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# **Icelandic Fisheries Management: Fees vs. Quotas<sup>\*</sup>**

Thorvaldur Gylfason and Martin L. Weitzman

## **Abstract**

We discuss the quota system by which Iceland's fisheries have been managed since 1984, and explore its implications for economic efficiency as well as fairness. We argue that the shortcomings of the Icelandic quota system are inherent in *any* type of quota system applied to high-seas fishing. Further, we find that regulating access to a limited, stochastic common-property natural resource such as Iceland's fish by fee rather than by quota – i.e., by relying on price incentives rather than quantitative restrictions – would constitute a more equitable and more efficient solution to the fisheries management problem. Our argument applies to the management of all open-seas fisheries, including the Common Fisheries Policy of the European Union.

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<sup>\*</sup> Thorvaldur Gylfason is Research Professor of Economics at the University of Iceland and Research Fellow at CEPR and CESifo. Martin Weitzman is Ernest E. Monrad Professor of Economics at Harvard University. This paper was presented at an international conference on *Iceland and the World Economy: Small Island Economies in the Era of Globalization* at the Center for International Development at Harvard University 20 May 2002. Parzival Copes and Rögnvaldur Hannesson made helpful comments on an earlier version of the paper.

## **1. Not by Fish Alone**

Large and small economies differ by more than mere size. Small economies tend to be more narrowly specialized in the production of a few commodities and, therefore, also more open to external trade than large economies. Because of their comparatively narrow industrial structure and their special vulnerability to sudden changes in their external environment, small countries need to be especially careful in the management of their economic affairs; typically, they have a smaller margin for error than larger, more diversified economies.

Iceland fits this general pattern fairly well, but only up to a point. For a country with fewer than 300.000 inhabitants, Iceland is not nearly as open to trade as might be expected: its exports of goods and services have hovered around a third of national economic output since 1870, without any tendency for the export ratio to rise over time. For such a small economy (about USD 8 billion), the industrial structure is also remarkably diversified. The single most important industry continues to be fish. Iceland's per capita earnings from fisheries remain by far the highest in the OECD region and in the world (Table 1). However, the share of fisheries in economic activity, exports, and employment has declined markedly over time. Specifically, since 1980, the share of the fishing industry in gross domestic product (GDP) has declined from 17 percent to 10 percent, its share in total exports has fallen from 60 percent to 40 percent, and its share in the labor force has decreased from 14 percent to 9 percent. This trend seems likely to continue even if, in principle, it should be possible to manage the fisheries in such a way that fish exports could grow in tandem with the rest of the Icelandic economy; this, however, has not been the case in the past, partly, we presume, because excessive catch capacity in the industry and hence overfishing has severely reduced fish stocks and catches. For this reason among others, including perhaps medium-term changes in the ocean climate, most and possibly all fish stocks of interest in Icelandic waters and even in the North Atlantic are now fully utilized. This state of affairs limits the medium-term growth potential of the fisheries. Even so, Iceland's fishing industry remains important from a macroeconomic point of view, and also weighs heavily in the political arena because fishing and fish processing remain the mainstay of that part of the country's populace that inhabits the numerous small villages along the long but increasingly sparsely populated coastline of the country. The political importance of fisheries as well as

agriculture in Iceland is sustained in part through the longstanding overrepresentation of rural areas in the Icelandic Parliament, the Althing.

**Table 1. Value of fish catches per capita 1999  
(US dollars)**

Iceland	2970
Norway	282
Japan	85
Korea	73
Australia	58
Canada	38
European Union	16
United States	13
Mexico	10

Source: OECD (2001).

Note: Comparable figures New Zealand are not available. Other sources suggest that fish catches per capita in New Zealand are well below those of Norway, but above those of Canada (see OECD, 2000).

One of the reasons for the continued macroeconomic importance of the fishing industry in Iceland despite its decreasing relative size is the rent: the natural resource rent that emanates from the industry each year has been estimated at about 5 percent of GDP (National Economic Institute, 2000, p. 35; see also Árnason, 1995). In today's money, this rent flow is equivalent to about USD 500 per month for every family of four in the nation. The fishing rent is variable, however, because of variations in fish prices and quotas. For comparison, the oil rent in Norway amounts to about 10 percent of GDP, but the figure varies from year to year because the price of oil is variable in world markets. The government absorbs about 80 percent of Norway's oil rent. When need arises, a relatively small part of the rent is used to finance the budget deficit, the rest being paid into the Government Petroleum Fund, which is invested mostly in foreign securities. For further comparison, the Alaska Permanent Fund, whose principal comes from the dedicated oil revenues automatically deposited in the Fund in accordance with the State Constitution and state laws, pays out to each resident of Alaska an annual dividend that, in the year 2000, amounted to almost USD 2,000. The dividend program was conceived as a way to provide Alaskans a personal

stake in how the Fund is managed and a personal interest in protecting it.<sup>1</sup> As the fishing industry in Iceland gradually becomes more efficient with time, the resource rent may be expected to decline more slowly relative to GDP than the output and export earnings generated in the industry. So, unlike agriculture, the fishing industry will remain a macroeconomic concern in Iceland for years to come – in principle, perhaps, as far as the eye can see into the future.

The structure of the paper is as follows. In Section 2, we discuss the quota system by which Iceland's fisheries have been managed since 1984, and explain why, in our view, the system is neither fair nor fully efficient, even if, on efficiency grounds, it outperforms by far its Norwegian counterpart as well as the Common Fisheries Policy of the European Union, for example. We then go on to argue, in Section 3, that the shortcomings of the Icelandic quota system are inherent in *any* type of quota system applied to high-seas fishing. Further, we argue that regulating access to a limited, stochastic common-property natural resource such as Iceland's fish by fee rather than by quota – i.e., by relying on price incentives rather than quantitative restrictions – would constitute a more equitable and more efficient solution to the fisheries management problem. We conclude and summarize our argument in Section 4.

## **2. From Free Access to Fair and Efficient Management**

Until the mid-1970s, when the Icelandic Marine Research Institute issued its so-called “Black Report” with dire warnings about the impending collapse of the cod stock, Iceland's fish resources had appeared unlimited. The fish stocks were in decline, true, at least in part due to overfishing, but catches, while volatile, remained high by historical standards. The “Black Report” made it clear that, somehow, access to the fisheries would have to be restricted. The successful expulsion of foreign fishing vessels from Icelandic waters and the subsequent extension of Iceland's fisheries jurisdiction to 200 miles in 1976 may have seemed perhaps to provide a respite, but only briefly. Shortly thereafter, however, it became evident to most observers that, sooner rather than later, free access would jeopardize or even deplete the resource. Something had to be done. The first reaction was to attempt to regulate fishing effort directly by imposing artificial technological restrictions on fishing effort (for example, by reducing the number of days that boat owners could keep their vessels at

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<sup>1</sup> The dividend program was enacted in 1982 and the first dividend (USD 1,000) was issued the same

sea, mesh size, gear restrictions, and such). This method proved ineffective because it did not provide any incentives to vessel owners to reduce the fleet, which, at the time, was estimated to be perhaps 40 percent larger than necessary (Helgason and Ólafsson, 1989). Out of this initial failure grew the harvest quota system that was established by law in 1984, and has since remained in force, with minor changes.

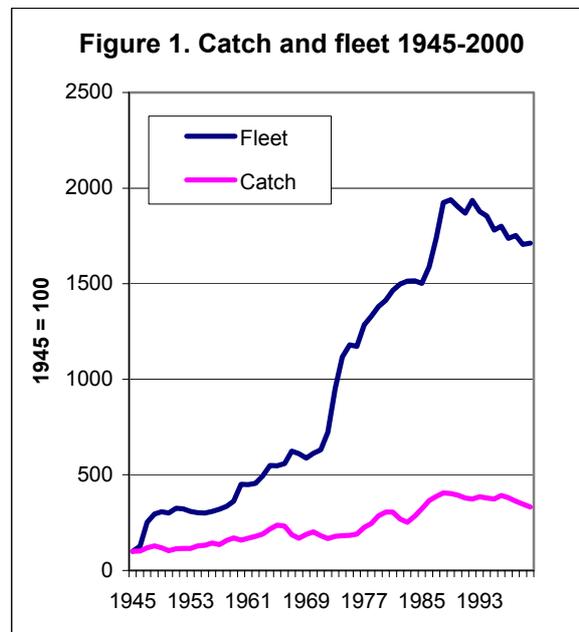
The salient features of the system are as follows. The exploitable marine stocks of the Icelandic fishing banks are, by law, the common property of the Icelandic nation, whose national government constitutes its “sole owner.” The Icelandic public has no title to marine fish as personal property until reduced to possession, but fish stocks are nevertheless “owned” by their government in its controlling sovereign authority as trustee for the benefit of all its citizens. As trustee, the government has vested in the Ministry of Fisheries the authority to determine the total allowable catch (*TAC*) each year, species by species, and to hand out fishing permits in the form of quotas to individual boat owners, based on their catch experience in the years 1981-1983. The quotas are specified in tons – more precisely, as shares of the *TAC* – such that the sum of quotas issued each year equals the *TAC*. Subject to some restrictions (more on these below), the recipients of quotas are free to harvest them or to sell them as they see fit. The transferability of quotas from one vessel owner to another is an essential ingredient of the system as it is intended to ensure, under ideal conditions, that the quotas ultimately end up in the hands of the most efficient firms. Free trade in quotas is thus intended to minimize cost and the resulting dissipation of the resource rent in the industry. Yet, for mostly political reasons reflecting wide-spread skepticism of and resistance to market-friendly reforms in an industry that, like agriculture, had been partly shielded from market discipline for a long time, the historical evolution of the quota system has been propelled less by grand design than by crises due to pending collapses of fish stocks unless something was done, and has, therefore, lagged behind the good intentions that have paved the path of reform of the fisheries management system.

However, as it has been implemented in Iceland since its inception in 1984, the Individual Transferable Quota (*ITQ*) system is, in our view, flawed in that the fishing quotas have been given away for free to boat owners in a discriminatory fashion. This arrangement entails not only inequities, but also inefficiency, for several reasons.

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year (for more, see Hannesson, 2001).

Figure 1 shows that the value of the catch from Icelandic waters has roughly tripled at constant (i.e., inflation-adjusted) prices since 1945, while fish stocks have dwindled due to overfishing (not shown), the cod stock by a third or even half according to estimates by Icelandic marine biologists. At the same time, the fishing fleet (measured in krónur at fixed prices rather than in tons) has increased almost seventeenfold. This means that output per unit of capital in fishing has contracted by almost 80 percent since 1945.<sup>2</sup> As Figure 1 shows, the size of the fleet has decreased slightly under the current *ITQ* system, but hardly at all when measured in tons (not shown). In 1990, long-term quotas were introduced in lieu of short-term quotas that expired after one to three years, and parallel effort quotas for vessels above a certain size (six *GRT*, or gross registered tons) were eliminated. Nonetheless, the fleet is still too large.



Source: Statistics Iceland.

We start by presenting some microeconomic arguments, aiming to draw attention to several harmful or uneconomical practices that are widespread under the *ITQ* system. We then discuss some additional macroeconomic issues that are bound to arise in Iceland in view of the fishing industry's importance to the national economy. Our discussion of the damaging incentives built into the current *ITQ* system as well as of the macroeconomic problems involved leads us to propose what we regard as a

<sup>2</sup> If catches taken by Icelandic vessels from international waters were included, the rise in the capital/output ratio shown in Figure 1 would be a little less rapid, but not much.

more equitable and more efficient system in which access to the fish resource would be regulated by landing fees, or resource depletion charges (*RDCs*), rather than by harvest quotas. At the “highest,” “first-order” level of abstraction, that is, assuming away such features as uncertainty, imperfect information, etc., the *RDC* system that we propose is analytically equivalent to one in which the fishing quotas would be sold or auctioned off to boat owners initially rather than given to them gratis.

## 2.1. Microeconomics and Incentives

Let us start with the microeconomic arguments. The *RDC* system that we advocate will put in place strong incentives to eliminate or at least to cut back (cleanly, in one fell swoop, as opposed to the “administratively dirty” ad-hoc patch-up measures required under the *ITQ* system) the following fifteen harmful or uneconomical practices, which are widespread under the *ITQ* system:

**(1) *The excess-capacity argument.*** The *ITQ* system induces wasteful excess capacity because the rigid *TAC* ceiling does not allow sufficient smoothing of effort over good and bad harvest years. Fishing firms thus find it profitable under an *ITQ* system to maintain greater capacity per quota species actually caught than they would under an *RDC* system.<sup>3</sup> Moreover, the *ITQ* system encourages both quota busting (i.e., catching more fish than the quota allows) and data fouling (i.e., underreporting catches in order to evade detection); see Copes (1986).

**(2) *The dumping-at-sea argument.*** The *ITQ* system induces the discarding or dumping at sea of less valuable by-catch species because a fishing trawler naturally feels some time pressure to fulfill its quota on the more valuable species first. It is a near-universal experience with *ITQ* systems that vessels carrying observers report on average a lower proportion of the more valuable species than corresponding vessels fishing the same area that do not carry observers, indicating that some form of discarding behavior is occurring.<sup>4</sup> The core issue is that an *ITQ*-type system stochastically encourages discarding of by-catch species because of a rush to fulfill the quasi-rigid quota on the more valuable species, thereby ensuring throughout this “rush” period a low opportunity price on the by-catch. An *RDC*-type system makes

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<sup>3</sup> The “administratively dirty” ad hoc *ITQ* patch-ups of 5 percent possible overfishing by borrowing quota from the next period and the 20 percent possible underfishing by banking quota until the next period alleviate somewhat the excess capacity problem, but do not address it fundamentally and do not eliminate the problem.

every kilo of every kind of fish valuable throughout the period; there is no incentive to discard a fish species so long as its price net of the *RDC* exceeds the opportunity cost of transportation to port.

**(3) *The high-grading argument.*** The *ITQ* system induces the discarding or dumping at sea of relatively less valuable specimens within the same species to obtain a higher value per quota-fulfilled kilogram of that species (see Copes, 1986). This “high-grading” emerges almost routinely under a quota system whenever a premium price is paid for fish of a certain size or quality and is considered by many to be a serious problem in Icelandic fisheries. Again here, the core issue is the quasi-rigid quantity quota, which encourages high grading whenever the quota constraint is binding. Under an *RDC*-type system, there is no incentive to high-grade fish so long as its price net of the *RDC* exceeds the opportunity cost of transportation to port.

**(4) *The timing argument.*** The *ITQ* system induces an artificially induced, uneconomical, and costly fine-tuning-of-timing behavior observed along an exploitation path in the fishing industry throughout the quota implementation period as an understandable response to the need for avoiding expensive quota overruns. As just one example among several timing aberrations inherent in a real-world discrete-period *ITQ* system, such desirable species as cod that are accidentally caught toward the end of the fishing year when *ITQs* are scarce and the lease price is inordinately high, are apparently thrown back into the sea in non-negligible numbers, thereby rendering such valuable fish neither live capital nor harvested catch.

**(5) *The under-run argument.*** The *ITQ* system entails costly and uneconomical *TAC* under-runs characteristic of a mature *ITQ* system, like New Zealand’s, which awaits Iceland too when fish stocks are built up closer to long-run equilibrium levels. *TAC* under-runs are yet another consequence of the generic inability of an *ITQ* system to match quasi-rigid fixed-proportions multi-species quota quantities with actual multi-species catches.

**(6) *The rigidity argument.*** The *ITQ* system entails efficiency losses inherent in a quantity-based management/planning system that selects rigid quantity quotas applied to fish species *before* the fishing period begins, when a lot of uncertainty exists about the relevant fish stocks, fish densities, seasonal variability, migration patterns, and so forth. The *TACs* are decided before the period starts and at times there can be large

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<sup>4</sup> The 5 percent limited cod-equivalent quota conversions alleviate somewhat the multi-species discarding problem, but do not address the problem fundamentally and do not eliminate it.

unanticipated changes in some fish stock, or the fishery managers may get their estimates wrong. Much of the relevant information will become partially resolved *during* the fishing period, by which time it is too late for an economical response by the fishing industry, because the inherently rigid quantity quotas have already been fixed. By contrast, a price-based system such as an *RDC* system is able to make efficient use of such information.

**(7) *The multi-species argument.*** The *ITQ* system also entails efficiency losses inherent in a management/planning system based upon imposing output quotas in quasi-rigidly-fixed proportions on a multi-product industry, whose jointly produced output mix is quite far from being fully controllable, and whose agents' behavior in adjusting the actual output mix to planned output proportions is not observable.

**(8) *The potential-outsider argument.*** The Icelandic *ITQ* system limits quota holdings to owners of fishing vessels, which reduces dramatically the number of potential outsider participants, impairing fishing efficiency by erecting an artificial barrier to entry and causing the quota market to be excessively thin. The Icelandic quota system thus deprives the fishing industry of the new blood that is necessary for any industry to thrive.

**(9) *The cartel argument.*** The *ITQ* system creates an incentive for a small group of big quota holders to form a cartel, whether explicitly with “visible handshakes” or implicitly with “invisible handshakes,” and to then possibly be in a position to use their considerable market power to manipulate the price of quotas, in a market which is extremely thin, and therefore highly manipulable, in the first place – thanks largely to government-imposed barriers to new entry by outsiders. The explicit or implicit cartel power of big quota owners in a thin quota market, whose thinness is sanctioned and re-enforced by government policy itself, constitutes a significant barrier to the proper functioning of a fair auction market and a self-reinforcing major impediment to the government ever considering seriously the auctioning of quotas to siphon off rents.

**(10) *The risk-exposure argument.*** The *ITQ* system leads to an excessive and unfair “up-front” exposure to risk carried by those fishermen initially without sufficient quota, who are already in a risky business, yet are being forced under the current system to purchase a quota portfolio first, and only then are being given government permission to set sail and attempt to harvest an uncertain catch, as opposed to the built-in-insurance properties of a system that requires payment only

upon landing a catch. This “quota-first” restriction impairs dynamic efficiency, because it discriminates against any newcomer fisherman who wants to try out what he thinks is “a better way” to catch fish. In general, the *ITQ* system is biased in favor of existing vessel/quota owners, some of whom are awash in cash and do not cut costs as aggressively as they would if they were vigorously challenged by potential new entrants.

**(11) *The absentee-owners argument.*** The *ITQ* system tends to trigger quota profiteering by absentee owners “sitting on the beach,” which results in welfare losses – from strikes and slowdowns of “tenant” fishermen, and from widespread feelings of resentment among the general population against absentee “lords of the sea” or semi-retired “quota kings,” discrediting and undermining market-based fisheries management.

**(12) *The local-consent argument.*** In the Icelandic *ITQ* system, it is necessary to obtain the consent of the municipal government and the local fishermen’s union before leasing or selling quota to a vessel operating from a different place. This is yet another pernicious barrier to free commerce, erected in this instance to deal with the adverse social consequences of requiring any “new” local fisherman to purchase an expensive quota portfolio before leaving harbor.

**(13) *The compulsory-harvesting argument.*** The Icelandic *ITQ* system imposes the restriction that holders of *TAC* shares must harvest at least 50 percent of their quota every other year to retain their special privilege of being able to hold quotas, which causes there to be operated more vessels than are efficient, and results in general overcapitalization in a “ghost fleet” of the fishing industry.

**(14) *The economies-of-scale argument.*** The Icelandic *ITQ* system imposes the additional restriction that no firm can hold more than 8-10 percent of the share of total quotas, thereby reducing efficiency by not allowing any significant economies of scale to operate, and, worse, preempting even the possibility that economies of scale will occur by making it impossible to observe them in the first place.

**(15) *The small-boat argument.*** There are loopholes in the Icelandic *ITQ* system allowing “small” fishing vessels or “recreational” fishermen to operate outside the system, arising essentially from a guilty conscience about the fundamental unfairness of the government’s erecting a complicated and costly barrier to entry in the form of a quota requirement, with all of its concomitant bureaucratic red tape, on the little operator, whether self-employed or amateur.

## 2.2. Macroeconomics and Public Policy

Let us now turn to the macroeconomic issues.

**(16) *The public-finance argument.*** By not levying charges on the right to exploit a limited common-property resource like fish, the Icelandic government misses an opportunity to improve its revenue collection by replacing highly distortionary taxes (e.g., income taxes and the value added tax, *VAT*) in part by less distortionary lump-sum-like *RDCs*. At present, the marginal rate of tax on labor income in Iceland is above 40 per cent and the *VAT* rate is 24.5 per cent. In view of recent research showing how costly tax and trade distortions can be (Feldstein, 1999), it seems likely that the efficiency gains from reorganizing revenue collection in Iceland along these lines could be substantial. Further, at 96 per cent of GDP at the end of 2001, external debt in Iceland is high, partly for public-finance reasons, and public (and private) expenditures on education, at 6 per cent of GDP in 1997, are low compared with neighboring countries. So, if the revenue from fishing fees were absorbed by the government, there would be strong economic grounds for using this revenue to finance some combination of (a) an income tax cut or a *VAT* decrease and (b) increased outlays on education, in a way that would be consistent with sustainable fiscal balance. Alternatively, the revenue from the *RDC* could be kept outside the government budget and returned directly to households, in which case (a) the government would have more scope to reorganize its revenue collection and balance its budget and (b) households could use the money thus received for education provided that greater scope for private expenditure on education would be created. The Government Petroleum Fund in Norway or the Alaska Permanent Fund may serve as a possible model for a corresponding Icelandic Resource Depletion Fund (more on this below) – in view of the somewhat paradoxical, but apparently real, possibility that renewable fish resources may be almost as susceptible to depletion as non-renewable oil resources. Accordingly, it may be advisable not to use up all the revenue from fishing fees from year to year but to invest part of it abroad along Norwegian lines (or repay external debt).

**(17) *The transparency argument.*** Unrequited quota allocations to vessel owners since 1984 have reduced the transparency of fiscal and monetary operations (a) by hiding substantial *de facto* government subsidies to the fishing industry and (b) by keeping serious structural weaknesses in the still mostly state-owned and state-operated banking system from plain view by enabling fragile fishing firms to use their

quota allocations to service their debts rather than repudiate them and declare bankruptcy. Even so, from 1987 to 1997, the Icelandic banking system wrote off bad debts equivalent to about 13 per cent of the country's GDP in 1997, including a large chunk of the bad debts of fishing firms. Like excessive subsidies in general, especially concealed subsidies, the unrequited allocation year after year of valuable, transferable fishing rights to boat owners tends to promote and perpetuate inefficiency as well as a lack of financial self-responsibility in the fishing industry. A well-designed *RDC* system would (a) reduce or remove the subsidy implicit in the present *ITQ* system and (b) make fiscal operations, regional policy, and the banking system more transparent, and thus more efficient.

**(18) *The Dutch-disease argument.*** Iceland is almost unique among the industrial countries in that its exports of goods and services have been stagnant relative to GDP for a long time, as mentioned in Section 1. This seems likely to be a symptom of the Dutch disease that plagues many countries that depend excessively on primary-product exports. Recurrent booms and busts in the fisheries have kept the real exchange rate of the currency higher and more volatile than it otherwise would have been, thereby reducing the profitability of other export and import-competing industries. In this way, it may be said, Icelandic consumers have received part of the resource rent indirectly through cheap imports, but this roundabout way of distributing the rent is inefficient. Other symptoms of the Dutch disease include virtually no foreign direct investment in Iceland until very recently (except for large hydro-related projects with substantial government involvement), declining domestic investment relative to GDP since the 1960s, and an insufficient commitment to education in the mistaken belief, apparently widespread in resource-rich countries, that natural resources are more important than human resources. By speeding up the necessary reduction of the fishing fleet to an optimal size and the associated rationalization of the fishing industry, a well-designed *RDC* system would render the economy less prone to the vagaries of catches and fish prices in world markets and to the associated recurrent booms and busts that have resulted in a systemic overvaluation of the currency. By the same token, fishing fees would reduce the extent to which booms in the fishing industry tend, through centralized wage bargaining, to lead to nation-wide wage hikes that other export industries can ill afford.

We can approach the Dutch-disease argument from a different direction. Just as import restrictions tend to increase the real exchange rate by reducing the demand for foreign currency, export subsidies also tend to increase the real exchange rate by increasing the supply of foreign exchange. In this fashion, government support for fish exports over the years – at first through almost automatic extension of credit to fishing firms from the state-owned banking system, then by repeated devaluation of the króna at the virtual discretion of the fishing industry, and now through the allotment of valuable fishing rights free of charge – has contributed to a systemic overvaluation of the Icelandic króna, as witnessed by persistent deficits in the current account of the balance of payments and mounting external debts, and still does.<sup>5</sup> This helps explain the longstanding stagnation of exports mentioned before. From this vantage point it appears that the introduction of market-based *RDCs* and the concomitant abolition of indirect state support for the fishing industry would lower the real exchange rate for a while, thus enabling non-fish manufacturing and services to gain a stronger foothold in the economy, even if the króna subsequently would most probably appreciate in real terms as a results of increased productivity.

**(19) The EU argument.** The stipulation in the Fisheries Management Law from 1984 that the fishing rights be handed out for free rather than sold to boat owners, or taxed, seems likely to keep Iceland outside the European Union (*EU*) indefinitely because (a) giving quotas to foreigners free of charge is clearly out of the question and trading them on a barter basis, as has been done on a limited scale, is obviously inefficient and (b) selling quotas to foreigners while continuing to give them to Icelandic vessel owners for free might be deemed to involve discrimination by nationality, thus, in principle, constituting a violation of the Treaty of Rome.<sup>6</sup> Auctioning off part of the fishing rights, without any restrictions based on the nationality of would-be buyers competing on a level playing field in accordance with the Treaty of Rome, would replace free access by foreigners to the resource, which is clearly out of the question, by their access to the Icelandic market for fishing rights. This would reduce or eliminate the single most important obstacle to Icelandic accession to the *EU*, that is, the fear of many Icelanders of having to sacrifice part of their hard-earned, exclusive rights to fish in Icelandic waters, and thus would make it

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<sup>5</sup> Iceland's gross long-term foreign debt amounted to 96 percent of GDP at the end of 2001, compared with 50 percent of GDP in 1996.

easier for them to assess the pros and cons of *EU* membership without prejudice (Gylfason, 1991). The fisheries-policy-based objections to *EU* membership at present and, by extension, to Icelandic membership in the Economic and Monetary Union (*EMU*) may be viewed as an additional symptom of the Dutch disease in the sense that we have here a case where natural resource dependence stands in the way of closer economic integration.

**(20) *The fairness argument.*** To many Icelanders, the current *ITQ* system is unfair. In December 1998, the Supreme Court of Iceland ruled unanimously that the legislation behind the current system of allocating the fishing rights free of charge to individuals who happened to own boats in 1981-1983 violates the constitutional provision protecting the general principle of equality. The Parliament reacted by revising the law in a way that does not, however, substantively change the system of allocating the fishing rights free of charge. In early 2000, the Supreme Court reversed its position, when it ruled (with 5 votes against 2) that the quota system was not in breach of the constitution after all. Even so, the new ruling is quite critical of the system. The minority of two justices confirmed the earlier, unanimous verdict.<sup>7</sup> The fairness argument, however, is not solely normative. Social injustice, real or perceived, can threaten economic stability, efficiency, and growth. In a highly unionized economy such as in Iceland, this may occur through centralized wage bargaining in which labor unions may demand excessive wage increases in compensation for what they consider less than their constituents' fair share of the rent from a natural resource that by law belongs to the nation as a whole. While this has not happened yet in Iceland to any considerable extent, this threat looms over the economy, as does the somewhat less likely prospect of significant social unrest that, if it were to occur, might disrupt economic activity also in other ways.<sup>8</sup>

Let us elaborate on the effects of the current *ITQ* system on income distribution. In the situation of a small open economy, like Iceland, where earnings are essentially determined on the margin by more-or-less-constant-returns-to-scale constant-cost

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<sup>6</sup> However, there may be some scope for granting differential access to specific fish banks by nationality on the basis of historical precedence without violating the Treaty of Rome.

<sup>7</sup> The new verdict was passed in connection with the case of a quotaless boat owner who went to sea in the belief that he could not be denied this right in the name of a law that the Supreme Court had ruled unconstitutional. He was acquitted in a lower court with reference to the earlier Supreme Court ruling, but the Supreme Court reversed the acquittal.

<sup>8</sup> The recent debate on fisheries management in Iceland is reviewed in Matthiasson (2001). Hannesson (1996) reviews of the experience of Iceland, the Faeroe Islands, and Newfoundland as well as the Common Fisheries Policy of the *EU*.

manufacturing of internationally traded goods, there is not a strong or theoretically reliable trickle-down effect. The usual avenues – whereby the rents created might have been hoped to have some tendency to flow eventually toward the general public (such as happens typically with genuine technological innovations), thereby allowing the public over time to get some reasonable part of their fair share – are blocked here because wages and returns to capital are determined on the margin primarily by international competition, more or less independently of the distribution of fisheries rents. Hence, in all likelihood and barring some unforeseen mechanism being at play, a genuine inequity exists (as opposed to merely a perceived inequity), which was artificially created, and will tend to persist indefinitely over time. That is to say, in such a situation, which more or less accurately characterizes Iceland, an untaxed rent created by limiting access to fishing in *any* way (not just by quotas, tradable or otherwise), will raise national income, but primarily by raising the income of those fishermen enjoying the access (in this case owners of fishing boats in 1981-1983, who were given the quotas gratis), while leaving more or less unaffected the incomes of everyone else in the economy.

Thus, the primary distribution effect of the present *ITQ* system has been to increase sharply the income of owners of capital in the fishery sector while the welfare of other groups in the economy has remained essentially unaffected. In this particular (Icelandic fisheries) situation, therefore, there is no basic economic reason or principle to presume here that “what is good for Icelandic boat owners is good for the Icelandic public.” Furthermore, there are no significant economic forces out there, in Iceland or the world economy at large, to rectify this situation over time. Rather, the base presumption here is that the inequity situation will remain stationary, or at least that it will change very slowly over time, and even then it is difficult to say whether it might be more likely to move in the direction of greater or of lesser inequity.

To give a vivid, precise example here, suppose there were two brothers, one of whom in 1982 worked in manufacturing while the other brother worked in fishing. At around that time, both brothers were making about the same money per year (averaged, say, over five years). Suppose, further, it so happened that the second brother owned his own fishing boat in the years 1981-1983, just as it so happened that the first brother owned his own manufacturing equipment of about the same value in the same period. Then the re-equilibrated situation after the *ITQ* system is in place has the first brother’s earnings being about the same, while the second brother now

receives about triple that amount of money each year. Furthermore, there is no automatic trickle-down from the second brother to the first brother, because the first brother's income, like Icelandic income on the margin generally, is essentially equal to the international price of internationally traded goods being manufactured in Iceland, multiplied by the labor plus capital used in producing a unit of them divided by the time required.

### **3. The Road Not Taken**

We now proceed to describe the *RDC* system that we advocate and to outline its basic advantages compared with the current *ITQ* system.

#### **3.1. A Roadmap of Reform**

Before we referred to the government's controlling sovereign authority as trustee for the benefit of all its citizens. In the *RDC* system that we advocate, any such "benefits" are considered to be held in equal shares by each Icelandic citizen residing in Iceland. Beginning on the date when the full implementation of the *RDC* system will take effect (after, say, a four-year phasing-in transition period), there are to be no legal distinctions between owners of fishing vessels and non-owners of fishing vessels, or among owners of fishing vessels or fishing gear of various sizes, types, technologies, regions, and so forth – concerning any property rights in fish, real or imagined, or any jurisdiction over harvest rights, real or imagined, other than the common right to catch fish of all Icelandic citizens, consistent with the basic constitutional principle of freedom of occupational choice. The underlying philosophy behind the *RDC* system is to establish fisheries management consistently on the basic principle of completely symmetric treatment of all citizens, in full harmony with the constitutional rule against any form of discrimination.

##### **3.1.1. Objectives**

The broad intent of the reform that we propose is to institute a complete package of measures that, taken as a whole, should give Iceland the best-managed fisheries in the world. The intent is not just to patch up temporarily the existing system, merely for the sake of postponing a revisitation that will be required again some few years hence, but rather to put in place a philosophically consistent framework unifying cleanly the

ethical, legal, economic, and managerial aspects of Icelandic fisheries into one coherent workable structure that will serve Icelandic national interests well into the 21st century. More particularly, the purpose of the reform is to establish a national fisheries management and accountability structure with a clear and specific mandate, and to codify the operation of a system of policy instruments, that are intended to ensure the simultaneous fulfillment of the following five objectives:

(1) The reform is designed to induce the *highest possible efficiency* of the fishing industry.

(2) The reform is designed also to ensure an *equitable distribution* of national fishery rents. This means that, in passing the reform legislation, the Icelandic Parliament recognizes that the former *ITQ* method of managing fisheries – while well-intentioned when it was introduced, and while absolutely necessary at that time in order to undertake urgently needed, politically feasible emergency action to rescue a then-dangerously-damaged fishery situation, and which, by using market-based quantity instruments, introduced some important elements of efficiency into the fishery industry – was flawed from its inception by being based fundamentally upon an arbitrary, unjust, and discriminatory redistribution of the fisheries properties and fishing rights of all Icelandic citizens in a highly asymmetric way, unlikely to change over time, all being done without any attempt to make adequate compensation to non-boat-owners. The reform is intended to address centrally this unintended and unforeseen equity-injustice consequence by now putting in place the most fair, politically feasible fisheries-rent-distribution method possible, even though it cannot possibly please fully all members of society.

(3) The reform is designed to have the *clearest possible transparency*, with uniform rules that are simple, easy to understand, easy to administer, easy to see what is the motivation behind, have few or no exceptions, indicate clearly and transparently what is the impact on fishing and on the rest of the economy, and are applied in practice – as well as in theory – equally to every Icelandic citizen.

(4) The reform is designed to ensure that there is *no absentee profiteering* or any other such socially divisive owner-tenant situation having negative feudal overtones. Without any such explicit provisions, the very logic of the reform will automatically lead to “on-board” owners being active in the owner-operated fishing business. There will be no more owners “sitting on the beach” because, under the new *RDC* system, unless *your boats* are actively making a profit, *you* cannot make any profit.

(5) The reform is designed consistently on the bedrock principle of *equal treatment of all Icelandic citizens*, in complete harmony with the constitutional right of freedom of occupational choice and the constitutional prohibition on any form of discrimination.

To summarize, the reform holds out the ambitious implicit promise that Iceland will have *the best-managed fisheries* in the world, now and for some time to come. The reform is intended to deliver the highest possible efficiency of the fisheries industry combined with an equitable distribution of fisheries rents, along with the minimum possible government intrusion. The intent of the reform is to have uniform rules, that are simple, transparent, easy to administer, and which apply equally to all Icelandic fishermen, actual and potential.

The objective of national fisheries policy is to set market-based management instruments at levels that maximize long-term returns of the fisheries for the benefit of the Icelandic people, who collectively constitute the sole owner of all fish stocks. The proper setting of fisheries instruments in Iceland is probably at least as important to the Icelandic economy as the proper setting of monetary instruments by the Federal Reserve Board is to the United States economy (or the proper setting of monetary instruments by the European Central Bank (*ECB*) is to the European economy).

Therefore, and for reasons entirely analogous to the logic behind the enabling legislation establishing the independent apolitical authority of the Federal Reserve Open Market Committee or the *ECB* Governing Council, the reform aims to establish formally by legislative decree a national “Open Market Fisheries Committee” vested with a broad mandate and broad powers to set market-based instrument values to maximize the long-run profitability of fisheries for the benefit of the sole national owner. The setting of fisheries management instrument values is simply too important a task to be left, ultimately, in the hands of a politically appointed minister, no matter how capable or well intentioned the currently appointed individual happens to be. Like Caesar’s wife, the fisheries authorities should be above even the hint of suspicion of manipulation. There needs to be clear and specific management and accountability structure, formalized in the national interest by the reform legislation. The time to fix a leak in the roof is when the sun is shining, not when it is raining.

Beyond establishing the new legal entity, the reform is intended to enable the Open Market Fisheries Committee to possess the independent authority to stand above short-run political pressures or sectarian interests in pursuing a broad long-run

mandate to act as prudent custodian for the designated sole owner of all of the fishery stocks. The ownership-management structure clarified – and codified into law – by the reform is exactly the following more precise and more modern version of the ancient common-law public-trust doctrine:

1. Icelandic citizens residing in Iceland constitute in equal shares, through their government, the *sole owner* of all Icelandic fish stocks. By the conveyance of the reform act it is clarified legally that Icelandic fisheries are a collective, binding, inalienable, non-sellable, societally indivisible and non-terminable form of property.
2. The Open Market Fisheries Committee is considered to be the independent custodian, steward, or trustee assigned to manage prudently the relevant instrument values, which control the stock-depletion or stock-enhancement of fisheries capital, in the long-run best interests of the sole public owner, and whose policy mandate, by the conveyance of the reform act, is best described succinctly as *maximization of long-run return on fisheries capital*.

The reform therefore places Icelandic fisheries firmly in a longstanding legal tradition of having the management of inherently public properties be consistent with a contemporary version of the public trust principle, which holds that the state or public has no title to marine fish as personal property, but they are nevertheless “owned” by government in its sovereign capacity as trustee for the benefit of the citizens.

In accordance with current concepts of best-practice national income accounting, and in consistency with the basic philosophy underlying this reform, henceforth the economic value of annual *changes* in Icelandic fish stocks will be estimated by established national income accounting principles as a named mean value plus-or-minus a named standard deviation. These numbers will be appended as a satellite entry to the calculation of annual Icelandic Net Domestic Product and Net National Product, under the newly created category “*Estimated Net Investments in Natural Resources Stocks – Fisheries*.”

### **3.1.2. Organization**

The Open Market Fisheries Committee (*OMFC*) will consist of five appointed members, including an appointed chairman. The term of each member will be five years. Membership terms are staggered evenly over time, so that each year one “old”

member's term expires while a "new" member's term begins simultaneously. "New" members are to be nominated by the Prime Minister on the basis of their scientific, economic, or management qualifications, and also for their perceived integrity to act responsibly and independently in maximizing the long-term return on fisheries capital on behalf of the sole owner, over and above any other interests, perceived or real. After nationally televised public confirmation hearings held by the Natural Resources Committee, where a candidate's expertise and his or her integrity to act responsibly, prudently, and independently in the national interest are examined publicly and judged accordingly, then, if he or she is reported favorably by a majority vote out of committee, the nominee must be confirmed by a majority vote of Parliament. The Chairman of the *OMFC* will appear before the Committee on Natural Resources once a year for nationally televised public hearings intended to elucidate, by way of answering Committee members' questions, the scientific, economic, and managerial logic behind the important *OMFC* decisions of the recent past, and to outline where *OMFC* policy is likely headed in the near future, and to explain why it is likely headed in that direction. A member of the *OMFC* may be removed at any time, but only by a two-thirds vote of Parliament. A member of the *OMFC* may be appointed for an indefinite total number of terms, but may not serve more than two consecutive terms.

The *OMFC* shall meet regularly during the last week of each month to review the latest biological and economic information for each species. This information will be assembled from a wide diversity of sources, including, as warranted on occasion at the *OMFC*'s discretion, boat captains, boat crew members, owners, unions, processors, regional representatives, scientists from Iceland and abroad, economists from Iceland and abroad, fisheries managers from Iceland and abroad, and so forth, and so on. By the last day of each month, the *OMFC* will issue a list of the as-if-in-kind *RDC* percentage rates to be applied to each fish species harvested throughout the following month. While, all other things being equal, it is considered desirable, naturally, to achieve a relatively stable regime of more or less steady as-if-in-kind *RDC* percentage rates for many months in a row, the *OMFC* reserves the right to change this management instrument as it sees fit on a monthly, or, if required, weekly, or even daily basis. In an age of spreadsheets and highly computerized accounting, even frequent changes of *RDC* rates are not considered to represent an unbearable hardship on fishing firms, neither for making short-run fishing decisions nor for analyzing

long-run investment opportunities.

### **3.1.3. Instruments**

The primary management instrument to be used by the *OMFC*, to maximize long-term return on fisheries capital on behalf of the sole owner, is a species-specific as-if-in-kind *harvest payment*, considered legally not to be a tax, but rather, consistent with the basic philosophy of this reform act, a form of Resource Depletion Charge (*RDC*) paid in exchange for drawing down the capital of the sole owner.<sup>9</sup> The *OMFC* will set these species-specific Resource Depletion Charges as percentages of raw wet-fish catch, to be paid as-if-in-kind, but only *after* the catch is made, at a time within two working days of landing the catch in port. The fisherman need not worry about having the correct portfolio of catching rights before setting sail, or being forced to pre-commit scarce funds up front to buy quota beforehand on an uncertain catch, thus lessening greatly the fisherman's exposure to risk. If no fish of a particular species are found and harvested, then no *RDC* fees are paid on that species. For every raw wet-fish kilogram taken of each species, the harvesting fisherman must pay as *RDC* the króna value of the assigned *RDC* percentage of the current free-market price of a wet-fish kilogram, or a reasonable approximation thereof, for that species, calculated on the day it is landed. All fish caught in Icelandic waters must be brought ashore in Iceland.

The idea that the primary management instrument envisioned for the *OMFC* is the relatively "clean" instrument of *RDC* percentage rates (to be set and reset as frequently as needed) does not in any way mean or imply that auxiliary quantity-based measures will not play a significant role. The *OMFC* will issue specific prohibitions on disturbing spawning grounds or grounds where recruits graze. The *OMFC* will mandate which types of gear and mesh sizes are to be used in which places under which conditions. And so forth, and so on.

The general mandate of the *OMFC* is to set *RDC* rates, by using the best theories and data available, but mostly by trial-and-error monthly iterations, to "maximize the long-term return on fisheries capital" on behalf of the sole owner. This mandate translates into a simple conceptual rule, which the *OMFC* may think of itself as using to fulfill its mandate. The *OMFC* need only be concerned with adjusting the *RDCs* in

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<sup>9</sup> The choice of fish species covered and possible size gradations within species are considered to be the prerogative of the committee.

*the direction* of increasing long-term returns. Following this simple rule will automatically lead to the optimal overall multi-species management, subject to the best information available to society. It is by no means excluded that *negative RDC* percentage rates might be set on some fish species that are not especially valuable themselves but compete with, or prey upon, the valuable species like Cod, Haddock, Greenland Halibut, or Plaice.<sup>10</sup>

The setting of the schedule of *RDC* percentage rates is considered to be the primary market-based instrument used by the *OMFC* to handle almost all conceivable stock management issues, including most foreseeable crisis issues, such as chance outbreaks of epidemic disease among some fish stocks. In fisheries crisis situations, appropriate changes in the *RDC* (presumably sharp immediate increases for epidemic diseases and weekly or daily adjustments thereafter) constitute a first line of defense. However, the *OMFC* also has the power to take any and all measures deemed necessary to safeguard for posterity the property of the national sole owner, including such quantity-based measures as closing down some fishing grounds entirely.

All *RDC* receipts are deposited in a Resource Depletion Fund (*RDF*), to be held in trust for the sole national owner. By January 31 of each year, the entire previous year's *RDF* accumulation is to be paid out in equal portions to every Icelandic citizen who legally resided in Iceland during that previous year (as normally defined for national income-tax purposes). Shares belonging to minors under the age of 16 are paid to their mother, if she is alive in Iceland, or, if not, to the minor's legal guardian residing in Iceland, or else, finally, to the minor's closest non-minor relative residing in Iceland. For taxation and other purposes, this annual *RDF* payment is treated as ordinary income.

#### **3.1.4. Timing**

Following a four-year phasing-in transition period,<sup>11</sup> the fully implemented version of the reform act takes effect. From that day forth there will be no government restrictions whatsoever on entry into fishing activity, aside from the standing injunction to do no harm to the fisheries environment and aside from possible national emergency measures. On or after the day when the *ITQ* regime will formally end, an

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<sup>10</sup> A negative *RDC* might be considered comparable to having a price placed on the head of such "rogue" land species as wild mink or fox.

<sup>11</sup> Of course, other phasing-in timing sequences are possible.

Icelandic citizen will not need any special government permissions to fish, in the form of special permits, quotas, vessel restrictions, regional approvals, or any other government-imposed barriers to entry. In the four-year transition period between the enactment of the reform and its full implementation, a “mixed” regime will be in place where *both ITQs and RDCs* are in effect and *ITQs* are required, as previously, to cover catch quotas. Throughout this transition period, the *OMFC* will set *both* annual *TAC* values *and* monthly *RDC* rates. Gradually throughout this four-year transition period, the *OMFC* will be increasing *RDC* rates month by month, at their discretion, causing *ITQ* values to decline correspondingly over time, until, by the end of the transition period, an *ITQ* will be worthless and all *ITQs* will be abolished, along with all other remaining fishing-entry restrictions. From that day forward, there will essentially be no entry restrictions, along with complete symmetry and full equality in the government treatment of all actual and potential Icelandic fishermen throughout Iceland and Icelandic waters.

### **3.2. Prices vs. Quantities under Ecological Uncertainty**

It is important to realize that a basic built-in design drawback inherent in applying quantity-constrained management instruments to open-seas fisheries is the relatively high “rigidity costs” of *ITQ*-type systems in the fisheries context. This inherent inflexibility causes efficiency losses both *within* the relevant time period for a single fishery species and *across* species. The *ITQ* system attempts to “patch up” these quasi-fixed-coefficients rigidities with exception clauses allowing up to 5 percent of quota to be shifted across periods or among species. However, these exception clauses are relatively “dirty” in their inefficiency effects compared with the relatively “clean” automatic efficiency properties designed extrinsically right into an *RDC*-type system.

The “pure-timing” rigidity occurs within the quota-applicable time period because, basically, one more cod caught at a few kilograms below quota is worth a *large positive* amount of money, while one more cod caught at a few kilograms above quota is worth a *large negative* amount of money. This arbitrary discontinuity in the marginal value of fish around the quota level is a significant causal agent for some of the inefficient and harmful fishing practices described in Section 2.1. Notice that it is the *combination* of a timing rigidity and the difficulty of observing actual fishing behavior on the open seas that makes this type of inefficiency costly in *ITQ* fishery management. This particular bad combination occurs in no other application of

market-based instruments for correcting externalities, other than the open-sea fishery.<sup>12</sup> For open-seas marine fisheries, where actual fishing behavior is difficult to observe, *price*-restricted market-based instruments are generally more flexible than *quantity*-restricted market-based instruments – in the fisheries-context-important sense that the fisherman faces as a reward function the *same* value per extra kilogram of cod and does not have incentives to distort non-observable harvest behavior by following any of the socially inefficient but privately profitable exploitation paths described in Section 2.1.

Probably far more significant in the magnitude of its induced inefficiency losses than the pure-timing rigidity is the general inherent inability of a quantity-based *ITQ*-like system to achieve efficiency in situations with multiple interrelated outputs, which is such a characteristic innate feature of most fisheries. The inevitable mismatch of more-or-less rigidly-fixed quota proportions with rapidly unfolding new information in an industry where actual catch proportions are to a significant degree stochastically determined, and far from fully controllable in the first place, represents a serious generic inefficiency of all multi-species *ITQ* fishery systems. It is critical that this set of issues be fully understood in any discussion of whether it is “better” to construct a fisheries management/regulatory system built around quantity-like market-based instruments or, alternatively, built around price-like market-based instruments. The same issues arise in every management/regulatory context, and so it should be explained what are the special management/regulatory features of fisheries, which predispose them to being better managed or regulated by price-like instruments rather than by quantity-like instruments – that is, by fees rather than by quotas.

The Icelandic Minister of Fisheries (*MOF*) currently sets annual *TACs* on some dozen fish (including mollusk and crustacean) species. These species interact with each other ecologically in significant and complicated ways, most of which are poorly understood. As just one class of examples among several, some of the dozen listed species eat others of the dozen listed species, or compete, directly or indirectly, for jointly shared food or other resources. The interactions become even more complicated, and the overall degree of externality-like-interaction is even greater, from a fisheries-management perspective, because now the poorly-understood ecological externalities are compounded by adding on a whole extra layer of

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<sup>12</sup> For example, *ITQ*-like sulfur-dioxide emissions trading systems do not exhibit any time pattern of concentrated “dumping” of pollution because it is not allowed and it is readily detected.

complicated fishing-fleet considerations about fish location, fish density, species co-mingling, seasonal variability, fishing gear selectivity, by-catch practices, processing considerations, marketing considerations, and so forth and so on. Thus, *any* open-seas Fisheries Management System (*FMS*) faces an extremely complicated regulatory problem, whichever instruments it uses.

Some “property-rights-based” fisheries economists argue that, once an *ITQ/TAC* system is institutionalized, the owners of *ITQs* can pretty much be counted on to set the *TAC* themselves more or less efficiently in practice, because they own the “property rights to harvesting.” However, this argument is controversial. To the extent that this argument is true, it could equally be argued that the “property rights to a share of fish landings” will induce the population of *RDC* shareholders to put pressure on their managers to set the *RDC* rates more or less efficiently in practice. Both symmetric arguments rely on the “reduced form” that the “property owners” will exert pressure to move toward maximum long-term rents. Both symmetric arguments are simplistic when applied in undiluted full strength to the complexities of the real world, although both arguments may well contain an important germ of truth.

In our view, what has happened in Icelandic and some other fisheries is that “property rights theory” has been misused in a one-sided, asymmetric, and unfair way to sanction one particular form of many possible “property rights” – namely the “harvesting property rights of the boat/quota owners.” “Property rights theory” can equally logically be used to sanction the “landing property rights of the national owners of the fisheries stocks” and to support their landing rights to *RDC* harvest payments, administered on their behalf to maximize long-term rents by their trustee managers, the *OMFC*.<sup>13</sup>

At this point in the argument it is critical to understand the extraordinary close connection between an *FMS* using *ITQ/TAC quantity*-like instruments and an *FMS* using *OMFC/RDC price*-like instruments. In the current Icelandic *ITQ/TAC*-based system, the marginal fisherman trying to make a decision about whether or not to enter or exit the fishery does not really care about the *TAC* per se. The marginal fisherman cares only about the bottom-line charge-per-kilogram-of-fish-species. The

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<sup>13</sup> “Information” and “incentive” considerations are as indecisive here in resolving which of the two forms embodies the better property right as they are in resolving the famous unresolved question: “Who performs better – publicly-traded companies with managers hired by shareholders or privately-held manager-owner companies?” There is no convincing theoretical or empirical evidence of one form being better managed than the other.

*ITQ/TAC*-based *FMS* essentially influences individual fishing decisions through the extra charge that must be paid (or received) on the margin for catching one more (or less) kilogram-of-fish-species. The bottom-line charge-per-kilogram-of-fish-species might be called the “reduced form” or the “sufficient statistic” for making individual fishing decisions because this is the only part of the *ITQ/TAC* regulatory system that is relevant for influencing the fisherman’s decisions on the margin. Note, therefore, that the *OMFC/RDC* system is essentially the same *FMS* as the *ITQ/TAC* system, with the only difference being that the *OMFC* fixes the charge-per-kilogram-of-fish-species more directly, by setting the *RDC*. There are not any of what might be called “fundamental” differences, such as basic differences in informational requirements or incentives to invest, between the two systems. A significant conclusion of this line of reasoning, which is but a particular application (to the fishery) of a general economic proposition tracing back in intellectual history to Adam Smith’s invisible hand idea (sometimes called the “second fundamental theorem” of welfare economics (there are only two)), takes the following form here (Weitzman, 1974): In a world of continuous adjustments (where the *MOF* adjusts the *TACs* daily and/or the *OMFC* adjusts the *RDCs* daily), both types of *FMSs* are essentially identical because the only part the fishermen notice, or are interested in, or that influences their decisions, is the reduced-form sufficient statistic of the charge-per-kilogram-of-fish-species. Furthermore, looking at the other side of the coin, the reduced-form sufficient statistic for both of the fisheries managers (the *MOF* and the *OMFC*) is the value of long-term rent-returns that are being generated. The *MOF* (*OMFC*) need only think in terms of adjusting the *TACs* (*RDCs*) in the direction of increasing long-term rent-returns, and in both cases the myopic increasing of long-term rent-returns leads automatically to the optimal overall multi-species management subject to the best information available to society.

So, the two *FMSs* are essentially identical in a world of continuous adjustments. Nothing in what follows should detract from the “big truth” that at the usual high level of abstraction in which economic analysis is typically conducted the two systems are isomorphic. To a “first order” approximation, then, there are no differences between the two market-based *FMSs*. What follows is a discussion of some “second-order” effects that, in our opinion, make the *OMFC/RDC* system be superior to the *MOF/(ITQ/TAC)* system for the multi-species fishery; *how much* superior is an empirical question.

Given the equivalence of the two systems in a continuous-regulatory ideal world, the next big question is: What happens in a world with discrete regulatory periods of finite length (in this example *one year* for the *MOF/(ITQ/TAC)* system and *one month* for the *OMFC/RDC* system)? It is in this much more realistic context of a discrete-period lagged-regulatory-adjustment world that the differences between quantity-like instruments and price-like instruments make themselves felt, and, for the particular case of open-seas fisheries, it turns out that the price-like instrument is more efficient than the quantity-like instrument (Weitzman, 2002). Let us see how.

Viewed as a regulatory-management problem, what are the unique distinguishing characteristics of open-seas fisheries regulatory-management that are different from other forms of regulatory-management, like, say, controlling sulfur-dioxide emissions?

There are four unique characteristics of open-seas fisheries not shared to anywhere near the same degree by any other regulatory-management context in the world today.

1. The *first* is the extraordinary difficulty of observing and monitoring what is actually happening hour-to-hour or even day-to-day on a fishing trawler located some 200 miles offshore. An inspector cannot effortlessly and instantaneously just “drop in,” as if he or she were visiting unannounced a coal-burning sulfur-dioxide-emitting electricity generating plant in Chicago, Illinois, or the gigantic asbestos-refining plant at Thetford Mines in Quebec.
2. The *second* unique characteristic of open-seas fisheries is the large number of outputs being jointly regulated or managed and the extreme degree of interdependence among their cost and production functions.
3. The *third* unique characteristic, related to the second, is that these complicated, interdependent fisheries cost and production functions shift and change very rapidly, so that even a one year regulatory-management implementation period locks the *FMS* instruments into lagged quasi-fixed settings that may be highly non-optimal by the end of the period.<sup>14</sup>
4. The *fourth* unique characteristic of offshore fisheries is the fundamental technological inability of fishermen to control exactly the “product mix” of jointly produced species caught, even under the best of circumstances.

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<sup>14</sup> There can be a very large amount of change and variability that occurs over the course of one year in high-seas fisheries. In fishing communities throughout the world is heard the refrain: “A year is a long time for a fisherman.”

Taken together, unique characteristics *two* and *three* above mean that an offshore fisheries regulatory-management instrument fixed on September 1 of one year is highly unlikely to be an optimal instrument setting on September 1 of the following year. In other words, the incentive effects of the lagged quasi-fixed instrument settings on fisheries operations *during* the one year implementation period, lasting from September 1 to August 31, is likely to be of major importance in judging the overall efficiency of a *FMS*. When unique characteristics *one* and *four* are added to *two* and *three*, the implications for *FMS* design turn out to be striking.

The *MOF (OMFC)* sets *TACs (RDCs)*, of course, *before* the beginning of the implementation period (one year starting September 1 for the *MOF* or one month starting on the first day of the month for the *OMFC*). At those times, it is not yet known what will be the relevant fish stocks, fish densities, species co-mingling effects, migration patterns, cohort structures, recruitment rates, and so forth that will apply *during* the fishing implementation period, *after* the *TACs (RDCs)* have already been fixed. But by the time the implementation period is underway, with the *MOF/(ITQ/TAC)* system any possible efficiency-increasing economic response by the fishing industry to the new conditions that emerge during the implementation period is blocked, because the rigid quota proportions have already been fixed.

The quantity-based *ITQ-type FMS* in place in Icelandic fisheries is undoubtedly more efficient than a straightforward *IQ-type FMS*, just as a straightforward *IQ-type FMS* is clearly more efficient than a free-access uncontrolled system. However, the quantity-based *ITQ-type FMS* is a less efficient alternative than an *RDC-type* system on straightforward “prices-vs.-quantities” lagged-regulatory-instrument grounds. With its quasi-fixed-proportions in quantities, an *ITQ-type FMS* does not allow clean ex-post substitution between species, so any information about fish species relative abundance or scarcity that is revealed *during* the plan implementation period cannot be used to major advantage to improve economic efficiency *during* this period.

The *MOF/(ITQ/TAC)* system in Icelandic fisheries today is a regulatory-management system that, in essence, is based upon the idea of imposing a dozen different output quotas, in more or less rigidly fixed proportions, on a dozen or so different products, jointly produced in an industry with a weakly controllable output mix, having highly interdependent cost and production functions that shift rapidly and unpredictably over time – and whose agents’ behavior in adjusting the actually produced output mix to the quasi-rigid quantity quotas cannot be observed. For such a

situation, a quantity-based control system seems to us to be the wrong design principle. Whenever the initial quantity commands turn out to be wrong, as they always do (both because of the inherently uncertain nature of fishing joint production and also because something important will have changed in the fisheries environment during the implementation phase), then the efficiency losses under an *ITQ* system are liable to be quantitatively significant because this relatively rigid quantity-command system cannot self-correct itself sufficiently well throughout the implementation phase. By contrast, a well-designed *RDC* system seems to hold out the promise of being more forgiving of planning mistakes made in the ex-ante instrument-setting phase, by building in the automatic flexibility of a self-corrective mechanism operating throughout the ex-post implementation period. With this price-based system, if, during the implementation period, it turns out that a particular fish species is more (less) abundant and costs less (more) to catch than was anticipated in setting the plan instruments, the fishermen will automatically and smoothly react to the new information by catching more (less) fish than was originally anticipated in the plan.

The superiority that we claim for an *FMS* based on fees rather than quotas under ecological uncertainty can be traced to the fundamental principle that states that price signals can compress into a simple reduced form all information that is relevant for inducing efficient decentralized decisions. By using flexible landing fees that can be revised from month to month rather than rigid harvesting quotas that are set for a year at a time, the fishery manager obviates or shunts aside the need to know the actual recruitment of fish stocks, and hence how much fish it is reasonably safe to catch without jeopardizing the stocks. The only use to the fishery manager of knowing recruitment under ecological uncertainty is that it makes it possible to set accurately the catch quota that will attain the desired escapement. The knowledge of recruitment stocks and the determination of quotas are two complementary means to the single end of hitting accurately an escapement target. By imposing an optimal landing fee, however, the fishery manager can automatically induce the fishermen to attain the desired escapement level most rapidly regardless of the actual recruitment (for proof, see Weitzman, 2002). Such compression of relevant information into a single sufficient statistic is the hallmark of an efficient price system: regulation by price rather than by quantity enables the fishery manager, as it were, to see through the uncertainty about recruitment. In the presence of ecological uncertainty, therefore, it is more efficient to control marginal fishing effort, which is what the fee accomplishes

indirectly, than to control the catch directly by quota. The fact that fish stocks are highly variable – ecological uncertainty, in other words – is, therefore, not a valid argument for preferring quotas to fees, as is often claimed. On the contrary, we see in pure ecological uncertainty a powerful argument for the superiority of landing fees as a regulatory instrument over harvesting quotas. This is important because ecological uncertainty is widely – and, we believe, correctly – perceived as the single most important type of uncertainty confronting fishermen.

How would *economic* uncertainty – for example, uncertainty about the shape of the profit and cost functions – influence our conclusion? This we do not yet know for sure. Even so, we can offer the following conjecture. While pure ecological uncertainty favors fees over quotas, for the reasons suggested above, pure economic uncertainty does not necessarily do so: the scales could tilt either way, depending on the shape of the profit and cost functions, among other things. If the profit and cost functions are relatively flat, i.e., if variations in fish stocks have only a minor impact on costs and profits, then quotas may have the upper hand. If, on the other hand, the profit and cost functions are relatively steep, meaning that costs and profits are quite sensitive to variations in stocks, this would tend to favor fees over quotas. Therefore, for quotas to dominate fees in the presence of both types of uncertainty, ecological uncertainty would have to be relatively less important than economic uncertainty *and* costs and profits would have to be relatively unresponsive to changes in fish stocks.

#### 4. Conclusion

The *ITQ* system is the predominant market-based system in fisheries today not by virtue of any inherent properties of maximum efficiency. The widespread use of the *ITQ* system is merely, in our view, the far-from-final outcome of a natural historical evolution, not the result of any design that has been well thought out from first principles. The first-generation immediate reaction to the “tragedy of the commons” is to limit access in one way or another by imposing some kind of quota-like restriction – on something. The second-generation *ITQ* solution comes from realizing that if people are allowed to trade output quotas, then the *TAC* will be produced efficiently in the long run, *i.e.*, at least cost. The preference for a permit system at this point in history is based upon nothing deeper than the low transition costs for most parties.

The third-generation *RDC* solution that we advocate comes from realizing that the second-generation system relies on a regulatory-management vector of quantity instruments that is essentially inefficient *within* the (very-long-for-fisheries) one-year implementation period for the multi-species high-seas fishery, and that a relatively-superior-overall *FMS* for delivering macro- as well as microeconomic efficiency, equity, minimal government interference, and maximum operating transparency can be attained by coming at the problem afresh from the price side. This is preferable to trying to patch up an inherently more rigid, and therefore inherently inferior, command planning system that attempts to control a dozen highly interrelated, highly uncertain, and inherently difficult-to-control jointly-produced outputs, whose production is not observable, by fixing quasi-rigid output quotas over the course of a year, which is a very long time for such a rapidly changing and inherently uncertain industry as high-seas fishing.

But just as it was initially difficult to convince the first generation that some kind of quota system, which they did not know or understand, was better than a no-quota system, which they did know and were accustomed to, and just as it was initially difficult to convince the second generation that an *ITQ* system, which they did not know or understand, was better than a rigid quota system, which they did know and were accustomed to, so now the third generation will at first display the same kind of initial resistance to accepting that an *RDC* system, which they do not know or understand, is better than an *ITQ* system, which they do know and are accustomed to. This implementation problem is compounded by two others: (a) the fact that the replacement of an *ITQ* system by an *RDC* system involves the abolition of an indirect subsidy, a prospect that is not likely to attract the politically influential fishing industry of Iceland, or elsewhere for that matter, to the socially optimal solution and (b) there is, as yet, no direct empirical evidence of the superior efficiency of the *RDC* system that we claim on theoretical grounds, for the simple reason that no-one has yet tried it out on a large scale. The only way to find out is to try.

While Iceland may be the only country in the world where fisheries management is a macroeconomic issue due to the fishing industry's weight in the national economy, other nations and regions nonetheless have much to gain from reforming their *FMSs*. Around the world, the *FMS* norm at present is either free access, which spells disaster, or simple *IQ*-type systems with all the local inefficiencies and inequities that they entail. The Common Fisheries Policy of the *EU* is a case in point. Consider the

following historical parallel. For more than a decade following the end of the Second World War, bank credit and foreign exchange in several European countries were rationed at below-market prices, a practice that survives in some developing countries to this day. The Europeans did not address the inefficiencies and inequities involved in the rationing of credit and currency by encouraging trade in subsidized allotments (there was no need for such encouragement, for there was a black market). Rather, they decided after a while that allocating domestic credit and foreign currency by price was a better idea, thereby removing the implicit subsidy that had previously accrued to those who had enjoyed special access to the banks. Our proposal for more equitable and more efficient fisheries management in Iceland, Europe, and around the world is put forward in the same liberal, free-market spirit.

**Addendum**

## Glossary of acronyms used

FMS	Fisheries Management System
IQ	Individual Quota
ITQ	Individual Transferable Quota
MOF	Minister/Ministry of Fisheries
OMFC	Open Market Fisheries Committee
RDC	Resource Depletion Charge
RDF	Resource Depletion Fund
TAC	Total Allowable Catch

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