Competitiveness within the Global Fisheries

Proceedings of a conference held in Akureyri, Iceland, on April 6-7th 2000

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University of Akureyri
Akureyri 2003

This publication is produced by the Faculty of Natural Resource Sciences at the University of Akureyri

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ISBN ISBN 9979-834-26-9

Typeset and printed in Iceland
Alprent
Akureyri , Mars 2003

Contents

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Introduction

For Iceland the question of competitiveness and efficiency in fisheries is not a question of rhetoric and theory, but one of survival. Fishing and fish processing earns about 50% of all export revenue (including goods and services) for the nation and the fishing industry is the single most important industry in the whole economy.

The Faculty of Fisheries Studies (now the Faculty of Natural Resource Sciences) at the University of Akureyri organized a conference on competitiveness in fisheries in April 2000. The objective of the discussion was to ask questions about how well the Icelandic fishing industry will fare in the ever-increasing competition characterising today's global economy. Several foreign speakers from academia, industry and government institutions were invited to give talks at the conference in order to map out current and future issues for the global fishing industry. Local speakers were also invited to present the Icelandic perspective on those issues, and to provide some ideas as to how the Icelandic fishing industry should develop in the future.

The speakers covered various fields, such as biology, oceanography, economics, public policy business, research and technology. Despite the diverse background of the speakers they all shared the same common thread in their talks; competition will increase in the future, and hence the Icelandic fishing industry must become more competitive if it is to continue to be a major backbone of the Icelandic economy.

Dr. Daniel Pauly and Dr. Gunnar Stefánsson gave talks on the impact of fisheries on fish stocks. Both argued that fishing mortality must decrease in order to protect, and later increase, fish stocks. Both argued that more drastic measures need to be taken in order to reduce fishing mortality in the North-Atlantic. The picture given is that future catch will have to decline under the current fisheries regime. One of Dr. Pauly´s main points was also that the fisheries affect not only the targeted species but the ecosystem as a whole. Marine food webs are quite complex and reducing one component results in cascading effects through the whole food web. This means that the ecosystem as a whole might be changed by overexploiting just one or only a few of its species.

A slightly different view was presented in the paper by Dr. Steingrímur Jónsson. Dr. Jónsson spoke on physics and fisheries, focusing on the oceanographic forces in the north Atlantic. His main point was that the environment sets the baseline for the size of the fish stocks, although the fisheries themselves also have a strong impact. He pointed out that the ocean climate in Icelandic waters has increasingly been influenced by warmer and more saline Atlantic waters. This will affect primary food production in Icelandic waters, possibly providing more nutrition for fish stocks to grow on. However, he also stressed the fact that due to the complexity of the marine environment future developments are highly uncertain.

The conclusion from these papers is that stocks can only be rebuilt if fishing effort is greatly reduced. How to reduce it is of course the main problem and a source of vigorous debate all around the world. We can only hope that this debate will not go on forever as Dr. Stefansson pointed out, since for many stocks just about any action to reduce fishing effort is better than doing nothing. However, optimism has also a place in marine science, since given the recent trends in oceanic conditions around Iceland some important fish stocks might rebuild faster than previously predicted.

But more fish might not be enough. Several speakers pointed out that the increase in fish farming will directly affect the competitiveness of fisheries. Dr. James L. Anderson and Dr. Karl Almås spoke on the issue of aquaculture and fisheries. Almås discussed how research and development helped to make the Norwegian aquaculture industry one of the biggest industries in Norway, and the largest aquaculture industry in Europe. But he also pointed out that there is still room for growth in the Norwegian aquaculture industry, even on such a scale that it could replace declining revenues from Norwegian oil exports. Dr. Anderson continued on the same note. He argued that the global aquaculture industry will grow substantially over the next decades, and even went so far as to say that the aquaculture industry will strengthen its comparative position against wild fisheries. Thus both speakers argued that fishing industries will face tougher competition from the aquaculture industry in the near future.

Matteo J. Milazzo reviewed the major concerns with respect to trade and subsidies in fisheries. He pointed out that several key issues relating to conservation measures and trade restrictions must be solved in the next negotiating round at the World Trade Organization. If agreement is reached on those issues, world trade in seafood products will directly affect fisheries management and conservation policies.

The distorting influence of subsidies and trade restrictions should be minimized, or at least made transparent, which in turn will make the global seafood trade more competitive, but will also open up new opportunities for the marketing of seafood (and aquaculture) products.

So how will the Icelandic fishing industry fare in this more competitive world of global seafood trade. Several Icelandic speakers spoke on the Icelandic fisheries, with respect to fisheries management, fishing technology and business. Dr. Rögnvaldur Hannesson and Dr. Ragnar Árnason examined the Icelandic fisheries management system. Dr. Hannesson noted that Icelandic fisheries are more productive than those of neighboring countries, but that this may be due to luck rather than wisdom. He noted that the Icelandic quota system must be strengthened if the industry is to be one of the driving forces for the Icelandic economy. He further argued that collection of fishing rent might be necessary in order to

increase the public acceptance of the quota system, and that politicians could use the rent to increase efficiency in other areas of the economy, maybe by reducing other taxes or creating investment incentives, thus allowing the fishing industry to remain the mainstay of the Icelandic economy.

Dr. Árnason examined productivity and productivity growth in the Icelandic fisheries. He noted that productivity growth in Icelandic fisheries is much higher than in neighboring countries. He observed that this could be due to several factors, the most plausible ones being better management of fishing companies and improvements in the fisheries control system, notably the implementation of private property rights in the fisheries. Though further research is needed to test this hypothesis, both Dr. Árnason and Dr. Hannesson agree that the current fisheries management system is an important factor in determining the competitiveness of the Icelandic fishing industry, today and in the future.

Guðbrandur Sigurðsson, the managing director of one of the largest fishing companies in Iceland, reviewed the dramatic changes that have occurred both within the fishing industry and in the environment which it operates in. He also predicted that further changes will occur, specifically referring to increased importance of aquaculture and that traditional fishing companies might change over to aquaculture in the future.

Ólafur Halldórsson, a pioneer in halibut farming expressed similar views. He stressed the growing importance of aquaculture and the need to invest in more research in that field. Aquaculture is a long-term commitment requiring substantial funds for research and development.

Einar Hreinsson and Dr. Hjörleifur Einarsson discussed the use of technology in fishing and fish processing. Mr. Hreinsson pointed out that it is inevitable for the industry to seek new ways to fish, both in terms of economic efficiency and the ecological effects of fishing gear. Dr. Einarsson also made the point that we do not add value by fishing. Value adding is achieved through the marketing and selling of fish products. The whole process from fishing (or aquaculture) to marketing fish products must always be under scrutiny. Value adding has not increased over the years in the Icelandic fishing sector and it is known that catch will not increase substantially. Hence, to stay competitive in the future the Icelandic fishing industry must focus on harvesting and processing technologies in order to gain more efficiency.

All of the speakers at the conference painted a similar picture of the future for the world fishing industry; it will become more globalized and competitive. It is therefore of crucial importance for the Icelandic fishing industry to prepare itself and be able to compete in this new world. This means thinking about old problems in new ways, and being prepared to tackle new problems. We must therefore educate future fisheries managers in matters relating to aquaculture and globalization so that they can set the right course for the Icelandic fishing industry in the future.

This conference helped bring about changes in the Faculty of Fisheries Studies. The faculty now includes biotechnology and aquaculture as formal study programmes and course offering within each program has been streamlined towards more specialization for the students. It is our belief that these changes will provide the Icelandic fishing industry with even better managers, and strengthen the future competitiveness of the industry. The conference was an important step in this direction. We thank all our speakers for their contribution towards the new Faculty of Natural Resource Science at the University of Akureyri.

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Papers submitted

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Fishing down the food web: an Icelandic case study

Abstract

'Fishing down marine food webs' (FDMW) occurs when the mean trophic level (TL) of fisheries landings decline over time, reflecting a decreasing abundance of high-TL (predatory) fishes in the underlying ecosystems. The FDMW phenomenon, which implies a lack of sustainability at the ecosystem level, and which has been demonstrated to occur throughout the world, is shown here to exist around Iceland as well. Based on the longest series of standardized catch data ever assembled for Icelandic waters, we show that the mean TL of landings has been decreasing during most of the 20th century as catches of high trophic level species, mainly cod, have declined while the fisheries have moved onto other species, especially small pelagics and invertebrates. Suggestions are presented on how these results may be used for monitoring performance in the context of at transition toward ecosystem-based management.

Fishing down the food web as a global phenomenon

Fisheries evidently must impact on the abundance of the species they target. It is less evident - though increasingly well demonstrated - that fisheries also impact the species they do not target - the by-catch -whether that by-catch is subsequently discarded or not (Alverson et al. 1994). Even less evident - at least to managers accustomed to dealing with single species - is that fisheries also impact species they do not catch, either through habitat modification or through their appropriation of biological production (Pauly and Christensen 1995).

These impacts are among the many reasons why it is now widely agreed that some form of 'ecosystem-based' management of fisheries is in order, even though there is at present, no sign of a scientific consensus as to how to implement such form of management (NRC 1999). It does seem, however, that any consensus on 'ecosystem-based' management will have to include the maintenance, in some form, of the ecosystem in which fisheries resource species are embedded, which itself requires indicators capable of tracking ecosystem states.

Pauly et al. (1998a) suggested that the mean trophic level (TL) of the fish and invertebrate species landed by fisheries provides such an indicator, due to the integrative nature of TL, which correlate with body size (and hence longevity), and which thus link the role played by different species within ecosystems' food webs to their vulnerability to exploitation.

Food webs can be defined in terms of TL:

- algae, at the bottom of the food web have a TL of 1;
- herbivorous zooplankton, which feeds on (microscopic) algae have a TL of 2;
- large zooplankton or small fishes that feed on herbivorous zooplankton have a TL of 3; etc. (Lindeman 1942; Odum and Heald 1975).

Large, long-lived fishes (cod, groupers, etc.), usually have TL s between 3.5 and 4.5, because their food tends to be a mixture of low and high- TL organisms. Thus, fisheries, when removing large fish tend to reduce the mean TL of the fish remaining in an ecosystem, which eventually leads to a trend of decreasing TLs in the landings extracted from that ecosystem, a phenomenon referred to as 'Fishing down marine food webs (FDMW; Pauly et al. 1998a).

Several objections have been raised to the use of mean TL as indicator of the ecosystem impact of fishing (Caddy et al. 1998), and these are addressed in Pauly et al. (1998b) and Pauly and Palomares (2000). One of the objections pertained to the use of the global fisheries statistics created

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and maintained by the Food and Agriculture Organization (FAO) for the demonstration of FDMW: Caddy et al. (1998) felt these statistics, to be too crudely aggregated (in taxonomic terms) to provide a consistent signal.

The answer to this, obviously, is to replicate the exercise in Pauly et al. (1998a) using better, more detailed data, including data starting earlier than the FAO statistics (i.e., earlier than 1950). Pauly et al. (2001) present such analysis for Canadian waters, and also address other issues raised by Caddy et al. (1998), notably the effect of within-species change in TL. Stergiou (2000) presents a similar analysis for Greek waters, while Pinnegar et al. (2002) presented a detailed case study of FDMW for the Celtic Sea.

This contribution replicates Pauly et al. (1998a) for Icelandic waters, i.e., in an area where long time series of relatively reliable catch data existed, or could be straightforwardly reconstructed, and where the management of major commercial species is generally considered successful - at least in comparison with other areas of the North Atlantic.

Hence a demonstration of FDMW in Icelandic waters would both corroborate the generality of the FDMW phenomenon, and indicate the need for management measures reaching beyond ensuring sustained yields of major species. Before dealing with FDMW around Iceland, we must however provide a context in form of a brief review of the relevant fisheries.

Fisheries in Icelandic waters

As in other areas of the North Atlantic, cod (*Gadus morhua*) has always been the most important species in Icelandic waters, although its relative importance has been declining during the later part of the 20th century (fig. 1). Other large gadoids such as saithe (*Pollachius virens*) and haddock (*Melanogrammus aeglefinus*) have also been fished extensively for the whole 20th century by the groundfish fleet, which, in the later part of the century also moved to deeper water to target redfish (*Sebastes* spp.) and Greenland halibut (*Reinhardtius hippoglossoides*). Pelagic fisheries concentrated exclusively on herring (*Clupea harengus*), until its collapse in the late 1960s, which led to capelin (*Mallotus villosus*) and recently blue whiting (*Micromesistius poutassou*) becoming the major species targeted by the pelagic fisheries. Invertebrate fisheries began around the middle of the century, initially based on Northern shrimp (*Pandalus borealis*) and Norway lobster (*Nephrops norvegicius*), the former eventually becoming one of the most valuable fisheries in Icelandic waters. Whaling was quite important for the economy in the first decade of the 20th century, but was much lower after the First World War (WWI).

Foreign boats have always long been fishing in Icelandic waters (fig. 1). Initially, English and German vessels dominated the foreign groundfish fisheries, and Norwegian vessels the pelagic fisheries. However, most foreign fleets were expelled from Icelandic waters as the economic exclusive zone was gradually extended, from 4 miles in 1952 to 200 miles in 1975. Presently, most fisheries around Iceland are under the sole jurisdiction of the country, which thus cannot ignore its responsibility with regard to maintaining the productivity of the stocks upon which much of the economy depend.

Material and Methods

The catch database used here is documented in Valtysson (2002), reaches back to the beginning of the 20 century, and includes catches from the fleets of all countries known to have fished in Icelandic waters (fig. 1).

Each of the species reported in this catch database was assigned a TL, calculated from

$$TL_i = 1 + \sum_{j=1}^{n} DC_{ij} TL_j$$

where i is the predator; j the nth prey; and DC_{ij} is the diet composition, expressing the fractions of each j in the diet of i. Assignment of TL starts with plants and detritus, both with a definitional TL value of 1.

The DC_{ij} and TLj used here were calculated based on diet composition data in Pálsson (1977, 1983) and Anon (1997). The TL of species for which diet information was not available from Iceland was estimated from diet composition from other areas, either for the same or closely related species, with FishBase serving as our main source of information (Froese and Pauly 2000; *www.fishbase.org*).

For all but one species the TL estimates thus obtained are assumed to apply to an average fish, i.e., ontogenic changes of diet are assumed to

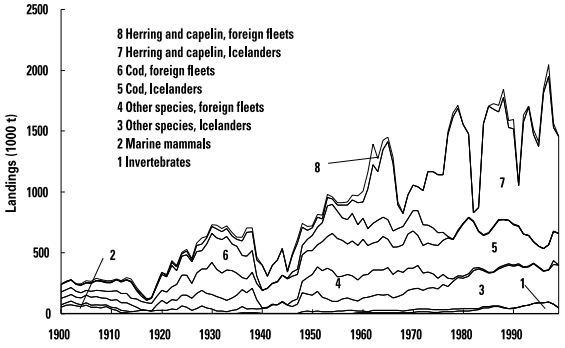

Figure 1: Time series of aggregated landings from Icelandic waters (ICES area Va and Icelandic EEZ) during the 20th century.

have negligible effect on the estimate of TL. For cod, the most important species in Iceland, enough diet composition data (Pálsson 1983) and information on size composition in landings (since 1969) were available for size specific estimates of TL to be computed for comparison. These were then used, along with the TL estimates for other species, to compute annual estimates of mean TL from

$$\overline{TL}_k = \sum_{i=1}^{m} Y_{ik} TL_i \; / \; \sum_{i=1}^{m} Y_{ik}$$

where Y_{ik} is the landings of species i in year k, and TL_{ik} its trophic level.

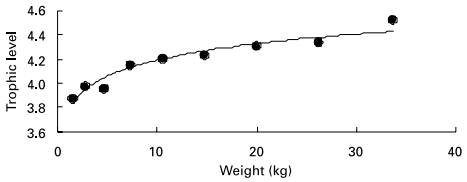

Figure 2: The relationship between trophic level and size of cod.

Results and Discussion

The diet composition data from Iceland used here led to TL estimates (table 1) similar to those derived from diet composition data from other areas (Armstrong 1982, dos Santos and Falk-Petersen 1989; Froese and Pauly 2000, Pauly et al. 2001). Conversely, we assume that the TL estimates we derived from diet compositions from other areas did not bias the results of our analysis. We also note, in passing, that, once body size is accounted for, TL estimates based on diet composition data are similar to estimates based on stable isotope ratios (Kline and Pauly 1998; Pinnegar et al. 2002), and hence do reflect the average position of fish within marine food webs.

Fig. 2 shows how in cod, TL changes with size, this relationship being described by

$$TL = 3.736 + 0.195 \ln(W)$$

where W is the body weight of cod, in g.

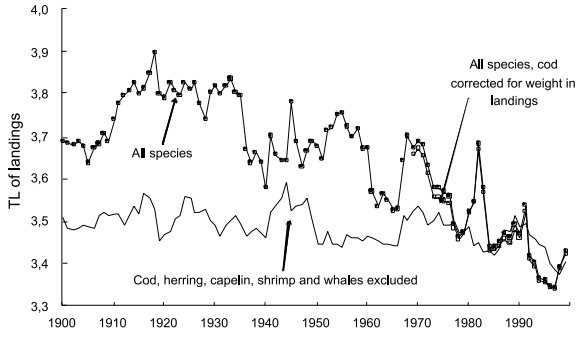

Figure 3: Time series of mean TL of all fisheries in Icelandic waters.

Thus, as increasing fishing mortality reduces mean body size, TL is reduced as well, a feature not considered in Pauly et al. (1998a), but later found not have much impact on observed mean TL trends, which appear more strongly impacted by changes of species composition than by within-species changes of TL (Pauly et al. 2001). Fig. 3 similarly shows that, while the FDMW phenomenon is very marked in Icelandic waters, accounting for change in cod size does not have a major effect on the general trend. This, although it duplicates a similar finding for the coast of Eastern Canada, is a somewhat surprising result. It suggests however, that FDMW is a robust phenomenon, detectable even in data-poor environment. We would however be curious to see if this is also the case with longer time series of size at age data or interannual or between-population differences in diet composition. It will be of interest, for example, to compare years when capelin is abundance with other years, as it has been shown that the growth of individual cod is largely controlled by capelin abundance (Jakobsson and Stefánsson 1998).

Overall, fig. 3 shows an increase in TL in the beginning of the 20th century from about 3.6 until after WWI, then a succession of steps, starting with stability at slightly more than 3.8 in the interwar period, a drop of 0.2 TL units in the mid 1930s, some stability until the mid 1950s, then a more marked decline to the present value of about 3.4. The overall decline for the 20th century is about 0.0036 TL per decade and 0.0053 TL if we consider only the years since WWI.

Table 1: Estimated trophic levels of major exploited species, and of common food groups around Iceland.

Species or group	TL
Seals, Greenland shark	4.6
Greenland halibut, halibut, toothed whales, average cod	4.0
Lings, grenadiers, humpback whale, minke whale, tusk, whiting	3.8
Dogfishes and skates, saithe	3.7
Blue whiting, catfishes, lumpsucker, Norway pout, squid, salmonids, long rough dab	3.5
Haddock, sandeels	3.4
Blue and sei whale, capelin, fin whale, herring, redfishese	3.3
Eelpouts, great silver smelt, chimaeras, misc. flatfishes	3.2
Crabs, Norway lobster, whelk, benthos (other)	2.5
Sea urchins, shrimps, euphausiaceans	2.3
Ocean quahog, scallop	2.1
Polychaets, (detritivorous), herbivorous zooplankton	2.0
Algae	1.0

Trophic levels increased at the start of the 20th century due to decreasing catches of baleen whales, which though large, have the low TL that befits zooplankton feeders (see Table 1). Mean TL after WWI were influenced mainly by the sustained, high catches of cod, a species with a high TL. This changed around 1935 when cod catches declined considerably and the TL of catches subsequently fell. Herring catches are also increasing during this time, further increasing the downward TL trend. The high catches of the large pelagic stocks feeding low in the food web, herring and capelin became the main reason why the TL of Icelandic catches failed to recover their pre-1935 levels. Fluctuating landings of these two large stocks do also largely explain the fluctuating decline in TL after 1955. Herring fisheries became extensive shortly before WWII, and reached a peak in the 1960s, with a corresponding drop in TL. The herring fishery collapsed in 1968 and the TL of catches increased again but dropped again to low levels when pelagic fishers began exploiting capelin. The small TL peaks from 1980 to 1990 correspond to temporary collapses of the capelin stock. Landings of cod have also generally been declining since 1955, further magnifying this drop in TL. Shrimp is the main reason for the declining TL after 1990, but increased landings of other low T.L. species such as green sea urchin (*Strongylocentrotus droebachensis*), ocean quahog (*Arctica islandica*) and various flatfishes also contribute. The shrimp stock expanded in size when predation by the cod was reduced due to low size of the cod stock after 1990. The upward trend in TL after 1998 can largely be attributed to a larger cod stock, both contributing to an increase in cod catches and decline in the shrimp stock and hence shrimp catches.

When the big impact species (cod, herring, capelin, shrimp and whales) are excluded from the analysis we get a fairly stable picture, with the TL of the fisheries fluctuating around 3.5. The exception is a substantial decline in the latest years. These are mainly due to the declining catches of high TL Greenland halibut and saithe as they have been overfished and increasing catches of low TL sea urchin, ocean quahog and flatfishes.

As with other fisheries in the northern regions, the Icelandic fisheries are generally high TL fisheries (Pauly et al. 1998, Pauly et al. 2001). The downward trend in the TL of Icelandic fisheries is, however, a fact. The declining TL level of the Icelandic fishery is a reflection of increasing interest in pelagic species and invertebrate due to new fishing technology, fish processing technology and marketing. However, these are of course driven by restrictions in groundfish catches due to declining stocks. The changes in TL are therefore not pronounced within each fishing boat class [data not shown], but rather reflect changing composition of the fishing fleet and fishing gear used.

It is also noticable that large high TL species such as Atlantic halibut and common skate (*Raja batis*), whose stocks were decimated by overfishing were never common enough to have any significant impact on the overall TL change.

Studies should be conducted on whether the FDMW trends based on catch or landing data under- or overestimate the TL trends in the underlying ecosystems, as can be ascertained from fisheries independent data, notably trawl survey. Pinnegar et al. (2002) found the FDFW trends based on trawl surveys to be stronger than those based on catch data, suggesting that over time, skippers attempt, but eventually fail to maintain high catches of high-TL fishes. This interesting result still needs verification from other areas. Close look at the Icelandic trawl survey data, now covering 17 years since 1985 would for example be a good candidate.

The question that remains is how dangerous the FDMW phenomenon is to the ecosystem(s) within which the marine fisheries around Iceland are embedded. Is there some TL/catch combination on the line fitted to the data in Fig. 4 that should be avoided at all cost? Or should alarm bells ring only when the annual data points start moving below that line, i.e., when the TL/catch plot (fig. 4) starts to 'bend backward' (Pauly et al. 1998a), and decrease in TL cease to lead to increasing catches?

Ecosystem collapse have been simulated by Vasconcellos and Gasalla (2001), and occurred at values of TL= 3.2, the same value that occurred when Northern cod collapsed in Eastern Canada, and close to the value for Icelandic fisheries in 1994 to 1996, when the Icelandic cod stock was at the historically lowest level ever (Anon 2001). A further point to consider

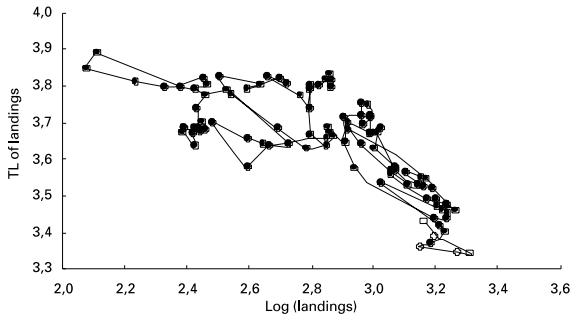

Figure 4: Trophic level of landings (with "average cod") vs log landings, 1995 – 1999 shown with open circles.

regarding this is that despite the fact that the stock size increased somewhat after 1995, the stock was still overestimated by fishery scientists for at least four years in row after 1996. This error was larger than ever before despite quite advanced assessment methods being used and considerable and improved data collection from the fisheries. Perhaps this implies some underlying changes in the entire ecosystem due to overexploitation of the top predators. Clearly, caution is warranted, as are attempt to identify such threshold in similar fisheries (Pauly et al. 2001), notably those of Greenland, Faeroe Islands, northern Norway, which are most similar to those in Iceland.

Acknowledgments

Daniel Pauly acknowledges support from The Pew Charitable Trusts through the Sea Around Us Project, and the Canadian National Science and Engineering Research Council

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James L. Anderson

Aquaculture, Competition, and the Global Seafood Market

Abstract

Aquaculture production is increasingly becoming a significant factor in the global seafood market. This paper considers the factors contributing to the competitiveness of aquacultured seafood products relative to wild-harvested fish. The discussion will focus on production practices, market management, research and development, and government policy.

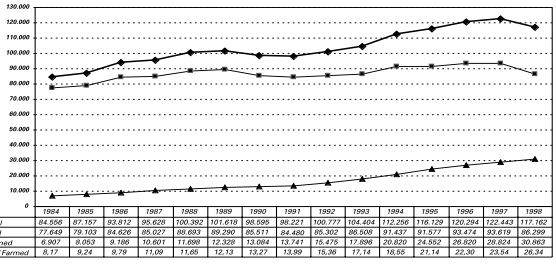
It is concluded that much of the aquaculture sector will experience a strengthening comparative position in the aforementioned areas relative to wild fisheries, and, therefore, will continue to have an increasing influence on the structure and performance of the world's seafood markets.

Introduction

One of the most significant trends influencing the marketing and international trade of fisheries products is the growth of aquaculture. As seen in Exhibit 1, aquaculture's share of world fisheries supply has increased

1,000 metric tons

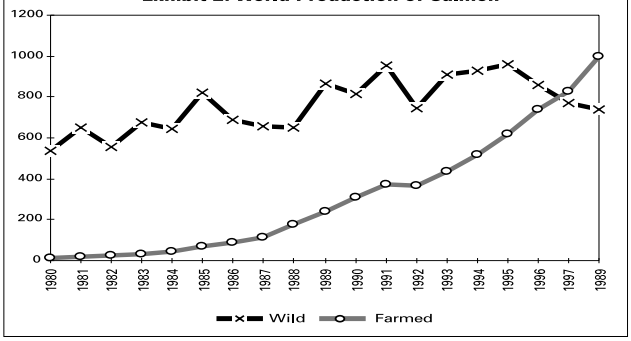
Exhibit 1: World Fisheries Production



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total	84.556	87.157	93.812	95.628	100.392	101.618	98.595	98.221	100.777	104.404	112.256	116.129	120.294	122.443	117.162
Wild	77.649	79.103	84.626	85.027	88.693	89.290	85.511	84.480	85.302	86.508	91.437	91.577	93.474	93.619	86.299
Farmed	6.907	8.053	9.186	10.601	11.698	12.328	13.084	13.741	15.475	17.896	20.820	24.552	26.820	28.824	30.863
% of Farmed	8.17	9.24	9.79	11.09	11.65	12.13	13.27	13.99	15.36	17.14	18.55	21.14	22.30	23.54	26.34

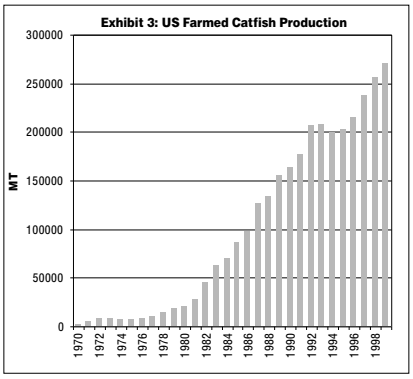
Source: FAO, 1984-2000.

Exhibit 2: World Production of Salmon



steadily over the past two decades. Species such as salmon, shrimp, tilapia, and catfish have all experienced great growth in aquaculture supply. More than one-half of the world's salmon is supplied from the harvest of ocean, pen-raised salmon (Exhibit 2). The salmon industry is unlikely to ever again see the traditional fishery as the dominant supplier. Farmed catfish production in the U.S. has grown steadily for three decades, making Mississippi one of the largest fish producing states (Exhibit 3).

Exhibit 3: US Farmed Catfish Production



The growth of aquaculture is also evidenced in changes in U.S. consumption trends. As shown in Exhibit 4, salmon, catfish, shrimp, Alaska pollock, and crab have experienced increased per capita consumption since 1987. For salmon, shrimp, and catfish, the

Exhibit 4: Top 10 Seafoods Consumed in the US (edible kg per capita): 1987 vs. 1999

Number	1987		1999		% Change
1	Tuna	1.59	Tuna	1.59	0%
2	Shrimp	1.04	Shrimp	1.36	31%
3	Cod	0.76	Salmon	0.77	285%
4	AK Pollock	0.40	AK Pollock	0.71	78%
5	Flatfish	0.33	Catfish	0.53	96%
6	Clams	0.30	Cod	0.35	-54%
7	Catfish	0.27	Crab	0.25	67%
8	Salmon	0.20	Clams	0.21	-30%
9	Crab	0.15	Flatfish	0.18	-45%
10	Scallops	0.15	Scallops	0.09	-40%
	Total	7.35	Total	6.95	-6%

Source: NFI: 1988, 2000

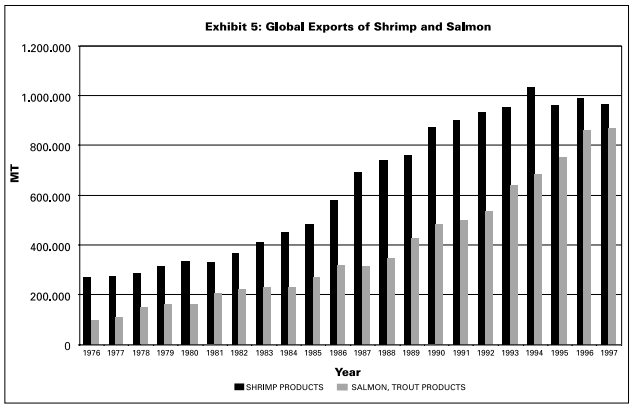
growth is explained almost entirely by aquaculture. The current growth in crab harvest is realized by utilizing catch from the waters in Thailand, Indonesia, and Venezuela, which were sparsely used previously, and from increased imports from Canada, Russia, and China. Growth in Alaska pollock is explained by increased harvest in the North Pacific. Note that the species based on traditional fisheries, such as: cod, flatfish, clams, and scallops, have experienced decreased consumption.

Although there is considerable growth in aquaculture of low-valued species such as carp in places like China, much of the growth in aquaculture is in high-valued species, which are destined for international trade. This is particularly true of shrimp and salmon (see Exhibit 5). Anderson and Fong (1997) estimated that over three-quarters of the salmon and two-thirds of the shrimp entering international trade are from aquaculture.

So, what explains this growth? Will it continue? How are regulators influencing aquaculture? What advantages does aquaculture have over traditional fisheries? What advantages does the traditional fishery have over aquaculture?

Production Costs

First, consider the cost structure and trends for fishery products.



Aquaculture

Estimated production costs (round weight) for Atlantic salmon grown in Norway (farm cost US$2.43/kg) and Chile (farm cost US$1.91/kg), the dominant producers, are shown in Exhibit 6. Clearly, feed is the most significant component of production at 52% (± 4%) of costs in Norway and 48% (± 4%) in Chile. This is followed by the cost of smolts, 15% (± 3%) in Norway, and 12% (± 3%) in Chile; and labor, which is 9% (± 3%) in Norway and 4% (± 2%) in Chile. When processing costs are added, the estimated cost for fresh, head-on, dressed Atlantic salmon is US$2.98/kg in Norway and US$2.71/kg in Chile.

What is more remarkable is how costs for farm-raised Atlantic salmon declined in the 1990s, as shown in Exhibits 7 and 8. For example, in Norway, direct production costs (in real terms, base year 1997) declined 68%, from 47.43 NOK/kg (US$5.52/kg) in 1985, to an estimated 15.39 NOK/kg (US$1.97/kg) in 1999. (Norwegian Directorate of Fisheries 2000). Many factors explain this decline, including: 1) better feed and feed management; 2) economies of scale; 3) reduced smolt costs; 4) improved genetic stock; and 5) reduced mortality and incidence of disease through use of vaccines and better veterinary practices. These cost-reducing factors are

Exhibit 6: Cost of Farmed Atlantic Salmon Production Item

	Chilean		Norwegian	
	$/Kg	Cost share	$/Kg	Cost share
Smolts	$ 0,237	12,4%	$ 0,373	15,3%
Feed	$ 0,909	47,6%	$ 1,263	51,9%
Pigments	$ 0,272	14,2%		
Vitamins	$ 0,008	0,4%		
Medication and Fish Health	$ 0,021	1,1%		
Labor	$ 0,083	4,3%	$ 0,224	9,2%
Insurance	$ 0,030	1,6%	$ 0,032	1,3%
Maintainance	$ 0,048	2,5%		
Finance/Interest Charges	$ 0,065	3,4%	$ 0,103	4,2%
Others	$ 0,025	1,3%	$ 0,355	14,6%
Total Direct Production Cost	**$ 1,698**	**88,9%**	**$ 2,350**	**96,6%**
Operation/Overhead	$ 0,120	6,3%		
Depreciation	$ 0,093	4,9%	$ 0,082	3,4%
Transportation of Harvest to Plant	$ 0,074	3,9%	$ 0,025	1,0%
Farm Cost (Round Weight)	**$ 1,985**	**100,0%**	**$ 2,457**	**100,0%**
Head-on Yield 91%	$ 2,181		$ 2,700	
Processing	$ 0,330			
Packaging	$ 0,200		$ 0,309	
Processed Cost (Whole, Dressed, Head-on)	**$ 2,711**		**$ 3,009**	

Source: Bjorndal and Aarland, 1998

being used around the world in the farmed salmon industry, explaining much of the price decline. For more detail on the evolution of the salmon industry, see Anderson (1997).

The estimated costs for U.S. channel catfish are presented in Exhibit 9. Compared to salmon, costs are noticeably lower and more stable, ranging between US$1.15 - 1.60/kg live weight (the lowest cost producers are in Mississippi), but the distribution of cost factors is similar (Engle and Killian, 1997). Feed cost comprises 45% (± 5%) of total production cost, followed by labor 9% (± 3%), and the cost of fingerlings 7% (± 2%). In recent years, the cost of catfish has not dropped noticeably, but production and demand continues to grow (Exhibit 3).

Finally, consider tilapia. This relative newcomer in the market outside of Asia has become a minor, but noticeable, factor in the U.S. market. Tilapia

Exhibit 7: Norwegian Salmon Operating Costs (1997 NOK/Kg)

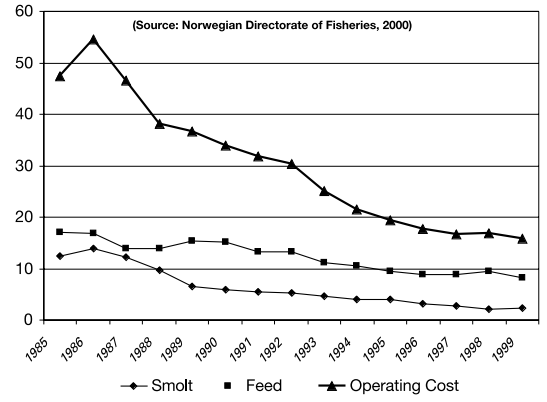


Exhibit 8: Norwegian Salmon Operating Cost Shares

	Smolt	Feed	Wages	Other	
1985	26,1%	36,1%	13,4%	24,5%	100,0%
1986	25,5%	30,9%	13,7%	29,9%	100,0%
1987	26,4%	29,9%	13,4%	30,3%	100,0%
1988	25,5%	36,5%	11,3%	26,7%	100,0%
1989	17,6%	42,3%	10,6%	29,5%	100,0%
1990	17,4%	44,6%	11,4%	26,6%	100,0%
1991	17,0%	41,8%	11,3%	30,0%	100,0%
1992	17,5%	43,5%	11,6%	27,5%	100,0%
1993	18,6%	44,7%	11,0%	25,7%	100,0%
1994	19,0%	49,0%	11,1%	21,0%	100,0%
1995	20,1%	49,0%	9,9%	21,0%	100,0%
1996	17,5%	50,0%	9,6%	22,9%	100,0%
1997	15,9%	53,8%	9,5%	20,9%	100,0%
1998	13,0%	56,5%	9,3%	21,1%	100,0%
1999	15,1%	52,7%	9,2%	22,9%	100,0%

Source: Norwegian Directorate of Fisheries, 2000. (provided by Frank Asche)

Exhibit 9: Costs of Catfish Production

Type of Cost	$/kg (live wgt.)	%/ Total cost
Variable Costs		
Repairs and Maintenance	$ 0,046	3,0%
Fuel(electricity, diesel, gas, oil)	$ 0,059	3,9%
Chemicals	$ 0,002	0,1%
Telephone	$ 0,002	0,2%
Water Quality	$ 0,002	0,1%
Fingerlings	$ 0,106	6,9%
Feed	$ 0,678	44,5%
Labor	$ 0,141	9,3%
Management	$ 0,046	3,0%
Harvesting and Hauling	$ 0,066	4,3%
Accounting/Legal	$ 0,003	0,2%
Bird Scaring Ammunition	$ 0,003	0,2%
Interest on Operating Cost	$ 0,095	6,2%
Total Operating Costs	**$ 1,248**	82,0%
Fixed costs		
Depreciation		
Ponds	$ 0,040	2,6%
Water Supply	$ 0,015	1,0%
Office Building	$ 0,002	0,1%
Feed Storage	$ 0,001	0,1%
Equipment	$ 0,092	6,0%
Interest on Investment		
Land	$ 0,055	3,6%
Pond construction	$ 0,022	1,5%
Water Supply	$ 0,009	0,6%
Equipment	$ 0,034	2,2%
Taxes and Insurance	$ 0,005	0,3%
Total Ownership Costs	**$ 0,275**	18,0%
Farm Cost (Round Weight)	**$ 1,523**	100,0%
	Range in US ($ 1.15-$ 1.60)	
Yield: Live to Head-off: 60%	$ 2,538	
Processing/Packaging $ 0,800		
Processed Cost (Whole, Dressed, Head-off)	**$ 3,338**	
	Range in US ($ 3.15-$ 3.70)	

Engle, C. and H.S. Killian, 1996

Exhibit 10: US Imports of Tilapia

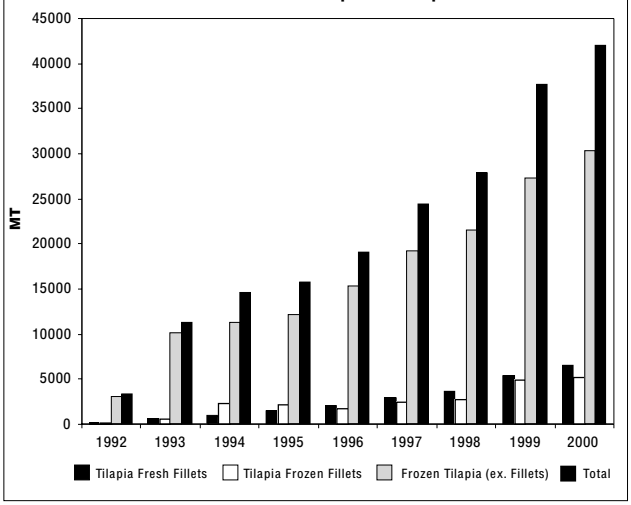


Exhibit 11: Costs of Tilapia Production in Honduras

	US$/Kg (Live Wgt.)	% of Total Cost
Variable Cost		
Fingerings	$0.02	1.4%
Feed	$1.10	64.6%
Labor	$0.11	6.2%
Other Variable Costs	**$0.22**	**12.7%**
Total Variable Costs	**$1.45**	**85.0%**
Fixed Costs (15% of total costs)	**$0.25**	**15.0%**
Total Costs	**$1.70**	**100.0%**
Range in S. & C. America	**($1.20-$1.80)**	
Range in US	**($1.60-$5.00)**	

Source: Green and Engle 1999

is generally raised in warm regions around the world, primarily in Asia, but the industry is growing rapidly in places such as Costa Rica and Ecuador, as indicated by exports to the U.S. (Exhibit 10).

Cost estimates for this species are more uncertain. Estimates for Honduras suggest that costs are about US$1.70/kg live weight (Exhibit 11) (Green and Engle, 1999). However, industry sources indicate costs in Central and South America are generally lower, ranging between US$1.20 - 1.80/kg. As seen in Exhibits 12a & b, U.S. costs for raising tilapia are generally notably higher--around US$1.60/kg - 4.00/kg (live weight). Due to high cost, the only viable market for most of the U.S.-grown tilapia is the live market, primarily ethnic markets.

The estimates show that the dominant cost for producers in warmer

Exhibit 12a. Costs of Tilapia Production from Recirculating 23,900 Kg System in Illinois

	US$/Kg (Live Wgt.)	% of Total Cost
Variable Cost		
Fingerings	$0.26	6.84%
Feed	$0.84	22.11%
Employee Wages	$0.48	12.63%
Oxygen	$0.40	10.53%
Water	$0.17	4.47%
Electricity	$0.43	11.32%
Maint. & Repairs	$0.26	6.84%
Miscellaneous	$0.04	1.05%
Interest Expense	$0.32	8.42%
Est. Operating Expense	$0.09	2.37%
Subtotal	$3.29	86.58%
Fixed Costs		
SL Depreciation	$0.45	11.84%
Fees & Licenses	$0.00	0.00%
Insurance	$0.04	1.05%
Property Tax	$0.02	0.53%
Subtotal	$0.51	13.42%
Total Cost	**$3.80**	**100.00%**

Source: O'Rourke, 1999

Exhibit 12b. Costs of Tilapia Production from 590,000 Kg Recirculating System in NY

	US$/Kg (Live Wgt.)	% of Total Cost
Variable Cost		
Fingerings	**0.1**	**6.17%**
Feed	**0.55**	**33.95%**
Employee Wages	0.19	11.73%
Oxygen	0.14	8.64%
Water	0.02	1.23%
Electricity	0.16	9.88%
Maint. & Repairs	0.17	10.49%
Miscellaneous		
Interest Expense		
Est. Operating Expense	0.07	4.32%
Subtotal	$1.40	86.42%
Fixed Costs		
SL Depreciation	0.14	8.64%
Fees & Licenses		
Insurance	0.07	4.32%
Property Tax	0.01	0.62%
Subtotal	0.22	13.58%
Total Cost	**$1.62**	**100.00%**

Source: Timmons, 2000

climates is feed (65% in the systems in Honduras), as is the case with catfish and salmon. However, in intensive recirculating systems, feed costs are only 21-34%, due to the high cost of system inputs, such as: oxygen, electricity, depreciation, and interest. It should also be noted that no sizable intensive recirculating systems for finfish as food have proven successful over the long-term in the U.S. Experience with recirculating systems for trout, salmon, hybrid striped bass, shrimp, and summer flounder is replete with failure. Recent cost estimates for recirculating system summer flounder aquaculture indicate breakeven prices in the range of US$14.00/kg for live fish (Zucker and Anderson, 1999).

Tilapia growers and others raising alternative species will likely benefit

Exhibit 13: Costs of Broiler Production

Item	$/kg	Cost Share
Chicks	$ 0,082	15,2%
Feed	$ 0,313	57,9%
Labor	$ 0,012	2,2%
Energy	$ 0,007	1,2%
Vet/med	$ 0,011	2,0%
Insurance	$ 0,004	0,8%
House & equip.	$ 0,070	13,0%
Other (incl. catch & haul)	$ 0,041	7,5%
Total Farm Cost (live CIF processor)	**$ 0,54**	**100,0%**
Yield live to whole (76%)	$ 0,71	
Processing, equip,labor shipping	$ 0,310	
RTC whole CIF 12-city wholesale mkt	**$ 1,021**	
Interest, overhead, profit	$ 0,247	
RTC whole CIF 12-city wholesale mkt	**$ 1,268**	
Markup, distrib., retail package, profit etc.	$ 1,020	
Retail price (whole)	**$ 2,288**	
Yield whole to bonelss/skinless(61%)	**$ 2,079**	
Markup, distrib., retail package, profit etc.	$ 1,661	
Retail price (boneless breast)	**$ 3,740**	

Leland *et al.*, 1999
Madison, Milt, USDA, personal communication, Oct 5, 1999

from cost reduction due to improved technology, feeds, economies of scale, genetics, and better management, just as the salmon and catfish industries did in the 1980s and 1990s. Therefore, costs will likely decline.

Poultry

The poultry industry is often considered a model of how the aquaculture industry is likely to evolve. In fact, in many ways, the catfish and salmon industries are mirroring several aspects of poultry's development. As a somewhat analogous industry and competitor in the market, it is interesting to see that the distribution of costs is quite similar (Exhibit 13). Poultry feed accounts for about 58% of production cost; chicks, 15%; and

Exhibit 14: Fishery Cost Shares

	Bering Sea, Alaska Large Factory Trawler Fillet, H&G,Mince	Bering Sea, Alaska Large Factory Trawler Surimi, Fillet, H&G,Mince	North Pacific, Japanese Large Factory Trawler Surimi, Fillet, H&G,Mince	Newport, Oregon Trawler Whiting	New Bedford, US Trawler Groundfish
Fuel/Lubricants	6,8%	8,2%	9,9%	10,4%	16,9%
Repair/Maintenance	8,9%	11,2%	11,7%	23,4%	
Packaging	4,0%	3,1%			
Transportation	9,0%	6,2%		0,8%	
Storage	3,0%	1,8%			
Insurance	2,5%	4,3%		7,9%	
Interest	5,0%	9,6%		2,3%	
Depreciation	4,0%	8,8%	6,2%	0,0%	7,8%
Labor	38,3%	26,6%	28,7%	43,9%	40,2%
Other	18,5%	20,2%	43,5%	11,3%	35,0%

Souce: Ministry of Agricuuuuulture, Forestry and Fisheries, 1997; Sylvia, 1999

labor, 2.2% (US$). Although the distribution of the cost factors is similar, costs per pound are substantially less (total farm cost US$0.54/kg) than salmon, catfish, or tilapia, as most of the production cost gains from technological changes, improved management, economies of scale, and vertical integration have already been attained in the poultry industry. Therefore, costs will fluctuate primarily with the cost of feed.

Ocean-based Fisheries

Turning now to the ocean-based fisheries, consider the representative cost shares (Exhibit 14). Although the figures are for different areas, different fisheries, and are not necessarily directly comparable to each other or to aquaculture costs, some important conclusions can be drawn. First, as summarized in Exhibit 15, the cost factors are substantially different from those of aquaculture. In the typical fishery, labor costs range between 25% - 45% of harvest cost, while for aquaculture the range is 4% - 10%. The lower cost shares for labor are associated with large factory trawlers, and the higher values with traditional groundfish trawlers. Other important input cost factors are fuel (4% - 11%) and maintenance/repair (9% - 23%). In contrast, the dominant factors in aquaculture are feed (40% - 60%) and input animals, such as fingerlings (2% - 15%). Fuel (1% - 4%) and

Exhibit 15: Cost Share: Aquaculture vs. Fishery

Item	Aquaculture	Fishery
Labor	4-10%	25-45%
Maintenance	2-4%	9-23%
Fuel	1-4%	4-11%
Fingerlings	2-15%	--
Feed	40-60%	--

maintenance/repair (2% - 4%) comprise notably lower shares. Although farmed fish products may be viewed by consumers as the same as wild fish, the cost structure is radically different. This has substantial implications for the relative competitiveness of the products from the two sectors.

The fishery costs are sensitive to stock of fish, crew share changes, insurance rates, the price of diesel, the cost of meeting regulatory requirements, and the cost of maintenance/repairs. In contrast, in the aquaculture sector, technological change, better farm management, biotechnology, and improved feed at lower cost, have a strong impact on its economic viability. In addition, the relative security of property rights in aquaculture creates an incentive for innovation and investment in cost-reducing technology and management practices. So, in general, we can expect continued declines in the costs associated with aquaculture.

Market Factors Influencing Competitiveness

Although costs of many fisheries species, such as Alaskan pollock, are well below the costs of farmed fish, the costs of many other species, such as halibut, haddock, and Atlantic cod are well within the range of farmed fish, such as farmed catfish and farmed salmon. It is particularly important to note that when buyers view products as identical, or near-identical, cost is the defining issue. However, if the products are not viewed the same by the buyer, the cost of producing the protein is not all that matters. Marketing and market management matter. Consider Alaskan salmon. In 1998, the exvessel price for Alaskan pink salmon was about US$0.33/kg, and Alaskan chum had an exvessel price of US$0.45/kg. Yet, farmed Atlantic salmon, at a much higher cost and corresponding ex-farm price,

generally outcompetes these products due to supply consistency, uniformity, better quality, and handling. These products are much more than just protein. They embody service, quality, packaging, and reputation, as well as other attributes.

What really gives aquaculture an edge is the ability to manage production and the market. In contrast, the traditional fishery focuses on today's uncertain catch, and when not fishing, a morass of political issues linked to the fisheries management processes. Aquaculturists must plan ahead, anticipate harvest, target markets, and improve efficiency. This is not to say that aquaculture is not limited by regulation. Aquaculture faces many regulations, but there is generally more autonomy to anticipate and manage production and to make marketing decisions.

The aquaculturist's relatively greater ability to manage the market and plan is derived from the capability to reduce uncertainty. To illustrate, consider Exhibits 16 and 17, which provide an indication of the relative uncertainty faced by aquaculturists in growing: 1) pond-raised catfish; 2) pen-raised salmon; and 3) semi-intensive pond-raised shrimp, compared to the traditional wild fishery.

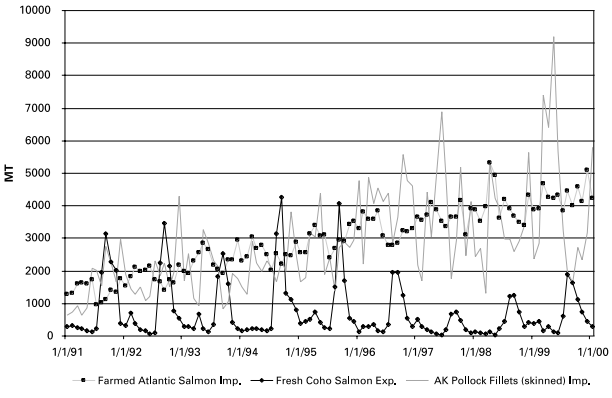
Exhibit 16: Risk and Uncertainty: Environment and Growth Processes

	AQUACULTURE			
	Catfish	Salmon	Shrimp	Capture Fisheries
Storms	Very low	Moderate	Moderate	High
Disease	Very low	Moderate	High	Moderate
Seasonality	Moderate	Moderate	Low	High
Growth	Very low	Low	High	High
Predators	Low	Low	Moderate	High

Exhibit 17: Risk and Uncertainty: Government Policy and Regulation

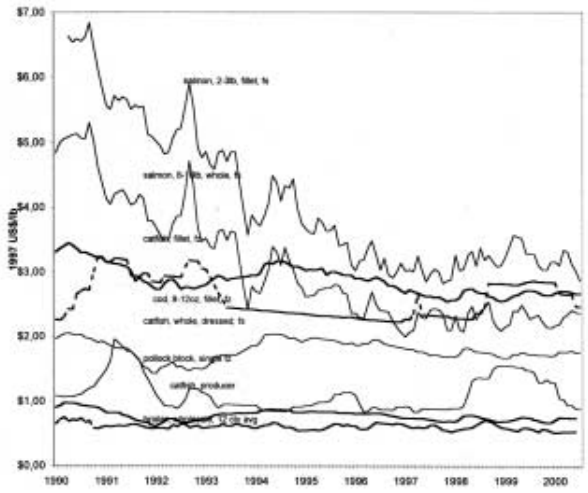
	AQUACULTURE			
	Catfish	Salmon	Shrimp	Capture Fisheries
Location Regs.	Very low	High	Moderate	High
Operation Regs.	Low	Moderate	Low	High
Property Rights	Very low	Moderate	Moderate	High
Trade Barriers	Low	Moderate	Low	Low
Endangered Species Reg.	Moderate	Moderate	Moderate	Moderate

Exhibit 18: Supply volatility (MT)



Through the adoption of technology and farm management practices, we see that, in general, pond-raised catfish faces much less uncertainty regarding environmental issues and stock growth processes than semi-intensive shrimp or harvest from a wild fishery (Exhibit 16). This also holds for regulatory uncertainty (Exhibit 17). When these uncertainties are reduced, there is more an orientation toward production and market planning, resulting in increased efficiency. As has been shown, this planning has led to consistent cost declines for salmon and catfish and increased market share. We can also see the results of reduced uncertainty by observing supply volatility. Compare farmed salmon supplies to the U.S. versus U.S. coho exports based on a wild fishery (Exhibit 18). There is clearly a relatively stable trend for the farmed salmon, in contrast to a highly uncertain cycle for the wild coho salmon fishery. Thus, it is obvious that it is

Exhibit 19: Real Price Trends (base year 1997)



much easier to develop a marketing plan for farmed salmon than wild coho. Even more uncertainty is observed with imports of Alaskan pollock filets (skinned).

The hypothesis that aquaculture costs will tend to decline and uncertainty will be reduced is also manifest in prices paid at the wholesale level. Exhibit 19 illustrates the price trends for selected farmed and wild fish products. Several observations stand out. Most remarkable is that in 1990, 8-12 oz. frozen cod fillets sold for about one-half the price of whole, fresh salmon. Today, they sell for about 10% more. They also sell for more than frozen catfish fillets.

Conclusion

The trend towards increasing aquaculture and rights-based fishing is changing the way fish is sold. It is expected that these systems will reduce waste and production uncertainty and improve marketing. This will result in a tendency toward increasing market share controlled by the aquaculture and rights-based fisheries. This will make the overall seafood sector more responsive to international trade and market conditions, resulting in less waste, better utilization, improved product forms, tighter quality control, and increased efficiency.

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Rögnvaldur Hannesson

The Icelandic fisheries and the future of the Icelandic economy

Abstract

The fisheries of Iceland are considerably more productive than those of the neighboring countries, but this may be due as much or more to luck than to wisdom. It appears that the ITQ system has increased the profitability of the industry and helped avoid excessive use of manpower, but it has taken considerable time to establish this system and its continued existence is still in doubt. It is argued that the fisheries no longer are an engine of growth in the Icelandic economy and that it is crucial to avoid using the industry as an employer of last resort if the Icelanders are to maintain their standard of living on par with their neighbors.

In a well managed fishery rents will emerge and, contrary to ordinary manufacturing, it is not desirable to let the rent be eroded by competition. To whom the rent accrues and how it will be used are questions of crucial importance for the future of the quota management system and the development of the Icelandic economy. Arguments for and against having the fishing rent accrue to the industry are discussed, as well as ways of rent recovery and rent use by the government.

Introduction

About twenty years ago, when subsidies accounted for over one half of the value added in Norway's fisheries, an official in the Ministry of Fisheries in Oslo is supposed to have uttered "in Iceland, you know, they've got to make a living out of their fisheries."

The importance of the fisheries for the Icelandic economy is well known to all Icelanders. Without the high productivity of the Icelandic fisheries the modern Icelandic economy as we know it would simply not exist. Until very recently economic growth in Iceland was synonymous with an expansion of the fisheries; application of more productive technology, greater catches, and higher value through improved product quality. It is tempting, therefore, to conclude that the Icelanders have chosen to govern their fisheries wisely because of the enormous importance of the fisheries for their economy, based on a deep understanding of what it takes to make the fishing industry not just viable but able to play its leading role in the economy. Unfortunately, this conclusion is by no means obvious. There is reason to believe that there has been not just wisdom but also quite a bit of luck involved in getting the Icelandic fisheries where they are today.

Iceland is in the enviable position of not having developed an overpopulated and inefficient fishing industry, unlike some of her neighbors, notably Norway and Newfoundland. Fish landings in Norway have on the average over the last 20 years (see Table 1) been about 50 percent greater than in Iceland, both in terms of volume and value. The number of fishermen in Norway is, however, about three times as high. However, about three times as high as in Iceland.[1] Before the collapse of the Northern cod fishermen in Newfoundland were two to three times as numerous as the fishermen in Iceland, but the value of their landings was only about one third of the value of fish landings in Iceland at that time.[2]

Why would the high productivity of the Icelandic fisheries be due more to luck than to wisdom? The temptation in Iceland of using the fishing industry as an employer of last resort has for most of the period after the Second World War not been very great. For most of that period the Icelandic economy was characterized by full employment. The expansion

[1] In 1998 there were about 15,000 people in Norway who had fishing as the main occupation. In addition there are about 6000 part timers. In Iceland the highest number of fishermen in any month in 1998 was just above 5000 (see Figure 1).

[2] In the euphoria in the wake of the 200 mile zone the number of fishermen in Newfoundland increased from 14.000 to 25.000 (Schrank, 1995). At that time the maximum number of fishermen in any one month was slightly above 6000 in Iceland (see Figure 1). The value of fish landings in 1980 was 161,286 thousand (Canadian) dollars in Newfoundland and 1823 million krónur in Iceland, which translates to about 138 (Newfoundland) and 380 (Iceland) million US dollars respectively.

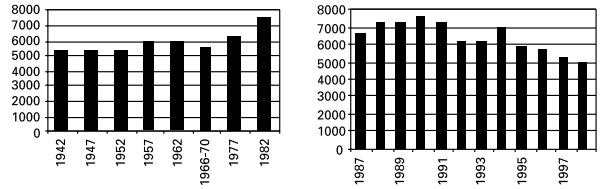
Table 1: Catches of fish in Norway and Iceland. Sources: "Landshagir", "Útvegur", "Fiskeristatistikk", "Statistisk årbok".

	Catch '000 tonnes		Value		Value ratio
	Norway	Iceland	Norway mill. NOK	Iceland mill. NOK	Norway/ Iceland
1979	2650,2	1640,7	3132,4	1762,1	1,78
1980	2400,2	1514,2	3501,3	1968,8	1,78
1981	2538,6	1434,6	3995,0	2155,2	1,85
1982	2484,9	785,6	3964,2	1852,0	2,14
1983	2812,6	835,0	4263,7	1847,1	2,31
1984	2440,0	1525,1	4339,2	2283,0	1,90
1985	2083,7	1672,3	4553,0	2650,9	1,72
1986	1864,3	1651,2	5150,6	3454,2	1,49
1987	1892,7	1625,4	5819,8	4362,2	1,33
1988	1749,6	1752,3	5032,5	4364,2	1,15
1989	1788,7	1488,8	4777,0	4025,0	1,19
1990	1591,6	1502,4	4976,5	5052,5	0,98
1991	2007,0	1043,8	5967,9	5484,3	1,09
1992	2430,0	1567,7	6384,7	5273,0	1,21
1993	2414,6	1698,4	6269,5	5135,9	1,22
1994	2365,6	1510,9	7470,1	3974,3	1,88
1995	2523,7	1607,1	8175,7	5199,3	1,57
1996	2623,9	2055,2	8662,3	5520,7	1,57
1997	2855,7	2199,1	9183,8	5731,4	1,60
1998	2844,4	1678,7	10409,4	6469,1	1,61
Average	2318,1	1539,4	5801,4	3928,3	1,57

of the fisheries could be accommodated by increased availability of fish, through expanded fishing limits and by turning to underexploited fish stocks. While the fish catches grew, the number of fishermen did not increase much (see Figure 1). Nevertheless, the need to limit the number of fishermen and the investment in fishing boats, compared to what would happen in an unregulated industry, was gradually and belatedly realized by the industry, the general public and policy makers alike. When individual transferable quotas (ITQs) were first tried in the Icelandic cod fisheries in 1984 a reform along those lines was overdue. Despite the 200 mile zone and the exclusion of foreign fishermen who used to take roughly one half

of all catches of demersal fish around Iceland the fishing industry had already become overcapitalized. The fishery regulations in place at that time did little or nothing for dealing with the overcapacity problem and made the industry less efficient through ill-conceived effort regulations.

Figure 1: Maximum number of fishermen in any one month in Iceland. Sources: Hagstofa Íslands (Statistical Bureau of Iceland): "Tölfræðihandbók", "Landshagir".



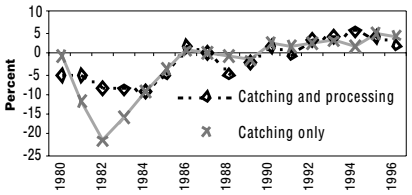
The effects of the ITQ system

What, then, has the ITQ based management accomplished? Figure 2 shows profit as percentage of gross revenue for the fishing industry, for catching and processing combined, and for the catching sector only, since 1980, a few years before the ITQ system was put in place in the cod fishery. Over time there has been considerable increase in profitability, particularly since 1990 when the quota management system was made more comprehensive and the quota shares became valid for an indefinite period.[3] It is, to say the least, tempting to ascribe this increase in profitability to the quota management system itself. Even if this is a very crude indication and the effects of the quota management system certainly merit a deeper study I think it can be said with confidence that the onus is on those who might wish to prove that the quota management system has not increased the efficiency and the profitability of the industry.[4]

[3] A quota share is a right to a certain portion of the total allowable catch (TAC) each year. The annual catch quota of a quota share holder is simply the quota share multiplied by the TAC.

[4] The report by the National Economic Institute in Auðlindanefnd (1999) demonstrates improvement in productivity in the fisheries since the quota management system was introduced but is very cautious in concluding that this is due to the quota management system, listing a number of other factors which could be behind this.

Figure 2: Profits in the fishing industry, as percent of gross revenue. Source: National Economic Institute: "Atvinnuvegaskýrsla," Table 2.3, various years.



There is additional evidence that the quota management system has increased the profitability of the industry. As is well known, fish quotas change hands at a considerable price; sometimes the lease price of an annual quota is about one half of the value of the fish it allows the quota holder to catch. This points to a quite high profitability of the industry, although one needs to be aware that high quota prices may be due to remaining overcapacity in the fleet and the irrelevance of fixed capital costs when calculating the price a buyer can afford to pay for a marginal increase in his quota holdings. More importantly perhaps, these quota prices have increased substantially since the individual transferable quotas were put in place.[5]

This apparent increase in profitability is, however, not exclusively due to the individual transferable quota system. It is also due to a successful management of the fish stocks; that is, the limit on the total catch that can be taken from a fish stock. The profitability of the fisheries is, needless to say, critically dependent on the stocks being in good health. The benefits of individual transferable quotas would be very limited indeed if the stocks to which they are applied were not in good shape.

Paradoxically, perhaps, the apparent success of the quota management system is also its worst enemy. The capitalization of future profits into a

[5] The development of quota prices is discussed in the report from the National Economic Institute in Auðlindanefnd (1999).

very substantial value of fish quotas has caused much consternation because some people who originally got their quota shares for free have been able to realize a handsome capital gain. In a small, egalitarian and transparent society as the Icelandic one such development is not easily tolerated. Needless to say, it would be a major tragedy if disputes over the distribution of the gains from greater efficiency in the fishing industry were to lead to the abandonment of the management system which has made these gains possible. Let me, therefore, turn to a discussion of what precisely these gains are and to ways which might facilitate their preservation.

Fishing rents and other rents

The gains from a better fisheries management system are reflected in rents from fishing. To the reader who might be unfamiliar with this concept let me offer a brief explanation of this term. Rent is the difference between revenues and costs, including capital costs. In ordinary manufacturing industries these rents are usually eroded by competition. If the manufacturing of something, cars, for example, is so profitable that revenues exceed all necessary costs, more firms will start producing cars, until the rents have been eroded by a lower price of cars due to increased production. Normally this is considered a happy outcome; people get more goods at a lower price.

In some cases, however, it may be advisable not to let the rent be eroded too quickly. This is why patents are granted; patents protect the owner of the patent from competition from others who seek to emulate his product. The reason why patents are deemed desirable is that they provide incentives for invention and innovation; the reward for this is a profit over and above ordinary production costs. Indeed the point can be made that such "patent rents" are nothing other than production costs necessary for stimulating innovation and invention.

In the fishery competition for a share of the rent does not result in increased production but simply in higher costs. In fact, if fish stocks are badly managed, such competition can result in a smaller catch of fish. The reason is that the productive capacity of fish stocks is limited by nature, and it is not enhanced by adding fishing boats to the fleet. Therefore, in a

well managed fishery, one may expect that there will be some rent, but how much depends on the price of fish and the effectiveness of the fishing technology.

The gains from efficient fisheries

The existence of rent in the fishing industry is thus a result of good fisheries management. This means not just that the total catch of fish is appropriately set, it also means that manpower and capital are not being wasted in the industry. There are examples where fish stocks have been well managed from a biological point of view but where the economic benefits are wasted through what is often called "olympic" competition for a given total catch. The real gain from managing fisheries efficiently is, however, the alternative production value that can be realized by not having a given amount of fish being taken by, say, hundred boats instead of fifty, or fifteen thousand fishermen instead of five thousand. The excess manpower and capital could be employed for a better use, including improvement in the overall growth of the economy. It is most unfortunate when excessive manpower and capital has been attracted to the fishery, because it may be difficult in the short run to redirect capital and manpower to other industries. Fishing boats and their equipment are usually not very useful for other purposes, and fishermen might need retraining for other skills. Yet this is the direction in which one will need to move when overcapitalization and excessive employment has occurred in the fishery.

There is reason to emphasize the enormous importance for Iceland to avoid this problem. It is more obvious in Iceland than in most other places that increasing the number of fishermen above what is needed to take the fish that is available will add nothing to the material welfare of the nation. If the present standard of living in Iceland is to be maintained, let alone increased further, it is imperative that the increase in the work force will find its way into other industries than the fishery and that these industries be competitive in international markets. The fishing industry has played a pivotal role in developing the modern Icelandic society, and it will continue to be extremely important, but it will not be able to improve the living standard of Icelanders much further. There is not much more fish to be had from Icelandic waters, and the possibilities of expanding into other areas

are severely limited. There will undoubtedly be further gains in productivity and product quality in the Icelandic fishing industry, but it is not going to be the engine of economic growth as it was for most of the 20th century. Furthermore, increased productivity gains in the fishing industry are likely to cause some reduction in employment in the industry, as appears to be taking place already (see Table 2).

I dwell on these points at some length because I fear that the understanding of these issues among the general public in Iceland is rudimentary at best. One often hears arguments such as "it is necessary to make it possible for young people to get into the fishing industry," or "the fish stocks around Iceland are the common property of the nation to which everyone should have access." These are dangerous fallacies. There are enough people employed in the fishing industry as it is, and probably more than enough. New employees are needed only to the extent others leave and need to be replaced. In a management system based on transferable quota shares held by boatowners there is need for new boatowners only to the extent that some quota shares are up for sale and the existing boatowners are unwilling to buy them at a competitive price. The market price of quota shares is an adequate instrument for regulating who and how many get into the industry. Clearly that price must be high enough to create a balance between supply and demand. To put it differently, those who cannot pay their way into the industry are simply not needed there. If anything, young people should be discouraged from trying to get into the fishing industry; they should rather be encouraged to acquire the skills necessary in new industries which will have to be developed or established ones that need to be strengthened in order to make sure that the Icelandic economy will be able to provide a standard of living that continues to be comparable with that of the neighboring countries.

The fishing rent: who should get it?

Let me return to the rent which will emerge in a well managed fishery, and which has emerged in Iceland in the form of market values of quotas. Using the rent judiciously could facilitate economic growth and enhance the efficiency of the Icelandic economy.

Who, then, should be entrusted with the rent? The rent is ultimately the

result of the fisheries management system in a wide sense; it is first and foremost the result of the fact that Iceland has an internationally recognized 200 mile exclusive economic zone which it can use in the best interest of the nation. But this is not a sufficient condition, as we can see from the sad experience of countries which also have 200 mile zones but which have treated their fisheries not as a source of wealth but as a repository for excessive manpower and outmoded technology. In addition there must be an adequate management system in place. It can be said, therefore, that the existence of the fishing rent is the result of political processes; it is the result of a development in the international arena, to which the Icelanders contributed very actively, and which ended in the general acceptance of the 200 mile zone. The fisheries management system itself is the result of decisions made at the governmental and the parliamentary level, and it is ultimately the result of the support of critical sections of the industry itself and the general public.

Who, then, gets the rent? On the first round, the rent accrues to the industry, as it is simply a part of its gross revenue. Some quota holders may, however, have paid for acquiring their quotas and for them the rent is in whole or in part a payback for the quota rights they have acquired. As the system is now in Iceland those who pay for their quotas are the ones who rent their quotas or bought their quota shares from those who got their quota shares for free initially. In this case the rent stays within the industry but accrues as a windfall gain to those who were around when the quota shares were initially allocated.

Arguments for having the industry collect the rent

How is the industry likely to use the rent? The argument has been put forward that the industry is more likely than the state to invest the rent profitably. There is some reason to expect that this will be the case. The industry is profit driven, and firms in the industry may be expected to be on the lookout for profitable opportunities. It is quite possible, therefore, that the industry would be the best caretaker of the rent. Letting it accrue unabridged to the industry and be invested by the industry might be the mechanism that would best ensure economic growth and the development of alternative industries.

This argument has many parallels with arguments being made about the use of other rents, mineral rents for example. Mineral rents arise for reasons not entirely dissimilar from renewable resources, and are in many cases very substantial, particularly for oil and precious metals such as diamonds. Many countries have, however, squandered their rents through corrupt and incompetent governments which have wasted them on unprofitable projects, or stolen them outright, as we have sad examples of from Nigeria and Congo (formerly known as Zaïre). But all governments are not equally bad. Some of the countries that have been most successful in investing their mineral rents are run by authoritarian but enlightened, even if sometimes traditional, governments (Botswana). Two countries that have obtained considerable rents from their sugar plantations, Mauritius and Jamaica, have fared differently with respect to how wisely these rents have been spent. It has been alleged that the better track record of Mauritius is due to the fact that the private sector gets and spends most of the rents (Lal and Myint, 1996).

Another argument for letting the rent accrue to the industry is that it gives the industry a collective interest in promoting good management of the fish stocks. The value of a quota share is the discounted value of the profit the quota holder will be able to make in the future on the basis of his quota. That value depends critically on how well the fish stocks are managed. To the best of my understanding we see evidence of this effect in the Icelandic fisheries. The attitude of the boatowners' organization (LÍU) appears to have changed quite substantially since the indefinite quota shares were put in place in 1990. Instead of using its influence for trying to increase the TAC beyond what fisheries biologists recommend, the industry has in recent years supported a more cautious policy where the so-called TAC rule has been applied consistently.[6]

[6] The TAC Rule stipulates that the TAC for cod be set at 25 percent of the fishable stock. The rule was arrived at through bioeconomic analysis in which the industry participated. An economic purist might argue that the TAC ideally depends on economic and biological parameters that may be expected to vary from year to year. Such fine tuning is hardly practical, however, and the TAC Rule appears sensible and robust enough to be a major improvement over previous practices where the TAC usually was set well above what the fisheries biologists recommended.

Arguments against having the industry collect the rent

There are nevertheless a number of skeptical points that can be raised about whether the Icelandic boatowners should be entrusted with the fishing rent. There is some doubt as to whether fishing firms are adept at identifying the best investment opportunities. They are not unlikely to invest in the things they know best, that is, fishing and fish processing, if not at home then abroad. An in-depth study of foreign investment by Icelandic fishing firms would be interesting and might throw some light on this.

There is, furthermore, the argument, that the future rent will be capitalized as value of quota shares for those who originally got them for free. This process will take some time but seems to be well under way in Iceland. If the rent remains in the industry it will accrue disproportionately to what we might call "the first generation" of quota holders. It will be that generation, then, which decides how the rent will be used. There are many examples of this wealth having been cashed in and invested in projects outside the fishing industry, but some of it has undoubtedly ended up as consumption among those who got these gains, and some of it may have fled the country as it were through emigration of the recipients of these windfalls.

Finally, it is likely that Icelandic public opinion simply will not tolerate the uneven distribution of income which results from letting the fishing rents accrue unabridged to those who got their fishing quotas gratis when the quota system was introduced. The windfall gains that some individuals have been able to make by selling privileges that they got for free is one of the reasons why the quota system is under dispute. There is reason to believe that there is a number of people who would support the quota system as a way of increasing the efficiency of the economy but unwilling to tolerate its real or perceived income distributional effects.

The government as a rent collector

So, even if the fishing industry might spend the fishing rent more wisely than the government and the parliamentary majority, it is probably necessary to divert a substantial share of the rent to the public sector, in order to bring about a wider acceptance of the system. There are a number of ways

to do this. The best option is probably to withdraw a certain proportion of quota shares annually and auction it off. This will turn the quota system into a permanent source of income for the government, even if the income is likely to vary from one year to another due to changing circumstances for the industry.

This is not necessarily a bad option, from the point of view of economic efficiency, and it might in fact be just as good or even better than letting the industry spend the rent. It all depends on how wisely the government uses this income. It is true that governments are sometimes influenced by perverse incentives, such as buying short term popularity for elected politicians and their parties by spending which otherwise yields few benefits. Provided that this pitfall will be avoided, what are the options for using the rental income of the public sector wisely?

First of all, the rental income could be used to replace other taxes instead of boosting the level of government activity. There is a very real danger that this would not be done, and that the rental income would just be used for increasing governmental activity irrespective of whether this is warranted or not. A better option would be to use the rental income to reduce taxes. Most taxes are distortive, discouraging work effort or investment, or both. The advantage of taxing rents is that it is non-distortive if appropriately designed, falling only on profits in excess of all necessary costs. There is reason to believe that it would be much easier to design a non-distortive tax for fishing rents than for mineral rents for example. A tax on fishing quotas, or the auctioning off of such quotas, appears to come very close to being a non-distortive tax and very much preferable to ordinary taxes as a source of government income.

By letting the rental income replace other taxes, the government would in fact be redistributing the fishing rents among the general public, in proportion to what each taxpayer would otherwise have to pay in taxes. It would then be up to the individual taxpayer to decide how to use the rental income, or rather the tax rebate financed by the rental income. To the extent the tax rebate would be saved it would enhance the growth of the economy, or its financial assets abroad. If the taxpayers are spendthrift, little will be saved and little will go toward increasing wealth in the econo-

my. Those who argue that too little will be saved and invested if that decision is up to the individual taxpayer would also argue that the government should itself invest the rents. This raises the question of the criteria to be applied to such investments. While investment in education, health, infrastructure and other government services can be just as productive as investment in the private sector, such investment is open to abuse, because of the absence of clear criteria of profitability. Such investments too often fall prey to manipulations by politicians who use them to promote prestigious but not necessarily productive projects in their constituencies. It is not for nothing that some public institutions in the United States are named after the senator who had the clout to direct the money to his state. A better way, if the rent is to be invested, might be to channel it into a fund which invests it on the basis of undisputed market criteria of profitability.

The virtual redistribution of the fishing rent among the taxpayers reminds us that the government could use other methods of redistribution, such as a flat rebate per individual, similar to the way a proportion of the oil rent of Alaska is redistributed among the Alaskan public. In fact it is not the rent that is being redistributed but the income obtained from investing the rent in an investment fund. Such redistribution might be regarded as more equitable than redistribution through lower taxes. This method of redistribution would not, however, result in mitigating the distortive effects of taxes which otherwise would have been lowered.

Conclusion

Over the last hundred years or so Iceland has risen from poverty at its worst in Europe to the top league of nations in terms of national income per capita. This has gone hand in hand with expanding the fisheries. In the beginning it was possible to draw on common resources which still were not fully exploited. After the Second World War it became increasingly clear that this was no longer possible; a further expansion of the fisheries could only take place at the expense of foreign fishermen who used to take about one-half of the fish catches around Iceland. The Icelanders could unite in fighting foreign fishing interests, a process which was remarkably devoid of second thoughts or self criticism and showed little recognition of what nowadays are called historical rights.

The common property arrangement and the expulsion of foreign fishermen are things of the past. There are few if any underexploited fish resources in Icelandic waters, and there are no more foreign fishermen to chase away. The greatest contribution of the fishing industry to economic growth and development is through making it as economically efficient as possible. This in turn requires a fisheries management system which avoids the pitfalls of overinvestment and overmanning which is otherwise so endemic in fisheries all around the world. The quota management system is in all probability the best method of achieving this as conditions are in Iceland, and it has already shown promising results. Abandoning this system in favor of more wasteful methods would be a major economic misfortune for the nation. The economic future of the nation hinges, therefore, in large part on whether there will be sufficient support for the quota management system, as I can see no other method on the horizon which could provide better results. Unfortunately, however, nations often find it easier to unite against an external enemy, real or imagined, than overcoming internal divisions that stand in the way for sensible politics. Let us hope that the future growth of the Icelandic economy will not be so blighted.

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Ragnar Árnason

Productivity and Productivity Growth in the Icelandic Fisheries

Abstract

This paper attempts to measure productivity growth in the Icelandic fisheries during the period 1974 to 1995. The standard theory of total factor productivity (TFP) is extended to accommodate the special case of the fisheries where the size of the fish stocks represents a major input into the production process. Utilizing aggregative time series data on the Icelandic fisheries from 1974-1995, a Törnquist approximation to the appropriate Divisia index is employed to obtain estimates of changes in total factor productivity in the Icelandic fisheries. According to these measurements the average annual growth in total factor productivity has been quite high during this period compared to that of other major industries in Iceland and abroad. Moreover, there are no signs that this growth in total factor productivity has abated over time. Indeed, it seems to have increased during the latter half of the period. It is tempting to associate this experience with the impact of the ITQ fisheries management which became the dominant form of fisheries management in Iceland during this period.

Introduction

This paper attempts to estimate productivity and productivity growth in Icelandic fisheries during the period from 1974 to 1995. This interval of time was imposed by the availability of the necessary data at the time the basic study commenced (1998). Since then, one year of additional data, i.e. 1996, has become available. Some data relevant to productivity measurements before 1974 are available but they are somewhat spotty and most

likely inconsistent with the time series that have been systematically collected since then.

Several studies of productivity in Icelandic fisheries have previously been done. Most, however, are quite simplistic and their results, consequently, not very reliable. Recently, however, there have been four more noteworthy studies in the area. Three of them (Hagfræðistofnun 1997, Valsson and Klemensson 1998 and the study by the National Economic Institute published in Committee on Natural Resources, 1999) employ the classical methods of *total factor productivity (TFP)* which I, in this study, have chosen to refer to as two-factor productivity or *2FP*. The fourth, published by the Ministry of Fisheries 1999, is more advanced and employs inter alia the method of three factor productivity or *3FP*. The current paper draws extensively on this last study.[1]

This paper has two basic aims. The first is to explain the deficiency of the traditional *2FP* or *TFP* methods to measure productivity in industries where unpriced natural resources constitute an important part of the inputs and to develop the more appropriate *3FP* measure for these cases. The second aim is to present reasonably reliable estimates of productivity and productivity growth in the Icelandic fisheries. These results are interesting in themselves not least in relation to the rather dramatic changes in the institutional framework of the Icelandic fisheries in the past two decades.

As it turns out, productivity growth in the Icelandic fisheries since 1974 has been very high compared to what is usually observed in mature industries. This, of course, suggests the need for explanations in terms of the causal relationship from exogenous changes, institutional and otherwise, to this unusually high rate of productivity growth. For reasons of space, however, I will refrain from providing such explanations in this paper.

The paper is organized broadly as follows. The next section reviews the basic theory of *total factor productivity (TFP)* and its measurements. This is followed by a section on the special problems for productivity measurements posed by resource based industries such as fisheries and the development of the *3FP* measure to account for the impact of the natural resource. The third section describes the data on which the productivity measurements are based. In the fourth section, actual productivity measurements for the Icelandic fisheries are presented and compared to corresponding productivity measurements for other industries. The final section of the paper, provides a brief discussion of some of the results.

[1] My main co-workers in that study were Sveinn Agnarsson, Benedikt Valsson and Jon Oskar Þorsteinsson. Their contribution to the current paper is hereby gratefully acknowledged.

Basic theory

Productivity refers to the quantity of outputs obtained from a given quantity of inputs. Productivity change refers to a shift in this relationship. This shift can obviously be either positive or negative, i.e. it can either increase or decrease the volume of outputs obtained from a given level of inputs.

Let us for illustrative purposes assume the existence of a single valued production function[2]

$$(1)\quad y = Y(x,t),$$

where y represents the quantity of output, the vector $\boldsymbol{x}$ the quantity of inputs and t time. More generally we may regard (1) as the (upper) boundary of a production possibility set.

Factor productivity is defined as the quantity of output obtained from the use of a given quantity of input. More precisely:

$$(2)\quad F(x_i; y, \boldsymbol{x}, t) \equiv y/x_i,$$

where $F(x_i; y, \boldsymbol{x}, t)$ is read as the 'productivity of factor x_i in producing y'.

In the case of production processes with more than one input, factor productivity is obviously a poor measure of productivity. As indicated in expression (2), factor productivity in this case depends in general on the use of the other inputs. Consequently, any given factor productivity may be altered by varying the other inputs. This deficiency has motivated the development of the concept of *total factor productivity* (*TFP*) to indicate the overall productivity of all inputs (factors) (Coelli et al. 1998, Grosskopf, 1993). *TFP* may be defined as:

$$(3)\quad F(X;y, \mathbf{x}, t) \equiv y/X,$$

where X represents the appropriate index for all inputs.

[2] The extension of the following theory to account for many outputs is straight-forward (Coelli et al. 1998.

The rate of change of *total factor productivity* may be written as:

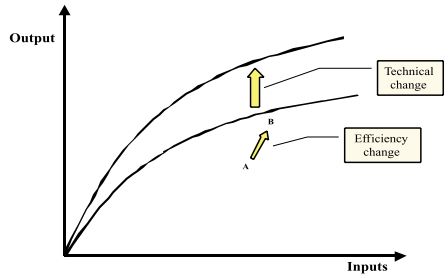
$$(4) \quad dlnF(X;y, \boldsymbol{x}, t)/dt = \dot{y} / y - \dot{X} / X ,$$

where $\dot{y} / y \equiv dlny/dt$ *and* $\dot{X} / X \equiv dlnX/dt$ represent proportional changes in outputs and inputs, respectively.

TFP change can be usefully decomposed into (a) shifts in the production possibility frontier and (b) movement by the producers toward or away from the production possibility frontier. The former is called technical change. The latter is referred to as a change in (production) efficiency (Grosskopf, 1993).

Figure 1 illustrates these two components of *TFP* change. The shift in the production possibility frontier (production function) represents technical change. The shift in production from point A to point B (with the production possibility frontier unchanged), represents an improvement in production efficiency.

Figure 1: Technical and Efficiency Change
(A= initial production point, B= final production point)



To formally establish this decomposition of TFP change into technical change and efficiency change, it is convenient to write the production function as:

$$(5) \quad y = Y(\boldsymbol{x},t)\cdot g(t),$$

where $g(t) \in [0,1]$ is the efficiency parameter measuring the (relative) distance of actual production from the production frontier. Obviously, $g(t)=1$ indicates full efficiency and $g(t)<1$ less than full efficiency.

Differentiating (5) in a logarithmic form yields:

$$(6) \quad dlny/dt = \Sigma \partial Y/\partial x_i \cdot (x_i/(Y)\,(\dot{x}_i/x_i) + Y_t/Y + g_t/g.$$

Profit maximization (i.e. efficiency) under perfect competition implies that $\partial Y/\partial\, x_i = w_i/p$, all i, where p is the market price of output. Hence we may rewrite (6) as:

$$(7) \quad dlny/dt - \Sigma s_i \cdot \dot{x}_i /x_i = Y_t/Y + g_t/g,$$

where $s_i \equiv w_i x_i/p \cdot Y$ is the expenditure on input i as a fraction of total revenues. It should be noted that the expression $\Sigma s_i \cdot \dot{x}_i/x_i$ represents the change in a Divisia index for the use of inputs (Deaton and Muellbauer 1980, Chambers 1988). Divisia indices, as is well known, are actully in many respects ideal indices (Diewert 1976).

Now, according to our definition of *TFP* above[3], the LHS of (7) is the rate of change of *TFP* where the use of inputs are measured by the appropriate Divisia index. The first term on the RHS of (7), Y_t/Y, is the rate of change in the production possibility frontier. It represents, in other words, technical change. The second term, g_t/g, is the change in production efficiency. This establishes the proposition that *TFP* change can be decomposed into (a) technical change and (b) efficiency change. For later reference we summarize our results so far in the expression:

$$(8) \quad dlnF(X;y, \boldsymbol{x}, t)/dt = dlny/dt - \Sigma s_i \cdot \dot{x}_i /x_i = Y_t/Y + g_t/g,$$

where, as before, $F(X;y, \boldsymbol{x}, t)$ is *TFP*.

In interpreting any observed *TFP* change it is helpful to recognize that its two components, technical change and efficiency change, are qualitatively different. Technical change refers to shift or alterations in the production possibilities. It is purely a technological matter. Efficiency, on the other hand, has nothing to do with production possibilities. It is a measure

[3] See equations (3) and (4).

of how well firms are run, i.e., how close they are to the technically attainable upper boundary of production.

The first equality in expression (8), is the fundamental equation for the measurement of *TFP* change. It has been widely used to estimate changes in *TFP* in firms, industries and the macro-economy (Solow, 1957, Jorgenson and Griliches 1967, Denison 1972). More recently it has been used in the so-called growth accounting (Laitner 1993, Herbertsson, 1999).

The great advantage of (8) is that it doesn't require knowledge of the production function or its parameters. It only requires observations on the quantity of outputs, inputs and input cost shares.

For observations in discrete time, (8) may be approximated by the Törnquist (1936) expression:

$$(9)\quad lnF(X;y,\boldsymbol{x},t-lnF(X;y,\boldsymbol{x},t\text{-}1)=(lny_t - lny_{t-1}) - 0.5\cdot \sum_{i=1}^{l} (s_{it} + s_{it-1})\cdot(lnx_{it} - lnx_{it-1})$$

Finally, before proceeding further, it may be helpful to draw the reader's attention to the following:

- In many productivity studies gross factor income (or value-added) is employed instead of gross production, y. This has inter alia the advantage that the factor costs shares, s_i sum to unity.
- In most cases it is inappropriate to talk about total factor productivity, TFP. There are almost always factors that are not accounted for. Consequently, the terminology of multi-factor productivity and more specifically one-factor productivity, two-factor productivity etc. is more accurate and, therefore, probably preferable.
- It is important to realize that, at least in principle, factor productivity and in particular productivity growth should be largely independent of the level of the inputs used. The reason is that the productivity measurements constitute an attempt to focus on shifts in the production possibility frontier and/or production efficiency by eliminating, to the extent possible, the impact of the input level. In the case of separable technological shifts and efficiency as e.g. given by the production function y = A(t)(Y(x)(t), where A(t) and g(t) represent the level of technology and efficiency, respectively, this independence would be perfect.

Productivity in Fisheries

All industries use natural resources as inputs. In some circumstances this complicates the measurement of productivity and its development over time. If the natural resource inputs are bought in the market place like the other inputs there is no problem. Equation (8) for total factor productivity still applies and can be measured by its empirical counterpart, equation (9). Many natural resources used in production, however, are common property and obtainable free of charge. For these *'non-market natural resources'* the corresponding cost share is, consequently, zero and equations (8) and (9) no longer apply.

Fisheries are to a very great extent based on the use of non-market[4] natural resources, namely the fish stocks. Empirical studies of fisheries production functions show that the size of the fish stocks is a major determinant of the volume of landings (see e.g. Helgason and Kenward 1985, Bjorndal, 1987, Arnason, 1990). It follows that for the estimation of productivity change in fisheries it is necessary to include the size of the fish stocks.

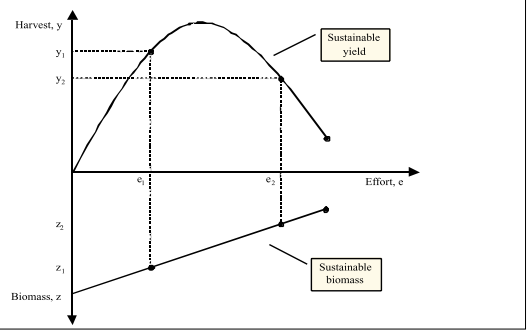
The following very simple fisheries model may help to clarify these ideas. Figure 2 illustrates the conventional sustainable fisheries model. Measured along the horizontal axis are the usual economic inputs, capital and labour, here subsumed under the heading fishing effort. The volume of production, i.e. harvest, is measured up along the vertical axis and stock size as biomass down along the vertical axis in the lower half of the diagram.

The curve in the upper half of the diagram in Figure 2 represents the sustainable yield function which traces out the sustainable relationship between sustainable effort and the harvest. The line in the lower half of the diagram is the sustainable biomass curve which traces out the relationship between sustainable fishing effort and biomass. As indicated in the diagram, sustainable biomass falls with increased fishing effort and vice versa.

Now, the effort level e_2 corresponds to output y_2 and biomass z_2.

[4] It is interesting that this may be changing with the advent of individual transferable quota systems that generate an implicit price for fish stock utilization.

Figure 2: The Sustainable Fisheries Model



Reducing effort to e_1 will lead to an increase in sustainable harvest to y_1. Hence, this appears as an increase in productivity. This, however, is not correct as the other input, biomass, has increased to z_1. In fact, there has been no shift in the production function and both production points (y_1,e_1,z_1) and (y_2,e_2,z_2) lie on the production possibility frontier. Hence there has been no change in productivity.

With fish stocks as a production factor, our basic expression for change in total factor productivity, *TFP*, equation (8) must be modified as follows:

$$(10)\quad dlnF(X;y,\boldsymbol{x},t)/dt = dlny/dt - \Sigma s_i \cdot \dot{x}_i/x_i - \Sigma\, \epsilon_i \cdot \dot{z}_i/z_i,$$

where z_i denotes the volume of fish stock i or some appropriate aggregation of several fish stocks and ϵ_i represents the elasticity of production (harvest) with respect to stock i. The corresponding discrete time Törnquist approximation is:

$$(11)\quad lnF(X;y,\boldsymbol{x},t) - lnF(X;y,\boldsymbol{x},t\text{-}1) = (lny_t - lny_{t-1} - 0.5 \cdot \sum_{i=1}^{I} (s_{it}+s_{it-1}) \cdot (lnx_{it} - lnx_{it-1}) \\ 0.5 \sum_{i=1}^{J} (\epsilon_{it}+\epsilon_{it-1}) \cdot lnz_{it} - (lnz_{it-1}).$$

It should be noticed that this analysis has clear implications for the impact of improved fisheries management on productivity. The long term aim of fisheries management is to move the fishery toward a more efficient point as for instance described by the movement in fishing effort from e_2 to e_1 in Figure 2. This, however, is merely a movement along the sustainable yield function. There is no increase in productivity. Thus, improved fisheries management in the sense of adjusting fishing effort to a more appropriate level and rebuilding the fish stocks does not imply an increase in productivity as this concept is normally defined.

Nevertheless, it may be the case, that improved fisheries management indirectly leads to increased productivity. Thus, for instance, a movement from a common property fishery toward a private property one, often not only reduces fishing effort and rebuilds fish stocks but also leads to an increase in economic efficiency as more efficient fishing firms and more appropriate fishing and marketing methods replace previous ones.

Data

According to equation (11), calculation of total factor (or rather in thise case three-factor) productivity requires data on:

(1) Production quantity or gross factor income
(2) Labour use,
(3) Physical capital use,
(4) Natural capital (i.e. fish stocks).

The available data consist of annual time series observations on these four sets of variables. These data are obtained from public sources; the National Economic Institute and the Marine Resource Institute, and cover the period from 1974-1995. The data are listed in Appendix 1.

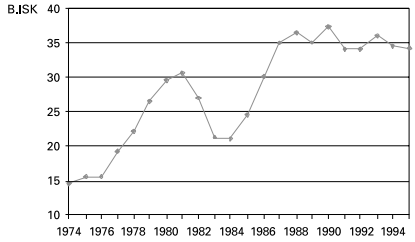
The volume of production is estimated as gross factor income[5] at constant prices as calculated by the National Economic Institute.[6] It is important to realize that this series is deflated on the basis of its own separate price index. Hence, the quite considerable real increase in the price of fish

[5] Gross factor income is defined as total fishing revenues less all costs except those associated with labour (labour remuneration and all associated charges) and capital (depreciation). This is essentially value added in the production process.

[6] For the basic methodology employed to generate this series see National Economic Institute 1994.

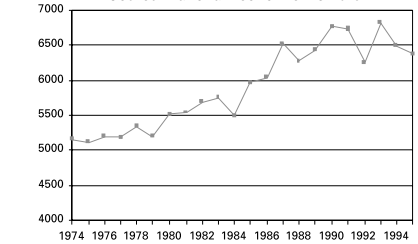
landings since the early 1980's[7] do not show up in this series. Consequently, they do not affect the productivity measurements either. The development of this variable is illustrated in Figure 3.

Figure 3: Fisheries Gross Factor Income 1974-1995 (B.ISK, Constant 1995 prices) Source: National Economic Institute



Labour use is estimated as the total number of man-years in the harvesting sector of the fishing industry. It is of some importance to realize that in addition to vessel crew this includes a good deal of land-based labour such as vessel and gear maintenance staff, office workers, procurement and marketing people, managers and so on. The evolution of this variable since 1974 is illustrated in Figure 4.

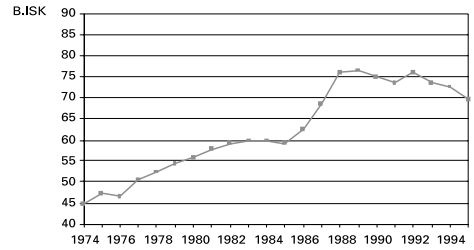
Figure 4: Fisheries Use of Labout 1974-1995 (Man-years) Source: National Economic Institute



[7] Thus, between 1987 and 1995, the years for which data are readily available, the real price of landed cod increased by almost 18% or just over 2% per year.

Physical capital is measured as the total value of the fishing fleet according to a series maintained by the National Economic Institute (National Economic Institute 1994 and 1999). Basically this series is calculated as the accumulation over time of the value of annual investments in vessels and equipment at procurement prices deflated by the appropriate price index and depreciated annually according to predetermined depreciation rates for the various components (vessel hulls, engines and equipment) of the investments. The path of this series is illustrated in Figure 5.

Figure 5: Fisheries Physical Capital (B.ISK, 1995 prices)



Finally, the biological capital variable was obtained by aggregating the biomass of all major stocks (Marine Research Institute 1998) multiplied by their market value in 1995 (Fisheries Association of Iceland 1996), the basic price level of the calculations. More precisely:

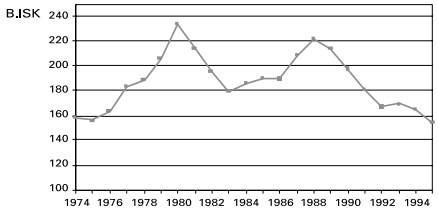
$$Z = \sum_{i=1}^{I} p_i z_i ,$$

where Z represents the aggregate stock, x_i the stock size of species i, p_i the corresponding unit landings price in 1995 and I the number of species involved.[8] Since, the elasticity of catch with respect to biomass differs greatly between demersal and pelagic species, two separate biological

[8] Actually, the calculation involves 9 species (cod, haddock, saithe, redfish, Greenland halibut, shrimp, Norway lobster, herring and capelin) which account for over 90% of the total value of landings.

capital variables one for each of these group of species were actually generated*. The evolution of the aggregate biological capital according to this statistic is illustrated in Figure 6.

Figure 6: Fish stocks: Aggregate measure (B.ISK) : Marine Research Institute, Fisheries Association of Iceland



Measurement

We are now in a position to turn our attention to the actual measurement of productivity and productivity growth in the Icelandic fisheries. Our basic equation for measuring *TFP*-change, or more properly *3FP* in the Icelandic fisheries is the Törnquist approximation as given in equation (11) in section 2.

$$(11)\quad lnF(X;y,\boldsymbol{x},t) - lnF(X;y,\boldsymbol{x},t\text{-}1) = (lny_t - lny_{t-1} - 0.5\cdot \sum_j (s_{it}+s_{it-1})\cdot(lnx_{it} - lnx_{it-1}) \\ 0.5 \sum_j (\epsilon_{it}+\epsilon_{it-1})\cdot lnz_{it} - lnz_{it-1}),$$

where, it will be recalled, the output measure, y, is gross factor income, the economic market inputs, x_i, are the use of physical capital and labour respectively and the non-market input, z_i, represents the size of the fish stocks. These variables were described in section 2 and listed in the appendix.

The cost (or factor) shares, s_i, employed are the actual factor shares as calculated by the National Economic Institute every year. The fish stocks were divided into two substocks; the pelagic stocks and the other stocks (of which demersals dominate). The reason for this is that studies of harvesting production functions have generally found the elasticity of output (harvest) with respect to these two species of fish to be very different. More precisely, it is generally found that the elasticity of harvest with respects to stocks is quite low for pelagic (and schooling) species, but approaches unity for demersal species. Following the estimates of Helgason and Kenward (1985), Björndal (1987) and Arnason (1990), we set in this study these elasticities to 0.1 for the pelagics and 0.85 for the other stocks. These elasticities are assumed constant over the calculation period.

The resulting calculated path of *3FP* is illustrated in Figure 7. The corresponding numerical results are listed in Appendix 2.

Figure 7: Three factor productivity for the Icelandic fisheries

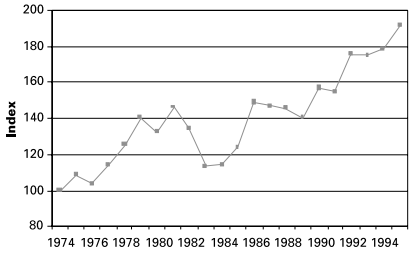


Figure 7 indicates a substantial growth in productivity in the Icelandic fisheries as measured by the *3FP* measure. Over the data period as a whole (22 years), factor productivity increased by over 91%. The average rate of productivity growth is about 3.1%.[10] This rate of productivity growth over such a long period is much higher than in other major Icelandic industries and indeed most major industries abroad.

The Institute of Economic Studies (Hagfræðistofnun) at the University of Iceland has recently published a report on the trend in *TFP* for various

* For further details see the reclion on messurement.

[10] I.e. the compound rate of growth calculated as ln[FP(1995)/3FP(1974)]/21, where *FP(t)* is measured productivity at time t.

Icelandic industries (Hagfræðistofnun, 1997). These results, which may be compared with the current results for the Icelandic fisheries, are listed in Table 1.

Table 1: Trend* in total factor productivity in Icelandic industries (1974-1995; 3FP for fisheries 2FP for the others industries)

Fisheries according to the current study	3,49
Fish processing according to the current study	1,25
Agriculture	0,8
Manufacturing industry	1,02
All industries	1,13

* Calculated as the coefficient b in the regression $Z=a+b\cdot$time, where Z represents the estimated productivity.

Table 1 shows that productivity growth in the Icelandic fisheries has been much higher (about 3 times higher) than in other major Icelandic industries.

Comparison with foreign industries produces a similar result. Table 2 lists average annual growth[11] in factor productivity in the Icelandic fisheries and several industries in Denmark and the USA.

Table 2: Average productivity growth* in industries in Iceland, Denmark and USA (Denmark and USA 1973-93 and 2FP; Iceland 1974-95 and 3FP)

Country	Industry	Annual average productivity growth
USA	Agriculture/fisheries	-1.1%
	Manufacturing industry	0.5%
	Services	1.0%
Denmark	Agriculture/fisheries	-0.9%
	Manufacturing industry	1.3%
	Services	0.2%
Iceland according to the current study	Fisheries	4.4%

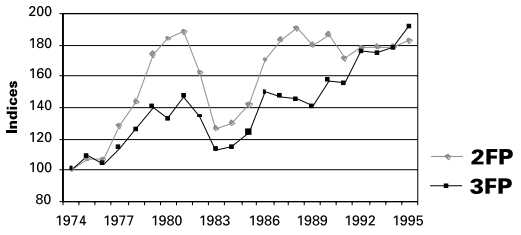
* Calculated as [FP(T)-FP(0)]/(T-1), FP(t) is measured productivity at time t and T is the length of the data period.

[11] Defined simply as the total growth divided by the number of years-1

The international comparison tells very much the same story as the domestic one. Productivity growth in the Icelandic fisheries has been much faster than in the listed industries abroad. This result seems sufficiently robust and the magnitude great enough to be regarded as significant. As such it suggests the need for an explanation in terms of special factors.

One explanation that could be forwarded is that the *3FP* is responsible for this result. After all this novel productivity measure is used to estimate the productivity of the Icelandic fisheries and not the other industries. This, however, cannot be the case for the simple reason that the more standard *2FP* measure yields very much the same average productivity growth for the Icelandic fisheries for the period as a whole. This is illustrated in Figure 8 where both the *3FP* measure and the *2FP* one are drawn.

Figure 8: Two and three factor productivity for the Icelandic fisheries



As indicated in Figure 8, total productivity growth over the period as a whole is almost identical on both the *3FP* measure and *2FP* measures. Hence, the comparatively high rate of measured productivity growth in the Icelandic fisheries cannot be a spurious outcome of the *3FP* measure.

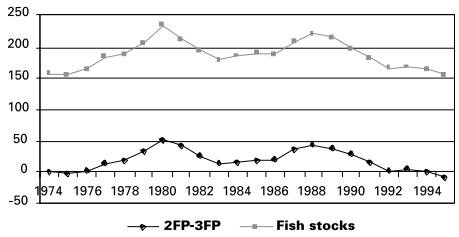
In spite of yielding about the same overall productivity growth, the periodic difference between the *2FP* measure and the *3FP* one illustrated in Figure 8 may appear curious. There is, however, a ready explanation. The

2FP does not correct for the size of the fish stocks. Hence, the variability of the fish stocks during the period (illustrated in Figure 6 above) is bound to show up in the *2FP* measure. Indeed, it turns out that there is a substantial positive correlation between the size of the fish stocks and the *2FP* measure. The correlation coefficient is r=0.54 and is highly significant.

The *3FP* measure, on the other hand, in order to focus on true factor productivity, attempts to correct for the impact of the fish stocks. In this, it seems to have been highly successful because it turns out that the correlation between the calculated *3FP* and the size of the fish stocks is virtually zero *(r=-0.03)*. Herein lies the great advantage of the *3FP* measure for the current work and probably fisheries productivity measurements in general. It manages to eliminate almost all the impact of the fish stocks on output and hence allows us to see true productivity changes more clearly.

Given all this, it is not surprising that almost all the observed difference between the evolution of *2FP* and *3FP* can be explained in terms of variations in the fish stocks. The following figure, Figure 9, traces out the path of the fish stocks as given in Figure 6 and the annual difference between the calculated 2FP and *3FP*.

Figure 9: Fish stocks and 2FP-3FP



As indicated in Figure 9, the graph for the difference between the two productivity measures, namely *(2FP-3FP)*, and the graph for the fish stocks are almost identical. Indeed, the correlation between the two is r=0.99.

This, again verifies the appropriateness of the *3FP* as a measure of productivity.

By correcting for fish stocks, the *3FP* measure manages to substantially smooth out the evolution of calculated productivity growth over the period from 1974-1995 compared to the *2FP* measure. This is, of course, as it should be. Shifts in production frontiers and efficiency are more likely to exhibit a fairly stable trend rather than erratic fluctuations. Nevertheless, in Figure 7 we see clear indications of certain variability in productivity growth. For instance there is high growth in productivity from 1974 to about 1980. This is followed by a large drop in productivity from 1981 to 1984 with the result that overall productivity growth from 1974 to 1984 is relatively low or just above 1% per annum. From 1984, on the other hand, productivity growth in the fisheries has been quite high and stable and shows no signs of abating. This raises the question of whether the productivity series shows some signs of a structural change in the statistical sense. Are there indications of a shift in the underlying data generating process during the period, or can we conclude that what seems to be a systematic pattern is just a random fluctuation?

To investigate these questions, linear splines have been fitted to the *3FP* series: The splines take the following general form:

$$3FP(t) = a + b \cdot t,$$

where t refers to time (here 1974-1995) and a and b are coefficients to be estimated. These splines were fitted to the *3FP* series over various intervals of time. The question of structural break in the series can then be tested by standard statistical tests e.g. the Chow test (Chow 1960) or a simple F test on the estimated slope coefficients, i.e. b.

These investigations suggest a clear and highly significant structural break in 1983/4. This can be interpreted as evidence that productivity evolves differently in the pre-1984 period comparred to the post-1984 period. There is also some evidence, although less significant, of a similar structural break in 1990/91. The corresponding trends in productivity (the b coefficient) over the sub-periods are reported in Table 3.

Table 3: Growth in Productivity (3FP) in subperiods

Periods	Growth trend, b
1974-1983/4	3.6
1983/4-1995	6.0
1983/4-1990/1	5.6
1990/91-1995	7.4

According to Table 3, the growth in *3FP* productivity is substantially and significantly higher during the period, from 1983/4, than in the preceding period. Similarly it seems that productivity growth has increased after 1990/1 compared to 1983/4-1990/1. This increase, however, is not statistically significant at the 5% level although it is close to being so.

Discussion

The estimated productivity growth in the Icelandic fisheries discussed above is quite high and much higher than in other major Icelandic industries as well as comparable industries abroad. It follows that there must be some special factors operating in fisheries that account for this difference. Several possibilities jump to mind. Among them the following may be mentioned:

(1) The extension of the fisheries jurisdiction to 200 miles.
(2) Technological advance in fishing methods.
(3) Improved management of the fishing companies encouraged partly by the greatly increased public ownership of these companies.
(4) Improvements in the fisheries management system, especially the introduction of the property rights based ITQ system that took place in a stepwise fashion during the period.
(5) The development of new fisheries.
(6) The liberalization of the Icelandic economy.

Of these hypotheses, the last one should apply to all the industries in the Icelandic economy. It cannot, therefore, explain the difference between the productivity growth in the Icelandic fisheries and Iceland's other industries.

Of the remaining five possible explanations, (1), (2) and (5) should be mainly felt as a shift in the production possibility frontier. The rest should be primarily felt as an increase in production efficiency. In particular, most of the impact of (3), the improved management of fishing companies, and (4), the improved fisheries management system, should precisely have this effect, i.e. enable the fishing companies to get closer to the technological production possibility boundary. Indeed there is a great deal of circumstantial evidence from the industry such as improved quality of landings, greatly increased specialization in fisheries, better co-ordination of harvesting to demand and etc., that indicates that this is precisely what has taken place.

If this is true, then it may be expected that a good deal of the productivity increase in fisheries since 1974, actually consists of increases in efficiency rather than technological progress. Another study currently in progress (Agnarsson, 1999) employing different and in some respects more flexible productivity measures, has uncovered evidence that this may in fact be the case.

The role of the new fisheries management system, the ITQ system, in the productivity growth of the Icelandic fisheries is an inviting area for further research. It is easy to conjure stories to explain precisely how the ITQ system can have this effect. In fact, some of the other explanations such as improved management of the fishing companies and the development of new fisheries can be traced back to the impact of the ITQ system. Also, in many respects, the movement of productivity over time fits nicely with major advances in the ITQ system. However, these are just possibilities that hardly amount to formal arguments and certainly not proofs. An interesting and relatively easy test of this hypothesis would be to compare fisheries productivity and productivity growth across a number of fisheries that have become subject to property rights based fisheries management systems at different times or not at all.

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Appendix 1: Basic data

	Gross factor income (B.ISK)	Number of Man-years	Value of fishing capital (B.ISK)	Value of fish stocks (B.ISK)
1974	14,53	5160	44,8	158,0
1975	15,63	5110	47,2	156,1
1976	15,62	5197	46,6	163,2
1977	19,22	5189	50,6	183,4
1978	22,17	5339	52,4	188,3
1979	26,60	5207	54,4	205,6
1980	29,57	5506	55,7	233,8
1981	30,61	5541	57,8	213,5
1982	27,04	5691	59,1	195,7
1983	21,25	5751	59,7	179,0
1984	21,04	5498	59,7	185,6
1985	24,57	5970	59,2	189,6
1986	30,14	6047	62,6	189,2
1987	35,00	6511	68,6	208,6
1988	36,46	6271	75,9	221,5
1989	35,06	6425	76,5	213,8
1990	37,40	6761	75,0	197,1
1991	34,14	6726	73,6	180,6
1992	34,09	6247	75,9	166,5
1993	35,94	6820	73,6	169,3
1994	34,53	6480	72,6	164,5
1995	34,35	6372	69,7	154,4

Appendix 2: Calculated Productivity

Year	2FP	3FP
1974	100,0	100,0
1975	107,4	108,7
1976	106,1	103,6
1977	128,2	114,2
1978	143,5	125,3
1979	173,7	140,4
1980	184,0	132,4
1981	188,4	146,5
1982	162,1	134,5
1983	126,1	113,2
1984	129,6	114,4
1985	142,1	124,0
1986	170,2	148,9
1987	182,8	146,7
1988	190,5	145,4
1989	179,6	140,6
1990	186,1	156,6
1991	171,5	154,8
1992	178,4	175,6
1993	178,9	174,8
1994	178,9	178,4
1995	182,3	191,5

Matteo J. Milazzo

The International debate on fish subsidies[1]

Abstract

This presentation reviews the major issues in the international debate of the last several years on the trade and conservation effects of subsidies provided to the fisheries sector. Specifically, four issues are discussed in detail: First, what is a subsidy under the 1994 GATT agreement; second, how broadly (or narrowly) should governments seek to reform these subsidies; third, is there such a thing as a "good" subsidy in fisheries; and fourth, how can we assess and distinguish between their trade and conservation effects. Resolving these (and perhaps other) issues will be complicated and time-consuming, but a successful outcome of the proposed WTO sectoral negotiation on fish subsidies will depend significantly on reaching agreement on these contentious points. The presentation closes with the argument that a WTO agreement, however difficult to obtain, will be well worth the effort for a number of specific reasons.

Introduction

As just about anyone with a passing interest in international fisheries issues knows, a lively debate has developed and continues today on the role of subsidies in fisheries. Just a few years ago, this issue was taken up by the WTO when its Committee on Trade and Environment (CTE) issued a report in late 1996 suggesting that reform of fish subsidies could have positive outcomes for trade and conservation. In May 1997, New Zealand and the United States presented submissions to the CTE that fleshed out that same theme, and, soon after, reform of fish subsidies was often advocated as a potential agenda item for the next WTO multilateral trade round.

More recently, the cause of subsidies reform was embraced by a group of developed and developing nations, and formal negotiations proposed in the WTO multilateral trade negotiations. As we all know, the WTO Ministerial in Seattle that would have kicked off this MTN round late last year failed to produce the necessary consensus, and, at least for the time being, it is not entirely clear where the subsidies issues is headed. On the other hand, an FAO-sponsored International Plan of Action (IPOA) for the Management of Fishing Capacity was adopted and approved, which explicitly addressed subsidies in three articles.[2]

In the wake of these events, we are left in something of a dilemma. On the one hand, the effort to address trade and conservation aspects of this issue in the next WTO trade round has stalled, but, at the same time, negotiations leading to an FAO-sponsored IPOA on the management of fishing capacity were successful. Under the FAO plan on capacity, Members agreed to "assess the possible impact of all measures, including subsidies, contributing to overcapacity" (Article 25), and "to reduce and progressively eliminate all factors, including subsidies and economic incentives and other factors which contribute, directly or indirectly, to the build-up of excessive fishing capacity" (Article 26). FAO also accepted a responsibility to "collect all relevant information and data which might serve as a basis for further analysis aimed at identifying factors contributing to overcapacity such as, inter alia, lack of input and output control, unsustainable fishery management methods, and subsidies which contribute to overcapacity." (Article 45)

[1] The views and assessments expressed in this paper are the author's own and do not necessarily reflect the positions of the United States Government.

[2] FAO Fisheries Department, The International Plan of Action for the Management of Fishing Capacity (1999), can be found at: www.fao.org/WAICENT/FAOINFO/FISHERY/IPA/capace.

But where does this leave WTO and FAO Members? They are in effect being asked to reduce and eliminate subsidies that contribute to overcapacity in their domestic fisheries without any sense of how such a course of action would affect trade interests or fit into a WTO agreement on fish subsidies, which we assume will someday be negotiated.

Until some minimum level of consensus is reached on both the trade and environmental implications of fish subsidies, it is distinctly possible that little meaningful progress will be made in either the WTO initiative or in implementing key provisions of the FAO IPOA on the management of fishing capacity. However, as the debate during the run-up to the WTO Seattle Ministerial made clear, there are a number of sharp disagreements on matters that are fundamental components of the subsidies issue, and these disagreements often stem from a perceived tension between the issue's trade and environmental aspects.

As a matter of fact, the fish subsidies issue was largely driven from the beginning by resource-related concerns. Mounting worries over flat world harvests and individual stock declines inspired much of the initial research about a decade ago. Most critiques of the harmful effects generated by fish subsidies reflected environmental more than trade considerations; the international organization that first drew attention to the problem was a United Nations subsidiary with primary missions related to resource conservation and food supply, FAO's Fisheries Department, whose pioneering work in the early 1990s identified subsidies as a major problem and introduced the $54 billion global subsidies estimate into the public debate; and a number of environmentalist organizations, mainly in the United States and Europe, actively promoted the reform cause.

The fundamental problem is how these resource conservation concerns and goals fit into a context of trade law. This paper will review the most contentious and complicated questions that have emerged in this quickly developing debate, especially in light of the proposed WTO negotiation of an agreement to reform subsidies in the fisheries sector.

A special effort will be made to place the debate over subsidies in fisheries in a more meaningful and larger context of general fisheries policies, in particular, policies aimed at achieving "sustainability" in the fisheries sector. Conversely, although this paper will refer repeatedly to WTO trade law, in particular the 1994 Uruguay Round agreement that addresses subsidies, it is not about trade law, since others have done a much better job at that difficult task,[3] but about the implications of the debate on subsidies for fisheries policy.

But what are the major issues that have driven this debate, and, as is increasingly clear, that so divide the pro- and, for want of a better word, the anti-reform groups? Anyone who has participated in or followed this debate knows that there are many such issues, but a few stand out and merit detailed discussion.

This paper is organized around four of these issues that appear to this writer to be the most basic and in some ways intractable in this debate:

- First, how to define subsidies in fisheries. What kinds of governmental programs should legitimately be placed under the heading "subsidies"?
- Second, how to deal with subsidies provided to sectors other than captures fisheries, including subsidies provided to completely different, i.e., non-fishery sectors.
- Third, what to do with allegedly "good" subsidies in fisheries, i.e., subsidies with sufficiently positive effects that they should be treated as permissible or "non-actionable".
- Fourth, how to assess the trade and conservation effects.

Finally, while this paper focuses on the WTO implications of this issue, it merits repeating that fish subsidies are also being addressed in other,

[3] One excellent example is Christopher D. Stone, "Too Many Fishing Boats, Too Few Fish: Can Trade Laws trim Subsidies and Restore the Balance in Global Fisheries?" *Ecological Law Quarterly*, vol. 24, No. 3 (1997), pp. 505-544.

non-trade international organizations and in domestic policy, where a number of developed and developing countries are reforming the economic incentives that government policies encourage in this sector. Accordingly, following the discussion of the above four questions, this paper will review briefly the prospects for reform of subsidies in fisheries, both in domestic policy and international agreements.

What is and what isn't a "Subsidy" in fisheries?

The most fundamental question is to define precisely what is meant by fish subsidies. This question has not been seriously broached until fairly recently. In trade law, until the Uruguay Round (1986-1994), the major emphasis had been given to export subsidies, with the weakest disciplines applied to subsidies to "primary products", which included fish.[4] During the Uruguay Round, agriculture was lifted out of "primary products" and subjected to special rules and reduction commitments in the Uruguay Round Agreement on Agriculture. Subsidies in the fisheries sector, on the other hand, are by default[5] governed by the provisions of the WTO's generic agreement on that issue, the 1994 Agreement on Subsidies and Countervailing Measures (hereinafter referred to as the WTO SCM Agreement), which went into effect in 1995.[6] Even a quick perusal of notifications of fish subsidies made to the WTO Committee on Subsidies and Countervailing Measures in the last several years reveals an extremely wide and diverse range of programs. Not surprisingly, the FAO IPOA on the management of fishing capacity, as noted, mentions "subsidies" in three articles, all relating to their contribution to overcapacity in the harvesting sector, but offers no definition of that term.

Unlike previous GATT agreements on this issue, the 1994 WTO SCM Agreement includes a definition of a subsidy in Article 1 that, in abbreviated and simplified form, treats as a subsidy government programs that provide:

(1) a "financial contribution", including:

- - direct or potential direct transfers of funds,
- - foregone or uncollected government revenue, or
- - the provision by government of goods or services other than general infrastructure,

or

(2) an income or price support,

and

under both (1) and (2), a benefit is conferred.

In addition, the WTO SCM Agreement provides that subsidies may be treated as "prohibited", or "actionable" and therefore subject to countervailing duty investigations only if said subsidies are "specific" within the meaning of Article 2, which, simply stated, requires that they be targeted to an enterprise, industry, or a group of enterprises or industries, rather than being made available more generally in the economy.

[4] A good brief review of the antecedents to the 1994 WTO agreement can be found in: WTO, Committee on Trade and Environment, Note by the Secretariat, "GATT/WTO Rules on Subsidies and Aids Granted in the Fishing Industry," March 9, 1998.

[5] Fish were for a while proposed for inclusion in the URAA negotiations but were later removed from the product coverage of that agreement. Interestingly, Japanese fishery officials have taken the position publicly that fish are not governed by WTO SCM Agreement, but only by the loose disciplines of the Tokyo Round (1979) Subsidies Code, which only requires that subsidies not be applied in a manner that results in the subsidizing Member gaining "more than an equitable share of the world trade in that product." See intervention of K. Katsuyama, Japan Fishery Agency, "Consideration on Fishery Management and Subsidies: Japan," in Pacific Economic Cooperation Council, *The Impact of Government Financial Transfers on Fisheries Management, Resource Sustainability, and International Trade: Report of Proceedings, (hereinafter cited as PECC Workshop on Financial Transfers)* Manila, Philippines, August 17-19, 1998.

[6] Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations, General Agreement on Tariffs and Trade, *Agreement on Subsidies and Countervailing Measures,* (Washington, D.C.: Office of the United States Trade Representative, 1995), pp. 229-272. This agreement will hereinafter be cited as the WTO SCM Agreement.

Therefore, the WTO SCM Agreement establishes a three-step process that (1) defines subsidies as financial contributions, or income or price supports, (2) requires that they confer a benefit, and (3) stipulates that they must be "specific", or targeted to particular groups of beneficiaries.

At the risk of stating the obvious, since the WTO SCM Agreement is a trade agreement, its terms and provisions are interpreted in precisely that context. "Financial contributions" point to government budgets, and how their allocations benefits certain domestic economic sectors. The requirement that a subsidy must "confer a benefit" is interpreted in Article 14 in an exclusively commercial context. Most important, the WTO SCM Agreement's provisions on the "adverse effects" of subsidies all deal with commercial injuries. These comments are not intended to criticize a WTO agreement because it does not explicitly address environmental issues, but simply to point out that, in addition to adverse effects to trade, there are also negative environmental effects. In the fisheries context, these negative outcomes are widely thought to include overfishing, overcapacity, environmentally destructive harvesting practices, habitat destruction, and the like. The question, then, is how government policies and programs that conform with the WTO's definition of a subsidy contribute to this environmental harm.

As a start, subsidies have to be identified, and this is not an insurmountable task with most explicit and budgeted subsidies, including subsidies in fisheries. These programs are direct and explicit, and generally correspond to the commonly understood notion of what constitutes a subsidy in any economic sector, including fisheries. In this category, we can place grants, loans, loan guarantees, market development, export rebates and bounties, and the like. In each instance, a government financial transfer or support program provides a tangible benefit directly to well-defined recipients. Finally, within this group of direct and widely acknowledged subsidies, the most explicit are those that are budgeted, in particular in the budgets of government agencies responsible for fisheries.

Problems arise, however, when the definition of subsidies in the WTO SCM Agreement is applied to other programs/policies that are fairly widespread in the fisheries sector. The WTO definition of subsidies poses certain problems of interpretation, especially with respect to policies in publicly managed natural resources. The major questions concern the meaning of two Article 1 provisions that define a subsidy as a "financial contribution", where:

- "government revenue that is otherwise due is foregone or not collected (e.g., fiscal incentives such as tax credits)", and
- "a government provides goods or services other than general infrastructure, or purchases goods."

These difficulties of interpretation seem to stem from two sources:

First, the WTO SCM Agreement is not entirely clear about the full meaning of these two subsidiary categories of "financial transfers". Experts have often observed that the fishing industry is notoriously undertaxed, and that tax avoidance is a widespread problem in this sector. At the present time, for example, reports allege that fishery products are frequently traded without the payment of government-mandated charges, including export taxes and customs duties, in Russia's Far East[7] and in China. However, the basic problem with interpreting "foregone or uncollected revenue" is determining to what degree revenue is foregone because of an affirmative government policy to undercharge. Depending on that determination, a given practice is either a subsidy or another example of tax avoidance. Further, "revenue" that is due to governments is a broad concept. Clearly, governments should receive customs duties from seafood importers, value added and sales taxes from seafood dealers, and income taxes from fishermen, but how about user charges, or what we later call "resource taxes" in this paper? Such taxes are an integral element in domes-

[7] Various sources have reported that fishermen and traders have avoided literally hundreds of millions of dollars in export taxes in recent years through a variety of illegal transhipping and exporting activities between Russia and Japan.

tic fisheries policy in New Zealand and Australia, but not in many other countries.

Similarly, there are fundamental problems of interpretation associated with the language on "goods or services other than general infrastructure." Governments typically pay for the basic infrastructure used by fishermen, i.e., ports and landings facilities, and for a wide range of "services", including management bodies and institutional arrangements, stock surveys and assessments, and enforcement of fishing regulations, but, in some countries, the commercial users of domestic fish resources are being asked to pay for some share of these expenditures under "full cost recovery" or "resource rental" policies. If fishermen in country A pay cost recovery fees and their competitors in B do not, does the industry in nation B enjoy an unfair and potentially countervailable advantage? In the final analysis, the "goods or services" issue boils down to resource charges. Those who think that users of publicly managed resources should pay some fair charge for them tend to think that traditional policies of providing access free of charge is or ought to be construed as a subsidy. Those others who rely more heavily on generally prevalent practice, which is not to charge domestic users for access to these resources, dismiss this suggestion, maintaining that government policies on these internal matters should not be constrained by trade laws.[8]

Second, these uncertainties are magnified by the major governmental role in supporting a publicly managed economic sector like fisheries. Recent studies have shown that spending on fisheries programs in the world's major powers typically amounts to 20 to 30 percent of total ex-vessel, or first sale, revenues. The bulk of these expenditures support management, science, enforcement, and the supporting infrastructure.[9] As a result,

[8] Of course, one solution to this fundamental dilemma is to develop a new or altered definition of subsidies for purposes of a fishery, or more generally, a natural resource negotiation. Prospects for such a bold approach do not, at this point, seem promising.

[9] OECD is completing a study on the impact on fisheries resource sustainability of government financial transfers, which will, among other things, analyze further how the OECD Members allocate their fisheries sector budgets to these broad activities.

publicly funded programs play a significant role in determining the availability of fish resources, who may harvest them, how and when they may be harvested, and the conformity of production activities with government regulations. Whatever the objectives and motivation of these government activities, they inevitably have some effect on output and prices, and, therefore, on trade. Oftentimes, the trade effects may be ancillary to some other purpose, but the activities in question may still fall within the boundaries of the WTO's definition of a subsidy.[10]

This dilemma of interpretation can be illustrated specifically. Four examples (and there are others) of fisheries programs/policies that may or may not conform with the definition of subsidies in the WTO SCM Agreement are: (1) the absence of resource taxes, i.e., fees/charges to recover management costs or capture resource rentals; (2) payments by government A to government B to ensure access for A's distant-water fleet in B's waters; (3) fisheries infrastructure, especially port construction and maintenance; and (4) government ownership and management of fishing enterprises.

At the risk of oversimplifying, most proponents of reforming fish subsidies favor a "liberal" reading of Article 1 of the WTO SCM Agreement, arguing that the above programs/policies (and others) should be treated as subsidies, especially if fish subsidies are reformed for conservation as well as trade ends, while the opponents (or doubters) of reform generally prefer a more conservative interpretation of the WTO language, maintaining that these programs, for a variety of reasons, have not been subjected to the disciplines of a trade agreement on subsidies and should not be so constrained in the future. A brief discussion of the debate on these three programs/policies illustrates further the problems of interpretation:

[10] The EU may be said to have pioneered the notion that, in some broad sense, fisheries management actions have trade consequences and should be viewed in a trade context when, during the Uruguay Round negotiations, they argued that (international) access to resources should be effectively treated as a trade issue. The EU, as a distant waster fishing nation that had lost considerable access to foreign resources in the general move to 200-mile EEZs in the 1970s, wanted compensation for this loss of access.

(1) Failure to charge resource taxes

This is almost certainly the most important implicit or ambiguous subsidy, and one that sets fisheries somewhat apart from other economic sectors, including most natural resources.

To begin with, governments obviously have and exercise the right to levy charges on their domestic fishermen as part of a sectoral policy to recover management costs or capture resource rentals. Further, it is the opinion of many experts that such a policy is conducive to sound management and improved economic efficiency in the fishery sector.

But how far can we go with this issue? Is a government's failure to implement such a sound management and economic policy merely an example of its sovereign right to deal with this sector as it sees fit, or can we go further and claim that this failure effectively gives its fishermen an unfair advantage, with possible trade implications? Are uncharged user fees the same thing as foregone or uncollected revenue, and/or are fish resources given away free of charge or at minimal cost to domestic fishermen to be construed as goods or services other than general infrastructure provided by governments? Stated in more practical terms, should we use as our standard generally prevalent practices (low or no fees), or should the standard be the policies advocated by economists, environmentalists, and practiced a handful of "progressive" governments (e.g., domestic fees based on what the resource users would offer in an auction)?

Even if we agree that failure to charge adequate resource taxes constitutes a subsidy, we still have the difficult questions of assessing economic benefits and identifying the beneficiaries. Subsidies must confer benefits and be specific, i.e. they must benefit an identifiable and discrete group. But uncharged resource taxes promote excessive inputs and serve to eventually undermine the economic viability of the fisheries sector, and therefore do not generate "benefits" in the ordinary sense of that term. Instead, these uncharged taxes are effectively a subsidy to current (and excessive) participation in the sector. In other words, they are a subsidy to full

employment in fisheries. It is not at all clear that the WTO can accept such a reading of the requirement that subsidies must confer benefits.

The point is that there is no easy answer to these questions. Neither the WTO SCM Agreement nor GATT jurisprudence addresses this specific question. Therefore, we are left with two opposing views. One school argues that this issue is essentially a matter of domestic sectoral and budget policies; that most governments do not have cost recovery or resource rental programs; that these charges do not constitute any significant share of "government revenue", and that there are few or no identifiable trade impacts. The opposite point of view holds that there is an increasing trend toward these kinds of charges in many countries; that such charges should be held up to a progressive standard; and that, without such charges (and other domestic policies), fish resources are significantly underpriced.

However, this issue involves more than just a theoretical dispute over the standards that governments should implement in the fisheries sector. In the last decade or so, a handful of countries have made real progress on domestic resource pricing, and their fishing industries may arguably have a legitimate complaint on this score. For example, if Australia, which does have a plausible full cost recovery policy in its domestic fisheries, brought a WTO complaint against another Member that does not have such a policy, alleging that the disparity gives that other Member's fishing industry an economic advantage, who can predict with confidence how a Dispute Settlement Body would rule on this point?

(2) Foreign access payments

A handful of governments fund another type of program that may or may not conform with the WTO SCM Agreement's definition of a subsidy: they provide payments or some other economic benefit to another government in exchange for fishing rights for their distant water fleet in the recipient government's waters. Normally, the government providing the payment or benefit is a developed country with a redundant distant-water fleet, and the government receiving the payment is a resource-rich devel-

oping country whose domestic fishermen lack the means or economic incentive to harvest all available fisheries quotas.

The environmentalist critics of fish subsidies have written extensively about these arrangements, and generally consider them to be a particularly obnoxious form of subsidy.[11] In some instances, these access payments allegedly transfer excess capacity from the waters of the country paying for access to the waters of a developing country that receives the payment. The payments support the poorly monitored activities of uncompetitive fleets in foreign waters, compromising the domestic industry's development prospects, the local population's food needs, and even the viability of the resource.

But are access payments in support of distant-water fishing operations a subsidy under the meaning of the WTO SCM Agreement?

Those who maintain that these payments are not subsidies make a number of arguments, some of which are difficult to refute. Access payments are made by one government to another government or to a governmental body, not the sort of transaction that we normally have in mind when speaking of subsidies.[12] The payments often provide badly-needed financial help to a developing country. The payments may be provided in the form of foreign economic assistance, and, whatever they are called, they certainly constitute a "payment" for the resource, something that reformers normally see in a positive light. Finally, the right of resource-rich coastal states to provide these resources to foreign-flag fishing vessels in exchange for access payments seems well established in international fisheries law,

[11] A good example is the World Wildlife Fund's, The Footprint of Distant Water Fleets on World Fisheries (London: WWF, 1998).

[12] There is some disagreement, even among proponents of subsidies reform, over whether a "financial contribution must be provided directly to a beneficiary to qualify as a subsidy under the terms of Article 1 of the WTO SCM Agreement. Some observers believe a direct transfer is required, although the precise language of Article 1 does not explicitly address this point. Obviously, those who believe that access payments are subsidies believe that government payments to other governments may be made on behalf of beneficiary groups in ways that conform with the WTO's definition of a subsidy.

in particular Article 62 of the United Nations Convention on the Law of the Sea (UNCLOS).[13] By extension, under Articles 61 and 62 of UNCLOS, if a distant-water fishing nation subsidizes its fleet's operations in the waters of a resource-rich developing country, the more appropriate remedy is presumably to reduce or deny their continued fishing rights, not to make a trade complaint in the WTO.[14] All these considerations raise troubling and complicated issues. Should WTO law be used to penalize government-to-government transfers that help developing countries with serious foreign exchange problems, are firmly grounded in UNCLOS, and may even begin to address resource underpricing?

On the other hand, access payments may in fact conform with the definition of subsidies in all essentials. The payments are clearly "financial contributions"; they can be interpreted as an implicit "grant" to the distant-water fleet (since, ideally, industry, not government, should pay for access), or as a financial contribution that effectively provides a "good" (i.e., the fish) other than general infrastructure; they certainly provide an economic benefit, namely, access to the fish on favorable terms, and the beneficiaries are a well-defined industry segment and therefore the payments meet the "specificity" test in Article 2 of the WTO SCM Agreement. Finally, access payments arguably have trade consequences. Distant-water fishermen in developed countries whose governments make these payments have an obvious advantage vis a vis fishermen in other countries whose governments are unable and/or unwilling to pay for access to foreign waters. Fish that are harvested with the support of these access payments can be sold in the home market of the distant-water fishing nation or exported to another market, in both cases displacing exports of other WTO Members. Even the WTO Secretariat seems to think that access arrangements may fall within the definition of a subsidy in the 1994 agreement, noting that, under such bilateral access agreements, fishing licenses

[13] Article 62.4 (a), listing the obligations of nationals flying the flag of A while operating in B's waters, includes "... the payment of fees and other forms of remuneration". However, the question which UNCLOS does not answer is: Who pays the fees? The fishermen or their governments?

[14] As suggested in a personal communication by Christopher D. Stone, March 11, 1997.

constitute an indirect subsidy because the cost of the licenses is often undervalued compared to the commercial value of the catch.[15]

The issues surrounding access payments are further complicated by the fact that the "payments" assume many forms. The most common is a payment in explicit exchange for access rights, but, in other instances, the payments may be provided as foreign economic assistance with an ambiguous relationship with the access arrangements. Or the "payment" may be in the form of (1) assistance made available to a distant-water fleet's foreign joint ventures, or (2) a preferential tariff concession that is made available to imports from the recipient country in exchange for access provisions, or (3) government-funded insurance that protects distant-water fishermen from fines and other penalties they may incur in the operations in foreign waters.

However one defines "access payments", it is undeniable that this form of alleged subsidy involves considerable sums of public financial resources. According to a paper prepared by New Zealand and presented at the February 2000 meeting of the WTO Committee on Trade and Environment, the EU and Japan collectively provide almost $600 million of access payments, and, if one adds comparable payments by a handful of other distant-water fishing states, the world total is almost certainly in the neighborhood of 1 percent of global ex-vessel revenues in both inland and marine capture fisheries.[16] If one counts as access payments some of the other, less direct forms given above, the total is probably somewhere between 1 and 2 percent.

In summary, there appears to be a threshold question concerning the conformity of access payments in fisheries with the terms of the WTO SCM Agreement, and then a series of subsidiary questions relating to specific forms of these "payments." Even environmentalists who have urged reform of fish subsidies grant that the applicability of WTO law to this category of assistance is not clear.[17]

This alleged subsidy is one of the most contentious in the fisheries sector for the obvious reason that it pits a handful of developed country governments against another group that wants to challenge this practice, and also divides developing country governments. For this reason, it is entirely possible that WTO negotiations will not resolve the differences, and that a formal legal challenge may be required to obtain a ruling.

In the meantime, governments that provide these payments are considering changes in their policies for internal political and budgetary reasons. Thus, even the defenders of access payments have questions about this policy. The EU, which funds foreign access payments for their distant-water fleet more generously than anyone else, is reportedly carrying out a cost-benefit analysis of fishing agreements with third countries, and intends to announce a new external component of their soon-to-be-revised Common Fisheries Policy.[18]

(3) Fisheries infrastructure

Another ambiguous and potential subsidy is fisheries infrastructure, in particular publicly funded construction, improvement and maintenance of

[15] See WTO, Committee on Trade and Environment, Note by the Secretariat, "Environmental Benefits of Removing Trade Restrictions and Distortions," WTO/CTE/W/67, Part IV, p. 33. In many government-to-government access arrangements, there is a large publicly-funded component and a smaller share paid by the vessel owners. The apparent point that the WTO Secretariat made in this Note is that the industry share is too low, given the benefits (access to fish) they receive.

[16] New Zealand Permanent Mission to the WTO, "Subsidies in the Fisheries Sector: Update on recent Work Conducted by New Zealand," February 21, 2000, lists EU ($350 million) and Japanese ($245 million) access payments that total $595 million. Assuming that access payments provided by a handful of other distant-water fishing nations total another $200 million, the resulting world total is about $800 million. FAO estimates global ex-vessel revenues from capture fisheries at $83.1 billion in 1997, the last year for which they have official data. *FAO Fishery Statistics - Capture Production 1997* (Rome: FAO, 1998).

[17] For example, David Schorr, "Towards Rational Disciplines on Subsidies to the Fishery Sector," in *The Footprint of Distant-Water Fleets on World Fisheries*, (Washington, D.C.: World Wildlife Fund, 1999), on page 153, places access payments in an "uncertain/possibly" category with respect to conformity with the WTO SCM Agreement's definition of a subsidy.

[18] Unclassified cable from U.S. Embassy Lisbon, January 19, 2000.

fishing ports and landing facilities. This category of public works is funded practically everywhere from government resources, and, for that reason, would seem to be exempted from the WTO SCM Agreement's definition of subsidies, because it is "general infrastructure". And as a practical matter, publicly funded fisheries infrastructure is probably more a subsidy to the construction and engineering sectors more than to the fishing industry.

In addition, fisheries infrastructure is funded virtually everywhere by public works agencies and not governmental agencies responsible for fisheries. The major exception is Japan, which categorizes roughly 60 percent of the Fishery Agency of Japan's annual $4 billion budget under the heading "infrastructure". In other WTO Members, however, fisheries experts probably do not even have a rough idea of how much is spent on infrastructure.[19]

Trade experts advise that it is extremely difficult and rare to attack infrastructure projects under these rules. To be treated as a subsidy, a publicly funded infrastructure project would have to be designed to benefit a single firm or small group of firms with the clear intent of providing a special and unusual advantage.

In the fisheries sector, however, an argument could be made that ports and landings facilities play a unique and vital role. Modern and updated facilities promote fishing effort, and their capacity and location may influence significantly the economics of harvesting operations. Larger boats may be accommodated, and the length and distance fishing trips may be appreciably shortened.

In short, a government's policies with respect to fisheries infrastructure may have the effect of boosting effort and investments, and promoting a level of operations that exceed the capacity of the resources. Some experts in development lending institutions believe that infrastructure is a significant category of fisheries subsidies in developing countries and in countries with statist economies.

[19] This is certainly true of the United States. The expert task force that recently completed the Congressionally mandated Federal Investment Study had no success with this issue.

(4) State ownership and management

In the course of the debate on fish subsidies, little has been said about state ownership and management of fishing enterprises as an important category of subsidies in this sector. Nor is it difficult to see why. This form of statist intervention in the fisheries sector has diminished greatly in the last few decades, in particular in Russia and the Soviet Union's former East European client states, and in developing countries, especially in Latin America. However, one other soon-to-be WTO Member, the PRC, continues to maintain a large statist sector in agriculture and fisheries, and, therefore, this remains a relevant issue. In fact, the PRC now produces almost 40 million tons of fish and shellfish annually through aquaculture and capture fisheries operations, almost one-third of total global output. In capture fisheries, the PRC's annual harvests are more than twice as great as Japan's.

Not surprisingly, little is known for sure about fish subsidies in the PRC, but occasionally some pertinent information leaks. At a workshop organized by the Pacific Economic Cooperation Council in Manila of August 1998, the PRC delegate presented a paper noting that, in the 1993 to 1997 period, the government funded approximately 10 percent of all "investments" in the fisheries sector.[20] This figure undoubtedly applies to direct, budgeted "investments" and does not include unbudgeted outlays, including soft money, tax breaks, and the like. Also in 1998, China's largest deep-sea fishing firm, the China National Fisheries Corporation's Offshore Fisheries Co., aided by "the support of government policy," raised a large sum on the stock exchange to fund, among other things, the purchase of "more fishing boats to expand overseas fishing capacity.[21]

The most difficult question is how to assess the favorable terms reportedly extended to the large state-owned and cooperatively-managed sector. Although the general liberalization drive that began in the late 1970s has brought about important changes in PRC fisheries, even recent reports

[20] Li Yingren, "Function of Governmental Investment in Fishery Production: China," in *PECC Workshop on Financial Transfers.*

[21] As reported in *Pacific Rim Fisheries Update*, Vol. 7, No. 32 (March 1998).

suggest that the state-owned sector continues to suffer enormous but impossible-to-quantify losses.[22] An unclassified U.S. Government intelligence report on trends in China economy (1995-1997) estimated that "excess capacity and rising inventories have contributed to deteriorating state enterprise performance," and that at least 40 percent of these state enterprises were operating in the red in 1995 and 1996.[23] But how are these losses covered? Note that Article 6 of the WTO SCM Agreement provided (before it lapsed at the end of 1999) that "(s)erious prejudice shall be deemed to exist in the case of: (b) subsidies to cover operating losses sustained by an industry," and "(d) direct foregiveness of debt, i.e., foregiveness of government-held debt, and grants to cover debt repayment."[24]

Aside from the above tests of serious prejudice, the WTO SCM Agreement does not address state ownership subsidies in great detail, in large part because WTO Members are all market economies that rarely resort to this form of intervention, while those few nations that do practice state ownership and management on a large scale tend not to be WTO Members. In the case of the PRC, however, we have a huge nation that will soon join the trade body and that accounts for an enormous share of fisheries production.

Article 1 of the WTO SCM Agreement includes "equity infusions" paid by governments as an example of a direct financial contribution, and the GATT does devote Article XVII to "State Trading", imposing an obligation that such entities conform with "general principles of non-discriminatory treatment" but these rules probably do not go far enough. More helpful is Article 14 of the WTO SCM Agreement providing that, for purposes that of determining the existence of a "benefit", the provision by governments of equity capital shall not be considered as conferring a benefit "... unless the investment decision can be regarded as inconsistent with the usual investment practice (including for the provision of risk capital) of private investors in the territory of that Member".

However complicated the task of analysis, state ownership and management has to be considered a major category of fisheries subsidies solely because of the PRC's dominant position among the world's fishing powers. The danger is that, if the PRC's fishery sector somehow escapes such disciplines, the result could be a seriously unbalanced WTO sector-specific agreement.

In summary, there are clearly major problems of interpretation in applying the WTO SCM Agreement to the fisheries sector. For the most part, the debate is between two groups, one arguing for a conservative and narrow interpretations of Article 1 of the WTO SCM Agreement, and the other taking a more liberal and expansive view. Perhaps unfortunately, there are still more extreme views. Japan has openly questioned whether the provisions of the WTO SCM Agreement even apply to fisheries, and submitted comments stating that "the present WTO Agreement on Subsidies and Countervailing Measures does not provide measures on the discipline of fishery subsidies," and "the issue of fishery subsidies exceeds the framework of the existing Agreement".[25]

A broad or narrow approoach to reform?

Many people naturally assume that, if there are legitimate concerns about the trade and/or conservation effects of fish subsidies, those concerns should be directed exclusively at those subsidies that are provided to the fishing industry, and not to other economic sectors. This sectoral perspective is reinforced by the fact that most government experts involved in the debate on fish subsidies are employed by agencies responsible for fisheries.

[22] In an article entitled "Chinese Puzzle" by Sebastian Mathew, the Executive Director of the International Collective in Support of Fishworkers, in SAMUDRA, No. 24 (December 1999), pp. 45-49, based on a recent field trip to Beijing and Shanghai, Mathew states that "(t)he State-owned (fishing) enterprises are operating at tremendous losses because of decline in production and high operational costs of large fishing vessels."

[23] U.S. Central Intelligence Agency, China's Economy in 1995-1997 (APLA 97-10008), December 1997, esp. pp. 3-6.

[24] WTO SCM Agreement, Article 6 (Serious Prejudice), (b) and (d).

[25] Japan's Comments on the Fisheries Subsidies Proposal submitted by Australia, Iceland, New Zealand, Norway, Peru, Philippines, and United States, September 1999.

In addition, much of the discussion of the allegedly negative effects of fish subsidies has been driven by mounting concerns about their impacts on wild stocks. Therefore, within the fisheries sector, the debate on subsidies has emphasized the impacts on resources of subsidies provided to fishermen. Alternatively, assistance given to other sub-sectors, such as seafood processors and fish farmers, have received less attention. This narrow focus within the fisheries sector may, however, be unfortunate because subsidies provided to all sub-sectors, including processors and aquaculturists, probably have indirect implications for the status of the wild stocks.

However, the fisheries sector cannot be separated from other economic activities, and, therefore, government programs that subsidize these activities inevitably have spill-over effects on fish resources and habitats and on the key capital asset used by the fishing industry, i.e. fishing vessels. Hence, any comprehensive attempt to assess the effects of subsidies on fishery trade and resources should ideally take into account these "cross-sectoral" subsidies. The WTO Secretariat implicitly prefers a broad approach, as evidenced by a March 1998 Note on fish subsidies that organized them in four categories, including subsidies provided to (1) harvesters, (2) the shipbuilding industry, (3) the seafood processors, and (4) fisheries R&D and marketing.[26]

In conclusion, the problem of "cross-sectoral" subsidies has two components. First, more attention should be paid to subsidies provided to the entire fisheries sector, in particular subsidiary sectors such as processors and fish farmers. Second, governments should acknowledge mounting evidence that certain categories of "cross-sectoral" subsidies have meaningful implications for fisheries, including subsidies provided to:

- shipbuilding
- port and harbor construction and maintenance
- riverine transportation

[26] World Trade Organization, Committee on Trade and Environment, Note by the Secretariat, "GATT/WTO Rules on Subsidies and Aids Granted in the Fishing Industry," March 9, 1998

- agriculture, especially wetlands modification
- forest products

Questions surrounding the overall environmental desirability of subsidies provided to fish processors and farmers are exceedingly complex, but they should be addressed more explicitly than they have so far, either in the academic literature or international governmental meetings.

The more troublesome and contentious of the two is probably subsidies to promote aquaculture.

From a trade standpoint, it seems obvious that subsidies provided to aquaculture should be treated as subsidies to any other sector. Farmed shrimp, salmon, and shellfish are major traded seafood commodities. In fact, during the last decade, the two best known fisheries sector countervailing duty actions were levied pursuant to disputes over salmon farming (the CVDs implemented by the United States and the EU against Norway and Chile). From a broader fisheries perspective, aquaculture's global role in production and trade has grown impressively. In 1998, the latest year for which FAO has preliminary data, marine and freshwater aquaculture accounted for almost one-third of total production of fish and shellfish.[27]

Unfortunately, relatively little has been written on levels of subsidies provided to aquaculture. On the one hand, we may infer from trade cases brought by the United States and the EU against Norway and Chile, and from U.S. industry complaints about subsidized shrimp aquaculture that the global levels of subsidies to fish farming are probably rather modest. In the U.S. case against Norway's salmon farming industry, only a 2.3 percent countervailing duty was imposed., and in the EU's case, just 3.7 percent.[28] Still, it seems that some countries subsidize aquaculture more than others. The EU appears to subsidize is salmon aquaculture industry in Scotland (UK) more generously than their U.S. and Canadian counterparts.[29] And in

[27] FAO, Committee on Fisheries, "Expert Consultation on the Proposed Subcommittee on Aquaculture of the Committee on Fisheries", January 2000.

[28] *INFOFISH International*, 4/97, p. 7.

Ireland, for example, there has been a massive shift in the last two decades of fishery sector subsidies away from boats and toward land-based activities, of which the chief beneficiary has been the Irish fish farming industry.[30]

The most difficult question is sorting out aquaculture's positive and negative contributions to sustainability, and, on this issue, we are confronted with a bewildering array of often competing and conflicting allegations.

On the one hand, government policies that promote aquaculture, including by means of subsidies, may have beneficial impacts on the sustainability of the wild stocks. Aquaculture provides another source of supplies, and may serve to dampen prices that, in the absence of the cultured supplies, would increase and stimulate additional effort by fishermen. The strong growth in U.S. imports of cultured shrimp in the last two decades appears to have had some price restraining effect. In a broad sense, subsidies to aquaculture may have the positive effect of easing the transition away from capture to culture fisheries, with benefits to both. An excellent example is British Columbia (Canada), which, in the decade from the late 1980s to late 1990s, has witnessed its aquaculture crop steadily grow and exceed the value of its capture fisheries.[31] Similarly, salmon farming now outpaces capture fisheries as an economic activity in coastal Norway.[32]

On the other hand, subsidies that promote environmentally unsustainable aquaculture could have unfortunate effects on the wild stocks and their habitats. Referring again to the example of shrimp aquaculture, it has been alleged by some environmentalists that the environmental damage caused by shrimp aquaculture outweighs the benefits. In summary, the trade effects of subsidies to aquaculture are basically the same as in any other sector, but the environmental effects are numerous, complicated, and hard to assess.

Subsidies paid to seafood processors are probably less complicated and contentious. Clearly, these subsidies may have harmful trade effects, and may also encourage a build-up of excess processing capacity that has the ancillary effect of encouraging additional fishing effort.

Finally, it is increasingly apparent that "cross-sectoral" subsidies may have meaningful impacts on resource sustainability, and, for that reason, should not be overlooked by reformers. Recent U.S. experience is highly relevant. In the 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act, the U.S. Congress mandated the so-called Federal Investment Study, to assess the influence of government subsidies and other programs on levels of capacity and capitalization in the U.S. domestic fisheries. This study was completed in 1999 by a Task Force of non-government experts, and the report concluded, among other things, that subsidies provided to river transportation, hydroelectric power, the woods products industry, and agriculture contributed to significant harmful impacts on fish resources and habitats, especially in the Columbia River basin, the Mississippi River delta, and the Florida Everglades. The Federal Investment Study termed these programs "negative" subsidies (from a fisheries perspective). That is, subsidies to these other non-fishery activities may have promoted navigation on the Mississippi, hydro-electric power generation and logging on the Columbia River, and sugar cane farming in the Everglades but at the expense of the local fish resources and their delicate ecosystems. In the view of the Task Force, subsidies contribute to overcapacity in fisheries not simply by reducing fishermen's costs but also by taking away their fish.[33]

[29] D. Jarvinen and G. Magnusson, "Public Resources for Private Mariculture: Northeastern United States, Atlantic Canada, and Scotland after NAFTA and GATT," *Marine Policy*, 24 (2000), pp.21-32.

[30] Villi Wiium, "Subsidies in Irish Fisheries," in *Overcapacity, Overcapitalisation and Subsidies in European Fisheries:* Proceedings of the first workshop held in Portsmouth, UK (October 28-30, 1998) (hereinafter cited *EU Workshop on Capacity*,) p. 157-165, states that approximately 50 percent of total fishery subsidies presently go to aquaculture..

[31] As reported in *INFOFISH Trade News*, January 17, 2000. This reversal reflects tremendous increases in the volume and value of farmed salmon.

[32] FAO INFOFISH Trade News, February 16, 2000.

[33] Federal Fisheries Investment Task Force Report to Congress (Washington, D.C.: National Oceanic and Atmospheric Administration, July 1999), especially Chapter V "Habitat and Ecosystems", pp. 47-57.

Once we grant the relevance of these "cross-sectoral" subsidies, the practical problems just begin, two of which are worth noting.

First, and most fundamentally is the problem of how to deal with the adverse fisheries effects of subsidies provided to sectors other than fisheries. It is highly unlikely that these "cross-sectoral" subsidies will be formally included in multilateral fisheries negotiations, and much more likely that they will be addressed, if at all, in negotiations dealing with shipbuilding (or maritime transportation), agriculture, and forest products. Therefore, one task facing negotiators of a future WTO fisheries agreement will be to bring certain fisheries-related environmental concerns to other WTO sectoral negotiations. Given the normal and perhaps growing tendency of multilateral trade negotiations toward sectoral compartmentalization, this will not be an easy task.

Secondly, most nations can more easily deal with the adverse effects on fisheries resources and habitats of non-fisheries sector subsidies through domestic reform rather than international negotiations. Hence, to the degree that countries are serious about comprehensively reforming subsidies that negatively affect fish resources and habitats, that reform program will almost certainly include a strong domestic component.

Is there such a things as a "good" subsidy in fisheries?

The debate on subsidies in fisheries has spawned two subsidiary questions: what are the harmful and undesirable subsidies, and what others, if any, are "good" subsidies and may therefore be formally permitted and even encouraged in international law. In the technical literature, "good" subsidies are often referred to as "environmental", "conservation", "capacity-reducing" or even "desirable" subsidies, but, perhaps unfortunately, the public debate has all too often used the terms "good" and "bad".[34] Arguments about these "good" subsidies have focused largely on government payments to fund fishing vessel or permit buybacks, or, put in other terms,

[34] One of the first public assertions of the need to distinguish between desirable and undesirable subsidies in fisheries was made by the EU at the April 1997 meeting of the Commission for Sustainable Development in New York.

capacity reduction programs. In large part, this emphasis on government-funded buybacks reflects, first, concerns that the EU and other governments, including Japan and the United States, have publicly expressed, and, second, the simple fact that the recent trade-and- environment debate on subsidies in fisheries has singled out the overcapacity problem.

Still other government-funded programs in fisheries may qualify as "good" subsidies, or, alternatively, not be counted as subsidies at all. Examples are publicly supported resource enhancement (fish hatchery) programs and artificial reefs, and government support for R&D and purchase of "clean" harvesting technology.[35]

Finally, there are various types of adjustment assistance, as administered in the EU, or disaster relief, as we have in the United States, or the analogous programs in Atlantic Canada, that are usually intended to aid fishing communities that are adversely affected by resource downturns and generally to ease the transition to sustainable fisheries. Elements of these programs could in theory be interpreted as income supports and therefore qualify as subsidies, but, in other respects, these programs may not conform with other provisions in the WTO SCM Agreement.[36]

To further confuse the issue, various experts have proposed even more novel means that may contribute to fishing effort and capacity management, or, more generally, to the achievement of sustainability, which also may appear to some to be potentially "permissible" subsidies. For example, a Dutch academician recently proposed that EU fisheries management could be significantly improved by a mixed regime of individual transferable quotas, value added (sales) taxes, and government-funded premia paid to fishermen for under-quota harvests.[37] The rationale for the three-

[35] One rationale for not classifying the above programs as subsidies is that they are increasingly widely practiced and, therefore, a normal management program that falls under "general infrastructure" in fisheries.

[36] The link between adjustment assistance in fisheries and adverse trade effects may be particularly weak.

[37] Tsjalle van der Burg, "Neo-classical economics, institutional economics and improved fisheries management," Marine Policy, 24 (2000), pp. 45-51.

part proposal is that the premia would offset the political, enforcement, and transaction costs associated with implementing the ITQs and value added taxes. But the government-funded payments are clearly financial contributions paid directly by government to a distinct group of beneficiaries, and they certainly confer an economic benefit. Are these premia therefore "good" subsidies, because their overriding intent is to foster "improved management"?

The argument that these and perhaps other categories of fish subsidies should be set aside and treated as permissible measures rests essentially on a distinction between environmental objectives and economic effects. Proponents of "good" subsidies generally maintain that government-funded programs that are intended to reduce overcapacity, enhance the resource, promote the development and adoption of clean technology, and facilitate adjustment to stricter management regimes have non-trade and praiseworthy goals, and can ease the fisheries sector's transition to a more sustainable state. Stated succinctly, such "subsidies" are essentially conservation, and not trade or marketing programs. Therefore, WTO trade rules should not be construed to limit the rights of governments to move their fisheries sectors in a positive, more sustainable direction.

On the other hand, critics of "good" subsidies make three general points.

First is the argument that, whatever their motivation, allegedly "good" subsidies may also have undesirable economic and trade effects. Buyouts are normally designed at least in part to improve the economic status of fishermen who remain in the bought-out fishery; fish hatcheries result in increased catches and may therefore implicitly constrain imports; government payments for R&D in clean technology reduce industry's costs, since, in theory, fishermen should pay for their own gear. In fishing capacity reduction subsidies, the owners of boats that remain in the fishery will face fewer competitors, at least in the short run, and will presumably be more viable economically. If the government's buyout policy becomes or appears to be permanent, rather than a one shot affair, the fishermen's banks, perceiving a reduced risk, may be persuaded to extend loans on more favorable terms to those who remain in the fishery. Thus, "good" subsidies, although put in place mainly for environmental reasons, are not necessarily neutral with respect to trade effects.[38]

The second broad argument against "good" fish subsidies is that they are generally not an effective means to achieve the capacity reduction goal. In the case of government-funded fishing vessel buyouts, risk is reduced and perverse economic incentives thereby encouraged.[39] More precisely, boats that remain in bought-out fisheries have an added incentive to increase effort and investments through "input stuffing", and fill a newly created void in the fishery.[40] Even more fundamentally, capacity reduction subsidies are hard to administer effectively. In some EU Member States, for example, while policymakers in Brussels insisted increasingly from the mid-1980s on capacity reduction, the Member State governments continued to support new construction and modernization. In France's northern fishing industry, EU directives against subsidizing new vessels were effectively undercut by national subsidies for the purchase of used, second hand vessels.[41] As with many government-funded programs, the benefits

[38] On the other hand, these kinds of "subsidies" have not prompted a barrage of trade-inspired complaints. Criticisms of these programs have stressed their inefficiency and the alleged fact that they tend to leave fundamental problems unaddressed.

[39] This criticism of "good" subsidies seems to be increasingly widely accepted by experts. The EU-sponsored October 1998 conference dealing with "the future economic management of Europe's fisheries" concluded that "managers imposing fleet cuts should act to correct the perverse incentives that arise from a lack of well-defined property rights in the fishery (and) that repeated buy-back programmes are likely to significantly reduce the investment risk and so encourage excessive capacity." Aaron Hatcher, "Summary of the Workshop on Overcapacity, Overcapitalisation and Subsidies in European Fisheries," *EU Workshop on Capacity*, p. 1.

[40] This basic point has been made by many experts, and just one is Jan Willem de Wilde, in whose study on fisheries restructuring policies, "Effects of Subsidies on the Distant Water and Coastal Fisheries of the Netherlands", in EU *Workshop on Capacity*, the author states on p. 134 that "(s)ubsidies for building new fishing boats almost inevitably result in capacity increases, even when a simultaneous decommissioning of equivalent capacity is required."

[41] Jean Boncoeur et al., "Assessing the Influence of Investment Subsidies on the Solvency and Viability of the Firms in the Fishing Industry: The Case of the French Fleet Operating in the English Channel Fisheries," in *ibid*., pp. 187-199.

tend to flow to industry groups (fleet sectors) who have the most political influence with budget-voting legislative bodies, as opposed to the fleet sectors that have the greatest need. Hence, capacity reduction subsidies encourage some of worst kinds of rent-seeking behavior in industry.

Even when capacity reduction subsidies achieve their stated goals, there is some tendency to question their ultimate effectiveness. In the EU, for instance, more than a decade of publicly funded capacity reduction plans (effected through the Multiannual Guidance Programmes) have reduced EU-wide capacity levels in terms of tonnage and engine power but manifestly have not had equal success in improving the underlying viability of Europe's fisheries. Paradoxically, the Netherlands has made much more progress than other EU Members in adopting "incentive adjusting" mechanisms, but has fallen far behind its capacity reduction targets.[42]

Third, capacity reduction subsidies have a tendency to "leak", i.e., they effectively result in a spillover of excess capacity into other, often overfished fisheries. In too many cases, bought out fishing vessels become redeployed in other overfished fisheries. If vessels are bought out in country A and are redeployed in country B, the problem is suddenly no longer just a domestic matter, but assumes an international dimension.

Fourth and finally, there are more practical, trade policy-related reasons for exercising caution with respect to "good" subsidies. If certain kinds are subsidies in fisheries are formally recognized to be "good", some governments will want to green-light them, and this presents a problem, particularly given the fact that all the "non-actionable" subsidy categories lapsed at the end of 1999. Even more fundamentally, many experts in the trade

[42] Aaron Hatcher, "Subsidies for European Fishing Fleets: The European Community's Structural Policy for Fisheries, 1971-1999," *Marine Policy* 24 (2000), pp. 129-140. Hatcher concludes on p. 139: "What does not appear to have been seriously questioned within the Community institutions, however, is whether the sort of planned and administered fleet adjustment programmes which now form a key part of Community fisheries policy are an appropriate means to tackle the apparent over-exploitation of fish stocks in Community waters."

community are not convinced that any "non-actionable" categories serve a practical purpose. Thus, in June 1999, when the U.S. trade agencies filed their annual report to Congress on the operation of the WTO SCM Agreement, the authors had to note that "(t)o date, there have been no subsidies notified to the (Subsidies and Countervailing Measures) Committee as green light subsidies."[43]

On the other hand, the debate over "good" subsidies and how to deal with them has been one of the most lively subsidiary issues argued on both sides. Accordingly, there is a contrary point of view, i.e., that any acceptable world agreement on fish subsidies has to explicitly deal with set-a-sides.

Those who support setting aside certain categories of subsidies can claim that it has not been demonstrated that these subsidies inevitably have to fail, and they may, if properly designed and implemented, play a useful role in a larger transition policy. Some experts continue to maintain that capacity-reduction subsidies may have a salutary effect, if combined with proper management. Decommissioning programs may help "jump start" a move to implement rational management, as in New Zealand in the 1980s, or may help "speed up and enhance the adjustment process," as in the case of the Development Fund of Icelandic Fisheries.[44]

The defenders of "good" subsidies also argue that their benefits include public as well as private goods, and therefore that the fishing industry should not be expected to pay their entire costs. Surely, capacity reduction subsidies, if well implemented, may help promote resource sustainability, which the general public supports; and resource enhancement subsidies, such as fish hatcheries, help fishermen but also generate a public good. Public funds spent to assist fishermen in the installation of turtle excluder

[43] U.S. Department of Commerce, *Report to the Congress: Review and Operation of the WTO Subsidies Agreement*, June 1999.

[44] Olafur Orn Klemensson, The Development Fund of the Icelandic Fisheries: Objectives, Activities, and Impacts," in *UK Workshop on Capacity*, pp. 226-233. To be fair, this Fund was paid for by industry but was organized and legislated by the Icelandic Government.

devices may be a subsidy in some sense, but such a program will presumably contribute to the conservation of endangered sea turtles, an objective in which there is a manifest public interest. The point is quite simple: "good" subsidies serve public ends more than "bad" (capacity and effort enhancing) subsidies, and, to some degree, they are not really subsidies in any pure sense.

Proponents of "good" subsidies may in addition argue that this debate has focused too narrowly on the merits and demerits of capacity reduction subsidies, neglecting other "good" subsidies such as resource enhancement, the construction of artificial reefs, and public support for the development and installation of clean harvesting technology. In other words, while it is probably true that the environmental benefits of capacity reduction programs can easily be dissipated, those same criticisms seem to have less force with respect to fish hatcheries and the like. Put simply, although there may be many practical disadvantages associated with vessel buyouts, those shortcomings may be unique to capacity reduction subsidies, essentially because of the common pool problem. Surely, publicly supported efforts to increase the availability of fish resources and to reduce bycatch levels in commercial fisheries are laudable government activities that should not be excessively constrained by trade law.

Finally, there are also political realities. It seems highly unlikely that the EU, the United States, and Japan, and others will ever agree to a WTO reform of fish subsidies that significantly compromises their ability to fund and implement capacity-reducing, resource-enhancing, and disaster-relieving subsidies. What's more, subsidies alleged to have good or permissible effects seem to be increasing in the developed world. These same countries will not reduce or forbid them, but may be willing to apply appropriate standards and criteria to their design and administration.

The debate over "good" subsidies leaves reformers in a dilemma. Broadly speaking, there appear to be three solutions: (1) treat them like other subsidies and include them in a WTO negotiation, which would satisfy the purists; (2) create a new "non-actionable" category for fish, explicitly removing them from negotiations, a hard sell with trade experts and agencies who are understandably uncomfortable with exceptions; or (3) simply set them aside, to be addressed as "actionable subsidies" under the rules and disciplines of the WTO SCM Agreement, essentially a "do nothing" option, since this is presumably where we are now.

What are the effects of subsidies on trade and conservation?

Perhaps the most complicated question in the debate on fish subsidies is how to sort out and possibly distinguish between their effects on trade and conservation.

Unlike the three broad questions discussed previously in this paper, interpretations are not neatly divided in two opposing camps. Rather, there is a general tendency among proponents of reform to argue that negative trade and conservation effects of fish subsidies are considerable and basically identical, or flip sides of the same coin,[45] while opponents and doubters of reform normally minimize and segregate these adverse effects, apparently considering that just a small sub-set of fish subsidies have negative trade consequences and another small number may be harmful to resources.

There also seems to be fairly widespread agreement that the precise effects of subsidies depend on the management environment, but little accord on precisely what sorts of management measures can effectively insulate subsidized fisheries from harmful effects. Closely related to questions about the alleged adverse effects of subsidies is the suggestion that the controversy over subsidies has inappropriately slighted other, more consequential factors, like ineffective management, illegal fishing, operations of Flags of Convenience vessels, and the absence of well defined and enforced harvest rights in the fisheries sector.

Some degree of uncertainty about trade and conservation effects even

[45] A good example of this pro-reform view is Gareth Porter, *Fisheries Subsidies, Overfishing, and Trade* (Geneva: United Nations Environment Programme, 1998).

exists among different proponents of subsidies reform. At the risk of oversimplifying, the coalition of forces supporting reform include environmentalist organizations who stress conservation implications and a handful of WTO Members who are motivated by both and trade and environmental considerations. This mix of motivations was reflected in the draft WTO Seattle Ministerial text on fish subsidies, which referred to: "... certain subsidies that may contribute to overcapacity in fisheries and overfishing or cause other adverse effects to the interests of Members,." and that contribute to "... overcapacity in fisheries and overfishing, or have trade distorting effects".[46]

There are serious questions about assessing and measuring these effects. Monetizing subsidies is an inherently treacherous task. Information is often simply unavailable; monetizing the unbudgeted subsidies is difficult; and WTO notifications under Article 25 of the WTO SCM Agreement are uneven and, in some cases, offer no or little information on their monetary values.

To a considerable degree, different assessments of effects reflect different interpretations of what constitutes a subsidy. If one holds to a narrow and conservative reading of the WTO SCM Agreement and treat as subsidies only those support programs that are direct, budgeted, and explicit, the result will probably be a global incidence of subsidies of, say, about 10 percent. At the other end of the spectrum, those who interpret the WTO more liberally, counting resource underpricing (domestic resource taxes and access payments) and other implicit forms of support as subsidies, will get a much higher estimate of global subsidization, perhaps as high as 20 to 25 percent. This higher estimate will naturally justify more significant trade and conservation effects.

Clearly, a discussion of these issues in just a few pages can not resolve these questions, but can hopefully summarize the contending views in a fair-minded way, and at least place them in a meaningful context.

[46] WTO, Draft (Seattle) Ministerial Test, December 1999.

(1) Effects on Trade

A reasonable and fair-minded observer would have to conclude that a category of government programs that reduce operating (variable) and capital (fixed) costs and, to a lesser degree, enhance revenues would have to have some discernible effects on prices and therefore on trade. Determining those impacts more precisely, however, presents serious problems. Even environmentalists who urge reform of fish subsidies have allowed that they do not have firm any answers.[47]

There is no doubt that trade plays a major role in world fisheries. World trade in fish and fish products totals about $50 billion annually, or almost 40 percent by volume of global harvests (when the traded commodities are converted to live weight equivalents). This amounts to 11 percent of the value of world agricultural trade and 1 percent of total merchandise trade.[48]

However, measuring the adverse trade effects of subsidies is an inherently complicated task. The WTO SCM Agreement applies various "thresholds" of adverse trade effects, some of which can only be applied on a case by case basis. To begin with, "prohibited", or trade-contingent subsidies do not require a test of effects, but should simply be eliminated. On the other hand, "actionable"subsidies, i.e. all subsidies that are neither "prohibited" nor "non-actionable" require tests of effects. Accordingly, adverse effects exist when subsidies provided by a WTO Member cause "injury to the domestic industry of another Member," "nullification or

[47] See, for example, David Schorr, in "Towards Rational Disciplines on Subsidies to the Fishery Sector," in *The Footprint of Distant Water Fleets on World Fisheries* (World Wildlife Fund, 1999), who states on page 149 that "... the trade consequences of subsidies are even less well documented than the environmental consequences, and in some cases are more speculative". Or consider Gareth Porter, *Fisheries Subsidies, Overfishing and Trade* (Geneva: UNEP, 1998) on p. 58: "The extent to which fisheries subsidies distort trade in fish and fish products has never been systematically analyzed."

[48] Izzat H. Feidi (FAO Fisheries Industries Division), "Expected Trends in Fish Production, Utilization, and Trade," presented at the 5th North Pacific Rim Fisheries Conference, Anchorage, Alaska, December 1-3, 1999.

impairment of benefits", or "serious prejudice". Until recently[49], the last test, "serious prejudice", could have been proved several ways, but one such proof involves a purely quantifiable exercise, with "serious prejudice" deemed to exist in the case of "the total ad valorem subsidization of a product exceeding 5 percent".[50] Note that the 5 percent subsidization test applied to specific products. Arguably more important is the fact that the 5 percent "serious prejudice" test did not require an explicit showing of trade harm or distortion. Hence, the easy answer to questions about the trade effects under WTO law of fish subsidies is that such effects have to be determined case by case and product by product.

Recent countervailing duty investigations (CVD) conducted by WTO Members do not offer much guidance. In fact, the WTO Secretariat advised in 1998 that only two CVD investigations had been conducted since 1987 with respect to wild-caught fish and fish products.[51] In 1986, the United States had decided, in a case brought by New England groundfish fishermen against Canada, to levy a countervailing duty of 5.82 percent, but this complaint addressed practices in place a decade and a half ago.[52]

Nor do non-government studies and reports shed much light on the strictly trade implications of subsidies in fisheries. It has been suggested that subsidies tend over the short term to encourage overproduction and reduce prices, but that they eventually serve to depress resources, constrict supplies and therefore promote prices increases.[53] However, case studies on the trade effects of subsidies are rare.

[49] The "dark amber", or "serious prejudice" test, including the 5 percent subsidization threshold, lapsed at the end of 1999.

[50] WTO SCM Agreement, Part III (Actionable Subsidies), Articles 5 and 6.

[51] The two CVD investigations were carried out by the United States and Australia. WTO, Committee on Trade and Environment, Note by the Secretariat, "GATT/WTO Rules on Subsidies and Aids Granted in the Fishing Sector," March 9, 1998.

[52] Certain Fresh Atlantic Groundfish from Canada, 51 Fed. Reg. 10041 (1986).

[53] Presentation by Marshall Moffat (Canada DFO), "Fisheries Management and International Trade," at the November 24-26, 1996 symposium on fisheries management and trade at Wellington, New Zealand. There was a lively discussion at this meeting of whether subsidies tend to increase or decrease fish prices.

A recent highly preliminary analysis conducted by an organization specializing in international environmental law focused on two possible fish subsidies cases: a possible Namibian complaint against EU subsidies to the Spanish fishing industry and a complaint by one or more Pacific Island nations against Japanese subsidies to its tuna longlining fleet.[54] This draft feasibility study tentatively concluded that there may exist a legal basis for a Namibian challenge against Spain and the EU but not for the Pacific Island nations against Japan. Namibia seemed to the FIELD researchers to offer better prospects because that African nation manages its fish well; has no access agreement with the EU; and has a resource, Cape hake, whose exports to Europe are at least allegedly hindered because Angola and Argentina can sell hake to Europe on more favorable terms. In both the Namibian and Pacific Island nation examples, the researchers examined data on prices as tests of whether Spanish- and Japanese-harvested product enjoyed a countervailable advantage, and in neither case did the researchers even suggest any quantified estimate of EU or Japanese subsidies.

Against this background of sparse information and analysis, are there any more broadly applicable statements that can be made, however tentatively, about the adverse trade effects of fish subsidies?

Assessing the global (or even the regional or national) effects of fish subsidies on trade is, by definition, almost an impossible task. One fundamental problem is that, with relatively few exceptions, subsidies provided to the fisheries sector tend to be programs that directly and indirectly support fishing operations rather than export promotion activities. In fact, subsidies explicitly designed to promote exports or inhibit imports of fish products are, according to the secondary literature, fairly rare.

Nevertheless, we may reasonably infer from available evidence certain general observations about the economic and trade-related effects of subsidies.

[54] Foundation for International Environmental Law and Development (FIELD), "Challenging Environmentally Harmful Government Subsidies through the WTO Dispute Settlement Procedure: Feasibility Study of the Fishery Sector," 1998.

First, although these adverse trade effects manifest themselves with respect to specific products traded between certain WTO Members, a few generalizations may be made about the incidence of fish subsidies globally. If we take a conservative view of subsidies, confining the definition to non-controversial subsidies (essentially, grants, soft loans and loan guarantees and tax programs), we would probably have an aggregate or global level of subsidization in the neighborhood of 10 percent.[55] Obviously, this figure would vary considerably from product to product and from nation to nation, but 10 percent is a defensible, bottom line global estimate that includes only the direct and explicit subsidies.

Second, and alternatively, if we include all the implicit, indirect, and ambiguous subsidies in our total (especially the absence of resource taxes, access fees, subsidies to shipbuilding and "good" subsidies), the global level of subsidization could be as high as 20 to 25 percent.

Third, it appears that subsidies in fisheries distort trade by suppressing costs more than by increasing prices and therefore revenues.

Fourth, subsidies may have relatively greater trade distorting effects in the distant-water fishing sector. Given the apparent higher-than-average incidence of subsidies in the distant-water fleet sector, it follow that trade in fish product harvested in distant water fisheries (tuna, cephalopods, and some groundfish) is more influenced by subsidies than trade in products of coastal fisheries. It is revealing that EU harvests in waters of "third countries" with which Brussels has concluded access agreements accounts for about 20 percent of total EU production of fish and shellfish.[56]

[55] This 5 to 10 percent range is broad but conservative, and compatible with recent FAO estimates of the probable global incidence of subsidies in fisheries. See Ulf N. Wijkstrom, "Global Overview of Fisheries and the Subsidies Issue," in *PECC Workshop on Financial Transfers*. Wijkstrom suggests a global figure of "just under $10 billion per year," which works out to about 12 percent FAO's reported aggregate first-sale revenues.

[56] European Commission, DG XIV (Fisheries), *The Common Fisheries Policy* (December 1998), Part 4, "Fisheries Agreements with Third Countries."

Fifth, it seems likely that fish subsidies, which are implemented overwhelmingly in developed countries and the PRC, probably have the most adverse trade effects on exports originating in two groups of WTO Members: first, the exports of developing countries, in particular those developing countries that do not have access agreements with developed nations, and, second, that small group of developed nations that are rich in fish resources and parsimonious with their own subsidies (e.g., Norway, Iceland, New Zealand, and Australia).

Finally, we should not ignore recent trends in world seafood trade, which appear to have stagnated for several years. Recently released provisional FAO data show the following trends in trade for the 1993-1998 period[57]:

	1993	1994	1995	1996	1997	1998
			- (US $ Millions) -			
Global fishery exports	41.4	47.5	51.8	52.9	51.4	48.9
Developed Countries	21.3	23.7	25.6	26.8	26.1	25.5
Developing Countries	20.1	23.8	26.3	26.1	25.3	23.4

These data show declines of almost 3 and 5 percent respectively in global trade in the last two years for which information is available, 1997 and 1998, and suggest that these decreases have affected exports of developing countries moire than the developed FAO Members. In fact, the developing countries' fisheries trade "surplus", i.e., the difference between exports and imports, has been essentially flat for the last five years. Clearly, the above trends reflect a host of factors, including flat and declining catches, economic and financial difficulties in a number of major seafood importing nations, especially in Asia, and the El Nino/La Nina effects.

Whether trade restrictions in general, including subsidies, tariffs and non-tariff border measures, have contributed in a meaningful way to the stagnation in world fisheries trade that we seem to be witnessing today is

[57] FAO, Committee on Fisheries, Sub-Committee on Fish Trade, "Status and Important Recent Events Concerning International Trade in Fishery Products", January 2000.

hard to determine, but is at least a possibility. As already noted, there are few case studies that analyze the impacts of governmental measures on seafood trade, and no study that satisfactorily determines whether subsidies and border measures, in the aggregate, are increasing, declining or have remained about the same.[58] Finally, there is a distinct possibility that subsidies and border measures have opposite rather than mutually reinforcing effects, which makes the task of assessing their aggregate impacts even more difficult.[59]

(2) Effects on Resource Conservation

The environmental effects of fish subsidies present still other problems of analysis and assessment. Among all their alleged negative effects, the proponents of reform have stressed that most subsidies tend to foster excessive levels of effort and capacity in the harvesting sector, thereby contributing to overfishing and resource stress.

It should be stated at the outset that virtually everyone rejects the suggestion that subsidies are a primary or the sole cause of the widespread conservation problems present in so many fisheries around the world. Fishery economists stress that the major cause is the lack of well-defined and effectively enforced harvest rights, which in turn promote perverse incentives that lead to overfishing, overcapacity, and the race to fish.[60] Others, like the Japanese, maintain that subsidies are, at most, one of many factors that have created resource problems, and they far prefer dealing with these other issues, in particular the operations of Flag of Convenience fishing vessels.[61]

In the last few years, a good deal of theoretical work and empirical case studies have been done that demonstrates the broad interactions between subsidies and fish resources. As a start, subsidies either reduce costs or enhance revenues, and, in fisheries, it is widely agreed that most subsidies suppress costs. Using bioeconomic models, cost-reducing subsidies tend to lower the total cost curve (or the perceived total private costs) and promote increased levels of effort. In suboptimally managed fisheries, or what economists call "open access" or "regulated open access" fisheries, the inevitable effects of subsidies are levels of overfishing and overcapacity that are even worse than without the subsidies. One noted fisheries economist has even roughly mapped out an analysis that estimates the global implications of subsidies on resources.[62] This analysis assumes global "effort" subsidies on the order of about 20 percent of total revenues, and concludes that such effort and capacity enhancing subsidies will result in a 10 percent decline in world fish harvests and "social losses" of about 20 percent of first-sale revenues.[63]

However, measuring these environmental effects presents problems. For

[58] FAO experts have voiced the opinion that, worldwide, subsidies are declining, but some experts have countered that available data do not support any conclusion on global trends in levels of subsidies.

[59] In theory, most subsidies in fisheries reduce fixed and variable costs, and therefore tend to exert some downward pressure on prices, which in turn stimulates demand. Tariffs and non-tariff measures, on the other hand, tend to reduce imports, which constricts supplies and raises prices.

[60] A concise statement of this view can be found in Gordon R. Munro, "The Economics of Overcapitalisation and Fishery Resource Management: A Review," in *PECC Workshop on Financial Transfers,* pp. 7-26, where he concludes that "Noone can deny that "bad" subsidies, world-wide, aggravate the fisheries overcapacity problem. Our analysis indicates, however, that it would be quite wrong to suppose that, if "bad" subsidies were eliminated, the overcapitalisation problem would vanish. The basic "perverse" incentives remain".

[61] The Japanese are hardly the only ones who dismiss the role of subsidies as a factor contributing to resource decline. In a recent article, two specialists in Pacific tuna fisheries took an almost harder line. See Roman Grynberg and Martin Tsamenyi, "Fisheries Subsidies, the WTO and the Pacific Island Tuna Fisheries," *Journal of World Trade* (32 (6), pp. 127-145, arguing that "... an end to fish subsidies will only relieve pressure on fish stocks in the medium term as subsidies are largely symptomatic of the larger problem of diminishing returns in an open access fishery which is caused by rising global income and population operating on a fixed stock of marine resources."

[62] Ragnar Arnason, "Fisheries Subsidies, Overcapitalisation and Economic Losses," *EU Workshop on Capacity,* pp. 27-49.

[63] Critics and doubters of reform can of course dispute the 20 percent estimate of global effort subsidies (which is taken from recent World Bank and FAO papers), but they will have a harder time challenging the direction of effects. Most subsidies enhance effort, and, over time, reduce stocks and rents. The claim that subsidies have generally benign and/or positive effects on resources seems to be an assertion that has little if any support in the technical literature.

one thing, the precise effects of subsidies on resource conservation depend on one's definition of subsidies. A conservative and narrow interpretation of subsidies confined to the explicit, direct and budgeted subsidies will probably yield a modest conservation effect. On the other hand, a more liberal interpretation of the term, in particular a definition that includes uncollected resource taxes, will probably result in major negative impacts, especially in open access fisheries.[64] Another problem is measuring the resource conservation effect. "Overcapacity" in the fish harvesting sector has received the greatest attention, and generally serves as a proxy for a number of harmful environmental effects. Fortunately, experts have made some notable progress in developing metrics to assess capacity and overcapacity in fisheries, but they are just beginning to apply these measures to specific fisheries.[65]

Recent work on the effects of subsidies in fisheries is not confined to theoretical exercises. Fortunately, this issue has also been addressed in a growing number of empirical case studies. A workshop convened by the Pacific Economic Cooperation Council (PECC) in Manila, Philippines, in August 1998 and a conference held in Portsmouth, UK, a few months later under the aegis of the EU's FAIR program, reviewed a number of revealing studies in both developed and developing countries. In the United States, a Congressionally-mandated study of subsidies and harvesting capacity in domestically managed fisheries was issued last year, and the EU has commissioned a roughly similar study of the Common Fisheries Policy. OECD will soon complete its study of the "impact on fisheries resource sustainability of government financial transfers"in the developed country membership of that organization. Simultaneously, spurred on by the growing interest of governments and international organizations in this issue, numerous studies prepared by academic experts and environmentalists addressing one or more aspects of this problem have appeared in the last several years. Hence, to an increasing degree, the debate over the effects of subsidies on conservation involves more than a simply a clash of opposing theories and explanatory models, but also reflects different interpretations of a growing body of solid evidence.

Empirical and case studies conducted in many countries generally point to adverse conservation consequences of fish subsidies of one degree or another. In the United States, the Congressionally mandated Federal Investment Study concluded that subsidies provided by the U.S. Government, chiefly the National Marine Fisheries Service, contributed modestly to an expansion of harvesting capacity, with these impacts felt in different fisheries in different regions at different times, but generally from the late 1970s to the late 1980s.[66] In the Pacific tuna fisheries, a decades-old history of Statist subsidies in the central and western Pacific Island States has created a bloated, inefficient, and uncompetitive infant industry.[67] More generally, subsidies that promote effort in international fisheries, i.e., fisheries conducted outside 200-mile EEZs, have been shown to inevitably lead to stock declines.[68] In the EU, publicly-funded assistance for vessel construction and modernization, although declining appreciably over the last few decades, especially as a share of total fisheries spending, still represents considerable amounts, and does not lag far behind the levels allocated to capacity adjustment.[69] In Portugal, in a period when cod quotas

[64] Gordon Munro, in "A Theoretical Framework for Examining Interactions between Subsidies, Overcapitalisation and Resource Overexploitation," in *PECC Workshop on Financial Transfers*, states that "... if the definition of subsidies is broadened to include resource taxes, then one can, under special circumstances, make the case that subsidies are the primary, if not sole, cause of the overexcploitation/overcapitalization problem."

[65] This work has been undertaken largely pursuant to the FAO International Plan of Action on the Management of Fishing Capacity. Technical consultations held in La Jolla, California in April 1998 and Mexico City in November 1999 have gone a long way toward establishing a consensus among experts, chiefly fishery economists, on the most practical and appropriate technical and economic measures of capacity in fisheries.

[66] *U.S. Federal Investment Study*, especially "Conclusions and Recommendations" on pp. 157-164.

[67] According to Stephen Pollard, "Pacific Tuna Subsidies: An ADB Overview," in *PECC Workshop on Financial Transfers*, who goes as far as saying that "(A)s far as the Pacific Islands are concerned, I do not know of one case where these subsidies have led to a profitable and sustainable domestic fisheries industry."

[68] Gorazd Ruseski's then-unpublished manuscript, "International Fish Wars: The Strategic Roles of Fleet Licensing and Effort Subsidies,"1998.

[69] Aaron Hatcher, "The European Community's Structural Policy for the Fishing Industry," EU Workshop on Capacity, p.57.

and landings were declining, the vessel owners continued to press the government for subsidies to support the construction of "marine monsters", or "large scale ships for which there was no fishing opportunities in sight." With this policy, which lasted until into the 1990s, ""structural funds were wasted, firstly in constructing, and then in putting out of service, boats with no future."[70] In northwestern Spain (Galicia), the heart of Spain's fishing industry, subsidies contributed significantly to overcapacity in several fleet sectors during the 1970s and 1980s, and even the corrective measures administered subsequently have not resolved the problem, with the result that "the fleet fishing in Galician waters is obviously oversized both in number and vessel capacity (especially trawlers' capacity per fishing ground."[71]

However, recent research seems to confirm that many, if not all, subsidies not only increase levels of harvesting capacity, but contribute to the stress on resources. A report published by the European Court of Auditors in 1993 made a number of criticisms of EU structural policy, including the charge that "new capacity tended to be directed to fishing for those stocks under most pressure, while capacity withdrawn tended to be the least effective."[72] Numerous case studies seem to indicate that, in most instances, subsidies tend to reduce variable and fixed costs and/or enhance revenues, and that these outcomes in turn tend to encourage increases in levels of effort and therefore capacity. When capacity exceeds the level required to efficiently harvest the TAC, the frequent result is harvests in excess of the TAC limit. Another by-product of excess capacity is the steady pressure exerted by fishermen on scientists and fishery managers to set the TAC at an inappropriately high level. As one expert put it succinctly, "... subsidies increase equilibrium fishing effort and, consequently, reduce equilibrium biomass." Thus, subsidies exacerbate overcapacity, and

[70] Manuel Coelho, "Overcapacity and Overcapitalisation in the Portuguese Cod Fleet," in *ibid*., p. 152.

[71] Carlos Iglesias -Malvido et al., "Overcapitalisation and Overfishing Problems in Fisheries: The Development of the Fish Industry in Galicia (Spain)," in *ibid*., p. 182.

[72] As paraphrased in Aaron Hatcher, *ibid*. p.62.

overcapacity generally undermines management and is harmful to fish resources.[73]

Some experts have expressed doubts about the alleged adverse conservation effects of subsidies, or have significantly qualified those negative consequences. It has been suggested, for example, that subsidies probably have negative environmental consequences if and only if fishing effort is not adequately controlled.[74] Japanese officials have even stated that the alleged harmful effects of subsidies on resources can be avoided through buybacks and stricter quotas.[75] More precisely,

subsidies have the worst effects on resources in open access fisheries, where their cost-reducing and price-enhancing impacts will drive effort and investments to sub-optimal levels. Alternatively, subsidies provided to participants in rights-based fisheries will probably not have any harmful effects on resources, but may increase the value of the quota share instrument.

Many proponents of reform argue that rights-based arrangements (usually understood to mean individual transferable quotas or community based quotas), and resource taxes provide effective insulation against the harm generated by subsidies. In well-managed fisheries, subsidies will tend to inflate the value of the quota instrument, but will not promote

[73] This general scheme of causes and effects is taken from Aaron Hatcher, "Summary of the Workshop on Overcapacity, Overcapitalisation and Subsidies in European Fisheries," in *EU Workshop on Capacity*, pp. 1-5. These conclusions are telling because they reflect the recent and careful case study work of a number of European fishery economists from a handful of EU Member States, some of whom openly question the environmentalists' critiques of fish subsidies. It is extremely difficult to read these papers without concluding that most subsidies in most management environments are bad for conservation.

[74] See, for example, Ulf Wijkstrom, "Overview of Global Fisheries and the Subsidies Issue," *PECC Workshop on Financial Transfers*.

[75] K. Katsuyama, of the Fishery Agency of Japan, in "Consideration on Fishery Management and Subsidies: Japan," in *PECC Workshop on Financial Transfers,* stating that "I believe that any fisheries subsidies can not cause over capacity when we can manage the fishing capacity directly at an appropriate level." Again, the FAJ official said that "... if we observe an overcapacity for specific fishery resource, we should simply take certain measures to reduce the fishing vessels or quota allocation."

excessive levels of effort and capacity. On the other hand, some experts fear that, even in rights-based fisheries, subsidies could encourage the quota holders to press for higher-than-optimal TACs, or that subsidies provided to vessels operating in rights-based fisheries could cause harm once those same vessels are deployed in other, less well managed fisheries. Most significantly, the vast majority of world fisheries are not rights-based or properly taxed, and those fisheries in a handful of country with rights-based systems are among the least subsidized. In summary, it is probably is basically true that rational management can insulate fisheries from most of subsidies' harmful effects, but that leaves many problems unsolved.

In most fisheries, subsidies tend to exacerbate the fundamental perverse economic incentives of the open access or regulated open access regulatory regime. Some opponents and doubters of reform question the inevitability of subsidies' negative outcomes, and continue to maintain that conventional fisheries management, such as TACs, can protect the resource or that good subsidies (buybacks) will cancel the negative effects of bad ones,[76] but the preponderance of evidence seems to suggest that the harmful effects eventually prevail.

(3) Summary of Discussion of Trade and Conservation Effects

Clearly, many questions surrounding the trade and environmental effects of fish subsidies are far from resolved. However, a growing body of recently-presented theoretical work and case studies generally favors the arguments of those who maintain that, for the most part, subsidies provided to the fisheries sector are harmful both to trade and conservation. One may legitimately question the degree of harm or challenge the priority assigned to subsidies as a factor that causes harm, but the negative effects are hard to deny. Many case studies also show that most subsidies tend to cause a wide range of negative effects, of which adverse trade and conservation outcomes are simply the best known. One additional negative effect

[76] See, for example, the statement made by the Japanese fishery official, K. Katsuyama, at the 1998 PECC workshop: "... (I)f we observe an overcapacity for specific fishery resource, we should simply take certain measures to reduce the fishing vessels or quota allocation. Why don't you discuss such direct reduction instead of the argument of fishery subsidies?"

is harm to equity, since subsidies provided to the fisheries sector often have a tendency to favor the better-organized owners of larger boats.[77] Another often-cited negative is the waste associated with governments' costs of operating these programs.

Nevertheless, the issues addressed in this paper are adverse trade and conservation effects, and this experts' work seems to agree that the adverse trade and environmental effects are basically different aspects of one fundamental negative outcome. Thus, subsidies encourage excessive levels of effort and capacity, leading to erosion of the stocks and reductions in long-term yields, and eventually to net economic and trade losses in the fisheries sector.[78]

FAO data suggest that global fisheries have plateaued in the last decade and may have entered a period of modest decline. The flat and perhaps declining recent trend is particularly evident in the dominant marine sector, which accounts for roughly 90 percent of total capture fisheries production, and shows up in the data on both volume and value.

World Harvests from Capture Fisheries
(1991-1997)

	1991	1992	1993	1994	1995	1996	1997
	(Millions of Metric Tons)						
Inland Fisheries	6.2	6.2	6.5	6.7	7.3	7.5	7.7
Marine Fisheries	78.2	79.1	79.9	84.7	84.3	85.7	85.6
Total Capture Fisheries	84.4	85.3	86.4	91.4	91.6	93.2	93.3
	(Millions US$)						
Total Ex-Vessel Revenues	75.2	78.2	73.4	78.2	82.4	84.3	83.1
Revenue Per Ton	891	917	849	856	900	905	890

[77] One example is Norway, where the annual payments by government to industry have historically favored the operators of large trawlers based in northern Norway. Svein Jentoft and Knut Mikalsen, "Government Subsidies in Norwegian Fisheries," *Marine Policy*, July 1987, pp. 217-228.

[78] These few general statements summarize the work of Ragnar Arnason, "Fisheries Subsidies, Overcapitalisation and Economic Losses," in *EUI Workshop on Capacity*, pp. 27-49.

At the same time, as noted above, world trade in seafood has also leveled off and even dropped modestly in the last few years, and appears stuck in a narrow range of approximately $50 billion annually. Thus, the FAO data show a global capture fisheries sector that has apparently entered a phase of stagnation both in terms of harvests and trade. Obviously, lower harvests must have some restraining effect on levels of trade, and trade distorting measures (subsidies, tariffs and non-tariff barriers) must collectively have some impact on both fishing operations and international trade in products derived from those operations.

Nonetheless, while experts increasingly agree on the general nature of these effects, they still do not understand their precise degree or agree on how best to measure them. Accordingly, it is likely that additional work will have to be done to measure and quantify the trade and conservation effects of subsidies. This work will probably be undertaken by several international organizations. Already, OECD is finishing s study on the government financial transfers and their contribution to responsible fisheries; FAO has a mandate in the 1999 IPOA on the management of fishing capacity to study the role of subsidies as a factor that contributes to overcapacity; and, more recently, some WTO Members have suggested that the WTO's Committee on Subsidies and Countervailing Measures and/or the Committee on Trade and the Environment could do relevant analytical work.

These efforts may take advantage of different approaches, including cooperative analyses using bioeconomically driven models or the calculation of producer subsidy equivalents (PSEs) for fisheries. PSEs would also have the advantage of addressing the market effects of tariff and non-taruiff border measures, as well as subsidies. In both instances, however, the results will be valid for specific case studies or on a product-by-product basis. Thus, no matter what the approach, at some point, governments must be willing to make certain reasonable assumptions about the trade and environmental effects of subsidies that apply across the board or nearly so.

The prospects for reform

This paper has reviewed some of the outstanding issues in the ongoing debate over the trade and conservation implications of subsidies in fisheries. Taking this approach, it is suggested that reform of subsidies will likely be addressed in several contexts, chief among them: (1) the prospective WTO trade initiative, which deals with both the trade and environmental implications of this issue; (2) the FAO IPOA on the management of fishing capacity, under which FAO Members accepted in 1999 a political, non-binding obligation to reduce subsidies that contribute to overcapacity;[79] and (3) the domestic policy sphere, where many developed and developing nations, responding to economic, resource conservation, and budget motives, will continue to revise their domestic priorities in the fisheries sector.

Fashioning a WTO sectoral agreement on fish subsidies will be a daunting task for a variety of reasons. As the debate on fish subsidies over the last few years has made clear, WTO Members do not agree on what is and is not a subsidy; on how broad or narrow the negotiations should be; on how to deal with allegedly "good" subsidies; nor on the seriousness of the adverse trade and conservation impacts. Some of the issues are so contentious that a successful resolution may even require a formal complaint under the WTO SCM Agreement.

At the risk of oversimplifying, there are two identifiable poles in this debate. On one side, there are proponents of reform of fish subsidies. In this camp are those who:

- support liberal interpretations of fisheries programs that meet the definition of subsidies in Article 1 of the WTO SCM Agreement;

[79] International action on subsidies may be taken in several organizations other than WTO, not just FAO pursuant to implementing the IPOA on the management of fishing capacity. The full spectrum of international interest in this issue is reviewed in: Ronald P. Steenblick and Gordon R. Munro, "Current International Work on Subsidies in Fisheries: A Survey," in *EUI Workshop on Capacity*, pp. 254-265.

- want to examine and possibly modify subsidies in all subsidiary components of the fisheries sector and cross-sectoral subsidies;
- tend to view skeptically suggestions that some considerable share of subsidies are "good" and therefore preferably permissible from a conservation standpoint, and, hence, prefer that reform encompass all subsidies; and
- generally believe that all or virtually all fish subsidies are ultimately harmful both to trade and to the resource.

On the other end of the spectrum are the opponents, or, more generously, doubters of reform, who basically hold that:

- Article 1 of the WTO SCM Agreement should be interpreted carefully and conservatively, relying heavily on GATT jurisprudence, with the result that fish subsidies in question are for the most part the explicit and direct measures, and not the implicit subsidies;
- assessments and negotiations should be confined to programs provided to fishermen, since the capture fisheries sector is the locus of the major environmental problems;
- subsidies should be evaluated significantly according to their intent, and subsidies implemented for positive environmental reasons should be taken off the table; and
- adverse trade and conservation effects should be conservatively estimated and segregated.

Opponents and doubters of reform tend to minimize the scope and effects of subsidies, affirming that the harmful impacts are modest in nature and manageable through conventional regulations and through "good" subsidies. According to this group, overfishing and overcapacity, and the associated stress on resources, are the results of many factors (including subsidies), such as ineffective management, illegal operations, Flags of Convenience, and even excessive trade competition.

Obviously, this model is organized around two extremes, and, in fact, many participants in the debate fall somewhere between these opposite poles. As a practical matter, if fish subsidies are reformed in the next WTO multilateral trade round, the shape and outcome of these negotiations will probably fall somewhere in the middle. While forecasting the results of future negotiations is a hazardous task, it also appears that the most politically likely outcome is a negotiation that addresses most or all the direct and explicit subsidies, some of the implicit ones, perhaps none of the cross-sectoral subsidies, and somehow sets aside or treats separately subsidies whose major intent is to correct overcapacity, improve the resource base, and facilitate adjustments in fishing communities.

Many of the implicit/indirect and practically all the cross-sectoral subsidies may remain unaddressed or addressed outside a formal WTO fish negotiations. These other fora include other WTO negotiations and, perhaps more important, the domestic policy and budget deliberations of coastal states. In this context, we should not overlook the important fact that considerable reform of fish subsidies has already been achieved without the benefit of an international trade agreement. In the last few decades, subsidies to fishing fleets have virtually disappeared in Russia and Eastern Europe, and have been dramatically reduced in Latin American countries like Mexico, Peru, and Chile.[80] Economic assistance provided more generally to fishermen and the fisheries sector has been significantly cut back in Norway, Iceland, New Zealand and Australia, and more gradual reforms have been under way in both the EU and the United States. In fact, it should be noted that some experts believe that, world-wide, subsidies to the fisheries sector are probably declining, or almost certainly are not increasing.[81]

If domestic reforms of fish subsidies are making progress all over and the proposed WTO negotiation will be as complicated as this paper fore-

[80] These three Latin American nations have turned decisively away from statist policies in their fisheries sectors. Personal communication from Dennis Weidner, NMFS, November 9, 1999.

[81] This view is argued by the FAO Fisheries Department official, Ulf Wijkstrom, in "Global Overview of Fisheries and the Subsidies Issue," in *PECC Workshop*.

sees, should nations even bother with an initiative on fish subsidies in the next MTN round? This writer's response to that question is affirmative, because, in spite of everything, the arguments in favor of a global negotiation to reform fish subsidies are compelling. Simply put, while it is almost certainly true that such a WTO agreement will be an enormously difficult task and will not address all the relevant issues, such a multilateral agreement should provide key benefits that are unavailable through other means. These benefits include:

- an agreed international framework that provides a roadmap for reforming environmentally harmful and trade-distorting subsidies in the fisheries sector;
- agreement on the status under WTO subsidies law of at least some of the implicit and indirect subsidies, or, put more plainly, agreement on whether or not they should be treated as subsidies;
- some common understanding of which kinds of fish subsidies may (or may not) be permitted because their positive intents and outcomes outweigh their adverse effects;
- a specific WTO sectoral agreement that assists in the implementation of provisions of a United Nations agreements, in this case the 1995 FAO Code of Conduct for Responsible Fisheries and the 1999 International Plan of Action on the Management of Fishing Capacity, perhaps as a model of how trade and resource agreements can reinforce one another.

In other words, however difficult and complicated the negotiations and acrimonious the debate, the advantages of a WTO agreement addressing this issue would appear to justify the effort. Therefore, we will probably be dealing with direct and indirect, explicit and implicit, and budgeted and unbudgeted subsidies in fisheries for years to come. And debating the merits of a broad as opposed to a more narrow approach to reform. And arguing about their positive and negative effects on trade and fish resources. Even more distressing is the likelihood that the debate over "good" and "bad" subsidies in fisheries has just begun.

Oh, what a terrible thought!

Abstracts of talks held at the conference

Steingrímur Jónsson

Physics and fisheries

Abstract

The environment shapes the background that the fisheries has to cope with. The basis for life in the ocean is the same as the basis for life on land, i.e. the energy radiated from the sun, and plants that can use this energy to change inorganic matter into organic matter. Other forms of life in the ocean then depend on the organic matter produced by the plants. The distribution of the production of the plants and therefore the starting point of all food chains in the ocean is mostly determined by physical factors. Usually, the closer in the food chain the harvested species is to the plants and the shorter its life cycle the more direct and more immediate is the effect of changes in the environment. Fisheries today is a global industry. Therefore changes that occur in one place may have effects all over the world. One such phenomenon is the onset of El Nino with a decline in the fish meal industry in Peru and Chile. This results in higher prices on fish meal and fish oil and the industry is booming in other countries. But when the El Nino retreats the catches rise again and prices fall. In recent years and decades the possibility that mankind is changing the climate system through the release of greenhouse gases has caused concern. How this will affect the fisheries is uncertain, but if it does have an effect the changes will probably be drastic.

During the last few years the ocean climate in Icelandic waters has been more increasingly influenced by warm and salty Atlantic Water. This has reached a state comparable to the conditions reigning in the warm period between the 1920-1965 in the North Atlantic. This has already influenced the 0-group index of gadoid species and if this continues we could see quotas for those species increasing considerably in the next decade.

Daniel Pauly

Fisheries impacts on North Atlantic food webs: long term trends and their implications

Abstract

The North Atlantic fisheries have experienced in recent years a number of spectacular, and well documented collapses, notably that of the stock of Newfoundland/Labrador cod. This has led, in some cases, to strong remedial action being taken, notably closure of the fisheries targeting certain species. During the period from the 1950s to the 1990s, the fisheries of the North Atlantic have been gradually shifting their attention toward smaller fishes lower in the marine food webs, thus reducing the mean trophic level of species in landings, a long-term trend also occurring in Iceland. This trend is not the results of a few pelagic species increasing, or of a single large, high-trophic level species (e.g. cod) diminishing somewhere. Rather, this reflects the overall results of serial depletions affecting the entire North Atlantic basin. Continuation of this tend of 'fishing down marine food webs' for a few more decades would imply massive changes in the structure and productivity of North Atlantic ecosystems. On the other hand, halting and eventually reversing this trend implies conservation measure rather different from those currently used to manage North Atlantic fisheries. Notably, serious consideration would have to be given to setting up relatively large marine protected areas, probably similar in their relative coverage of continental selves to the National Parks that were set up, in various countries around the North Atlantic, as our only device for preventing the extinction, in the wild, of populations of large mammals.

Gunnar Stefánsson

Fishery management, sustainability and the precautionary approach

Abstract

Fishery management in the light of sustainability is becoming an issue of major importance worldwide. This paper gives an overview of what issues are commonly taken into account when providing advice and implementing fishery management. It is also illustrated how most of these cloud the single most important issue of maintaining low enough fishing mortality.

Ólafur Halldórsson

To catch or to farm a fish?

Abstract

The average annual increase in supply from international fish farming has been over 10 per cent for the last 10 years. At the same time, in the North Atlantic, the average annual decrease in catch of the major groundfish species is 8 per cent.

Production in fish farming in the North East Atlantic is also increasing very fast and in this presentation this increase in fish farming is discussed in relation to the Icelandic fishing industry. Which way will the aquaculture industry develop and what impact may that development have on the fishing industry in Iceland.

James L. Anderson

Aquaculture, competition, and the global seafood market?

Abstract

Aquaculture production is increasingly becoming a significant factor in the global seafood market. This paper considers the factors contributing to the competitiveness of aquacultured seafood products relative to wild-harvested fish. The discussion will focus on production practices, market management, research and development, and government policy.

It is concluded that much of the aquaculture sector will experience a strengthening comparative position in the aforementioned areas relative to wild fisheries, and, therefore, will continue to have an increasing influence on the structure and performance of the world's seafood markets.

Karl A. Almås

Exploitation of marine resources and the future of aquaculture

Abstract

The exploitation of the oil and gas resources has represented the main source of income to Norway for the last 20-30 years. Although the gas resources will last for more than a 100 years, the export of oil will decline rapidly during the next 10-20 years. Exploitation of the renewable marine resources has both the technical and the market potential to substitute this development.

The renewable marine sector consists of the traditional fisheries, salmon farming, cultivation of new marine species, production of feed / increase of primary production, extraction of biochemical for marine biomass and production of fishing gear / vessels and processing equipment. For each of these sectors the Norwegian potentials will be quantified and discussed. With the development of the Norwegian aquacultural industry (salmon) as an example, focus will be made upon how research has contributed to this development.

Rögnvaldur Hannesson

The Icelandic fisheries and the future of the Icelandic economy

Abstract

The fisheries of Iceland are considerably more productive than those of the neighbouring countries, but this may be due as much or more to luck than to wisdom. It appears that the ITQ system has increased the profitability of the industry and helped avoid excessive use of manpower, but it has taken considerable time to establish this system and its continued existence is still in doubt. It is argued that the fisheries no longer are an engine of growth in the Icelandic economy and that it crucial to avoid using the industry as an employer of last resort if the Icelanders are to maintain their standard of living on par with their neighbours.

In a well managed fishery rents will emerge and, contrary to ordinary manufacturing, it is not desirable to let the rent be eroded by competition. To whom the rent accrues and how it will be used are questions of crucial importance for the future of the quota management system and the development of the Icelandic economy. Arguments for and against having the fishing rent accrue to the industry are discussed, as well as ways of rent recovery and rent use by the government.

Ragnar Árnason

On productivity and productivity growth in the Icelandic fisheries

Abstract

This paper attempts to measure productivity growth in the Icelandic fisheries during the period 1975 to 1995. The standard theory of total factor productivity (TFP) is extended to accommodate the special case of the fisheries, where the size of the fish stocks represents a major input into the production process. Utilizing aggregative time series data on the Icelandic fisheries from 1974-1995, a Törnquist approximation to the appropriate Divisia index is employed to obtain estimates of changes in total factor productivity in the Icelandic fisheries. According to these measurements the average annual growth in total factor productivity has been quite high during this period compared to that of other major industries in Iceland and abroad.. Moreover, there are no signs that this growth in total factor productivity has abated over time. Indeed, it seems to have increased during the latter half of the period. It is tempting to associate this experience with the impact of the ITQ fisheries management which became the dominant form of fisheries management in Iceland during this period.

Finally, simple one factor measures indicate that the productivity of the Icelandic fisheries is high compared to that of most other advanced fishing nations.

Hjörleifur Einarsson

Towards a competitive fish processing industry, future developments and considerations

Abstract

Export of seafood has been the major source of the gross national income for Iceland for many decades. This is a unique position among fishing nations in the world and has been conceived be constant improvements in both harvesting and on the processing side. In order to keep its competitive edge still further developments are foreseen and necessary. The complex requirements by the consumer for tasty, fresh, nutritious, convenient, environmental friendly, traceable and save food will have considerable effect on product supply and development in the near future. At the same time the processing companies will have to increase their profit by decreasing the costs by processing more valuable products by fewer people using cheaper raw material and improved processing and information technology.

The seafood processing industry is facing an increased competition from other and often much cheaper foodstuffs but also from competition concerning workforce and capital for investment. The competition for raw material within the industry will increase and new sources will be sought. Fish from aquaculture will be important and in some areas even a threat to traditionally caught fish. On the harvesting side further developments of fishing gear is necessary. Their impact on fishing ground must be minimised, their selectivity improved and the problem of by-catch must be solved. Onboard, handling techniques are developing fast and can increase the quality of fish considerably. Upgrading of low value products and production of valuable by-products are fields of increased interest and some new products have been introduced. The traditional processing methods are being developed further toward more automation but new methods like biotechnology will increase in importance. Hygiene is a constant worry for food processors. The way forward is better hygienic design, education and training. The workforce will change, fewer people will be needed but they will be better educated. The new information systems and information technology will change the way people work and the structure of the industry.

Based on the experience from Iceland and nearby areas it is concluded that the global scene in fisheries will change considerably during the next years and decades.

Einar Hreinsson

The technology state of fish industry: Description

Abstract

A novel view of the present devises and methods used for fish industry. Description of the present problems in modern fish industry. Future developments and tasks in fish technology.

Matteo J. Milazzo

The International debate on fish subsidaries

Abstract

This presentation reviews the major issues in the international debate of the last several years on the trade and conservation effects of subsidies provided to the fisheries sector. Specifically, four issues are discussed in detail: First, what is a subsidy under the 1994 GATT agreement; second, how broadly (or narrowly) should governments seek to reform these subsidies; third, is there such a thing as a "good" subsidy in fisheries; and fourth, how can we assess and distinguish between their trade and conservation effects. Resolving these (and perhaps other) issues will be complicated and time-consuming, but a successful outcome of the proposed WTO sectoral negotiation on fish subsidies will depend significantly on reaching agreement on these contentious points. The presentation closes with the argument that a WTO agreement, however difficult to obtain, will be well worth the effort for a number of specific reasons.

Guðbrandur Sigurðsson

Challenges ahead

Abstract

The fishing industry, including both fisheries and fish-processing, plays a role of fundamental importance in the present-day status of Iceland as a modern developed country. Throughout the century, the seafood industry has been the driving force of economic development. Presently, it accounts for about 15 per cent of the gross domestic income, occupies 11 to 12 per cent of the working force, and generates about 70 per cent of export revenue. Successive governments have tried to reduce the reliance on fisheries in the export trade and to increase diversity in the production of goods for export. Nevertheless, the fisheries share in merchandise export has remained at a steady level for many years.

There are, however, indications that the economy in Iceland is becoming less dependent on the fisheries sector than before. There are mainly two reasons for this development: Firstly we are seeing what has been called a capital effect which has been made possible due to more capital in the Icelandic economy than ever before. Secondly, we are seeing the impact of emerging technologies such as biotechnology and software based industries. This is a good thing to happen and hopefully one which will develop further and support the high standard of living to which we are used in this country.

In recent years, the seafood industry in Iceland has changed dramatically, for the better. It is my believe, which I share with many others, that the changes, both within the industry and in the environment, will have more effect on the industry in the next five to ten years than it has had in the previous 30 to 50 years. Those who have had some managerial experience will know that the most demanding and difficult management is during periods of change.

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