower transactions costs directly increase net benefits. For example, better rights can reduce the legal expenses incurred to write and enforce some contract. But more importantly, lower transactions costs expand the opportunities for contracts that capture more rents from the resource. The experiences to date with ITQs, and particularly in New Zealand, suggest that two types of transactions costs deserve particular attention in institutional design. First, the costs of contracting for resource use can be reduced by “unbundling” different rights attributes. Second, institutional design can substantially reduce the transactions costs of self-governance.

2. Separability of rights and transactions costs of contracting

The transactions costs of transferring quota shares are important because transferability promotes static and dynamic efficiency. Different economic agents can derive different streams of economic benefits from a fishery. With transferability, economic incentives are created to transfer the resource to those agents who can generate the greatest economic benefits. However, ITQs create not a single right, but rather a bundle of rights. Maximum efficiency and minimum transactions costs require that these various rights be separated and made independently transferable.

The delineation of separable rights for different aspects of the use of a resource has been an important

aspect of property rights evolution in many resources. For example, the right to extract water from an aquifer was historically tied to ownership of property and application was often restricted to the property from which the water was extracted. Water rights are now frequently separated from the land ownership right, so water can be extracted from a different property on the same aquifer. Separating the right to extract and to apply water enabled more efficient use of water resources. When different attributes of an asset become separable, the transactions costs of contracting for use of those different attributes are reduced.

Drawing upon experiences with ITQs and with analogous institutions for water rights management, we propose a three-part division of the ITQ rights bundle: (1) a permanent “entitlement share” in the resource; (2) an “annual catch allocation” that is determined each year from biological conditions and the entitlement share; and (3) a “license to fish” that authorizes and regulates harvest using the annual catch allocations. This delineation of rights suggests new directions in which to clarify fishing rights and explains some practical aspects of current ITQ systems. This three-part separation of rights parallels (and is drawn from) Young and McColl, who proposed a three-part “robust separation” of water rights under cap-and-trade structures [12].

2.1. The entitlement share

The entitlement share is the most obvious right to create. In fact, the simplest ITQ concept is simply the entitlement share. The owner of the entitlement share has a claim in perpetuity on a specific percent of some aspect of the resource. Under the conventional definition of an ITQ, the entitlement share owner receives a specified percent of the TAC, which is set by government. While this is the most obvious definition, other definitions are possible. For example, if the government divides the quota into sub-quotas, the entitlement may be for a share of each sub-quota. Sub-quotas might be for areas, for seasons, or for specific sizes of animals. In fisheries with by-catch limitations, the right to a predetermined share of any by-catch allocations might be specified.

The entitlement share should be registered indefeasibly under a Torrens title-like system. That is, legislation should guarantee that the person whose name is recorded in the central registry is the owner, that any encumbrance recorded in this registry takes absolute and total precedence over any other claims, and that any change in ownership is subject to those recorded encumbrances. Legislation must define any action that may diminish the title and the possibility of such action must be recorded on any certificate of title. For example, if violations of fishing requirements can result in

government claim against the right (such as forfeiture, financial claims against the title, or diminished future allocations), then such potential claims by government should be indicated on all certificates of title. Establishment of an indefeasible registry dramatically lowers the costs of an array of transactions, because both ownership and encumbrances are transparent. A guaranteed registry increases the value of the right as collateral and provides access to lower cost financing, because the loan originator can verify existing encumbrances and can record the priority of any new encumbrance. The registry guarantees that disposal of the right without clearance of the registered interest is impossible.

The ITQ entitlement share is almost always expressed as a proportion of a variable TAC. The experience of New Zealand with fixed, rather than proportional, allocations is well known (see [13] for a comprehensive discussion of New Zealand's quota management system (QMS)). In theory, government could achieve the necessary adjustment to variable stock conditions by buying and selling annual catch allocations. But this adjustment process would shift all risk onto the government, which may face expenses that are politically unacceptable if stocks decline unexpectedly. The government of New Zealand intentionally structured ITQ shares in fixed tonnages rather than as shares of a variable TAC. The government expected that, on average, future TACs would increase as better management improved stocks. Under this expectation, the government could realize part of the future rents by selling the expected increases in the TACs. But changes in scientific assumptions resulted in substantial downward revisions in estimates of orange roughy stocks, which would have required very large government expenditures. New Zealand then went through a difficult process of moving from volume allocations to share allocations, with only partial compensation to quota owners. Most governments will be unwilling to accept either the financial or political risks of volume-denominated ITQs.

Finally, the ability to transfer the entitlement share should not be restricted. For example, some ITQ programs limit ownership to licensed harvesters. There are three broad reasons not to restrict ownership to some class of owners. First, such restrictions raise the transactions costs of efficient use of the resource. Users who may be able to increase value from the resource may be restricted from ownership. A processor who wants to make a substantial investment in a new processing facility may wish to decrease supply risks by owning ITQs. A distributor who has developed a new market with a demand for a steady supply may likewise wish to guarantee the availability of product. And restrictions on ownership are notoriously easy to evade. Shares can be owned by family members or purchased in the name of trusted employees. The primary effect of

such restrictions is to require higher transactions costs for indirect ownership, in the form of complicated encumbering contracts and greater risk of loss of ownership.

Second, an unfettered market for entitlement shares will result in ownership of the shares by those with the greatest concern for the future. The entitlement share is a claim to a future stream of rents. That stream will be most valuable to investors with the lowest discount rate, i.e., those who are most willing to make short-term sacrifices in order to realize higher long-term returns. And third, the transfer of entitlement shares creates a market for efficient management. If a set of entitlement owners fails to take advantage of opportunities to increase the value of their resource, investors who see those opportunities can buy the entitlements and take actions to increase the value of the resource. And if some, but not all, entitlement holders want to pursue some strategy to increase stock value, those who want to make the investment can buy out those who do not.

2.2. *The annual catch allocation*

Transfer of the annual quota among harvesters is important for economic efficiency in harvesting and to maximize value of the resource. Transferability allows both long-run rationalization of fleet capacity and also efficient short-run adjustments. A vessel that experiences maintenance problems (or simply wants to take a vacation) can transfer its quota to another vessel. A processor who needs to schedule plant operations or a dealer who has a large supply commitment can acquire sufficient quota to meet those commitments. If the spatial pattern of fish availability fluctuates, vessels operating near the concentrations of fish can acquire quota from vessels in other areas. For vessels that harvest more than one species, the changeover in gear may require selling quota in one fishery and buying it in another. A vessel that wants to enter an ITQ fishery can buy sufficient quota to warrant the investment and still have the option to leave the fishery by selling the quota.

The mechanism to create the annual catch allocation is straightforward. Each year, the annual catch allocation for each entitlement share is computed by multiplying the percent share of the entitlement times the TAC. (If the quota has sub-allocations, for example by area, then each entitlement share may receive several annual catch allocations, one for each sub-allocation.) The annual catch allocation is distributed on a specific day. The registered entitlement owner on the day of the distribution gets the allocation and this allocation is unaltered by any subsequent transfer of the entitlement. Once the annual catch allocations are created, they are freely transferable.

In most cases, a central accounting of allocations would be maintained and this accounting would be

independent of the entitlement registry. To be eligible to acquire annual catch allocations, a firm would be required to register an account with the accounting agency, which might be a government agency or a privatized accounting firm (as in New Zealand). The central accounting agency would maintain a ledger of unused annual catch allocations, transfers of allocations, and landings made against the annual catch allocations.

In some fisheries, it may be possible to avoid a central accounting of annual catch allocations. If fish are landed in generally recognized increments (e.g., if landings are made in bins that have a specified weight), then coupons or tags could be issued for these recognized increments. Each landing would require surrender of an appropriate number of coupons or tags. In high-valued fisheries such as lobsters or bluefin tuna, landings might be denominated per animal so the annual catch allocation would be made as some number of landings tags. There are some disadvantages to the coupon/tag approach, however. Replacement of lost coupons/tags could create difficult problems. And coupons cannot deal with landings smaller than the designated coupon units.

The annual catch allocations must specify if and how catch allocations may be carried forward from one year to the next. Creating the annual catch allocations on a specific date each year is administratively necessary, but inherently arbitrary. If there is no provision to carry-over annual catch allocations, end-of-year surpluses or shortages can create a variety of undesirable problems. In most fisheries, carry-over rules (and perhaps borrow-forward rules) will be implemented to reduce end-of-year uncertainty. The simplest rule would be to allow free carry-over of all unused annual catch allocations into the next year. For a borrow-forward rule, entitlement share holders could be allowed to request some portion of their annual catch allocation in advance of the administrative issue date. For example, an entitlement holder might be allowed to request issuance of up to 10% of the following year's annual catch allocation during the final three months of the previous year. A small penalty, as a reduction in the annual catch allocation, might be imposed to discourage excessive use of this option. Of course, in annual crop fisheries such as shrimp, the appropriate rule may be no carry-over and no borrow-forward.

But in most fisheries, there are economic and biological reasons not only to allow but even to encourage carry-over. Fish that remain unharvested will add to the future stock by growing in size and by reproducing. If leaving fish uncaught generates a benefit, an economic incentive to delay harvest could be created to match this benefit. Townsend suggested that appropriate incentives to "bank" quota would be created if banked quota grew at the marginal rate of growth of the stock [14]. These incentives could be quite important

under some scenarios. For example, the severe acquired respiratory syndrome (SARS) outbreak dramatically reduced demand for some high-value seafood products, such as abalone, sold to China and Southeast Asia. Holders of annual catch allocations might well want the option of investing those allocations in future stock growth instead of selling at low prices. The banking option can also allow harvesters and dealers to manage the economic impact of resource variability. For example, if a stock has highly variable annual recruitment but a relatively long life span, banking allows the resource users to balance economic and biological factors in the timing of the exploitation of large year-classes.

If the entitlement share and the annual catch allocations are not separable, the necessary short-run adjustments can be accomplished only through sale-buyback agreements or lease agreements. Both sale-buyback agreements and lease agreements have disadvantages that increase transactions costs. Most obviously, these contracts are more complicated and require more legal expense to write. Because these contracts are more complex, the increased probability of court action increases expected transactions costs. Sale-buyback agreements and lease agreements run the risk that insolvency or financial claims against one firm will create serious legal and financial problems for the other. Legal problems in enforcement of lease or sale-buyback agreements may result in ambiguity over who can use the right while it is subject to litigation. For these reasons, significantly lower transactions costs can be achieved if the annual catch allocations are completely separable from the entitlement share.

2.3. *The license to fish*

Many ITQ programs require a license to fish that is separate from the ITQ right. Economists have often argued that this license is a superfluous and vestigial remnant of earlier limited entry programs. If the TAC is set at the appropriate level, then competition among harvesters for the available annual catch allocations will minimize the costs of fishing and maximize the value of the annual catch allocations. Restricting competition among harvesters is arguably inimical to the interests of entitlement share holders.

There is, however, a sound reason to license fishing operations independently of the entitlement share and the annual catch allocations. Fishing creates externalities that are not solved by the ITQ. Most obviously, non-target marine organisms are caught. The gear may disrupt the environment (e.g., the impact of dredges on the benthos). And the ITQ may not completely eliminate all external effects of fishing by a harvester upon the stock. The ITQ is typically specified as weight of the specified species. But removal of a ton of small fish may

reduce future harvests more than removal of a ton of large fish. Fishing on spawning aggregations may have greater negative impacts on future stocks than fishing on non-spawning fish. For these and other reasons, harvesting activity may be subject to a number of restrictions: mesh size or minimum size limits to reduce catches of small, fast-growing fish; limits on when or where fishing may take place; or requirements to modify gear to minimize catches of non-target species. These restrictions are not related to the weight of fish that are harvested, so they should not be attached to either the entitlement share or the annual catch allocation. Imposing these restrictions indirectly, through either the entitlement share or the annual catch allocation, will necessitate a complicated private contract to restrict any harvester who might eventually acquire that annual catch allocation. These restrictions may be more efficiently enforced by the government through exercise of its police powers than through the civil penalties available under private contracts. For example, if turtle excluder devices are required, it is more transparent to impose that restriction directly on the fishing vessel than on the holder of the entitlement share or the annual catch allocation.

ITQ programs sometimes require that all harvesting vessels own some minimum level of the entitlement share. As with requirements for licensing of users, this restriction seems superfluous or even inconsistent with the interests of the entitlement share holders, who benefit from increased competition for use of their assets. However, the requirement to own permanent entitlement shares serves as a bond that can be confiscated if the harvester violates fishing restrictions. There are perhaps some advantages to expressing this bond as a minimum holding of the entitlement share, rather than in cash or as a financial surety. The value of the implied bond changes automatically when entitlement share value changes. And it may be legally or politically difficult to require a financial bond of analogous magnitude. The bond is also more transparent when expressed as a minimum entitlement share. Ownership of the entitlement share could be verified through the central registry, while a financial bond may be more difficult to verify.

If the number of entitlement share holders is small, the requirement for a minimum holding of the entitlement share may partially internalize the enforcement process. A vessel that owns some entitlement share will incur part of the reduction in future harvests if it violates rules. The requirement to hold entitlement shares reduces turnover among harvesters and creates a repeated game in which rules and norms are more likely to be observed. Entitlement share holders may be able to sanction each other for violations. If an entitlement share holder violates some rule or norm, such as fishing in closed areas, other entitlement share holders may

refuse to deal with the offender on an array of transactions. Entitlement holders can also buy out an owner who repeatedly violates rules and norms, an option not available if anyone can obtain a license.

3. Transactions costs of collective decision-making

Economists have generally conceptualized ITQ management as a cap-and-trade mechanism to efficiently implement a government-imposed TAC. But this narrow conceptualization fails to recognize that ITQs address the core externality in a more fundamental way than do cap-and-trade pollution rights. In Haveman's terms, fisheries create a pool externality, while pollution creates a downstream externality [15]. In cap-and-trade pollution rights, the collective interest of the rights holders is still to pollute as much as possible. Government must determine the cap on pollution. Under an ITQ, the collective interest of the rights holders is to efficiently manage the resource. The ITQ owners do have an interest in setting an economically efficient TAC.

Permanent entitlement shares fundamentally alter the incentives of the ITQ entitlement holders and therefore change the appropriate balance between private and government decision-making. The entitlement share owners receive all future benefits of harvests from the resource. Their self-interest, to maximize the present value of this stream of benefits, is identical to the social interest. This reflects the more general advantage of private ownership of productive assets: owners have a self-interest in making decisions that maximize the social benefits from those assets. With an appropriate mechanism for collective decision-making, many decisions made by government under open access—including even the TAC—may be made more efficiently by the entitlement holders.

But the ITQ entitlement holders are joint owners of certain rights to a specified resource. To make decisions about the management of that resource, joint decision-making is required. This joint decision-making involves significant transactions costs. The ITQ institutions will determine the transaction costs of negotiation and decision-making and will therefore determine the scope of private decision-making.

If the entitlement holders can jointly make governance decisions, there are several reasons to expect that they will be able to achieve management results that are superior to government command-and-control decisions. First, many management decisions raise issues of implementation and enforcement that private decision-making can solve more efficiently than government. The industry has greater knowledge of how regulations affect operations and of the options available to avoid the rules. The industry may be able to detect violations

more easily and to sanction violators more effectively. To maximize the effectiveness of these private incentives, these incentives should encompass the costs of management as well as the benefits. This could be accomplished by devolving both costs and decision-making responsibility for administrative functions, enforcement, and research to the entitlement holders. Second, optimal management depends not only upon biological characteristics, but also upon economic considerations. Management can determine product characteristics (such as roe content, fat content, or size) that affect the value of the landings. Markets are dynamic; prices vary. To maximize the present value of landings, management must adjust for factors that affect product value. Third, management is fundamentally about risk management, an economic issue. Management balances various risks against the costs of acquiring information to reduce uncertainty. Once again, internalizing the decisions about research investments provides appropriate incentives to invest in research to reduce uncertainty about decisions.

When ITQ implementation ignores the structure for collective decision-making, two *de facto* rules are implied. First, entitlement holders must reach unanimous consent for any rule to be self-imposed. Second, government reserves the right to overturn any decision as its sole discretion.

These two rules impose exceptionally high transactions costs upon collective efforts to improve resource utilization. A requirement for unanimous agreement creates large obstacles in joint decision-making even in small groups. Being a holdout in such negotiations is often a dominant strategy. In large groups, unanimity is simply impossible to achieve. The need to obtain government approval for any decision further increases transactions costs. There are the direct costs of negotiating with government, which lacks incentives to minimize the costs of such transactions. Uncertainty over ultimate government approval reduces the expected value of gains from negotiations, which reduces the incentives to initiate negotiations. Most importantly, the political process of government review creates a *de facto* second round of negotiations, now in a formal regulatory arena. The results of the industry negotiations become essentially a starting point from which to convince the government to amend the terms. But this undermines the incentives to bargain within the industry. Agents will be unwilling to make concessions in private bargaining if they realize that those concessions will undermine their political position in the government review process.

To expand the opportunities for self-management, two steps must be taken to reduce transactions costs. First, decision-making rules other than unanimous agreement are required. Second, the government must clarify the potential scope for self-management activities

and specify transparent procedures to achieve government approval for devolution. With these two issues resolved, self-management of fisheries will become a prominent feature of ITQ governance.

3.1. Defining collective decision-making rules

The obvious, and most efficient, collective decision-making rule for ITQ fisheries would be one-share/one-vote rules in proportion to the ITQ share [16]. The entitlement share holders are joint owners of a set of resource rights. Joint ownership of economic assets is not unusual; most productive assets in modern economies are jointly owned by a large number of shareholders. Governance structures that require unanimous agreement to manage jointly owned economic resources are clearly not the norm; one-share, one-vote rules under corporate governance are the norm. Adopting corporate governance has the additional advantage of incorporating the accumulated body of law that governs the institution.

If majority share voting rules are not politically feasible, even super-majority voting rules (e.g., two-thirds approval) are a major improvement over unanimous agreement. Any non-unanimous rule substantially reduces the pay-off to the holdout strategy that dominates any unanimous agreement rules structure. Note, however, that rules that might require a majority vote of shareholders (i.e., one-person/one-vote rules) create very questionable incentives for entitlement holders to divide holdings among multiple nominal owners under their control (such as family members or employees) to increase their voting share. In general, corporate voting rules (one-share/one-vote) provide lower transactions of making economic decisions than democratic, cooperative (one-person/one-vote) rules [16].

As a minimum, the government should reserve the right to impose non-unanimous self-governance rules at a later date. Absent this reserved authority, those who can benefit from strategic behavior under unanimous agreement rules will object that their ITQ right is diminished by the requirement to cooperate in majority (or super-majority) voting structures. Such objections could be a serious political obstacle to the creation of more efficient institutions.

3.2. Defining the government role

The second issue, reducing the government contribution to transactions costs, is more complicated. Government regulation is a relatively high transaction cost institution. To promote private self-governance, it will be necessary to avoid many of the costs that are normally associated with regulation. While there are many dimensions to the transactions costs of

government regulation, three issues seem especially important. First, the regulation of residual externalities, such as by-catches of non-target species, should be separated from stock management decisions to the greatest extent possible. Second, the scope and criteria for self-governance should be clearly defined. Third, any government review process must avoid undermining private incentives to bargain self-governance.

Costs imposed on third parties are generally not encompassed in the ITQ incentives. Management of externalities such as by-catches of non-ITQ species and ecosystem impacts will typically require management outside the ITQ framework. These residual third-party externalities, for which appropriate private incentives are not created by ITQ entitlements, usually involve impacts of fishing itself. For example, fishing may result in by-catches of non-target species. Fishing, as with dredges or bottom trawls, may disrupt the benthos. The operation of one type of gear may conflict with other types of gear. The activity that needs to be regulated is fishing itself, not the volume of the targeted species removed.

In the three-part separation of rights, above, these regulations would usually be imposed upon the license to fish. The three-part separation not only reduces the transaction costs of contracting among entitlement holders and users, it also provides a clear separation of regulatory tools. The high transaction costs of government regulatory processes can largely be directed at the license to fish, because it is the fishing activity that generates most of the residual externalities. The government can reduce its regulatory oversight of the permanent entitlement and annual catch allocation without abandoning its responsibilities for the residual externalities. A reduced regulatory apparatus of the permanent entitlement and annual catch allocation will reduce the transaction costs facing the development of self-governance.

That is not to rule out the possibility that self-governance rules could address at least some third-party externalities. The enlightened self-interest of entitlement holders will be to reduce at least some third-party externalities. The entitlement rights structure may be less vulnerable to political attack if the rights holders anticipate and manage politically sensitive issues, such as incidental catches of endangered species. Industry self-management may be less costly to industry than the outcome of political and regulatory actions. The threat of political or regulatory action to manage externalities may motivate self-regulation. If self-imposed management is less expensive than government regulatory alternatives, the industry can increase its rents by implementing these less expensive options. Voluntary bargaining of a regulatory contract between an industry association and the government is an obvious approach to managing some external effects. But self-governance

of the fishery itself should not be conditional on resolution of the residual externalities.

To minimize transactions costs of self-governance, the government must clearly define which activities may be devolved and under what standards. For the industry to bargain an internal agreement, it must know the parameters of permissible self-governance. As the uncertainty increases about what activities can be devolved, the costs of bargaining increase because the negotiations must cover more contingencies. Increased uncertainty also reduces the expected gains from private negotiations. The increase in transactions costs and reductions in expected benefits will decrease the industry's willingness to undertake private bargaining.

Where government requires review of collective governance decisions, that review should be structured to support, rather than undermine, self-governance by the ITQ entitlement holders. The issues that will be reviewed and the standards to be employed should be clearly defined. The review process should consciously avoid rehearing conflicts among ITQ entitlement holders. If the industry-bargained position is only a starting point for the final negotiations in a government review process, the industry bargaining process will be undermined. Government officials should insist that once the industry reaches a bargain, individuals will not be allowed to use government to overturn that bargain. This may require considerable restraint by ministers and fisheries officials, who routinely listen to and respond to complaints by various industry sectors. This returns to the core issue that ITQ rights change the requisite role of government.

Proponents of on-going government oversight might argue that even rights holders with appropriate incentives will make mistakes. Therefore, government oversight will inevitably improve management because it can correct those mistakes. This conceptualization makes two errors. First, it assumes that government is less likely to make mistakes than private decision-makers. All human institutions make mistakes. The question is whether those institutions have appropriate incentives to correct and to learn from the mistakes. Private owners have every incentive to discover, correct, and learn from mistakes. Correcting mistakes will increase the value of the ITQ right. Government does not have these same incentives. Second, the argument assumes that the private decision-making will not be altered by government oversight. As discussed above, oversight undermines the private incentives to bargain. Government review tends to drift back to government regulation. Regulation usually sees its own failures as reasons for wider regulation. As regulation creates prohibitively high transaction costs for private self-governance, the regulatory apparatus will absolve itself of responsibility and conclude that self-governance is simply not possible.

Government must re-conceptualize its role to realize the maximum benefits of ITQ institutions. ITQ institutions decisively correct the destructive incentives of open access fishing. To realize the greatest possible benefits from ITQs, government must now lower the transactions costs of private decision-making to increase the value of the fishery. The residual government responsibility for management of third-party externalities must be accomplished without creating high transactions costs that undermine private incentives.

3.3. *The emergence of self-governance*

Despite steep transactions costs, self-governance agreements have arisen in ITQ fisheries (and even under limited entry) [17]. These experiences, which have occurred around the world and under very different institutional arrangements, provide compelling evidence that self-governance is a major and under-appreciated opportunity in fisheries management.

The most comprehensive case is the New Zealand Challenger Scallop Enhancement Company (“Challenger”). Challenger undertakes virtually complete self-management [18]. Challenger seeds juvenile scallops, closes newly seeded areas to allow growth, sets overall quotas, and monitors biotoxins and seafood safety. Challenger has negotiated agreements with recreational harvesters and with oyster dredge vessels to manage conflicts over use. A significant self-imposed fee on landings, which has ranged from 17% to 20%, finances this management activity.

Self-management is relatively common in New Zealand. FishServe, an industry-owned service bureau, provides complete monitoring and recording services for quota share (i.e., the permanent entitlement) transactions, the annual catch entitlement (“ACE”) transactions, and landings against the ACE. At least five industry companies other than Challenger undertake some traditional government management functions. These include the Bluff Oyster Management Company, the Hoki Fishery Management Company, the CRA2 Rock Lobster Company, the Orange Roughy Management Company, and the Squid Fishery Management Company.

Fisheries self-management is not limited to New Zealand nor is it even limited to ITQ fisheries. In several cases, permit holders in limited entry fisheries have negotiated private agreements to implement individual quotas. The four offshore catcher-processors with limited entry permits for US Pacific whiting negotiated an agreement to divide the available TAC [19]. The US Bering Sea pollock fleet first lobbied for Congressional authorization for private bargaining and then bargained a series of private agreements to allocate the TACs [20]. In a small herring roe fishery in Yaquina Bay, Oregon, the nine permit holders negotiated an

agreement that has been in force since 1989 to equally share the TAC [21]. In the British Columbia geoduck fishery, the limited entry permit holders negotiated with a reluctant government to implement an ITQ program that is administered under an industry-financed monitoring program [22]. In the Alaskan weathervane scallop fishery, the six largest permit holders negotiated an agreement to divide not only the scallop catch but also the crab by-catch allowances [23]. In the Alaskan Chignik salmon fishery, 70 permit holders negotiated a joint agreement to collectively harvest their allocated share of that fishery in 2002 and 2003 [24].

4. Reviewing the New Zealand experience

New Zealand has made the most comprehensive commitment to ITQs. All major fisheries are under the quota management system (QMS), and the government is committed to bringing all remaining fisheries into the program. New Zealand has seen the success of self-governance under the Challenger Scallop Enhancement Company and is actively encouraging greater industry self-governance. New Zealand’s leadership in the use and expansion of rights-based management makes its experience with institutional design of ITQs very informative.

New Zealand has already addressed the three-part separation of rights to reduce the costs of transferring rights. New Zealand’s 1996 revisions to the QMS explicitly separated the permanent entitlement (usually called “quota share”) from the annual catch allocation (called “annual catch entitlement” or “ACE”). For most New Zealand fisheries, the license to fish is separate from QMS rights. Discussion within New Zealand often suggests that this license to fish is simply a vestige of older management. But as the above analysis indicates, a separate license to fish can serve an important role in the ITQ framework, because it can address external effects not internalized by ITQ management.

Although New Zealand has not defined institutions for self-governance by ITQ rights holders, self-governance has emerged in several fisheries. The Challenger Scallop Enhancement Corporation stands out as a well-developed self-governance institution, but Challenger remains an exception rather than the rule. While other industry management companies have emerged, the scope of their activities is much narrower than Challenger’s. The government has expressed great interest in the development of more comprehensive self-management institutions that are modeled on Challenger.

Despite the government’s interest in promoting greater self-governance, New Zealand has not addressed the transactions cost impediments to self-governance.

New Zealand continues to rely upon unanimous agreement as the basis for such self-management. Absent a non-unanimous decision-making rule, the size of any group that is likely to self-govern will be small. And New Zealand has not laid out a well-defined set of criteria for devolution of management. Industry must develop a proposal for management, which the government will evaluate. The government has circulated a preliminary proposal for “fisheries management plans”, but the response from industry and environmental groups has been tepid. One possibility raised by that proposal is that industry will be expected to negotiate all aspects of management with all other interested groups. This might include environmentalists, recreational users, Maori customary users, and non-extractive users. Such a broad requirement would create virtually insurmountable transactions costs. These other interest groups not only lack any common interest with the commercial users, but may even have incentives to block agreements.

The New Zealand government and industry continue to struggle with how to accommodate an expanding industry role in fisheries management. To make progress, New Zealand must appreciate and address the transaction costs confronting self-governance. Separating the stock management issues from the third-party externalities would be an important first step. Adding the license to fish as a formal third component of the QMS could facilitate this separation. The ITQ license holders have clear incentives to improve stock management and government could reduce its activities in this area as industry assumed responsibilities. The regulatory role with respect to third party externalities could be accomplished via restrictions on the license to fish. These restrictions might be imposed via traditional regulatory mechanisms or through regulatory contracts between government and industry.

5. Transferable input systems

Economists tend to focus on ITQs as the most efficient fishery management tool. Input regulation is usually dismissed as inefficient, because it creates distortionary incentives to substitute unregulated inputs for the regulated inputs. However, ITQs have their own costs. ITQs create incentives to underreport landings, so higher transaction costs for monitoring are required. In systems that are difficult to predict biologically, it may be easier to specify an efficient effort level than an efficient output level. In some fisheries, restrictions on inputs have the benefit of reducing some external impacts of fishing (see [25]). An individual transferable input (ITI) system that denominates transferable rights for inputs, rather than output, may be an appropriate alternative to ITQ management in some fisheries. Hybrid systems, which have both ITQ allocations and

ITI allocations, occasionally appear as a way to reduce enforcement problems with the ITQs. Whether an ITQ or an ITI or a hybrid system is more efficient depends upon the relative size of transactions costs, such as an ITQ enforcement costs, and the residual inefficiencies. Under some circumstances, an ITI may be more efficient than an ITQ. For example, in some fisheries for lobsters, which are often very valuable and easy to distribute illegally, individual transferable trap management structures are common.

The issues of reducing the transactions costs of contracting and collective decision-making apply equally well to ITI systems. The three-part separation of rights can reduce the costs of transferring the licensed inputs among users. Non-unanimous decision-making rules and clear government standards can promote greater self-governance among rights holders.

The three-part separation of ITI rights is completely analogous to the three-part ITQ rights systems. A permanent share of an input cap is allocated. The input cap can vary with stock conditions, so the annual allocation of ITIs can vary. The annual allocations would be transferable. Transferable input systems present some enforcement issues that must be accommodated. Counting inputs requires that the vessel or gear be available to enforcement authorities at known times. Transferable input systems create incentives to use the regulated input more intensively. Some limits on transferability may be necessary to manage such incentives. For example, if the limit is on vessel length, the input allocation could be used to support two vessels fishing every-other-day on the same allocation if daily transfers were allowed. For these various reasons, transferability might be for some specified minimum period, such as a month or even the entire season, or be subject to advance notification requirements.

The separation of the annual input allocation from the entitlement share enables an ITI system to annually adjust the total input level, just as ITQs annually adjust to the TAC. This adjustment in total inputs is an important advantage over permanent, non-adjustable ITI systems. Annual adjustments can be made to accommodate stock variability, just as under an ITQ. But perhaps more importantly, input allocation programs must content with technology improvement and the incentives to substitute unregulated inputs for regulated inputs. To offset these incentives, input allocation programs must periodically reduce the number of inputs. Programs may also refine input definitions to minimize the incentives for input substitution. With an annual input allocation decision, these adjustments can be made incrementally, before the effects of technology and input substitution disrupt the entire system.

As under the ITQ institutions, a license to fish that is separate from the permanent input share and the annual

input allocation can be created. This license is the obvious vehicle for imposition of regulations that address third-party externalities.

The collective decision-making issues are virtually identical under ITIs and ITQs. The permanent entitlement holders have the same collective interest in self-governance and face the same transaction costs of negotiations. Non-unanimous self-governance rules and clear government standards for self-governance will reduce the transactions costs of self-governance for ITI entitlement holders.

6. Conclusions

With considerable justification, economists promote ITQ management as a major step forward in fisheries management. ITQs provide incentives to dramatically reduce harvesting costs, and the evidence strongly indicates that ITQs have achieved that objective. But economists still have work to complete on property rights in fisheries. The transactions costs of contracting under an ITQ system are as real as the costs of running a vessel. The three-part separation of rights can significantly reduce the transactions costs of using and managing these valuable fishery resources. The transactions costs of collective decision-making can be reduced by non-unanimous voting rules and minimized by one-share/one-vote rules. A clear specification of standards for devolution of decision-making will further reduce the transactions costs for rent-improving self-management of fisheries. ITQ fisheries have generated more than the predicted rents from cost reduction. Higher product value has been the norm, and in a few cases self-governance has emerged. By further reducing the transactions costs for entitlement holders, the opportunities to increase the social returns from these valuable assets will expand significantly.

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