Individual Transferable Fishing Quotas in Chile: Recent History and Current Debates[1]

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May 26th, 2002

Abstract.

Artisanal and industrial fishing sectors in Chile require the consolidation of fishery management schemes that promote the rationalization of fishing efforts, adjusting them to scarcer fish stocks. We argue that a system based on Individual Transferable Quotas (ITQs) is the best available option, especially for the industrial sector. Individual assignments favor the coordination of collective solutions to rationalizing fishing efforts, while transferability promotes economically efficient solutions to the excessive fishing capacity problem. We propose an initial assignment of ITQs based on historical presence, conditioning the ITQ user-rights to annual payments that allow financing of the ITQs' management and enforcement costs. We defend an initial assignment of ITQs as transitory user-rights, with a reasonably long period of validity (15-20 years). We argue that this favors the political viability of being able to continue perfecting the ITQs system in the future. We also propose to empower Artisanal Fishermen Associations, which be able to provide reliable proofs of having relevant local representation, with faculties for deciding on and administering the distribution and use (among their members) of the total quota assigned to them by the fisheries regulator. These self-governing faculties would include the possibility of allowing for transferability of individual quota allocations. Finally, we propose that artisanal fishermen have the legal ability to carry out transactions with industrial interests, so that some proportion of the industrial quota could be caught inside the first five miles (currently being a reserved zone for artisanal fishing), for example using artisanal vessels for these purposes.

[1] The ideas expressed in this article exclusively represent the personal opinions of the author, therefore in no way do they represent the official position of institutions with which the author maintains contractual relations. Since the end of the year 2000, the author has participated as an advisor in regulatory matters for the Minister of Economics in Chile, including analysis of options for legislative reform in the fishing sector.

1. Introduction

Extractive fishing sectors in Chile face the need to rationalize the levels of fishing effort that brought about their growth during the 1980s and 1990s. Fundamentally, this was growth via increments in tonnage caught. Over time this has generated scarcer fish stocks. As a consequence, new options for growth in the fishing sector are increasingly related to adding value to the final product.

Since the end of the 1980s a series of attempts have been undertaken to reform the regulatory institutions of the fishing sector. In spite of partial advances, the challenge remains in terms of consolidating regulations that promote economically efficient allocations of capital and labor, and that at the same time are compatible with sustainable catch levels. The legal reform that was enacted in January of 2001 is a step in the right direction. It introduced individual catch quotas per firm, subject to partial transferability, while being focused on the industrial fleets of the fisheries undergoing more significant catch pressures (i.e.. fisheries in 'full exploitation'[2]). The Transitory Fisheries Law that resulted from this reform was designed to be a transition instrument, oriented towards favoring the construction of longer term consensus, in areas of difficult negotiation.

This paper discusses the new Fisheries Law that should replace the present transitory regulations. We defend the idea that individual transferable quotas (ITQs) constitute the best solution for regulating the exploitation of a natural resource that would otherwise remain subject to incentives for over exploiting it, even under closed entry for new fishermen and enforcement of annual global quotas (total allowable catch, TAC). The fundamental reason for this is that ITQs are capable of generating more cost-effective production incentives than other fishery regulations, given that ITQs can promote self-regulatory efforts and at the same time generate longer term planning horizons.

We analyze frequent criticisms that have been wielded in Chile with respect to the use of ITQs: (i) arguments 'of principle' ("No to the privatization of the sea"); (ii) criticisms related to inequity effects (quota consolidation and the resulting income distribution, fewer opportunities for small/artisanal fisherman); (iii) induced unemployment (unemployment that, according to detractors, could be avoided if ITQs were not used); and (iv) opinions that question the need to introduce additional regulatory instruments ("it is sufficient to use the instruments available today in a better

[2] Fisheries where annual landings equals or exceeds the 'surplus productivity (SP)' of a given species, where SP equals the biomass level that exceeds at the least level necessary to maintain the current levels of biomass.

way", and "the fish will return").[3] We start by situating the debate historically, then we analyze key presumptions that condition the criticisms just mentioned, subsequently we discuss the main areas of controversy, and finally we propose solution strategies.

2. Recent legislative reforms

Since the late 1980s the possibility of implementing ITQs for our main fisheries has been under discussion in Chile. Signs of increasing scarcity of our main fish stocks have motivated this debate. As part of this process, the Fisheries Law of 1991 introduced the option of using ITQs, defined as user-rights with 10-year validity (Peña-Torres, 1996a, 1997). However, lobbying pressures during the enactment of this law finally led to ad-hoc restrictions on the scope of use for ITQs.[4] As a result of this, and under the rule of the 1991 Fisheries Law, the use of ITQs has been restricted to four industrial fisheries[5], none of which represent a significant share in the employment or value added generated by the Chilean fishing sector.

The fisheries crisis of the late 1990s triggered a second legislative initiative attempting to expand the use of ITQs. A short-term priority was to allow for the use of ITQs in the horse-mackerel fishery (Central-Southern zone), which had been severely punished by the *El Niño* phenomenon of 1997-99. However, this initiative ended up being trapped by successful opposition lobbying, led by some private interests linked to industrial fishing of the horse mackerel, with the support as well of a heterogeneous group of artisanal fishermen and small industrial fishing firms.

A Transitory Law: Maximum catch limit per boat owner

For the year 2000 the government decided to promote a transitory law proposal of lesser complexity, relative to prior efforts to reform the 1991 Fisheries Law. The resulting law, valid for the years 2001-2002, is applicable to all fisheries currently in full exploitation and which at the same time are subject to annual TACs. Its main innovations are:

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[3] For example, see opinions of the fishing businessman Rodrigo Vial, in *El Mercurio 10/5/00*, "Fishing Law".

[4] For example, the maximum percentage of fishing that can be administered under ITQs, in a fishery in *full exploitation*, is 50% of the annual TAC, upper bound that is attainable gradually over time: at the soonest, at the end of 10 years of annual auctions of ITQs (each of these auctions selling 5% of the corresponding annual TAC (Peña-Torres, 1996, 1997).

[5] These four fisheries involve species of high unit value. Two of them are demersal fisheries in the Southern-Austral zone of Chile (both in state of *Infant Development*): the *Chilean Sea Bass* (deepwater) fishery has been under ITQs since December 1992, and the *Orange Roughy* fishery since December 1998. The other two correspond to small crustaceans (both in state *of Recovery)*: the *Red Prawn* fishery (Regions V to VIII), with

(a) The annual TAC assigned to the industrial fleet is divided into individual fishing quotas (per boat owner), defined in tons. These initial allocations prevail only for the years 2001 and 2002; and they do not constitute a legal precedent for subsequent years. In the case of demersal fisheries, the assignment per boat owner is based on recent catch history (years 1999 and 2000). In pelagic fisheries, the allocation criterion gives a 50% weight to the boat owner share in historical catch (period 1997-2000) and 50% to the share in the total tonnage (storage capacity) of the whole industrial fleet (for the same period).[6]

(b) The direct transferability of individual quotas between boat owners remains excluded. Nevertheless, two possibilities of flexibility are implemented:

i) Prior to starting each fishing year, independent boat owners can associate among themselves in order to *consolidate* the quotas assigned to the ships under their control; thus they can decide if they will undertake fishing efforts with all or only a subset of these ships. The ships not utilized retain their fishing authorization, while being exempted from the annual payment of fishing licenses, and at the same time receive a prorated participation in the catch records of the ships used. This option seeks to promote, on one hand, a more cost-effective use of currently oversized fleets and, on the other, to increase the chances of operating under financially viable scales of production.

ii) In addition, each boat owner can opt to *permanently* exclude one or more of the ships under his control, from fishing activities in a given fishery. In this case, the *history* (catch and storage capacity) of the ship excluded can be transferred to other ships of the same boat owner, or sold to another. These transferable records of catch history have a 5-year validity. The transferability of a given boat's catch history seeks to promote not only the use of more cost-effective ships, but also that redundant fishing capacity is directed towards other uses.[7]

ITQs in place since March 1992, and the *Yellow Prawn* fishery (Regions V to VIII), operating under ITQs since December 1997.

[6] The reason for using this mixed criteria in pelagic fisheries is that individual historical catch records have been affected in recent years by seasonal closures and other restrictions, and these policies have been implemented on the basis of dissimilar criteria per boat owner (e.g. giving preference to catches whose final use is for the processing of products for human consumption). In the case of the criterion related to storage capacity, the cubic meters of storage under control of each boat owner are corrected by the marine area coverage defined in the fishing license that each boat has.

[7] One year after the initiation of this law, this second option has had essentially no use. The reason for this arises from a perception of legal precariousness with respect to the rights associated with the transferability of a vessel's catch history, a perception that boat owners link to uncertainty surrounding the future regulations that will replace the present transitory law.

(c) Private firms are now in charge of monitoring and certifying each vessel's landing for each fishing trip and accounting it to the corresponding boat owner's catch quota. Participation in this activity is decided by price competition in annual public auctions.

(d) Industrial boat owners have now the obligation of accepting observers on board which are appointed and financed by the Undersecretary of Fisheries (Subpesca), for the purpose of compiling information on their catch. This same obligation is in effect for the administrators of processing plants, with respect to observers monitoring production records and patterns.

(e) The Fisheries Enforcement Agency (Sernapesca) is endowed with additional enforcement powers, for the purpose of improving the effectiveness of control and enforcement.

(f) Explicit sanctions are introduced for: fishing over the individual quota assigned; unloading a catch and not reporting it or certifying it inadequately; discarding at sea species caught; and fishing without authorization in areas reserved for artisanal fishing.

In addition, a series of modifications were introduced with direct benefits for the artisanal fishing sector:

(g) During the validity of the Transitory Law, industrial ships are absolutely prohibited from fishing within the first 5 miles (zone reserved for artisanal fishing), from the Vth to the XIIth Regions.

(h) Procedures are established so that fishermen and artisanal ships without up-to-date inscriptions in the Register of Artisanal Fishing can normalize their situation in fisheries currently in full exploitation and under closed access. By means of this 'controlled opening of access' an attempt is being made to 'officialize' a significant proportion of the *de facto* (informal) activity existing in artisanal fishing, and therefore facilitate subsequent improvements in the fishery management of artisanal sectors.

(i) The number of representatives in the National Fisheries Council and in the Zonal Fisheries Councils is increased for fishing workers and artisanal fishermen. In the National Council, three new representatives are added to the artisanal and labor sectors. These two sectors have now 7 representatives in total, while the business fishing sector has 4 representatives, there are 4 other institutional positions, while 7 remaining members of the National Council are nominated by the President (22 members in total). In the Zonal Fisheries Councils (each with 18 members in total), the artisanal and labor sectors have now 6 representatives in total (two more than before), while the business sector has 4, there are 6 institutional representatives, and 2 representing the university sector.

(j) Lastly, for those artisanal fishermen that die while fishing, the conditions for inheriting their fishing licenses are made more flexibles.

Beyond the present Transitory Law, important areas of controversy remain with respect to what a longer-term reform project should address. Prior to the analysis of these controversies, we first discuss key presumptions that condition the diagnosis about the nature of the problems faced.

3. Initial clarifications

(3.1) Uncertainty and cycles of fish abundance: Will the fish return?

Underlying the differences of opinion observed in the debate over ITQs, diverse private interests are at play. In this context, it is true that uncertainties with respect to fish stocks availability add complexity to the discussion about fishery management systems. However, there is nothing particularly specific to the fishing sector that leads us to conclude that biological-environmental uncertainties in fisheries imply *qualitative* differences in decision making, vis-a-vis the effect of uncertainties in other productive sectors; for example, on agricultural production or on investment in any another asset subject to financial risk.

On the other hand, thinking of the present problems in the availability of fish stocks as if they were of exclusively cyclical character (e.g. a consequence of the *El Niño* phenomenon) is inadequate. A more complete perspective requires the evaluation of biological as well as economic risks associated with the expectations regarding fish stocks' future abundance. One clear virtue of this way of thinking is that it helps to make the differences explicit with respect to: (i) the probabilities assigned to facing situations such as the economic collapse of the fishery, and (ii) personal opinions on what is considered a permissible level of risk.

(3.2) Falls in annual catch levels

A peculiarity of fish stocks subject to abundance cycles is that, when mature phases of exploitation are reached (i.e. with declining catch productivity per unit of fishing effort), the fish growth dynamics can drop off suddenly to a new long-run equilibrium, implying significantly lower sustainable catches (Peña-Torres, 1996b).

In fisheries where cyclical behavior is related to environmental shocks difficult to predict (e.g. pelagic fish), it is difficult to discern how much of an eventual fall in catch is due to excessive fishing and how much is a result of environmental changes. This type of uncertainty will undoubtedly continue to condition fishery management decisions for a long time. Nonetheless, decision-making under significant uncertainty is not a problem particular to fisheries. As in other

productive sectors, the analytical response must aim at quantifying relevant risks (e.g.. the probability that economic collapse in the fishery could occur) that are associated with the biological/environmental uncertainties.

Today available analytical tools permit the numerical simulation of key uncertainties that condition fish stocks abundance. Therefore, reasonable quantification of the risk of fishing collapse is within the reach of fishery management. A relevant example is South Africa, where pelagic fisheries qualitatively similar to those in Chile are currently managed performing explicit quantification of the risk of fishing collapse (Butterworth et al., 1997). Recent efforts in other fishing countries (e.g. Namibia) point in this same direction (McAllister and Kirkwood, 1999). In Chile, preliminary efforts have been initiated in the last few years, limited for now to evaluating biological risks in the Horse Mackerel and Chilean Hake fisheries (Serra et al., 1999). Further advances in this direction should help build consensus on how to choose between different strategies of fishery management (Peña-Torres et al., 1999).

In Chile, since the middle of the 1980s a trend of increasing scarcity in our main fish stocks has been observed. Table 1 shows the case of the pelagic fisheries of the *Norte Grande* (regions I-II), considering the aggregate catch of the three main fish species in those regions, and of the Central-Southern pelagic fishery (from Regions V to X), in this case considering the horse mackerel annual catches (the dominant species in this fishery).

In the *Norte Grande* the peak catch was reached in 1986. Fifteen years later, the annual catch has fallen to a third of that peak. Northern sardines catch today shows marginal levels, after reaching historical maximums in the middle of the 1980s. Although a recovery in the biomass and annual catch of the anchovy have partially compensated for sardine losses, the net balance (considering the three main species, and after 15 years) is clearly less abundant fish stocks and a significant deterioration in the annual catch.

In the *Central-Southern* horse-mackerel fishery the maximum annual catch was reached in 1995, after an uninterrupted expansion in regional fishing capacity which was initiated at the beginning of the 1980s. However, towards the end of the 1990s a strong drop in catch levels was produced, for the year 2000 reaching only a quarter of the peak achieved five years earlier.

That the cyclical *El Niño* phenomenon of 1997-99 has had a strong impact on catch levels is undeniable. However, it is just as difficult to refute the thesis that the persistent increase in fishing

effort levels and the resulting catches have also been significant contributors leading to the current catch levels in this fishery.[8]

Table 1
Catch and Fleet Size in Pelagic Fisheries
Northern and Central-Southern fishing grounds

	Central-Southern fishery (regions V to X)			Northern fishery (regions I and II)		
	Total Annual Catch (1) *Horse Mackerel* (10^3 tons)	Number of Vessels (2)	Total Storage Capacity (2) (10^3 m^3)	Total Annual Catch (3) *3 main species* (10^3 tons.)	Number of Vessels (2)	Total Storage Capacity (2) (10^3 m^3)
1975	22.8	37	4.3	581.0	108	17.3
1980	274.4	47	6.3	1982.9	133	25.3
1985	870	81	22.5	3160.8	211	52.1
1990	1983	136	58.6	1639.4	213	58.7
1995	4089	173	107.4	1891.9	163	49.9
1999	1267	153	122.8	1147.1	132	46.3
2000	1065					

Sources: Undersecretary of Fisheries and Sernapesca.
(1): Artisanal and industrial fleets
(2): only industrial fleet
(3): three main species (horse mackerel, sardine and anchovy); artisanal and industrial fleets.

(3.3) Are the regulatory instruments available in the 1991 Fisheries Law enough?

There are those that argue that there is no need to expand the legal limits in the Law of 1991 with respect to the scope of use of ITQs, given that (i) other fishery regulations available today are sufficient, or (ii) in the case of accepting the usefulness of using ITQs, it would be enough to do so under the limits in effect under the Law of 1991.

In this respect, our basic premise is that if the limits in the Law of 1991 remain in effect with respect to the use of ITQs, fisheries that presently have an oversized fleet will end up sooner or later facing a crossroads of: (a) 'politically capturing' net subsidies from the rest of the economy,

[8] In Chile there is no explicit quantification on the economic concept of over-investment in fishing capacity. However, Annex 1 offers an interesting illustration. Column (A) reports the number of industrial ships with valid fishing licenses in the different fisheries currently subject to maximum catch limit per boat owner. Column (B) indicates the number of ships registered (to March year 2001) by vessel owners to undertake fishing operations during the year 2001. The difference between (A) and (B) offers an approximation to the number of redundant vessels per fishery, relative to peak catches achieved in previous years. In July of 2001 a new opportunity came up to inscribe vessels to catch the assigned quotas. For example, in the Horse Mackerel fishery (Regions V to IX) the number of ships registered by the businessmen was 53 (close to a 1/3 of the total available), these 53 ships representing about to 50% of the total storage capacity of the whole industrial fleet with valid fishing licenses in this fishery.

as their only option of economic survival in the longer term, or (b) becoming transformed into generalized and self-sustaining niches of poverty. Of these two evils, the first epitomizes the epitaph that today tends to prevail in what remains of the harvesting fishing industries in more developed economies.

The reasoning of our premise is simple but fundamental. We do not know of any other fishery regulatory instrument, other than implementing ITQs, that can achieve a better solution (balancing the pros and cons) to the excessive rent dissipation that is associated with over exploiting scarce fish stocks under common property. The more traditional instruments of fishery regulation (TACs, seasonal closures, or direct controls on fishing technology) have systematically failed to avoid fisheries in mature phases of harvesting development from having a similar epitaph to the one described above (Bjorndal and Munro, 1998; Scott, 1993; Townsend, 1990). Ineffectiveness in limiting global catch has been constant when applying traditional instruments of fishery regulation, for both fisheries in development as well as those in a mature phase.

In the case of annual TACs, even assuming full effectiveness in closing entry to new participants, strong incentives remain to increasing incumbents' individual catch, given the objective of anticipating a similar strategy from competitors. Empirical confirmation of this result abounds in the literature on fisheries economics.

The Chilean Hake fishery (Regions IV to X) provides additional evidence in this direction. This fishery reached its peak catch in the late 1960s (close to 130,000 annual tons), and then faced sustained drops in its productivity (arriving at annual catches around 25-30 thousand tons during the first half of the 1980s). This brought about the introduction of annual global catch quotas starting in 1992. Since then, these TACs have been either surpassed or completed in less time than the quota period.

For example, between 1997 and 1999 the annual quota was divided into two periods, January-September and October-December. In each one of these 3 years, the quota for the first period was exhausted before its term: in 1999 the quota assigned until September was exhausted by the middle of July. During 1998, a similar situation occurred with the quota defined for October-December (Annex 2). In the year 2000, the quota for May-August was exhausted in July. During the months from September to December, in spite of monthly quotas being defined, the quota was used up in the first few days of each month.

The premature exhaustion of quotas unmistakably triggers additional pressures to increase quota levels, given the economic costs associated with stopping production. In this setting, the

tendency is to expect increases in the incoming quota. A similar reasoning prevails with respect to the use of seasonal closures.

Regarding direct controls on catch technology or fishing gear (e.g.. net size), the history of fishery regulations in Chile and worldwide has repeatedly shown that regulated agents will find ways of neutralizing these controls, mainly by intensifying the relative use of input not subject to control (Munro and Scott, 1985). For example, in the case of limiting the number of fishing days, incentives will be generated to make use of greater fishing capacity during permitted seasons.

With respect to the argument that it would be enough to use ITQs under the limits indicated in the 1991 Fisheries Law, its logic is clearly questionable. This law limits the use of ITQs, in fisheries under full exploitation, to a maximum of 50% of the annual TAC. This maximum is attainable only gradually: at the soonest, at end of 10 years of annual auctions of ITQs, where each auction cannot sell more than 5% of the TAC for that year. The remaining of the TAC that is not subject to ITQs remains closed to new entrants; i.e., under the same faulty incentives that we have described for catch controls based only on a TAC.

Therefore, all agents with valid fishing licenses, whether or not they possess ITQs, will have incentives to catch the remaining annual quota not affected by ITQs as soon as possible. Hence, we should expect exhaustion of the TAC in a shorter time than the quota period; and as result, pressures to increase the incoming catch quota. In this scenario, ITQ holders would see eroded their incentives to invest in the fish stock, whether it were by way of more conservative harvesting plans, or via increases in the added value of the final product. The corollary is evident: to obtain the benefits expected from the use of an ITQ system, it is not enough to implement it only 'partially'. Coverage must be 100% of the annual TAC, and ideally subject to a minimum of restrictions on the transferability and divisibility of the associated fishing rights. Nevertheless, the economic-technical optimums are not always feasible to implement, given prevailing political constraints. Indeed, consensus and political equilibrium play a preponderant role in negotiating the definitions for implementing an ITQ system.

4. Areas of Controversy

In what follows we analyze issues that have played a key role in the ITQ controversies raging throughout the last decade in Chile. Several of these topics involve aspects of social equity (ITQ consolidation and the resulting income distribution; fears of greater unemployment; and future prospects for the artisanal sector). Some controversies revolve around the possibility of reassigning

fishery management power from the government to fishermen's organizations. Other debates depend more directly on aspects related to technologies available and their use (instruments and strategies for quota enforcement, problems related to fish discarding at sea).

The majority of these controversies depend on finding compromise solutions, conditioned by factors specific to each fishery. The use of ITQs is not a free-cost option. However, our argument is that ITQs can promote more cost-effective production incentives than those presently in effect, because ITQs can promote greater self-regulatory efforts on the part of the private sector, as well as foster longer term planning. Both effects are essential to fishing industries that aim at becoming self-sustaining in the longer term.

First we will analyze controversies where distributive considerations play the key role; then, we will consider debates where technological aspects acquire greater relative weight.

(4.1) Initial ITQ Allocation: Auctions or Historical Presence?

The implementation of an ITQ system requires initially defining who obtains which fishing rights. This creates conflict between potential winners and losers. Some will prefer allocations based on historical presence, ideally free of cost. Recent entrants may resent the use of historical presence as a criterion for initial assignments, particularly if their ships' productivity exceeds the average in the fishery. In this case they will probably demand recognition of the vessels which possess the most productive technologies. Others will emphasize initial allocations that reward catch processes which are more labor intensive, arguing that priority should be given to employment effects. While others will emphasize that protection be given to communities which are highly dependent on fishing. Answering these diverse demands is a complex task that is conditioned by political equilibria, given that at the basis of these controversies there are underlying distributive consequences.

In this section we discuss the alternatives of an initial quota allocation based on historical presence, or using public auctioning. In the case of the ITQs introduced under the rule of the 1991 Fisheries Law, these have been assigned using annual public auctions. In the case of the individual quotas per boat owner established according to the Transitory Law, assignment has been based on historical presence and free of cost. [9] Combining arguments based on legal principles and on the

[9] An important difference between one legal body and the other is that the Transitory Law applies to fisheries in 'full exploitation' where there already existed significant levels of sunk cost investment. The status of full exploitation does not apply to any of the 4 fisheries opened to public bidding under the 1991 Fisheries Law;

equity of the resulting distributive effects, it is possible to construct arguments in favor of, and against, charging for the initial assignment of ITQs. Aggravated by the importance of the distributive impacts involved, building consensus in this area is a complex political task.

With respect to the individual quota assignments for the industrial sector, our proposal is to assign them based on historical presence, conditioning these user-rights to annual payment of the fishing license, levied for the purpose of financing the direct costs of administering and enforcing the ITQ system. This principle of cost-recovery has been the predominant solution in all countries that have managed to implement successful ITQ systems (see section 4.8). The costs to be financed should include expenses directly associated with the work of the fisheries Regulatory Agency, including the cost of applied research necessary for deciding the quota levels, as well as the costs of monitoring and enforcing fulfillment of the quota system.

The justifications for our proposal are:

(1) This solution allows taking advantage of the significant consensus already gained, fruit of arduous and difficult negotiations, with respect to the quota shares of individual industrial boat owners in the TACs for different fisheries. This doubtless represents the most significant political achievement of the various results obtained from the enactment of the Transitory Law for the years 2001-2002.

(2) Assigning quotas based on historical presence, and charging annual user-fees to recover the costs of efficient fishery management, avoids political opposition based on arguments of expropriation of rents, whose origins are on sunk-cost investments already undertaken, under access rules valid at the time, and whose creation has required cumulative individual effort and risk-taking over the years. This argument represents a significant political disadvantage for allocation plans based on public bidding of fishing quotas; particularly in fisheries where a significant stock of sunk-cost investments already exists. Proposals in favor of using public auctioning as the initial assignment scheme for ITQs have in the recent past triggered significant political opposition from the fishing industry, and this has contributed to the legislative failure of prior attempts to widen the scope of use of ITQs in Chile.

(3) Considering the effectiveness of the scheme used to assign individual fishing quotas, the use of public auctioning in the main industrial fisheries in Chile faces various questions:

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nor in any of these 4 fisheries does the issue of prior sunk cost investments have a similar level of relevance as in most of the fisheries today in 'full exploitation'.

- If a priority objective is collecting fiscal revenues for the purpose of financing the costs of managing the ITQ system, there is a non-negligible probability that by using public auctions this objective will not be achieved.

The reasons for postulating this spring from, on one hand, that there is already a significant degree of industrial concentration in the majority of the relevant industrial fisheries in Chile. On the other hand, the dominant incumbent firms usually share a long common history, being common participants in various union associations, as well as facing simultaneous competition in various markets, in a situation of repeated competition. A probable corollary of this set of circumstances is that there are non-negligible chances of collusion between the established firms, if auctions are used to assign ITQs. And price collusion is precisely the bidding outcome that has tended to predominate in the annual auctions that have been conducted in the 4 Chilean fisheries with ITQs assigned according to the Law of 1991. As a result, auctioned prices in the majority of these auctions have not exceeded the minimum price defined by the fishery regulator[10] (Cerda and Urbina, 2000; Peña-Torres et al., 2002a).

It is true that among the causes for collusion in these ITQ auctions there are imperfections (in principle correctable) in the auctioning method used:

(i) In each fishery the annual auctions are conducted in a single event without interruption, where the price offers of each bidder occur out loud, in sequentially ordered auctions (each for a different ITQ %-lot auctioned), and where the bidder offering the highest price wins. This auctioning method facilitates mutual monitoring between potential collusive partners; and also favors the imposition of reprisals in the following auction phases to those who infringe on a collusive agreement.

(ii) With exception of the first auction process in each fishery,[11] the quantity to be auctioned in each round of competition is limited to lots of 1% of the annual TAC. This reduces the commercial attraction for new entrants, given the indivisible sunk costs characteristically required to starting fishing operations successfully.

(iii) It is possible to avoid paying the annual fees rising from adjudicated ITQs via auctions, without there being any penalty for exercising this option, except the obligation of paying as a

[10] The minimum price is defined for the purpose of assuring the recovery of administration and enforcement costs in the corresponding fishery.

[11] In the first auction for fisheries in state of 'Infant Development' or 'Under Recovery', the Government is allowed to sell up to 90%-100% of the annual TAC. Auctioned ITQs then lose 10% per year of the initially

minimum the first annual fee.[12] This favors already established firms which can practice 'price wars' in the auctions, to the detriment of potential new entrants, without this necessarily being translated into a greater actual cost for them.[13]

It is possible that correcting imperfections in the present auctioning method could reduce the chances of collusive agreement as observed to this point. But even accepting this possibility, there are reasons for doubting that the resulting auctioning process would involve significantly greater competition between the dominant firms; consequently implying expected auction revenues not significantly different from the results obtained to date.

Here a related question refers to how probable it is that market space exists, or can be created, for new competitors with more efficient costs than those of incumbent firms. There are reasons to believe that the industrial concentration which is observed in these fisheries is probably the result of optimal adjustments (from the point of view of efficiency in production costs), given technological and demand features that are relevant in fishing industries (Peña, Cerda and Urbina, 2002).[14] In effect, firm's scale of operation usually constitutes a significant factor in achieving competitiveness in these industries. This is a result of prevailing economies of scale in varying phases of the fishing business; especially in processing, but also when investing in marketing strategies and distribution networks for specific export markets. At the basis of these economies of scale there is investment in indivisible sunk-cost assets. It is this characteristic which leads one to anticipate significant cost advantages for dominant firms already established in a fishery.[15]

- The prior arguments lead one to think that, even if the auction method were defined in more adequate form, it is probable that few (if any) new competitors would be observed, particularly

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assigned TAC percentage. These 10%-ITQ lots are then re-auctioned each year (more details in Peña-Torres, 1997).

[12] The winning bidder is allowed to pay the auctioned price in 10 equal annuities.

[13] In several of the recent ITQ auctions (in the *Orange Roughy* and *Chilean Sea Bass* fisheries), the dominant incumbent firms have rotated in coordination to present price competition to new competitors, in each successive auction of 1% lots. As a result, they have managed to avoid entry of newcomers (Peña-Torres et al., 2002a).

[14] The phenomenon of industrial concentration in industrial fisheries is not infrequent at a world level, being frequently observed in extractive and processing sectors subject to contractual mechanisms of vertical integration. In more general terms, industrial concentration appears as a relatively frequent phenomenon in industries that produce and process food, especially in the processing sectors (Scott, 1984; Peña-Torres, 1996a).

[15] The exception to this proposition could be possible competition from foreign fishing firms. In this case an extra dimension of tradeoffs arises between policy objectives. On one hand, the expectation of increasing the

in fisheries where there are already dominant incumbents. This brings up reasonable doubts about the effectiveness of using auctions to meet objectives related to favoring newcomers' entry.

- With respect to the objective of having the exploitation of fish stocks assigned to the most efficient producers: on one hand, the advantage of sunk costs that act in favor of incumbent firms represents a justification of economic efficiency for a possible scenario with few or no new competitors. On the other hand, if lack of entry of new firms were due to incumbents' collusive strategies causing allocative inefficient entry, the existence of secondary markets (such as the leasing of ITQs[16]) would help reduce the consequences of the inefficiencies initially created.[17]
- With respect to the objective of assuring 'adequate rates of exploitation' for fish stocks: This is a challenge in essence related to the process of determination, and consequent enforcement, of annual TACs. Therefore, it is not an objective that is directly relevant for evaluating the relative efficacy of alternatives for solving the initial ITQ allocation.

Resolution of conflicts associated with the initial ITQ assignment

Controversies over the initial ITQ assignment carry the risk of spilling over into situations of institutional blockade, endangering the Government capacity to effectively arbitrate between the parties in conflict. It is therefore worthwhile to think about arrangements that help reduce this risk. In Chile, an example consists of trying to separate as much as possible the discussion about which criteria to use for deciding the initial ITQ allocation (among industrial fishermen), from discussions more directly related to harvesting rivalry between artisanal and industrial fleets.

Recent arrangements in Australia provide another example of interest. To reduce the risk of institutional blockade, the task of proposing formulas for the initial ITQ allocation has been transferred from the Fisheries Regulatory Agency to panels of independent advisors. These are brought together as the need for them arises (i.e. depending on the level of conflict). Their members

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fiscal revenue generated by auctioning the ITQs; on the other, the possibility of allowing foreign controllers to harvest fish stocks within areas that are part of the Chilean EEZ.

[16] In the Red Lobster fishery, with ITQs since April 1992, ITQ lease contracts have represented in different years between 20-30% of the annual TAC. In the case of the Chilean Sea Bass fishery, this percentage initially fluctuated between 20-35% during 1992-96, and then gradually decreased up to less than 5% of the annual TAC (e.g., 2% in 1999).

[17] If these secondary markets were reasonably competitive, the consequences of ITQ assignments based on historical presence would therefore be mainly of a distributive nature.

are lawyers, economists and representatives of the fishing sector that do not have any association with the private interests in dispute. Their task is to provide advice to the fishing authorities (on whose discretion the final decision remains) on the most adequate criteria for initially assigning ITQs in the fishery under evaluation. The panel consults extensively with the main private interest groups, and then identifies and validates the information sources required for implementing the options recommended. Experience accumulated to date shows in general industry support to these panels' recommendations (Kaufmann and Geen, 1998). Arrangements of this type offer the potential of leading to less costly litigation, given expected future questioning on the initial ITQ assignments.

(4.2) Fisheries Management and Structures of Governability

The previous arguments are related to issues about structures of government for fisheries management. Among them, the possibility of transferring part of fishery management powers from the government to the fishing industry itself. A trend towards "self-government" today plays a central role in the worldwide debate on the future of fisheries management; especially with respect to the two main contenders in this debate, ITQs and co-administration (Hatcher and Robinson, 1999; Townsend, 1999).[18]

In countries that already have several fisheries under ITQ systems, over time a gradual devolution of management powers has tended to occur towards the regulated agents. For example, regarding the funding of biological research and quota enforcement, both tasks are becoming increasingly financed by the fishing industry itself. In some countries, e.g. the United Kingdom and Holland, more extensive areas of fisheries management have been transferred to the private sector. In both countries the government has gradually transferred the management of annual quotas to fishermen's organizations. Today collective decisions by the relevant fishermen's organization determine how the annual quota they receive is distributed and how it is fished. These organizations administer the fishing quotas that the government defines and delivers annually to the member fishermen of the organization. These organizations register, organize, and enforce quota transactions among members of the organization (Hatcher, 1996a, 1996b; The Economist, 21/11/98: p. 29; and Valatin, 1999).[19]

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[18] The term 'co-administration' is usually associated with a partial transfer of fishery management powers towards the private sector (Pirkenton and Weinstein, 1995; Jentoft and McCay, 1995). Therefore, 'self-government' can also be part of ITQ systems.

[19] The assignment of fishing quotas in the UK to fishermen's regional associations has the peculiarity of being made up of *informal* agreements between Government and the fishing industry. In effect, the ITQs in

In Chile, some opponents to the use of ITQs have alluded to the danger that they could end up putting excessive discretion in the hands of the fisheries regulator. However, one should expect exactly the opposite result. The existence of individual quota holders, where these quotas represent rights protected by law, should lead to an effective political force when facing risks of regulatory arbitrariness.

(4.3) Transitory or Permanent Fishing Rights?

Objectives of *allocative efficiency*[20] would ideally be met by means of fishing rights that have a reliable and prolonged duration, that do not undergo unexpected changes in the rules of the game, and that are as freely divisible and transferable as possible. However, considerations related to the political viability of reform efforts may counsel accepting restrictions on some of the characteristics described above. Our proposal is based on this type of consideration. In order to advance to a new phase of reform and improvement with respect to the present system of individual fishing quotas, we suggest defining these as transitory rights (like a concession right); perhaps for a period of validity between 15-20 years. On one hand, this is a sufficiently long period as to offer reasonable stability for production decisions and investment; on the other hand, it offers the option that in a future phase of legislative reform, the usefulness of maintaining the transitory nature of these rights can be evaluated, or evolved towards a system with more permanent fishing rights.

Our central arguments are:

(1) This approach offers a transition period that would contribute to proving what beneficial effects a system of individual quotas can create 'in practice'. This offers the option of new spaces of transaction in future or compensations that could help to convince agents that today are opponents to this scheme of fishery management.

(2) The transitory nature of the fishing rights provides the fishing authorities with a greater margin of maneuverability, in case adjustments are required to the procedures/definitions that characterize the system in place. Developing an adequate ITQ system is not a simple task. It is not

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operation do not possess legal existence *per se*. In spite of this, a dominant vision prevails that individual quota holders do enjoy fishing rights that are clearly defined and defensible in court. At least the banks think so, proof of which is that they accept 'informal' ITQs as guarantees for loans (Hatcher, 1996; The Economist, 21/11/98). In the case of Holland, each fisherman is the owner of transferable fishing rights formally and legally recognized, and each fisherman can choose whether or not to hand over the administration of his fishing rights to a given fishermen's association. In the UK, each fisherman can also choose whether or not his quota is managed by the fisheries regulatory Ministry, or by the corresponding fishermen's association.

[20] Meaning that economically scarce resources be assigned to those uses where they generate greater value.

only required to overcome political opposition, but there are also complex technical challenges to be faced. On one hand, it is reasonable to expect that improvements in the effectiveness of enforcement systems will require time of learning and evolution. On the other hand, this demand for time and gradual advance also condition the approaching speed to a system of fishing rights with a reasonable degree of transferability, and adequate market competition.

The evolution of the Icelandic ITQ system is a good example of the results that can finally be achieved by advancing gradually. While the first system of individual quotas used in Iceland was put in place in 1979 (herring fishery), ITQs only began to be permanent as of 1990, while their transferability only became permanent in 1988. Previously, schemes of individual quotas functioned subject to restrictions on both dimensions. For example, in the middle of the 1980s ITQs with a one-year duration were introduced as an emergency measure when facing a period of crisis in an important cod fishery (Hannesson, 1997). It was only after the legislative reform that occurred in 1990 that a uniform system of permanent ITQs with a high degree of transferability, began to take effect. Today this system covers more than 90% of the total value of the annual catch in Iceland's EEZ (Arnason, 1997).

In the case of New Zealand, the other country where there exists a longer ITQ history and where profound advances towards a comprehensive system of fishery management based on ITQs have been achieved, the ITQ implementation process was quicker. The first efforts to develop the management of some fisheries based on fishing rights took place at the end of the 1970s. But it was during 1982-83 when more formal systems of management were initiated, based on transitory individual quotas and subject to a partial degree of transferability, for a total of 7-9 marine species. Subsequently, a new Fisheries Law enacted in 1986 legislated in favor of a uniform ITQ system, with greater coverage of species (21 fisheries were subject to this system), and where the ITQs became permanent rights with a high degree of transferability. In recent years, some 40 different species have become subject to this uniform ITQ system, which taken together represent around 80-90% of the total annual catch in New Zealand (Harte, 2000; Kidd, 2000; Annala, 1996; Clark et al., 1988).[21]

[21] The speedier advancement which occurred in New Zealand, regarding the evolution towards permanent ITQs with high transferability, was related to the deep market-liberalizing reforms which were initiated in 1984 and that afterwards continued with growing strength. (see *The Economist*, December 2nd, 2000).

Renewal of transitory fishing rights

Transitory fishing rights carry with them the problem of the uncertainty that they generate when the end of their validity is approaching. Finding solutions to this problem requires consensus and commitments that presently could turn out to be politically difficult to reach. This task might be less complex once the system of individual quotas has already been operating for some time. Then more complete information would be available about what should really be expected when using this system of fishery management.

Consequently, an intermediate solution could be to define the re-negotiation of the 'fishing concession' contract towards the middle of the period for which the ITQs are in effect, for example in the 10^{th} year if ITQs were valid for 20 years. If the re-negotiation failed in this phase, the fisheries authority and the ITQ holders would still have the option of continuing under the conditions of the original contract until the end of their term, and then face a new negotiation. But one would expect that both parties would have incentives to seek agreement at the 'midway point' negotiation. The government's incentive would be the option of an earlier introduction of corrective adjustments, while the ITQ holders would in turn attempt to assure greater stability in their planning horizons.

(4.4) ITQs and income inequality

Critics of ITQs state that their use will consolidate income inequalities within the fishing sector. Regarding this, it is important to clarify some basic points:

a) A key benefit of using ITQs is that they offer the potential of creating stronger incentives for increasing the level of sustainable incomes in the fishery. One would expect that it would be the most efficient producers who would initially take better advantage of the new opportunities created. This explains why firms that already operate in a fishery with over-investment could be willing to pay, once ITQs are implemented, to retire excessive fishing capacity, buying ITQs or the ships themselves in order to recycle them towards other uses. This also helps one to understand why industrial concentration may increase in a fishery under ITQs. Nevertheless, it is equally reasonable to expect that the profits of greater efficiency achieved in a first phase of adjustment would end up consequently generating beneficial effects for the remaining participants in the fishery.

b) There is nothing intrinsically erroneous or unjust in the possible effects described above, especially if they are a result of genuine differences in the productive ability of various producers. Cost-saving advantages of concentrating production and sales efforts in fewer

hands have a variety of expressions in different economic sectors (e.g. Chandler et al., 1997). However, in some fisheries the lack of greater productive ability can from time to time result from problems associated with situations of poverty, and not so much from dissimilar individual efforts, or a healthy ('just') market competition. In marine fisheries, sector structures are frequently observed that simultaneously accommodate fishermen living in poverty, subject to a very low labor mobility, along with firms having modern corporate organization and with assets clearly having greater inter-sector mobility. The most relevant policy challenges for the first group are related to problems that spring from living in poverty, while policy priorities for the second group are more directly related to adequate incentives to promoting aggregate wealth creation. Because of these differences, and given the limited labor mobility on the part of the labor force working at the fishing sector, one should be cautious when designing the rules of operation for ITQ systems.

c) Notwithstanding that, and even when differing opinions prevail about the relevance of possible distributive consequences, there are a variety of policy instruments, independent of the decision of using ITQs or not, that could be used to counter undesirable distributive effects. Therefore, seeking consensus on distributive consequences should not impede progress on achieving incentives for rationalization and economic efficiency that are associated with the use of ITQs.

(4.5) ITQ Consolidation and Entry Competition

Another line of criticism on the use of ITQs states that they will 'unjustly' limit the entry of new competitors. Regarding this, there are two main concerns. One refers to a possible lack of market competition, the other to the opportunities available for small firms and artisanal fishing in general. We develop the second issue in the following section.

The degree of industrial concentration that prevails in a fishery under ITQs is conditioned by the efficient scales of operation for that fishery. Therefore, one should expect 'quota consolidation' in fisheries where greater horizontal or vertical integration would be produced in any case, although perhaps in a longer term. Currently, significant industrial concentration already exists in many of the Chilean fisheries for which ITQs are in use today, or where their implementation has been subject to discussion.

Some examples are: in the southern *Chilean Sea Bass* fishery, around 10 firms have been participating in the annual ITQ auctions since they started in December 1992. In 1997, two of these

firms controlled 70% of the total volume exported. In the *Red Prawn* fishery, 10 firms began participating in the first ITQ auctions, initiated in March 1992; in 1997, 3 of these firms controlled 90% of the total volume exported. In the *Orange Roughy* fishery, 6 firms participated in the first ITQ auction (December 1998); in the year 2001, 5 firms controlled a large majority of the annual catch. In the *Antarctic Whiting* fishery, the 2 leading firms in frozen products controlled 87% of the volume exported in 1997, while the 4 leaders in freshly-refrigerated products controlled 68% of the total exported that year. In the *Horse Mackerel* fishery (Central-Southern zone), corporate ownership has historically been somewhat less concentrated. In 1995 the 5 main regional fishing groups (consolidating jointly owned firms) controlled 55% of the industrial catch in that fishery. Nevertheless, due to the crisis undergone by this fishery during 1997-2000, there have occurred recent mergers and acquisitions, involving some of the smaller firms in this fishery.

It could be argued that observed levels of industrial concentration are probably a result of optimal adjustments, from the point of view of the international competitiveness of Chilean industry. However, once an ITQ market is created, a small number of dominant ITQ holders could end up creating artificial entry barriers for new competitors, for example colluding in avoiding selling the ITQs under their control. In this case, not only could social equity objectives be endangered, but also allocative efficiency.

If there is evidence in the future of a lack of competition in ITQ markets, it will be the task of antitrust institutions to study the arguments of the case and, if required, establish the actions necessary to correct the problem; for example, obliging dominant firms that have abused their market power to sell a portion of their fishing quotas.

(4.6) Opportunities for the Artisanal Sector

The individual fishing quotas in use today in Chile are only applicable to *industrial* vessels.[22] This same restriction has conditioned recent debates on extending ITQ use to other fisheries. On the other hand, artisanal fishermen have privileged access to zones reserved for artisanal fishing, i.e. the first 5 miles from the coast and the interior waters of the country.[23] In Chile, harvesting competition for fish stocks shared between artisanal and industrial fleets occurs for

[22] Those with more than 18 meters of vessel length and with more than 50 tons. of registered tonnage.

[23] This privileged access is conditioned in the Law of 1991 by the possibility that the fisheries regulator may allow for industrial fishing in this zone, in areas where artisan fishing is not carried out or where fishing by industrial ships *does not interfere* with artisanal activity. Therefore, it remains under the regulator's discretion to decide when and how much industrial fishing can occur within the first 5 miles.

only a limited number of fish species (Table 2), although this takes place in the regions with greater artisanal fishing employment (Table 3).

In this context, ITQ critics have argued over: (a) the danger that the use of ITQs for industrial fleets could trigger greater pressures to permit industrial fishing within the zone reserved for artisanal fishing; (b) a threat to the survival of the artisanal sector, given predictions of 'greater unemployment induced by the use of ITQs'.

Table 2: Main Fisheries sharing both artisanal and industrial fishing

	Landings (10^3 tons), Year 1999		Artisanal share (%)	
	Industrial	Artisanal	1999	2000
Anchovy, III and IV regions	45.06	16.1	26.4	30.8
Chilean Sardine and Anchovy, regions V to X (Only region VIII)	1,341.6	506.5 (473.5)	27.4	34.4
Chilean Hake *	81.2	22.6	21.8	22.9
Antarctic Whiting, regions X to XII	15.5	9.1	37.0	58.7

Source: Fisheries Statistics Yearbook, years 1999 and 2000 (Sernapesca)
*: Main regions with artisanal fishing: IV (2,730 tons), V (12,320 tons), VII (3,171 tons), and VIII (4,258 tons).

Table 3
Register of Artisanal Fishermen, year 1999
(Shows the regions with the greatest number of registered artisanal fishermen)

Region	Officially registered Artisanal fishermen (*) (number)	Officially recognized landing sites ('caletas') (number)	Trade Unions ('Sindicatos') (number)	'Asociaciones Gremiales' (number)	Fishermen Cooperatives (number)	Fishermen Federations
II	2,243	17	22	1	0	1
III	2,279	21	14	2	0	1
IV	3,997	31	17	27	3	3
V	5,270	33	32	3	2	2
VIII	7,825	73	46	14	4	1
X	16,271	191	215	29	12	9
XI	2,593	19	13	8	0	1
XII	3,538	11	12	2	3	1
country	48,642		426	95	24	23

Source: Sernapesca (December 1999)
(*): The number of artisanal fishermen officially registered is smaller than the total actually working in the artisanal sector. Of the national total of officially registered artisanal fishermen, 73% are members of some fishermen's organization.

With respect to the first criticism, since the creation of the reserved area for artisanal fishing there have been complaints about fishing in this area by industrial ships. But monitoring

weaknesses have led to a situation where the majority of these complaints have not been substantiated. This regulatory weakness has been eliminated with legislation in operation since August 2000, when satellite monitoring was introduced for controlling the position of every fishing industrial ship that is operated and registered under the Chilean flag. This reduces the possibility of 'non-authorized' industrial catches in the zone reserved for artisanal fishing.

Nevertheless, important challenges still remain to be solved: (i) Marking off more clearly the discretion that today the fisheries regulator has with respect to when (and how much) to permit industrial fishing within the zone reserved for artisanal fishing.[24] One possibility would be to allow artisanal fishermen to carrying out transactions with industrial interests, so that some proportion of the industrial quota can be caught inside the first 5 miles (e.g. using artisanal vessels for this). (ii) Introducing incentives to reduce fish discarding at sea on the part of industrial ships, especially in areas neighboring artisanal fishing grounds, given that discarded fish often include species important to the artisanal sector.

With respect to the possibility of artisanal access to opportunities of exchange offered by a ITQ system, it would be advisable that the decision of participating or not, as well as the decision of how to administer the collective quotas, remain in the hands of relevant Associations of Artisanal Fishermen, i.e. with relevant local representation. Each Association should decide how to distribute the annual quota assigned among their members, and which restrictions to impose upon the use and transferability of the quotas held by each member.

As opposed to the industrial sector where each boat owner could choose between administering their ITQs themselves or handing over their management to some fishermen's association (as occurs today in England and Holland), the high dependency on fishing that is characteristic of artisanal fishermen's communities, leads one to think of management schemes for artisanal sector's quotas that be based on representative collective decision-making.

Nevertheless, problems in organizing efficient collective action in the world of artisanal fishing could become important obstacles to applying this principle.[25] Table 3 illustrates a significant

[24] The present Transitory Law 'freezes' this discretionary power during its two years of validity.

[25] The following doubt conditions any attempt to rationalize the management of artisan fishing, by using ITQs or any other instruments of management. Rationalization requires the capability of *effectively closing access* to new entrants into artisanal fishing. However, achieving this faces two significant obstacles: (1) artisanal fishing usually constitutes a sector of last resort employment for low skill (and informal) labor force, especially during downside cycles in the economy, and (2) in certain fishing areas, it can turn out to be too costly to monitor and control artisanal fishing effort.

degree of fragmentation in the legally constituted associations of artisanal fishermen, especially in the case of trade unions.[26]

If associations of artisanal fishermen opt to participate in systems of fishery management based on distribution of individual fishing quotas, subject to self-imposed restrictions upon their degree of transferability, the opportunity to acquire extra quotas should not be restricted by imperfections in the capital market. In Chile there are public funds designed to provide loans, under competitive access, to small producers including artisanal fishermen (Corfo funds and associated programs such as Fosic and Sercotec). These funds should be used to facilitate the competitive access of small fishermen to private financing.

With respect to the proposal that ITQs would represent a threat to the survival of the artisanal sector, is important to clear up some basic points. First, if the use of ITQs is concentrated in the industrial sector, the impact effects on employment should be fundamentally expected in this sector. Second, a general perception prevailing in the industrial fishing sector is that a significant part of the adjustments required in industrial employment have already occurred (to March 2002). Adjustments in this area had already been initiated prior to initiating the system of individual quotas per boat owner (February 2001), as a result of the cost pressures triggered by the eruption of the *El Niño* phenomenon during 1997-2000. Third, it is possible that part of the workers displaced from the industrial sector might migrate to the artisanal sector, increasing the labor supply in this sector. In whatever form this process is resolved, the essential problem remains: there will be reasons to fear for the survival of fishing employment, whether artisanal or industrial, every time current employment exceeds the sustainable capacity of harvesting fish stocks. And without an efficient system of closed access to fisheries, in effect, the previous scenario is inevitable. In this context, the introduction of ITQs (or variations thereof) constitutes a way of avoiding future adjustment costs that will be even more traumatic.

The virtue of introducing *individual* fishing quotas is that they facilitate the coordination of collective solutions to rationalizing fishing efforts. By permitting the *transferability of* quotas, incentives are generated so that the more efficient fishing businessmen will be willing to pay for the retirement of excessive fishing capacity. Thus, the use of ITQs reduces incentives for over-exploiting fish stocks via over-investment and over-employment. As a consequence, it is possible that, in the short term, adjustments in fishing employment will be generated. However, in the longer

[26] Of the various types of associations included in Table 3, the trade unions are those where objectives of more political content could end up playing a more predominant role.

term the evolution of the sector's employment is conditioned by the recovery of catch levels, and by changes in the structure of production and the intensity of labor use.

The only option that would allow oversized fishing employment to remain is that labor force in the sector success in 'politically capturing' net subsidies from the rest of the economy, paid by all Chileans. This is the political outcome that is at the basis of the problems currently faced by the Common Fisheries Policy of the European Union (e.g. Hatcher and Robinson, 1998). Subsidies from the rest of the national economy also account for oversized sectors in the main fisheries in Norway (Hannesson, 1996). Accepting this type of result for Chile would imply that the country as a whole would end up bearing costs greater than the benefits acquired by those favored with subsidies. Therefore, this political outcome must be avoided.

The way to avoid the fishing sector from ending up being transformed into generalized and self-sustaining poverty is having the authorities focused on two priorities. First, there must be advance in rationalizing the management of artisanal fishing efforts. This requires consolidating policies of effective closed entry to avoid additional fishing capacity entering into fisheries currently in full exploitation. It also requires implementing management schemes for the quotas assigned to the sector that give preference to strategies of use and control which achieve consensus at the local level, for example via collective decisions reached at the pier ('caleta') level.

Secondly, the authorities should give preference to policies directed at the artisanal sector that facilitate a gradual reassignment of part of the labor force today working in over-exploited resources, towards other sectors. This requires resisting support requests that imply promoting entry of additional fishing capacity into the sector. Reassigning workers with labor abilities having low inter-sector flexibility constitutes a complex and difficult challenge. The most frequent answer has been to implement re-training programs in order to create new productive abilities. However, increasing the chances of success of these programs often requires very costly implementation.[27] Unfortunately, in this area of public policy having to make difficult elections seems to be an inevitable challenge.

(4.7) Discarding

A frequent criticism to the use of ITQs is that they will increase the discarding of fish of lower value, generating a waste of products having positive value.

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[27] *The Economist*, 4/06/96: "*Training and Jobs. What Works?"*, pp. 21-23.

A first basic point is that discarding problems are not specific to the use of ITQs. Discarding arise every time that any restriction is effectively enforced (via ITQs or any another regulatory instrument) on catch levels and/or minimum size of species with commercial value. Discarding will occur every time that: (a) fish stocks are located in multi-species fish patches or with a mix of fish of varying size, (b) the fishing technologies utilized are not very selective, and (c) when catch levels and/or minimum size of species with commercial value are effectively regulated. Under these conditions, discarding will be inevitable. On the other hand, there is no conclusive empirical evidence in favor of the thesis that 'the use of ITQs *worsens* the discarding problem' (see OECD, 1997; Squires et al., 1996). Moreover, the severity of the discarding problem depends on technological characteristics of the harvesting effort, and of relevant demand characteristics.[28]

Nevertheless, and under any regulatory scheme, an important objective of the fisheries regulator should be to reduce incentives to discarding at sea. In the case of ITQs, there are forms of defining the ITQ system that would contribute to reducing the incentives for discarding (Table 4). However, the majority of these alternatives imply extra costs in other areas of fishery management.

Table 4
ITQ features as disincentive to discarding

Desirable ITQ definitions	Expected Costs:
1. Monitoring on board.	- More costly monitoring.
2. Regulating the species-selectivity of the fishing gear.	- Could produce undesirable rigidity with respect to the use of efficient technologies.
3. Flexibility in ITQs transferability options: - allow transactions of ITQs defined for different species. - regarding ITQs not used up in a given year: a) exchangeable for catch in a future period. b) exchangeable for current excess catch of other species under ITQs. (*) c) exchangeable for excess catch of another fisherman (for the same species).	- Greater flexibility in transactions: tends to increase the costs of enforcing ITQs.

Source: based on Squires et al. (1996) and Turner (1997)

[28] Discarding will tend to get worse under a combination of conditions. On the technological side, this will occur while there is a greater diversity of species existing in a fishing zone, especially if no clearly dominant species exists and the various species live together in nearby areas in high-density schools of fish; and when the catch technologies are not very species-specific (Grafton, 1996; Squires et al., 1996; Squires and Kirkley, 1996; Turner, 1997). On the demand side, discarding will be favored the greater are the price differentials between the varying species caught (this is not the case, for example, of the Chilean pelagic reduction industry).

(*): ITQs for different species can be valued according to the relative price of each species. Nevertheless, the lack of standardization in the quality (attributes) of fish landings implies enforcement challenges with respect to which relative prices should be considered for the effects of validating transactions occurring between ITQs defined for distinct species.

Though solutions in this area should be supported by diagnoses specific to each fishery, it is possible to anticipate generic actions that would help reduce the magnitude of discarding. For example:

a) Implementing a scheme of observers on board, with partial coverage of the fleet in operation (to give financial viability to the system), prioritizing their use on those users/ships with antecedents that indicate presumed discarding, because of direct verification by the observer, or by means of presumption based on comparing reported patterns of fishing 'with' and 'without' an observer on board.

   The fishing patterns reported by the observers, regarding average catch levels per net casting and their composition (fish size and species mix), could be used to estimate 'expected fishing patterns', conditioned by the type of ship and fishing gear, fishing ground, and fishing season. By comparing these expected fishing patterns with the catch reported by each boat owner, reasonable 'ranges of deviation' could be defined on which to base the presumed occurrence of discarding.

b) Presumed discarding justified in this way could trigger a sequential system of punishment. First, leading to more extensive monitoring of the fishing activities of the fishermen presumed to practice excessive discarding. And then triggering a growing scheme of sanctions, depending on the degree of repetition and seriousness of the presumed discarding.

c) In the case of regulations on minimum catch-size, it is advisable to evaluate their possible substitution by restrictions in terms of permitted fishing zones.

d) Regarding other direct regulations on catch, reasonable margins of flexibility should be considered for their fulfillment. For example, permitting some excess catch with respect to the quotas defined for accompanying fauna.[29] Another option is to define legal flexibility such that it allows trading of excess catch over the individual quota. In more general terms, offering legal flexibility for complying with the catch regulations, in such a way that those complying with them obtain a monetary benefit.

(4.8) Enforcement

Efficient enforcement is a basic element in order for ITQ systems to achieve improvement in fish stocks' sustainability, and in the economic efficiency of fishing efforts. We have already mentioned the challenges associated with discarding. There are also significant challenges related to improving the enforcement of catch quotas and landings, and the effectiveness of the sanction system.

In the last decade reforms have been introduced designed to fortify the effectiveness of enforcement. First, the Law of 1991 introduced a system of enforcement that increased the significance of auditing efforts, based on a dual system of information: reports on landings per fishing trip per vessel, and reports of the processing plants on catch use and their suppliers. Second, in the year 2000 a system of satellite monitoring began to operate, tracking the location of industrial fishing ships operating at high seas. Third, the recent Transitory Law introduced a series of new measures to improve the effectiveness of quota enforcement (section 2).

There is other enforcement areas that are susceptible to improvement. For example, reports to the fisheries enforcement agency could be performed via Internet. Or, improving the effectiveness of the present judicial process which deals with fishing infractions. Today a substantial gap exists between being initially fined for infringing upon a fishery regulation, and being finally penalized with the sanctions stipulated by law.

On the other hand, although ITQ implementation probably involves more demanding enforcement, ITQ use should at the same time promote greater self-regulation on the part of fishermen themselves, as well as providing incentives for making longer term production planning. Both effects should provide better incentives for organizing collective action on the part of the regulated agents themselves. For example, the private sector could become more involved in financing monitoring and enforcement efforts, as well as requirements of applied research.

Surprising evidence exists on just how powerful these incentives can become, promoting private financing for services traditionally perceived as public goods. Table 5 shows examples of fisheries in Canada, New Zealand and Iceland, countries where the fishing industry contributes to financing a significant proportion of the total costs of managing and enforcing the ITQs in use. In Chile, the industrial fishing ships presently pay an annual license, as a lump-sum tax, that is used to a

[29] The more precise the information available to the regulator on the species composition of catches, the smaller the margins of permitted excess catch should be.

significant extent to finance applied studies in fishery management (Peña-Torres, 1997).[30] In the case of fisheries managed under ITQs, other costs directly associated with fishery management should also be financed by the industry itself.

When ITQs begin to operate in a fishery, and a dominant vision is shared that they constitute rights defended by law, groups of businessmen and/or fishing workers can end up cooperating to internalize (i.e., be willing to pay to enjoy) diverse benefits associated with investing in assets having the characteristic of 'semi-public' goods, such as applied scientific knowledge or enforcement efforts. Conditions that facilitate this type of cooperation at the same time increase the chances of success when using ITQs. Examples of favorable conditions are: (a) well defined (relevant) limits for the fishery, (b) relatively homogeneous fleets with respect to the fishing technologies in use, and (c) adequately enforced fishing rights.

Despite the fact that in general we are optimistic faced with the feasibility of reasonably efficient enforcement for ITQ schemes in Chile, not we should forget that managing fish stocks under ITQs is not a universal panacea. Neither should we think that fishermen will always achieve successful collective action in financing enforcement efforts or applied research. High enforcement costs, together with disincentives to cooperation and self-control among the fishermen, can contribute to reducing the benefits expected from using ITQs. However, in cases where adverse conditions of this type may be present, it is still worth asking if there is some other better option for fishery management.

Table 5
ITQs and Funding of Enforcement and Applied Research Costs

Country	Fishery	Funding of Research (R) and Enforcement (E) costs
Canada	- *Halibut*, British Columbia:	100% of E costs: paid by ITQ holders (around US$1 million in 1993)
	- *Sablefish*, B. Columbia:	100% of (E+R) costs: paid by ITQ holders
New Zealand	- Total of fisheries under ITQs:	Since October 1994: around 80% of (E+R) costs have been paid by ITQ holders (year 1994-95). Before October 1994: a lump sum tax charged in each Fishery under ITQs, without explicitly aiming at recovering the costs of ITQ management and enforcement.

[30] The amounts collected in recent years have not been insignificant: between (Chilean pesos) $4,500-$5,000 million annually. Around 50% of the total collected is targeted to financing applied fisheries research, with a dominant focus on biological as well as technological aspects.

	- *Orange Roughy*:	Diverse R costs have been paid by ITQ holders (e.g. around US$ 5 millions during the early 1990s).
Island	- Total of fisheries under ITQs:	~0.4% of the annual value of TACs is devoted to paying for ITQs management costs. In total, these costs have fluctuated around 1.3% of the annual value of TACs. Payments are made in proportion to ITQ holdings.

Sources: Grafton et al. (1996), Annala (1996), and various other authors in the Conference on ITQs, Seattle-1994 (Proceedings published as Pititch et al., 1997).

5. Final comments

We have defended the general thesis, and with special emphasis on the industrial fishing sector, that the best way to complete the reform process of regulatory institutions for extractive fishing is to implement fishery management schemes based on individual transferable quotas. Assigning individual quotas favors achieving success in coordinating collective solutions to rationalize fishing efforts, while the transferability of these quotas promotes efficient private solutions to the problem of excessive fishing capacity. Thus, public funds can be concentrated on supporting the reassignment of the labor force displaced by rationalization efforts.

With respect to the artisanal fishing sector, we suggest strengthening the effectiveness of efforts of association and coordination within the artisanal world as a basic condition to promoting management schemes that help to rationalize artisanal fishing efforts. As a fundamental principle we propose handing over to artisanal fishing organizations, with relevant local representation, powers for: (i) managing the collective quota assigned by the fisheries regulator and (ii) deciding by collective agreement if they wish to be incorporated into management schemes based on individual quota allocations, subject to rules of assignment, use, and possible transferability under the discretion of fishermen's organizations. With respect to the zone reserved for artisanal fishing, we propose allowing transactions between artisanal fishermen and industrial interests, so that it is possible to fish some proportion of the industrial quota within this zone, for example using artisanal ships for these effects.

The essential consequences of the alternatives available today are: either (i) we achieve advancement towards a system of fishery management based on individual fishing concessions, ideally transferable and subject to efficient entry restrictions and enforcement, promoting through this self-sustaining developments in the fishing sector, or (ii) the rest of the national economy will be

faced sooner or later with the obligation of subsidizing the maintenance of productive capacity and fishing employment above sustainable catch levels, unless (iii) we are prepared to accept the beginning of the economic death of harvest fisheries in Chile.

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Annex 1
Industrial fleets at Chilean fisheries in state of full exploitation: Authorized versus Registered (Post February 2001) Vessels

Fishery Units	(A) Number of vessels with valid fishing licenses	(B) Number of vessels registered to undertake fishing operations (to March 2002)
(1) Sardine and Anchovy (III and IV regions)	76	4
(2) Horse Mackerel (III and IV regions)	118	58
(3) Horse Mackerel (from V to IX regions) ** (Total Storage Capacity,m^3)	180 (113,200)	53 (=32%) (64,900) (=49%)
(4) Horse Mackerel (X region)	196	20
(5) Chilean Sardine and Anchovy (from V to X regions)	137 and 146	23
(6) Hoki (or Tail Hake) (from V to X regions)	168	27
(7) Hoki (or Tail Hake) (XI and XII regions)	20	4
(8) Austral Pollock ('3 aletas' hake)	19	5
(9) Antarctic Whiting (Exterior Northern zone)	16	5
(10) Antarctic Whiting (Exterior Southern zone)	14	5
(11) Gonden King clip (Exterior Northern zone)	17	4
(12) Gonden King clip (Exterior Southern zone)	14	5
(13) Chilean Hake	58	20
(14) Red Prawn (Langostino)	18	8
(15) Pink Shrimp (Camarón)	38	13
(16) Yellow Prawn	25	(under full biological closure)

Source: Undersecretary of Fisheries

**: Vessels registered to July of 2001.

Annex 2
The Chilean Hake fishery: Annual TACs and Landings (in tons; industrial fleet)
(regions IVth to Xth)

Source: Undersecretary of Fisheries.

INDUSTRIAL		JAN	FEB	MAR	APRI	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	TAC	50,000 t									18,000 t		
	Landing	51,009 t									17,057 t		
1998	TAC	50.000 t									17,500 t		
	Landing	50,499 t									18,033 t		
1999	TAC	56,000 t									22,000 t		
	Landing	56,441 t									19,601 t		
2000	TAC	31,200 t				35,352 t				4,000 t	4,000 t	4,000 t	3,448 t
	Landing	32,336 t				35,687 t