# EFFECTS OF LIBERALIZING TRADE IN FISH, FISHING SERVICES AND INVESTMENT IN FISHING VESSELS

*by*

**Rögnvaldur Hannesson**
**The Norwegian School of Economics and Business Administration**
**Helleveien 30**
**Bergen**

## Foreword

In its on-going study on market liberalisation, the OECD's Committee for Fisheries noted a need to clarify the effects of trade liberalisation on trade and resource sustainability. To further deepen the understanding of these linkages, Professor Rögnvaldur Hannesson of the Norwegian School of Economics and Business Administration was requested to develop the attached conceptual paper. The paper is based on discussions of the Committee for Fisheries and its previous work on *Measuring Economic Assistance* (see www.oecd.org/agr/fish) and *Transition to Responsible Fisheries: Economic and Policy Implications* (OECD, 2000).

The Committee for Fisheries discussed this paper at its 87th Session (March 2001). Noting that this paper is an important contribution to global discussions on fisheries' market liberalisation, the Committee agreed to make it available to a larger public in the *OECD Papers* series.

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## 1. Introduction

Since the Second World War, a major liberalisation of international markets has taken place. This has encompassed both investment and trade in goods and services, although all economic sectors have not been affected in equal measure. Agriculture has been a major exception. While this sector has not been entirely unaffected by trade liberalisation, it has been much less thorough for this sector than for most other, and possibly all other, sectors.

Often, perhaps in most cases, the fisheries are lumped together with the agricultural sector. One reason is undoubtedly that in both cases we are dealing with the production of food, and arguments relating to food security issues therefore also extend to the fisheries. Another related reason is that the fisheries sector is usually much smaller than the agricultural sector and too small to justify being administered separately from agriculture. Hence, agricultural policies often extend to the fisheries sector by default. This affinity with agriculture is probably one reason why the liberalisation of trade has been less than complete in the fisheries sector.

Nevertheless, trade barriers are generally lower for fish trade than for trade in agricultural products. Tariffs are lower and import quotas more liberal. International trade in fish products is lively; fish is probably the most widely traded of all commodities, relatively speaking. This applies to trade in fish, both fresh fish and processed products. The picture is quite different when it comes to trade in fishing services, fishing rights and investment in fishing vessels. An outright ban on international trade in these areas is more typical than freedom to trade.

In this paper we consider the effects of reducing barriers to trade. “Barriers to trade” is a very comprehensive subject; trade can be hindered by many different means. Sometimes this is done deliberately while at other times trade may be impeded by unintended side effects of measures implemented for a quite different purpose. In an ongoing study being conducted by the OECD Committee on Fisheries the trade barriers addressed include:

- tariff measures
- non-tariff measures such as quantitative restrictions, anti-dumping duties, and price controls
- government financial transfers
- sanitary requirements that differ across countries
- access to ports
- regulations of foreign investment
- regulations of trade in fishing services.

In this paper, we will consider all of these except sanitary requirements. We do not distinguish, however, between the first two, as any quantitative restriction can be shown to be

equivalent to a tariff. Both may therefore, from the point of view of trade liberalisation, be treated as removals of barriers that open up or increase trade between two countries and raise the price of fish in the exporting country while lowering it in the importing country.

As it will turn out, the effects of relaxing trade barriers such as tariffs and quantitative restrictions depend crucially on what kind of management regime is applied in the countries affected. We therefore begin with identifying three stylised management regimes which we believe to be typical of regimes in OECD countries and elsewhere. Having done so, we move on to discuss the effects of lowering tariffs or relaxing quantitative restrictions on a fish exporting and a fish importing country and how these effects depend on the management regime applied. This discussion is also interesting from the point of view of resource sustainability, an issue which of late has been getting more and more attention. Not surprisingly, the effects on sustainability of removing these trade barriers depend critically on the management regime applied.

Fish is traded in many forms; fresh or processed in various ways. More often than not, trade barriers are applied differently to different products. Removing tariffs or quantitative restrictions on one particular product will not only affect trade in that product but also have repercussions for other products, because the supply of raw fish typically cannot be expanded to accommodate increased demand for a product for which trade barriers have been relaxed. When the total catch is controlled, an increased demand for a product the tariff of which has been lowered will have to be met at the expense of other products derived from the given total supply of raw fish.[1] Under open access the relaxation of tariffs or quantitative restrictions on one particular product will affect the supply of raw fish through an improved profitability of fishing. The immediate effect will be to increase the total supply of raw fish, but in the long run the supply may either increase or decrease, depending on how intensively the fish stock was exploited prior to relaxing the trade barriers.

How the effect of relaxing trade barriers on the profitability of fishing will be transmitted depends on the market for raw fish; in an auction market the relaxation of a trade barrier would raise the price of raw fish, as the demand for raw fish is derived from the demand for finished products. Under other market forms, such as a vertically integrated company structure, the effect would not be transmitted through market prices but would nevertheless be likely to be similar, because the relaxation of the trade barrier would make raw fish more valuable. The direction of the effect on the supply of raw fish would again depend on the management regime applied.

Next we consider subsidies. By subsidies we mean direct financial transfers by governments, recognising that trade barriers such as tariffs and quantitative restrictions result in indirect subsidies while not being direct financial transfers. Subsidies are not an explicit barrier to trade but they typically distort trade. Since the effects of subsidies also depend critically on the management regime applied it is in many ways appropriate to consider them together with trade barriers.

Finally, we consider the effects of liberalisation of investment in fishing vessels and trade in fishing services. These problems have not been much discussed in the literature on fish trade. Also here the effects depend on the fisheries management regimes involved. The paper concludes with a section summarising its main results.

## 2. Management regimes

The consequences of trade liberalisation depend critically on what kind of management regime is applied in the fishing industry in the country of study. Needless to say, fisheries management regimes can differ in many different ways. At this level of abstraction it appears fruitful to distinguish

between three major types of regimes which may be termed **open access**, **catch control**, and **effective management**. These are characterised as follows.

Under **open access** there is no control of the fishery, neither of the quantity of fish caught nor fishing effort. Individual fishermen or fishing firms can enter or leave the industry as they desire without having to acquire a license (except as a pure formality) or pay an entry fee in any form. Entry and exit will be determined according to whether fishing is more or less rewarding than what people could do otherwise. It is well known, both from theory and experience, that this results in an economic overexploitation of the fish resources, in the sense that the value that the marginal fisherman or fishing firm contributes to the economy in the long term is less than if he or the firm were engaged in an alternative occupation. The overexploitation could easily be so serious that the long term yield from a fish stock would be less than it could be. The reason for the overexploitation under open access is that fish stocks are scarce resources but yet available free of charge for the individual fisherman or firm. As is well known, if there is no charge for a scarce resource it will be overused; efficient outcomes in market economies depend on all resources being available only at prices that correctly reflect their scarcities.

Open access is probably no longer very representative in member countries of the OECD. Various regulations of catches and fishing activities have gradually become established, particularly after the 200 mile zone came into force in the 1970s. In other countries open access is still not uncommon, particularly in areas where the 200 mile zone has not yet been established or is disputed and where the internal administration is weak, in particular the monitoring, enforcement and surveillance of fisheries regulations. Partly for this reason, and partly for serving as a benchmark, it is useful to look at the implications of open access. But even if open access does not exist in a strict sense it must be kept in mind that fisheries regulations are always imperfect, and despite formal regulations the ultimate result may come fairly close to an open access situation if the regulations are weak or weakly enforced.

With **catch control** the total amount caught from a stock of fish is controlled, either directly through a limit on the total catch or indirectly through limitations on the activities of the fishing vessels. In this regime there is still open access, however, in the sense that anyone can participate in the fishery, provided he or she satisfies requirements pertaining to country of residence, etc. Under this regime the biological overexploitation of the fish stocks can be avoided by setting the total catch limit appropriately. Economically little or nothing is gained, however. The marginal fisherman or fishing firm still contribute much less to the economy than they would in an alternative occupation, not because they reduce the productivity of the fish stocks but because each takes fish that somebody else could catch. This leads to unnecessarily large fishing fleets and high costs of fishing and erodes what otherwise would emerge as rent in the fishing industry.

The real world regime that best corresponds to the catch control regime is the so-called “Olympic” fishery where fishing is stopped after the total allowed catch has been taken (e.g. the Alaska halibut fishery before the individual fish quotas were implemented). More boats and fishermen than are needed are attracted to this type of fishery, because the individual fisherman or fishing firm may still find participation in the fishery more rewarding than doing something else, even while making a negligible contribution to the net value generated in the fishery. Fisheries where the control over the fishing fleet is lax or ineffective while the total catch is firmly controlled would come close to this type of regime.

Under **effective management** the amount caught from each fish stock is set at an economically optimal level, and the costs to take it are minimised. One could think of a fishery conducted by a single company for its own profit, but there are few if any real world examples of that.

A practical example would be a regime where there is a total limit on the fish catch set by a government agency and where the industry has incentives to minimise the cost for taking that catch and to maximise the value derived from it. While it may be a tall order to expect government agencies to set economically optimal targets for fish catches it is not unrealistic to think of them as safeguarding the long term productivity of fish stocks through setting (and enforcing) limits on the total catch. For this regime to be economically efficient it is necessary that the industry be given a framework within which it may achieve maximum value added from the total allowed catch. A management system based on individual transferable quotas will help in achieving this; it will give the holders of quotas incentives to maximise the value of a quota and to minimise the cost of taking it. Under a regime like that the fish stock acquires a price in the form of a market price of a quota, as any outsider will have to buy his way into the industry by buying or renting quota. Even to remain in the industry will carry an opportunity cost, *i.e.* the value of a quota that could otherwise be rented or sold. Transferable boat licenses (concessions) may work in a way similar to individual transferable quotas, with the scarcity value of the fish stocks being reflected in the value of a fishing license, or the value of a boat with a license in excess of its value merely as a fishing vessel.

**Table 1 Attributes of three stylised management regimes**

| | *Open access* | *Catch control* | *Effective management* |
|---|---|---|---|
| *Catch level* | Outcome of competition among firms ignoring fish resource constraints | Limit set by management authority | Limit set by management authority |
| *No. of vessels* | Same as above | Outcome of competition for a maximum share of a given catch | Limited by cost minimisation of industry firms or by management authority |
| *Other capacity elements (gear, technology, etc.)* | Same as above | Same as above | Limited by cost minimisation by fishing companies. Can be partially limited by management authority. |

Most fisheries in OECD countries probably fall between the types effective management and catch control.[2] Over time there has clearly been a movement in many countries from catch control towards effective management, as more and more restrictions have been put on entering particular fisheries, for example by having to buy one's way in through buying and scrapping somebody else's licensed boat. Nevertheless, most countries probably are closer to catch control than effective management, although a few have come fairly close to effective management. The attributes of the three typical management regimes are summarised in Table 1.

Various measures often referred to as "technical measures" land us on either side of the stylised catch control regime. Among such measures are regulations of fishing effort through days at sea or restrictions on the use of fishing gear. In some cases at least these measures are used for indirectly controlling the total catch, when direct control of the latter is difficult. In a case like that we would be somewhere between open access and catch control, and how close we would be to open access would depend on how effectively the catch would be limited. In other cases we have various technical measures limiting the size, design or the number of fishing vessels, besides direct control of the total catch. This is likely to result in some limitation on investment in fishing vessels, as presumably is also the purpose. In a case like that we would be somewhere between catch control and optimal management, but how close we would be to optimal management would depend on how well

designed these rules are and how effectively they are enforced. Needless to say, in the real world we are dealing with a large variety of management programs but it seems to us to be a virtue in discussing only a few stylised types of these, to bring their effects better into focus.

## 3. Fishery dynamics under open access

Much of the following discussion is concerned with long term effects. Some of these effects may be counterintuitive, particularly under an open access regime. It is helpful, therefore, to give a short description of the evolution of an open access fishery over time.

Fish stocks are renewable resources. It is possible to utilise a fish stock indefinitely by catching only the surplus production of the stock. The surplus production is the growth of the biomass of the stock in excess of what is needed to replace the biomass that disappears through natural death. In a natural equilibrium without fishing there would not be any surplus production; the annual growth would just replace the losses due to natural death. Fishing from a stock in natural equilibrium means that more biomass is being removed from the stock than is replaced by the growth of the stock, and the stock will diminish. This depletion process will come to a halt, however, provided that a smaller stock is more productive than a stock in natural equilibrium. This can happen for a number of reasons; a smaller stock means less competition for food, so each individual fish will grow faster and it also means a relatively younger stock where the "typical" fish grows faster than the "typical" fish in a population with more old, slow growing fish. There may also be less predation on young fish by old fish, because there are less of the latter around. In any event, the fishery will end up in a new equilibrium where the amount caught corresponds to the surplus growth. In this new equilibrium the stock will be smaller than in the natural equilibrium, but it will be more productive, and it could sustain the fishery indefinitely as long as the amount caught does not exceed the surplus growth.

Things could, however, go wrong. It is possible that the fishing activity expands to such an extent that it exceeds the maximum surplus production of the fish stock. If that happens the stock is doomed to extinction. Some fish stocks have become extinct, at least in a commercial sense, and some have been virtually extinct for a while and then recovered. Without adequate fisheries management there is nothing that prevents extinction of a stock except the fortuitous circumstance that it will not be profitable to expand fishing to the point where it exceeds the surplus production. In most cases this seems to be true for fish, but for terrestrial animals the picture is more bleak, as exemplified by animals such as the American buffalo, the kiwi bird, and the great auk, which were hunted to extinction or nearly so more than a century ago.

Now consider a fishery that has become stabilised in an equilibrium. Under open access the fishing activity is pushed to the limit where the value of the catch of the least profitable fisherman or fishing firm, net of all costs, is equal to what the fisherman or the firm could earn, again net of all costs, in the next best occupation. Note that this value could be positive while the net value that this marginal fisherman or firm contributes to the fishery as whole is negative in the long term. This can happen because each fisherman or fishing firm has an adverse effect on the fish stock, soon to be described, which causes the catch value of all fishermen or fishing firms to decline. This decline has to be subtracted before we get the net contribution of the individual fisherman or fishing firm, but needless to say this effect does not show up in the individual fisherman's or the single firm's profit or loss account, so the fisherman or the firm has no incentive to take it into account.

Then suppose that some "disturbance" occurs in a fishery that has reached a long term equilibrium. Suppose that the price of fish rises or the costs of fishing fall. This will make the fishery more profitable. Existing fishermen and firms will expand their fishing effort, and more people or

firms might find it worthwhile to establish themselves in the fishing industry. The catches of fish will increase and exceed the surplus production of the stock. The stock will start to diminish, and it will be spared from going extinct only if a new equilibrium is attained where the surplus production is again equal to the catch. It is possible that the now smaller stock is capable of producing a larger surplus growth. In that case we have a greater fishing effort providing more fish, as would correspond to what ordinarily happens in other industries as a result of improved profitability and expansion of effort. But it is also possible that the new equilibrium will mean a smaller surplus production and a lower catch, despite the fact that there are more boats around and more people employed in the fishing industry. This is what some people who are not very familiar with the fishing industry sometimes find counterintuitive, but it is in fact readily explained. What happens is that the fish become more difficult to catch when the stock gets smaller; the catch per boat typically falls as the fish stock is depleted. There are some cases where the fishing technology is such that this effect is not very strong. In such cases, the risk of stocks going extinct because of intensive fishing is particularly high.

So, in brief, the fishery dynamics under open access work like this. As a fishery becomes more profitable and fishing effort rises, the catch of fish increases. Gradually, however, the catch falls again as the fish stock is diminished and stabilises at a new level when the stock has reached a new equilibrium. The time this takes varies inversely with the growth rate of the stock; in temperate waters it would normally take several years. The new level at which the catch stabilises may well be lower than the level from which it started. In that case the long term effect of a rise in profitability and fishing effort is a fall in the long term catch.

The scenario which has just been described is most directly applicable for a fish stock the growth of which depends only on the size of the stock itself. The fish stocks of the real world are not like that. The growth of a fish stock is affected by effects which are only imperfectly understood and therefore often called “stochastic”. The growth of a fish stock of any given size can be quite variable from one year to another, depending on the availability of food, whether there are many predators around, and whether there is good recruitment of young fish to the stock. These effects often make it difficult to detect the long term effects of expanding fishing effort. If fishing effort expands in a period of advantageous environmental effects (good availability of food, few predators, good recruitment) it may for a long time look as if the increased effort has resulted in a greater catch of fish even if the long term effect is in fact negative. These environmental effects, and the fact that all we know about fish stocks is highly uncertain, is one reason why fisheries management issues are controversial.

## 4. Effects of removing barriers to trade

A barrier to trade means that Country A sells less fish to Country B than it would otherwise do, or gets a lower price for its fish, or both. Import quotas would be an example of the first while tariffs would typically have both consequences; *i.e.* depress the price for the exporting country and probably reduce the quantity exported as well. Below we consider the effects of removing trade barriers for the fish importing and the fish exporting country and how these effects depend on the fisheries management regime in both countries.

The removal or lowering of trade barriers means that the price of fish must rise in the fish exporting country and fall in the fish importing country, so what we need to look at are the adjustments in each country to these price changes. Note that this happens even in the case where the trade barrier is a quota or some other quantitative restriction. Removing such restrictions means that less fish will be available for the consumers in the fish exporting country, which raises the domestic price in that country. The price abroad has to be higher than in the fish exporting country for any

establishment of or increase in trade to occur, even if, after a new equilibrium has been reached, prices will be the same (adjusted for transportation and transactions costs) in both countries.

Prohibition of direct landing of fish from foreign vessels is one trade barrier which has attracted attention. This has two effects. First, it makes fish more expensive, as it increases the transportation and perhaps processing costs of fish, in case the prohibition is an effective barrier. Second, it may affect different products differently, as the fish may have to be turned into a different final product if landed elsewhere (the fish might be barred from the consumer market for fresh fish because of having to be hauled over a longer distance). The effects on removing trade barriers for different products will be considered later in the paper.

The effects of removing barriers to trade under the three regimes, open access, catch control, and effective management, are discussed formally in a specific bioeconomic model in a separate Appendix to this paper. Below we discuss these effects in a non-technical language. We look at the effects of removing barriers to trade on the country removing the barriers, labelled the "fish importing country", and a country whose exports have been made easier by the removal of trade barriers, labelled the "fish exporting country". We do this for alternative management regimes in each country, but it should be noted that the management regime need not be the same in both; we think of the two countries as exploiting their own fish resources, to which they can apply their own form of management as they see fit or no management at all.

### *The fish exporting country*

*Open access*

A higher price of fish will make fishing more profitable and attract more labour and capital into the fishing industry. This will increase the overexploitation of the country's fish stocks. The catch of fish may increase or decrease in the long term, depending on whether the fish stocks were exploited beyond the maximum sustainable yield level prior to the relaxing of the trade barriers, but the exports of fish will increase. Over time, however, the gains from trade for the fish exporting country will be eroded and possibly outweighed by the loss due to overexploitation of its fish stocks. It is quite conceivable that the country will end up worse off than before the barriers to trade were relaxed; the bioeconomic specifications needed to get that type of result in a formal model are by no means unrealistic (Brander and Taylor [1997*a*, 1997*b*, 1998] and Hannesson [2000]). What happens is that the country ties up (and hence wastes) so much of its productive resources in the fishing industry that it ends up having less of both fish and other goods than before.

*Catch control*

In this case the higher price of fish will not lead to a further decimation of the fish stock, which by assumption is kept under adequate control. But the increased price will increase the profitability of the industry and attract more fishermen and fishing boats. Fishing seasons will become shorter; what happens is that a given catch is being taken at a higher cost (*i.e.* the combined costs of all fishermen and fleets). The gains from trade will again be eroded, not by depletion of fish stocks this time but by excessive use of manpower and capital in the fishing industry, which could be used more gainfully elsewhere. In other words, the increase in unit values of fish in the market will lead to higher unit costs and as a result the net effect on profits in the industry will be small or zero. The society as a whole, however, will lose for the same reasons as highlighted in the open access case.

*Effective management*

In this case the rise in the price of fish does not attract labour and capital unnecessarily into the fishing industry. A higher price of fish may lead to a higher allowed catch; the optimal catch is at the point where the long term marginal cost is equal to the price of fish, which would ordinarily imply a catch somewhat lower than the maximum sustainable yield, and a higher price of fish would make it worthwhile to push the catch somewhat closer to the maximum sustainable yield. But even if the total catch is set at some suboptimal level, the industry has incentives to minimise the cost of taking the allowed catch and would not increase its fishing effort except as necessary to take a larger total catch, in case the latter is raised. The profitability of the industry would be increased, and this would be reflected in a higher rent in the industry, *i.e.* a higher market price of quotas or fishing licenses. The fish exporting country would in this case almost certainly gain from relaxing barriers to trade.[3]

***The fish importing country***

*Open access*

The effect in this case mirrors the effect on the fish exporting country. A lower price of fish leads to less overexploitation of the fish stocks in the country. The country thus gets a double dividend; it gains from getting more fish at a lower price, and from less resources being tied up in the fishing industry. Labour and manpower will be diverted from fishing to other uses, increasing the production of other goods and lessening the overexploitation of the fish stocks.[4]

*Catch control*

The effect here mirrors what happens in the fish exporting country. A lower price of fish has no effect on the total catch, which by assumption is kept under control, unless it falls so far as to make the previously profitable catch level unprofitable. But a lower price of fish makes the fishing industry less profitable and leads to disinvestment in boats and gear in the industry. Labour and capital will flow from the fishing industry to other industries and increase the production of other goods. Also here the country gets a double dividend; it gets more fish at a lower price and more of other goods through less waste in the fishing industry. The country's fish stocks will not be affected, however, as long as the catch control is effective.

*Effective management*

A lower price of fish will first and foremost reduce the rent in the fishing industry. The catch is by assumption optimally controlled by a government agency, and it is possible that a lower price of fish will also mean a lower optimal allowable catch. Fishing effort will not change except if the allowed catch is reduced but the lower price of fish will mean less profitability in fishing, which will be reflected in lower market prices of fish quotas or fishing licenses. There will be no double dividend in this case; the country will gain by importing more fish in exchange for other goods it produces. Some restructuring of the fishing industry will occur in case the total allowed catch decreases, just as happens ordinarily when trade barriers are lowered and international competition leads to the expansion of some industries and contraction of others.

**Table 2. Effects of relaxing trade barriers**

| | *Fish exporting country* | | | *Fish importing country* | | |
|---|---|---|---|---|---|---|
| *Regime* | *Open access* | *Catch control* | *Effective management* | *Open access* | *Catch control* | *Effective management* |
| *Short term effects* | Increased effort, larger catches, more trade, gains from trade | Increased effort, no change in catch, higher profits, gains from trade | No change in effort unless higher allowed catch, gains from trade, higher market value of quotas and licenses | Lower effort, smaller catches, more trade, gains from trade | Lower effort, no change in catch, lower profits, gains from trade | No change in effort unless smaller allowed catch, gains from trade, lower market value of quotas and licenses |
| *Long term effects* | Fish stocks decline, catch may decline, possibly loss from trade | Increased investment in fishing boats, no change in catch, small gains from trade | Same as above | Fish stocks recover, catch may increase, "double dividend" from trade | Reduction of fishing fleets, no change in catch, "double dividend" from trade | Same as above |

*Summary*

Summing up, we have seen that the management regime can be critical for the effects of relaxing barriers to fish trade. This would ordinarily be expected to bring gain to both parties, as is the classical result in the theory of international trade, and perhaps particularly to those countries which have a comparative advantage in fish production. But if the management of the fishery is lax or non-existent the result is the opposite; a country with a comparative advantage in fishing will not gain much and may quite possibly lose from an increased trade in fish. With lax or non-existent fisheries management it is the fish importing country that stands to gain most from trade; not only will it get the classical gains from trade implicit in comparative advantage but the wastefulness of its own fishing industry will be ameliorated. The effects are summarised in Table 2.

Another conclusion we can draw is that there is less difference than one might think between open access and catch control with no restrictions on investment in fishing vessels and gear. In both cases the fish exporting country will gain little and perhaps lose while the fish importing country will gain all the more. The only difference is that the wastefulness which under open access manifests itself in depleted fish stocks and excessive use of capital and manpower only leads to excessive use of capital and manpower under catch control, the fish stocks are spared. Both regimes are equally detrimental, however, from the point of view of economic efficiency because both attract capital and labour at the expense of other industries where they would be better used. This is important to keep in mind, because many fisheries management regimes do not amount to much more than catch control and have economic consequences that are very similar to open access even if they formally look very different from open access.[5]

*Some further considerations*

A word of caution is in place with respect to the way the catch control and the effective management regimes have been characterised. The total allowed catch has been assumed either not to be affected at all by a higher price of fish, or to be adjusted upwards as warranted by the higher prices. Reality is likely to be less clear cut. A higher price of fish may lead to an increased political pressure from the industry to increase the total allowed catch, which after all is decided in political *fora*. This is particularly likely to occur under the catch control regime where there is open access to the industry if not to the fish stocks. This makes the difference between the open access and the catch control regimes even less than has been argued above. By contrast, under effective management it is less likely that the industry will press for higher than optimal allowed catch as a result of a higher price of fish. Under effective management the industry participants have a stake in the health of the fish stocks in the sense that the market value of their quotas or fishing licenses depends on the health of the stocks. They are therefore likely to exert pressure on the management authority for an allowed catch that would maximise the value of their assets. That notwithstanding, each individual fisherman or firm has an incentive to cheat on their quotas, or to use their boats more intensively than the regulations may specify. Higher prices of fish, resulting for example from market liberalisation, may encourage such cheating by making it more rewarding. Cheating is particularly likely to increase under a catch control regime, partly because the industry has less of a stake in the health of the fish stocks and partly because increasing participation in the industry will make it more difficult to monitor the total catch and ensure compliance of individual vessels with the necessary regulations.

Above we have considered cases where the exporting and the importing country each fish its own stock and apply the same management regime. In reality there will be cases where the importing country and the exporting country apply different regimes, and there will be cases where they fish the same stock(s). In the latter case there could not be too much difference between the management regimes practised by the countries sharing the same stock; it would in most cases not make sense for Country *A* to practice effective management if Country *B* with which it shares a stock practices open access, unless Country *B* has a small enough portion of the stock to inflict only a limited damage upon Country *A*.

One case that appears particularly interesting and relevant is where two or more nations fish a stock on the High Seas. It still remains to be seen whether the UN Agreement on Straddling Stocks and Highly Migratory Fish Stocks will fundamentally change the open access situation prevailing on the high seas; that is, whether it will be possible to establish a TAC management regime for high seas fisheries, let alone effective management. What would the effects of trade liberalisation be in a case like that? Suppose there are two countries, a fish exporting country and a fish importing country, exploiting a shared stock under open access. In equilibrium the marginal fishing cost of each would be equal to the price *as perceived by each country*. With trade barriers in place the marginal cost of the fish exporting country must be lower, since they get a lower price. If the trade barriers are removed the price will become higher for the fish exporting country, it will expand its fishing effort, and a new equilibrium will be established with greater overall effort, but some of the effort of the fish importing country would be replaced. The long run effects on the total catch are uncertain but are likely to be negative. The fish importing country would gain in a similar way as discussed earlier by wasting less of its resources in fishing and paying less for its fish, while the fish exporting country would lose, partly through wasting more resources in fishing and partly by getting less fish in its home market. In the Appendix a situation with two countries exploiting the same stock is considered. In the model used in the Appendix the effects of opening up for trade are dramatic; the more efficient country would entirely displace the other country but would nevertheless lose from opening up for trade as long as there is open access. In the real world the effects are likely to be less dramatic, but there is every reason to expect that they will be in the directions indicated.

Finally it bears mentioning that the effects of relaxing trade barriers could be quite different with respect to fish farming. The response in this industry is likely to be similar to what happens in agriculture; a price increase as a result of relaxing trade barriers is likely to elicit a positive supply response, and vice versa.

## 5. Trade in fish products

Fish is traded in various forms; fresh, both for the consumer market and for further processing, processed as intermediate products for further processing, and as finished products for final consumption. Tariffs or quantitative restrictions are applied to each individual product or group of products. Typically the tariffs and the quantitative restrictions vary with the degree of processing. Usually the tariffs rise with the degree of processing, in order to protect the processing industry in the country applying the tariff. The protective purpose of tariffs is most explicit in cases where fresh fish is subject to different tariff rates, depending on whether it is sold to the consumer market or to the processing industry in the importing country.

Tariff reductions and removal of quantitative restrictions may therefore affect different products differently, depending on how the liberalisation of trade is implemented. An across the board removal of trade barriers would normally have greatest effect for the products subject to the highest tariff and to the tightest quantitative restrictions. The effect of this will, as for fish in general, depend on the fisheries management regime.

*Effects in a fish exporting country*

Again, we shall look at the effects for a fish exporting country and a fish importing country applying the differential tariff rates. Consider, first, the fish exporting country. Suppose the total quantity of fish is controlled and hence not affected by the trade liberalisation. This could be the case both under the catch control regime and the effective management regime. At this point we make no difference between these regimes.

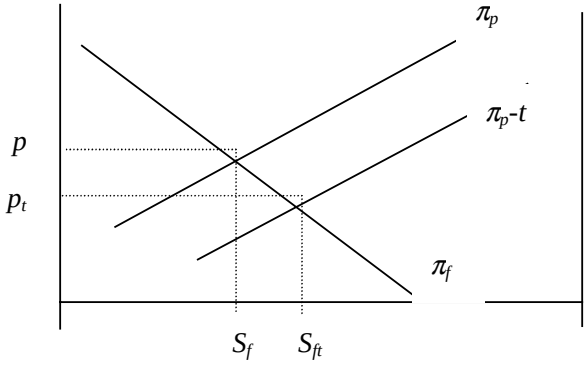
Suppose a given type of raw fish can be sold in two forms, fresh (for the consumer market) and processed. The marginal profit (market price less marginal cost of production) of each form will most likely be lower the larger is the quantity being sold. Even if the country is a price taker in international markets this could happen because of rising marginal cost of processing. The raw fish market is illustrated in Figure 1. The total quantity of raw fish available is represented by the width of the box in the figure and normalised to one. The share of the catch sold to the fresh fish consumer market is measured from the left while the share sold to the processing industry is measured from the right, with the curves $\pi_f$ and $\pi_p$ showing the marginal profitability of fish in the fresh fish consumer market and processed fish, respectively, expressed per unit of raw fish.

If the two types of products are produced in competitive industries buying raw fish in a competitive raw fish market the marginal profit lines will represent demand curves for raw fish in the two industries. Equilibrium in a competitive raw fish market will occur where the two demand curves cross; with a given quantity of raw fish the market will be cleared by a raw fish price common to both industries and denoted by $p$. The share $S_f$ will go to the fresh fish market and the remainder to the market for processed fish.

Now suppose that there is a tariff on processed fish but no tariff on fresh fish. Let the tariff on processed fish be $t$, measured per unit of raw fish. The tariff reduces the marginal profit of

processed fish for the fish exporting country, the marginal profit including the tariff being $\pi_p - t$. The new demand curve for raw fish for the processing industry is also shown in the figure. The new equilibrium implies a higher share of the raw fish going to the fresh fish market ($S_{ft}$) and a lower price of raw fish in the fish exporting country. If instead we start with a situation with a tariff the argument is reversed; removing the tariff on processed fish would increase the amount produced of processed fish and decrease the amount of fish provided for the fresh fish consumer market. The removal of the tariff would also raise the price of raw fish.

**Figure 1**




The division of a given quantity of raw fish between two use alternatives in a country exporting fish products. The width of the box shows the total amount of raw fish available and is normalised to one. The lines show the marginal profitability of raw fish used for the fresh fish market ($\pi_f$) and for further processing ($\pi_p$). Without tariffs the price of raw fish is $p$, and the share $S_f$ is sold to the fresh market and the remainder for processing. A tariff of $t$ per unit reduces the marginal profit of fish for processing to $\pi_p - t$ and increases the share of raw fish going to the fresh fish market to $S_{ft}$ and lowers the price of raw fish to $p_t$.

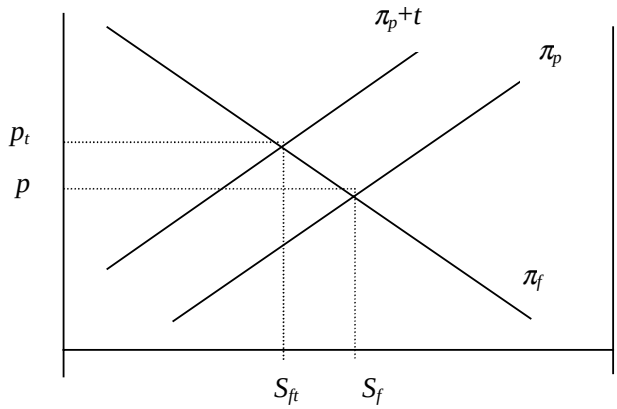
If there is open access we can no longer assume that the quantity supplied of raw fish will not change. A higher price of raw fish would lead to an increase in fishing effort, which would increase the catch in the short run, but the long run effect could be negative, depending on whether or not the fish stocks are exploited beyond the maximum sustainable yield level. As far as shares of the total catch allocated to fresh versus processed fish are concerned, we would have the same effects as shown in Figure 1; the share of the catch being processed would increase as a result of removing trade barriers for processed fish but what happens with respect to the absolute amount would depend on how the catch would be affected. A higher share of a smaller catch might mean that less would be exported of processed products than before.

*Effects in a fish importing country*

For the fish importing country applying the tariff on imports of processed fish the conclusions are exactly the opposite, as far as its domestic fishing industry is concerned. A tariff on processed fish would raise the marginal profit of processed fish to $\pi_p + t$. The share of raw fish provided for the fresh fish consumer market would be lower with the tariff on processed fish and more

would be produced of processed fish, as would presumably be intended by protecting the domestic processing industry with a tariff. Some of the protection would spill over to the catching industry, however, as the price of raw fish would be higher with the tariff. This case is illustrated in Figure 2.

**Figure 2**




The division of a given quantity of domestically caught raw fish between two use alternatives in a country importing fish products. The width of the box shows the total amount of domestic supplies of raw fish and is normalised to one. The lines show the marginal profitability of raw fish used for the fresh fish market ($\pi_f$) and for further processing ($\pi_p$). Without tariffs on processed products the price of raw fish is $p$, and the share $S_f$ is sold to the fresh market and the remainder for processing. A tariff of $t$ per unit of processed products raises the marginal profit of fish for processing to $\pi_p + t$ and lowers the share of raw fish going to the fresh fish market to $S_{ft}$ and increases the price of raw fish to $p_t$.

For a given supply of raw fish the effects of removing the trade barriers for processed fish on the domestic fishing industry in the fish importing country are exactly the opposite to what happens in the fish exporting country. The profitability of fish processing would fall, and the demand for raw fish for processing would be less; in Figure 2 the demand curve for raw fish for the processing industry would shift from $\pi_p + t$ to $\pi_p$. In the new market equilibrium the share of raw fish going to the fresh fish market would increase and the price of raw fish would fall. The country is likely, however, to get more of processed fish than before at a lower price, more than making up the loss of its own production with imports from other sources.

Under open access the effects are again uncertain in the long run. A lower price of raw fish would lead to less fishing effort and less catches in the short run. This would allow the country's fish stocks to recover, and they might recover to such an extent that domestic supplies of raw fish would increase in the long run. In that case the country would get a double dividend; it would get more processed fish at a lower price and increase its own supplies of raw fish due to the recovery of the stocks.

**Table 3. Effects from relaxing barriers to trade on highly protected fish products**

| | *Open access* | *Catch control* | *Optimal management* |
|---|---|---|---|
| ***Exporting country*** | | | |
| *Supply of highly protected products* | Share of total supply increases but total amount may decrease in the long run if the total catch falls | Increases | Increases |
| *Supply of less protected products* | Share of total supply decreases but total amount may increase in the long run if total catch increases | Decreases | Decreases |
| *Price of raw fish* | Rises | Rises | Rises |
| *Total catch* | Increases, but falls in the long term if the stock was exploited beyond maximum sustainable yield level | Remains the same | May increase due to improved profitability |
| ***Importing country*** | | | |
| *Domestic supply of highly protected products* | Falls in the short run, as less of domestic supplies of raw fish are processed, but may increase in the long run if total catch increases. | Falls | Falls |
| *Domestic supply of less protected products* | Increases in the short run, as more of domestic supplies of raw fish are processed, but may fall in the long run if total catch falls. | Increases | Increases |
| *Price of raw fish* | Falls | Falls | Falls |
| *Total catch* | Falls, but increases in the long term if less fishing effort allows stocks to recover above maximum sustainable yield level, in which case there is a double dividend | Remains the same | May fall due to less profitability of fishing |

*Summary*

From this we see that removing trade barriers that affect different products differently may give rise to complicated repercussions in the markets. The production of products most affected by the trade barriers would expand in fish exporting countries and contract in fish importing countries. But due to the given total supply of fish the production of products not affected by trade barriers, or affected less than others, would contract in fish exporting countries and expand in fish importing countries. Under open access the effects are still more complicated and perhaps counterintuitive. The effects under the three stylised regimes discussed in this paper are summarised in Table 3.

## 6. Government financial transfers

Government financial transfers are not a trade barrier but they may distort trade. Such transfers can generate an artificial "comparative advantage" by lowering the production costs for a high cost producer, enabling him to undersell a producer who in reality has a lower cost of production. The way in which these transfers affect the production of and trade in fish depends in part on how they affect the costs of production and in part on the fisheries management regime. Ordinarily, these transfers reduce the cost of production and are in fact designed for that purpose; this is true, for example, of subsidies on fuel, bait or other inputs, tax relief for fishermen or investment in fishing vessels, and subsidies of the building of fishing vessels, either directly to the boat builders or indirectly through grants for buying fishing vessels or low interest on loans for such purposes. Other kinds of transfers, such as government financed buy-back programs for fishing vessels, need not reduce the cost of production, at least not directly. Indirectly, however, such programs might reduce the cost of production by reducing the risk of bankruptcy and enticing fishermen and fishing firms to take greater risks when investing in fishing vessels. Payment of access fees to other countries' economic zones reduces the cost of fishing but the effect on fishing effort and fish production depends on the differential effect vis-à-vis the fishing fleet in the country in whose zone the right of access has been acquired.

In the following we will discuss the effect of government financial transfers on the total catch. The effect on trade depends on the effect on the total catch and whether it is the catch of a fish exporting or a fish importing country that is affected, as discussed above. Again, the effect on the total catch depends on the management regime. Under open access the long term effect on the total catch may be counterintuitive and contrary to the short term effect; government financial transfers to the industry may in fact lead to a smaller total catch in the long term. It may also be noted that these transfers do not necessarily lead to a lower price of fish. If that were to happen the total catch of fish would have to increase as a result of these transfers, which need not be the case.

*Open access*

Transfers which lower the cost of production ordinarily lead to expanded production and a lower price of the product. Under open access, cost-reducing transfers initially raise the profitability of the industry. This encourages more fishing effort and raises the fish catches in the short term. In the long term, however, the catches may in fact fall. The effect of government financial transfers on trade flows and prices is therefore uncertain under open access; if they lead to increased fish catches they would increase the exports of fish from the subsidising country, or reduce imports if the country is an importer of fish, and the world market price of fish would fall because of a higher production volume. This is what ordinarily happens as a result of subsidisation. But it could also happen that the catch falls in the long term. In that case the effects are in the opposite direction; the subsidising country would

export less fish if it is an exporter of fish, or import more if it is an importer, and the world market price of fish would rise because less would be supplied.

Buy-back programs will probably work in the same direction as cost-reducing transfers under open access. To begin with fish stocks would recover as a result of removing fishing boats from the fishery. But if nothing is done about controlling investment in the industry the buy-back program would be self-defeating; new boats would be built in response to the improved profitability in the industry, and effort would expand until the fishery is again at a break even level. The net effect would probably be one of reducing the total cost of fishing; first, because the buy-back program would generate expectations of future bailouts and thus reduce risk, and secondly because the new boats would probably be technically more effective than the old ones. The long term effect on the catch would depend on whether the stock was exploited beyond the level of maximum sustainable yield; if so, then the catch would decline in the long term.

Under open access, the effect of buying access to another country's fishing zone will be to further diminish the fish stocks in the host country's zone. The long term effect on the total catch would depend on whether the stocks were exploited beyond maximum sustainable yield before the foreign fleet arrived. The foreign fleet will increase the fishing effort in the host country's economic zone, although the addition need not be one for one; the foreign fleet may displace some of the vessels of the host country, depending on its size and cost advantage vis-à-vis the host country's fleet.

*Catch control*

Under a catch control regime the catch would not be affected by cost-reducing transfers.[6] Such transfers would, however, improve the profitability of the fishing fleet and increase investment in the industry and thereby raise the cost of taking the given catch of fish. Government financial transfers would not in this case have any effect on international trade in fish; for that to happen it is necessary that the total catch volume be affected. The harmful effects of these transfers would be felt by the subsidising country itself through the increased cost of fishing, which means that less would be produced by other goods to satisfy the needs in the country. The effect of buy-back programs would be similar; in the absence of effective controls over investment in the industry they would simply encourage investment in boats and fishing gear, and for the reasons given above the total costs of fishing would probably be higher than before. A buy-back program will therefore only result in still higher costs for the country implementing it; a buy-back program will simply represent a net deadweight loss for the taxpayers who finance it, and furthermore increase the overall deadweight loss through raising the total costs of fishing beyond the level before the buy-back program.

The effect of paying access fees to the economic zones of countries which practice catch controls but do not control their own fishing fleet will be a displacement of some of the host country's fleet. The access of the foreign fleet means an increase in the total costs of fishing, through a still shorter fishing season or more severe restrictions on fishing effort for the host country's fleet. It may be noted that the catch control regime itself may become more difficult to practice, because the activities of foreign fleets usually are more difficult to control for the host country than those of the domestic fleet.

*Effective management*

Under effective management the industry participants have incentives to minimise the cost of taking the given catch. Cost-reducing transfers will, of course, increase the profitability of fishing, but as long as the total catch is given the fishermen or the fishing firms have no incentive to increase

their effort. The increased profitability would instead be reflected in a higher price of the "entry ticket" to the industry, *i.e.* higher market value of fish quotas or fishing licenses. The transfers would not in this scenario have any harmful effects on the allocation of resources, either in the subsidising country or the world at large, but merely represent a transfer of income from the taxpayers to the fishing industry. Under effective management, buy-back programs are essentially transfers of money to the industry in exchange for leaving. This will benefit both those who are bought out and those who remain in the industry. The latter will benefit either because they will get the catch quotas of those who left, or their operations will become less constrained if the total catch is controlled by other means. Buy-back programs seem particularly redundant in an industry which is effectively controlled, *e.g.* by transferable quotas, because the most efficient firms in the industry would have an incentive to buy out the less efficient ones as long as there are too many boats in the industry.

Transfers through the payment of access fees could enable foreign fishermen or fishing firms to buy their way into another country's fishing industry and outbid the host country's own fishermen. The effect on the total catch would be nil, however, as long as the total catch is effectively controlled. If access to the foreign country's zone is controlled by its own government through the selling or renting out of fishing rights in some form this would provide the host country with an additional revenue which its own fishermen are not able to match. At the same time this would represent a trade distortion in that the trade, in this case in fishing rights, would be affected by subsidies that might outweigh the host country's comparative advantage. The host country might not want to take advantage of the foreign country's generosity, as this might prove temporary and the host country might at a later date have to build up again its own fishing industry.

**Table 4. Effects of government financial transfers to the fisheries**

| | *Open access* | *Catch control* | *Effective management* |
|---|---|---|---|
| *Total catch* | Increases in the short run but decreases in the long run if the stock is exploited beyond maximum sustainable yield. | Unaffected | Unaffected |
| *Price of fish* | Falls in the short run but rises in the long run if the catch falls | Unaffected | Unaffected |
| *Long term profitability of industry* | Unaffected "at the margin" but profits for fishermen who are more effective or have lower opportunity cost will rise. | Same as for open access | Increases |
| *Long term effects on trade* | Uncertain, depend on what happens to total catch | Small, but there might be repercussions for goods other than fish, cf. below | None |
| *Effects on the rest of the economy* | More capital and manpower is attracted to the fisheries and less will be produced of other goods | Same as open access | None |

The effects of government financial transfers under different management regimes are summarised in Table 4 above.

Finally, with respect to fish farming, the effects of government financial transfers are likely to be similar to the effects in agriculture. Government financial transfers will increase the profitability of the industry, which will lead to expanding production, unless the transfers are made conditional on not increasing the productive capacity or to decommissioning production units.

## 7. Investment

*Fishing fleets*

The liberalisation of rules relating to direct investment has seldom reached the fishing industry. Most OECD countries restrict foreign investment in their fishing industries, and some even apply restrictions on domestic investment, allowing only *bona fide* fishermen to own fishing boats. Those who apply the latter rule have, however, found it necessary to make exemptions for the most capital intensive types of boats.

By foreign investment we shall mean investment in fishing vessels which are registered in the country in whose jurisdiction they operate. Such vessels would have to abide by the same rules and regulations as vessels owned by nationals, much as a factory on land owned by foreigners would be subject to the same rules and regulations as other factories, unless otherwise specified. Fishing by foreign registered vessels will be treated below as a separate issue under the heading of trade in fishing services.

Liberalising rules of foreign investment could be advantageous both for the foreign investor and the host country. There are various reasons why a foreigner might find it more profitable than domestic investors to invest in fishing vessels in any given country. The foreign investor might, for example, have access to a better technology. Even if it appears that fishing technology can be "bought off the shelf" and the requisite specific human skills hired on contract, it is undoubtedly true that some foreign investment in the fishing industry has been due to this effect.

It is probably more likely, however, that differences in profitability originate in marketing, management or other factors having to do with vertical integration. It could, for example, be attractive to integrate vertically all the operations in fishing, from catching the fish through processing and to marketing the finished product. Companies that process and market fish might find it attractive to invest in fishing vessels in foreign countries to diversify and secure control over their sources of supply, and they might also be able to operate fishing vessels more profitably due to their control over the entire value chain.

Like in the case of eliminating subsidies or removing barriers to trade, the effects of foreign investment depend critically on the management regime in the country where the investment takes place. If foreign investment in the fishing industry of a certain country is more profitable than domestic investment it will initially come as an addition to domestic investment and may over time replace some or all domestic investment. Under open access this will lead to a further depletion of fish stocks. The long term effects on prices and trade depend on what happens to catches in the long run. If catches increase, the trade in fish will expand if the foreign country is a fish exporter, and the price of fish will fall due to greater supply. If catches fall in the long term the opposite will happen.

Under catch control there would be no effect on trade or prices but the participation in the industry would increase, and some of the domestic fleet would probably be replaced by foreign owned fleet. The replacement of the domestically owned fleet by a foreign owned fleet would be a bonus for the country; the excessive investment in the fishing industry implies that the overall return on investment in the fishing industry is lower than the return on other types of investment, and the host country would actually get a better overall return on its capital by being forced to withdraw some of it from the fishing industry. If all fishing vessels registered in the country are manned by domestic labour the waste of labour would increase; more labour would be drawn into the fishing industry where it has a lower return than in alternative occupations. Under this regime the country would gain from replacing some of its labour in the fishing industry by foreign labour, in the same way as it would gain by replacing some of its investment by foreign investment.

Note that even if the foreign investment adds no value at all to the industry in the host country it could still be profitable for the foreign investor. The net contribution of the foreign investment would be much less than the return on the foreign capital invested because this investment would raise the costs of fishing for all participants, but that effect would not be reflected in the profit and loss account of the foreign investor.

Similarly, under effective management the foreign investment would not have any effect on the trade flow or the price of fish. The foreign investor would have to buy his way into the fishing industry in the host country through buying a fish quota or a fishing license. This he can only do if he can operate more profitably and pay a higher price than domestic operators. If foreign investors are able to do this they will over time buy out domestic investors, and some and possibly all of the fish quotas or fishing licenses will end up being owned by foreigners. Some governments might see this as an additional reason for putting some rent recovery mechanism into place, such as a fee on or auctioning of fish quotas or fishing licenses, to make sure the fishing rent benefits the country in which jurisdiction the fish are located.

The effects of foreign investment in fishing fleets are summarised in Table 5.

**Table 5. Effect of foreign investment in fishing fleets**

| | *Open access* | *Catch control* | *Effective management* |
|---|---|---|---|
| *Total catch* | Increases in the short run but decreases in the long run if the fish stock is biologically overexploited | No effect | No effect |
| *Profitability of domestic fisheries* | Declines, but the country will gain from moving capital out of fishing while losing from increasing the use of labour in fishing | Same as open access | Some operators will be bought out by foreigners |
| *Price of fish* | Depends on what happens to catch | No effect | No effect |

*The processing sector*

Restrictions on investment in the processing sector are less common than in the catching sector but still exist in some countries. The effects of liberalising investment in fish processing would not be much different from investment in other industries. Unless the industry is vertically integrated such investment would not have any direct effect on the catches of fish. There could be indirect effects, however. If foreigners are willing to invest in fish processing to a greater extent than domestics this would mean that they could operate more profitably, or increase the profitability of domestic firms if they enter into partnerships with the latter. There are reasons, as already discussed, why this might be the case; foreigners might have better market access, a better technology, or better management procedures. This could quite possibly result in a higher profitability of fishing operations through a higher price of raw fish, but to what extent a higher profitability in fish processing leads to a higher price of raw fish depends on how the raw fish market works, especially the degree of competition between different buyers of fish. A higher price of raw fish could affect the total catches of fish, depending on what kind of management regime is being applied, as already discussed.

## 8. Trade in fishing services

Trade in fishing services can mean many things. It will be used here for arrangements where fishing vessels from Country A catch Country B's fish. The extension of the fishing limits that occurred in the 1970s greatly expanded the scope for such trade, as an enormous portion of the high seas to which there used to be open access irrespective of the nationality of the fishing vessel or its crew came under the jurisdiction of coastal states. The actual trade in fishing services has however been very limited, since most coastal states have given preferences to their own fishing fleets and in many cases deliberately barred foreign vessels from fishing within their 200 mile zone.

Letting fishing vessels from Country A catch Country B's fish would typically involve fishing vessels from Country A entering the economic zone of Country B, but it need not be so. The countries around the Northeast Atlantic which share fish stocks that are controlled by limits on the total catch often exchange fish quotas with one another without necessarily allowing each other's fishing vessels inside their boundaries. It is also common practice around the Northeast Atlantic for Country A to allow Country B to take some of Country B's quota from a shared stock inside Country A's zone.

The gains from international trade in fish quotas or fishing services could be substantial. Most fish stocks fluctuate considerably over time for environmental reasons that are outside human control and even poorly understood. These fluctuations typically lead to fluctuations in catches, partly because allowed catches from stocks being controlled by catch limits are set with a reference to the actual condition of the stocks, and partly because it is physically difficult or impossible to maintain a steady catch level from a fluctuating stock. These fluctuations are seldom synchronised in time for different stocks; fish stocks may be abundant, for example, in the Northeast Atlantic while they are at a low level in the Northwest Atlantic. If, however, any given stock is to be fished exclusively by vessels from countries in whose jurisdiction the stock is located the capacity utilisation of the fishing fleet could be very uneven. Significant economic gains could be obtained by allowing international trade in fish quotas or fishing services. This question is considered more formally in Hannesson (1994).

Trade in fishing services for the purpose of levelling variations in the use of fishing capacity could take place in various forms. National governments could offer "excess quotas" in good years for hire in an international market. Alternatively, private firms holding quotas defined as shares of the

total allowed catch of a certain stock could be free to hire fishing vessels from any country to take their quota. An arrangement like that would most likely lead to a more even utilisation of fishing capacity, with the largest and most wide ranging fishing vessels being available to be sent to a place where there is a particular need for their services at any given time. Lastly, multinational fishing companies would probably find it in their interest to acquire fishing rights (*e.g.* quota allocations) in different stocks and even out their capacity utilisation by sending their vessels where they are most needed at each point in time. Some such activity is taking place already, but rules stipulating that fish quotas of a given country must be taken by that country's fishing fleet make such adjustment difficult.

More generally there are many reasons why it would be advantageous to hire a foreign vessel to do the fishing. Some countries have a comparative advantage in fishing. The reasons for that comparative advantage are as different as in any other industry. Sometimes they are associated with specific knowledge and technology that cannot be "bought off the shelf" but requires human skills which it takes a long time to acquire.[7] In other cases the cause for comparative advantage lies in low wages or less stringent regulatory regimes applied to fishing vessels.

Trade in fishing services, based on comparative advantage, could take many forms, depending on the management regime in the country at hand. Take, for example, a management regime based on individual transferable quotas. Such quotas could be allocated by auction where anyone, also foreigners, could be free to make bids. If foreign fishing fleets are more efficient than domestic, the quotas would end up in the hands of foreigners but the revenue for the quotas would be maximised. In a case like that it probably becomes important, from the point of view of the country controlling the quotas, not to sell them permanently but only for a limited time period, or to make them subject to attenuation, in order to secure a reasonably even stream of income and to avoid having the ownership of fish quotas permanently in foreign hands. A management system with attenuating quotas is described in Hannesson (1996).

More often, however, individual transferable quotas have been allocated initially on the basis of the track record of industry participants rather than by auction. The quota holders could then be free to use them as they find in their best interest. Where such systems have been put in place many quota holders have opted for renting out their quotas. With a liberalised trade in fishing services they could rent their quotas to foreigners who could fish at a lower cost than domestic fishermen. This would lead to an increased competition in the fishing industry and an increased pressure to cut costs. Permanent transferability of quotas could also be extended to foreigners. In that case the government in question would probably want to consider very carefully how it could ensure a reasonable share of the fishing rent on a permanent basis for its own population. This could be accomplished either by a quota fee or auctioning of quotas, either for a limited time period or with an "attenuation" rule.

These remarks on the possible comparative advantage of foreign fleets raise the question of what the foreign fleet really is. A foreign vessel is a vessel flying another country's flag, but re-flagging of vessels is not a complicated procedure. Liberalising the trade in fishing services is quite likely to lead to considerable re-flagging of fishing vessels, for reasons that are very similar to the ones that have led to the re-flagging of much of the merchant marine of many OECD countries. The rules pertaining to manning and registration of vessels are more liberal in some countries than others, making it cheaper to operate vessels under one flag than another.

There is some reason to believe that much of the fishing operations would be conducted with vessels under foreign flags and employing people from low wage countries if there were a general liberalisation in the trade in fishing services. We have in fact seen some of that happening. Some of the fishing conducted outside the 200 mile zone, where national rules do not apply, has been done with

vessels owned by OECD nationals but flying the flags of countries like Belize or Panama and manned by people from Poland, Lithuania and other low wage countries.

Let us turn, then, to how the effect of opening up for trade in fishing services depends on the fisheries management regime. Under open access a liberalisation of trade in fishing services would amount to lower fishing costs. This in turn would lead to increased fishing effort and a further reduction in fish stocks. The long term catches could either increase or decrease, depending on whether the stocks are biologically overexploited or not. Under catch control the lower costs of boats and crew would lead to increased investment in boats and gear in the fishery, and in the end the total costs of fishing would in fact rise, due to unnecessarily large fleets and shorter fishing seasons. Note the similarity of the effects under open access and catch control; in the latter case there is really open access to the fleet but the fish stocks are spared through catch controls, so that the detrimental effects of excessive fishing effort only come through excessive costs. In this case, the free trade in fishing services might in fact be an improvement upon the situation where the fishery is open only to nationals. To the extent domestic labour is out-competed by foreigners there will be less wasteful use of domestic labour in the fishing industry, with domestic labour being employed in operations that are more rewarding, seen from the point of view of the entire economy. As for the investment, to the extent the vessels are financed by domestics there will be waste, because the marginal return of this investment may well be negative, even if it is profitable from the point of view of the single boat owner.

Lastly there is the case of effective management. Under this regime, the possibility to hire boats from other countries will represent a lowering of fishing costs. It may be noted at this point that the hiring of fishing services is becoming more and more widespread in countries where exclusive, long term use rights have been introduced. In Iceland, for example, some holders of fish quotas routinely contract with boat owners who do not own quotas to do the fishing. The possibility of doing so at a lower cost seems likely to further encourage this practice. In any event, the lowering of fishing costs would increase the profits in the fishery, but since the total quantity is given and the holders of quotas or licenses have every incentive to minimise costs, the effect would be an increase in fishing rent, capitalised in a market value of quotas or licenses to the extent it is not siphoned off by fees or auctions.

The effects in the three management regimes are summarised in Table 6.

**Table 6. Effect of trade in fishing services**

| | *Open access* | *Catch control* | *Effective management* |
|---|---|---|---|
| *Total catch* | Increases in the short run but decreases in the long run if the fish stock is biologically overexploited | No effect | No effect |
| *Profitability of domestic fisheries* | Declines, but the country will gain from moving labour and capital out of fishing, and from better use of fishing capacity | Same as open access | Owners of fish quotas will gain but domestic fishermen and boat owners will lose. Gains from better use of fishing capacity. |
| *Price of fish* | Depends on what happens to catch | No effect | No effect |

## 9. Conclusion

The most important conclusion emerging from this discussion is the critical role of fisheries management for the effect of market liberalisation, whether it be of trade in fish products, investment, or trade in fishing services. To start with trade in fish products, a fish exporting country practising open access to its fisheries will gain little, and quite possibly lose, from trade liberalisation while fish importers may reap a double dividend by way of more fish at a lower price and a recovery of their own overexploited stocks. These effects are counterintuitive and almost certain to be overlooked by people unfamiliar with the intricacies of fishing under open access.

While open access in its pure form may be a thing of the past in many if not most OECD member countries, it still prevails in some developing countries. Furthermore, lax and insufficiently enforced regulations may not be much of an improvement over open access. Control of the fish catch while there is still open access to the industry will, if effective, protect fish stocks from depletion but do little or nothing to prevent the waste of manpower and capital in fishing. In those circumstances there will be small gains for fish exporting countries from trade liberalisation; it will only encourage further waste of resources in the fishing industry and reduce the production of other goods. Fish importers may, on the other hand, reap double dividends; in addition to getting cheaper and more fish the lower fish prices will cause some of the excessive capital and manpower to be transferred out of the fishing industry.

The fact that the catch of fish is limited either by regulation (catch control or effective management) or by nature implies that removal of trade barriers for some fish products will have repercussions over a wide spectrum of products. With a given supply of raw fish the production and trade of products that previously were protected can only be expanded at the expense of other, less protected products. Removal of trade barriers for highly protected products will therefore have repercussions for the trade volumes and prices of other, less highly protected products. This is further complicated under open access where the change in profitability due to the removal of trade barriers will have uncertain consequences for the long term supply of raw fish. Under open access, fish importing countries may again reap a double dividend from trade while fish exporters may lose.

The effects of government financial transfers on trade are somewhat counterintuitive and again dependent on the fisheries management regime applied. Government financial transfers ordinarily encourage production and depress the market price of traded products. When the total catch is effectively controlled this does not happen; the total supply is given and the effect on trade and prices is nil. Government financial transfers are then harmful first and foremost for the countries providing these transfers, through attracting more people and investment unnecessarily to the fishing industry. Capacity-reducing measures such as buy-back programs need not have this effect, however, except that they may make investments in the fishing industry less risky than they would otherwise be. Under effective management where the industry has incentives to minimise costs, government financial transfers will simply increase the profits in the industry.

Under open access government financial transfers will increase the degree of exploitation of the fish stocks, which may lead to decreasing catches in the long run. This will affect trade flows but possibly in an unexpected direction; if a fish importing country subsidises its domestic fisheries it may lead to a long term decline in its catches and hence to an increased and not decreased imports of fish. When governments pay access fees to other countries' economic zones they will lower the costs of fishing and cause a further depletion of fish stocks in the host country or raise the cost of fishing through shorter fishing seasons in case the total catch is under control. Subsidising fishing in other

countries' zones may amount to subsidising the renting or buying of fishing rights, in case there is an effective, rights based management system in place in the host country. This raises questions of rent taxation.

The effects of opening up for foreign investment in the fishing industry will also depend on the management regime. With open access this would encourage further depletion of fish stocks in case the opportunity cost of foreign capital is less than that of domestic capital. This would have repercussions for trade, depending on whether the long term catch is increased or decreased, and whether the host country is a fish exporter or a fish importer. The foreign capital might displace some of the domestic capital, which in fact would be beneficial for the host country, as the latter would waste less of its capital resources in the fishing industry. The wasteful use of labour would increase, however, if the foreign owned vessels are manned by the host country's labour. Under catch control the depletion of the fish stocks would be avoided. With effective management the foreign capital might buy out some of the domestic capital, which raises questions of resource rent taxation in order to secure sufficient benefits for the host country.

The effect of removing restrictions on trade in fishing services also depends on what kind of management regime is applied. With free trade in fishing services these would be provided by low cost suppliers of such services. Under open access this would lead to a further depletion of fish stocks and possibly lower catches in the long term while under catch control the fish stocks would be spared and only the fishing cost would be raised. There might in fact be some gain to the host countries under both regimes through pushing excessive labour and manpower out of the fishing industry and replacing it with hired services from abroad. Under open access there would be repercussions for trade of a similar nature as with foreign investment.

The effects of free trade in fishing services would be most beneficial when there is effective management. It would make it possible to deal better with the problems of fleet capacity utilisation caused by fluctuations in fish stocks, which are not synchronised between different jurisdictions. Trade in fishing services would also increase the profitability of fishing operations under effective management, which would accentuate questions of resource rent taxation. One phenomenon that would be likely to arise as a result of a liberalised trade in fishing services is re-flagging of fishing vessels to countries where labour costs are low or where there are less onerous regulations with respect to fishing vessels and their use.

Finally, a few words on where one could go from here. The theory of international trade and its application to renewable resources such as fish, upon which this paper has drawn, is well developed. Further insights are likely to come from applying this theory to specific cases rather than from a further refinement of the theory itself. These cases are likely to be both interesting and challenging, not least because of the differential tariff regimes often applied vis-à-vis different countries and for different products. Non-tariff barriers to trade, such as sanitary and quality standards, are a challenging and important subject.

A particularly interesting and fruitful case for application is fishing of shared stocks on the high seas. On this subject some further theoretical development is called for, particularly with respect to pre-emptive strategies that nations engaged in fishing stocks on the high seas might employ to keep entrants out, and also on the trade regimes that might be supportive of whatever controls nations may agree to impose on fishing on the high seas.

The least explored areas with respect to effects of market liberalisation in fisheries are international investment and trade in fishing services. In this arena market liberalisation has made least progress. This may very well be the reason why there has been little research done on this, but it also

appears to be a good reason for devoting further attention to these areas, to stay ahead of a development towards market liberalisation that may come.

## NOTES

1. It is possible that the higher price of fish products resulting from relaxing trade barriers will imply a greater optimal catch in the long term, in which case the supply of raw fish will be expanded, but even so the increased demand for products for which the trade barriers have been relaxed is likely to have to come at the expense of other products to some extent.

2. See ”Towards Sustainable Fisheries” (OECD, 1997) in which a full description of the different types of OECD fisheries is given.

3. The only exception would be if there are many fish exporting countries affected by the relaxation of trade barriers, competing in an international market characterised by a low elasticity of demand. In that case it is possible to construct a scenario where the fish exporters lose from increased trade (see Hannesson, 2000).

4. It may be noted that a fish importing country could be one that has an inherently more effective fishing industry than other countries and would thus be expected to be a fish exporter because of its comparative advantage. What may reverse this is that the high technical efficiency of the country’s fishing industry translates into a decimation of its fish stocks to such an extent that it actually has a higher cost of fishing than other countries with less productive fisheries. The reader is referred to the Appendix for a further explanation of this.

5. This was one of the reasons why the COFI decided in 1993 to embark on the *study "Towards Sustainable Fisheries"* that analyses the fisheries management systems in the OECD countries.

6. Note, however, that government financial transfers may encourage lobbying for larger allowed catches or make monitoring and compliance more difficult, as discussed above in connection with increasing prices of fish. These transfers may therefore be less innocuous under catch control than the discussion in the text suggests. This may also happen under effective management, but is less likely, as discussed above.

7. Tuna fishing in the Pacific comes to mind as an example; it has turned out to be difficult for the Pacific island states to develop national tuna fisheries despite being close to the fishing grounds for tuna.

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## *ANNEX*

This appendix uses a formal model to derive the effects of opening up for trade between two countries. Two goods are produced, fish (*X*) and other goods. There is one factor of production, which we call labour (*L*). There are constant returns for other goods, so we measure these simply in units of *L*. The following utility function is specified:

(1) $U = L^{\alpha} X^{1-\alpha}$

Utility maximisation gives the following price (*P*) of *X*

(2) $P = \frac{1-\alpha}{\alpha} \frac{L}{X}$

The fish is produced from a stock (*S*) growing according to a simplified form of the logistic equation:

(3) $\frac{dS}{dt} = S(1-S) - X$

The production function for fish is

(4) $X = q(1-L)S$

*i.e.* the total supply of labour is normalised to one. We study equilibrium situations where $dS/dt = 0$, so we get from (3) and (4)

(5) $S = 1 - q(1-L)$

Inserting (5) into (4) gives

(6) $X = q(1-L)\left[1 - q(1-L)\right]$

*Open access*

With open access, the value of fish production per unit of labour employed will be equal to the cost per unit of labour, which is one:

(7) $$\frac{PX}{1-L}=1$$

Using (2) and (7) we get

(8) $$L=\alpha$$

Inserting (8) into (6) we get

(9) $$X=q(1-\alpha)\left[1-q(1-\alpha)\right]$$

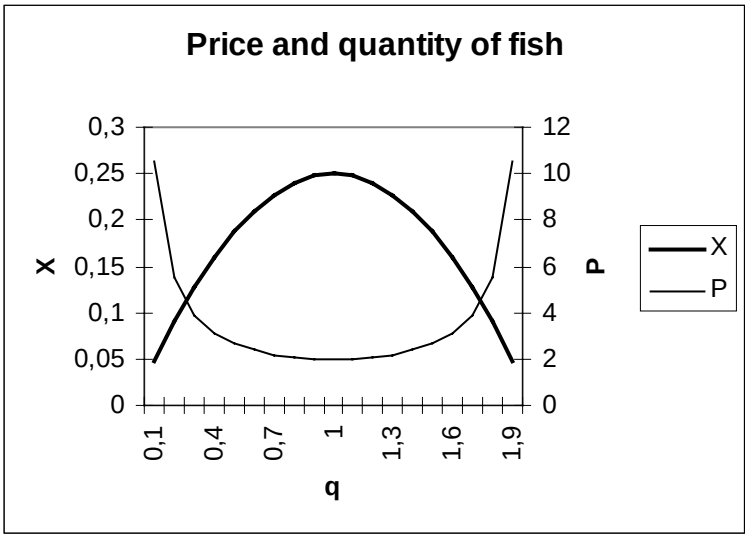
We now assume that the two countries, labelled *A* and *B*, are characterised only by different productivity of their fisheries, so that

(10) $$q_A \neq q_B$$

while all other parameters are the same.

**Autarky**

**Figure A1**




Without trade, prices and production will differ in the two countries. Figure A1 shows how the price and quantity of fish varies with the productivity coefficient, *q*, in the absence of trade (Equations [2], [8] and [9]). The utility parameter $\alpha$ is set equal to 0.5. Note that the quantity of fish is greatest when the productivity coefficient is equal to unity. As the productivity coefficient increases

beyond that we get the pathological result that the production of fish diminishes. This happens because the greater productivity in the fishing industry encourages overexploitation, which diminishes the fish stock to such an extent that the long term yield diminishes. Note, finally, that the countries are assumed to be identical in terms of total labour supply.

**Trade**

Now open up for trade. We assume that trade starts in a situation with equilibrium under autarky. The two countries will trade if the price of fish is different in the two countries, with fish being exported from the country where the price is lowest. For comparison, we fix the productivity coefficient of Country *A* at unity ($q_A = 1$). This does not qualitatively affect the conclusions, but with a different reference value of $q_A$ Country *B* would export fish for certain values of $q_B$. With $q_A = 1$ Country *A* will always export fish if the productivity coefficient for Country *B* ($q_B$) differs from unity.

The equilibrium solution with trade can be calculated as follows. From Equations (6) and (7) we get the equilibrium use of labour in the fishing industries in the two countries. Note that since Country *B* imports fish it must export other goods, *i.e.* labour embedded in those goods. The equilibrium use of labour in the fisheries of the two countries will therefore be

$$(11) \qquad 1 - L_A = \frac{Pq_A - 1}{Pq_A^2}$$

$$(12) \qquad 1 - L_B - L^e = \frac{Pq_B - 1}{Pq_B^2}$$

where $L_A$ and $L_B$ are the amounts of labour used to produce other goods in Countries *A* and *B*, respectively, and $L^e$ is the amount of other goods exported from Country *B*.

We can now use Equation (6) to calculate the production of *X* in both countries. The demand for fish ($X^d$) and other goods ($L^d$) in the two countries is given by Equation (2). Finally we have the conditions that the value of exports must be equal for both countries

$$(13) \qquad PX^e = L^e$$

and that demand must be equal to supply

$$(14) \qquad X_A^d = X_A - X^e, \qquad X_B^d = X_B + X^e$$

$$(15) \qquad L_A^d = L_A + L^e, \qquad L_B^d = L_B - L^e$$

This gives us 11 equations to determine 11 variables, Equations (11) and (12) (or the two variants of [7]), two variants of each of (6) and (2), Equation (13), and two variants of each of (14) and (15). The variables are $X_A$, $X_B$, $X^d_A$, $X^d_B$, $X^e$, $L_A$, $L_B$, $L^e$, $L^d_A$, $L^d_B$, and $P$.

Solving these equations for different values of $q_B$ ($q_A = 1$ by assumption) gives us, *inter alia*, equilibrium values for the production and price of fish in Country *B*. Figures A2 and A3 compare these with what obtains in the absence of trade. Trade will, of course, equalise the price in the two countries and lower the price of fish in Country *B*, as the country increases its supplies with imports

from Country *A*. When $q_B < q_A = 1$ this is due to the fishing industry in Country *A* being inherently more efficient than in Country *B*. Country *A*'s fisheries offer fish at a lower price, and the production of fish in Country B declines (Figure A3). But when $q_B > q_A = 1$ it is Country *B*'s fisheries that are inherently more productive. The price of fish is nevertheless higher in Country *B*, because the higher technical efficiency entices it to overexploit its fish stock. Imports of fish from Country *A*, which has an inherently less productive fishing industry, lowers the price of fish in Country *B* and reduces its fishing effort. This leads to a recovery of the fish stock in Country *B* and a higher yield of fish. The price of fish falls in Country *B*, partly because its own production of fish increases, and partly because it imports fish from Country *A*.

**Figure A2**

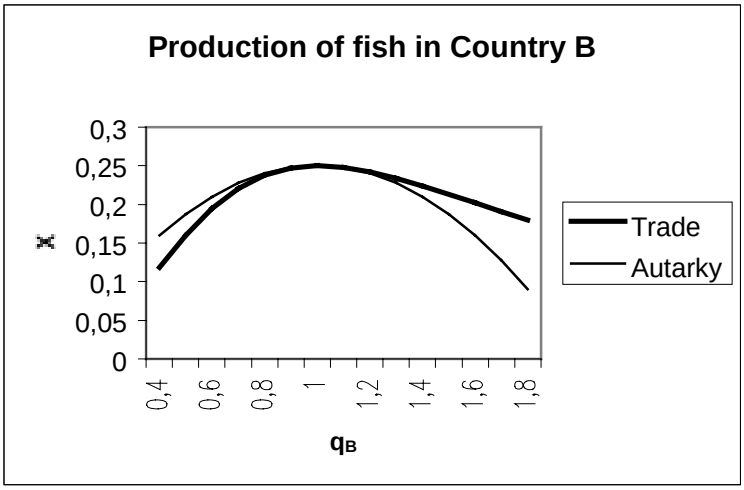



**Figure A3**

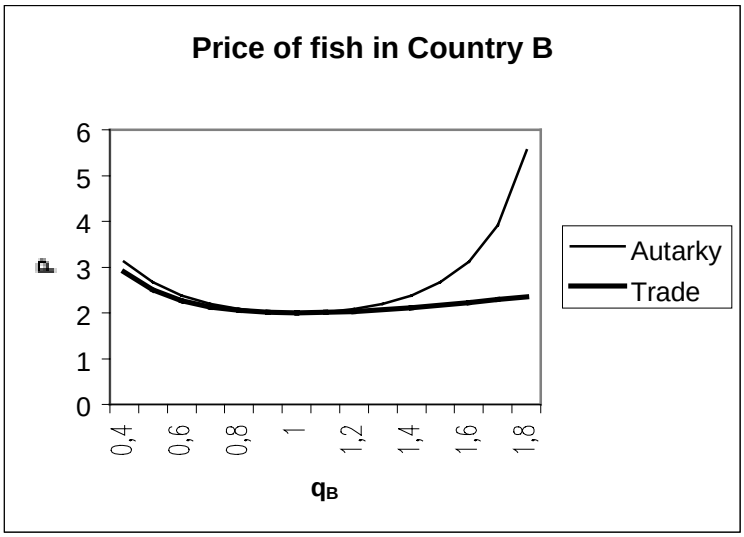
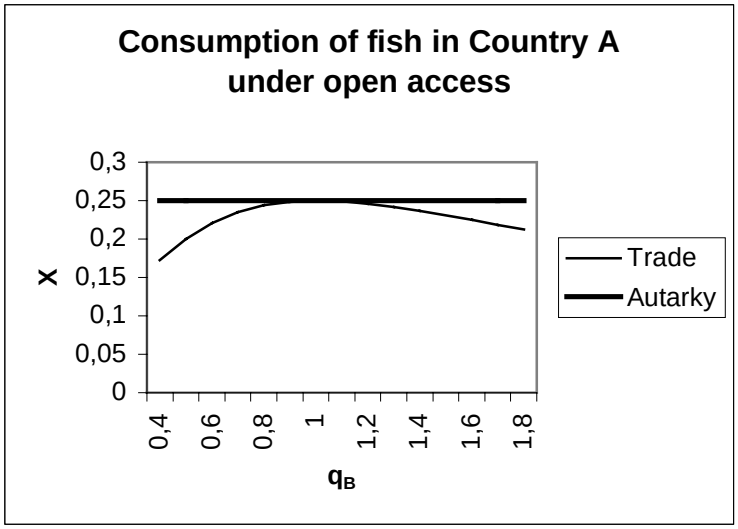



Figure A4 shows what happens to Country *A*'s consumption of fish. We see that it is less with trade than in autarky. This might not be a problem for Country *A* if it would consume more of other goods with trade than in autarky but this is not what happens; in this particular model Country *A*, the fish exporting country, consumes the same amount of other goods whether or not it trades with the

other country. The effect of opening up for trade is that Country *A* wastes more of its labour in the fishing industry and ends up losing from trade while the other country gains all the more. This is an example of the impoverishing effect of trade under free access discussed by Brander and Taylor (1997*a* and *b*, 1998). If, however, the exporting country specialises totally in production of fish it will gain from trade, as also shown by Brander and Taylor. Such total specialisation could result from different preferences (*e.g.* a linear utility function where the two goods are perfect substitutes).

**Figure A4**




*Catch control*

With catch control the depletion of fish stocks can be avoided but if nothing is done about limiting entry to the industry it will still end up where total costs are equal to total revenues, and more factors of production will be used to catch the fish than needed. The demand for fish and other goods will still be governed by Equation (2) and the equilibrium in the fishing industry by Equation (7), but instead of equation (6) the production of fish will be fixed at some given level

(16) $\quad X = \overline{X}$

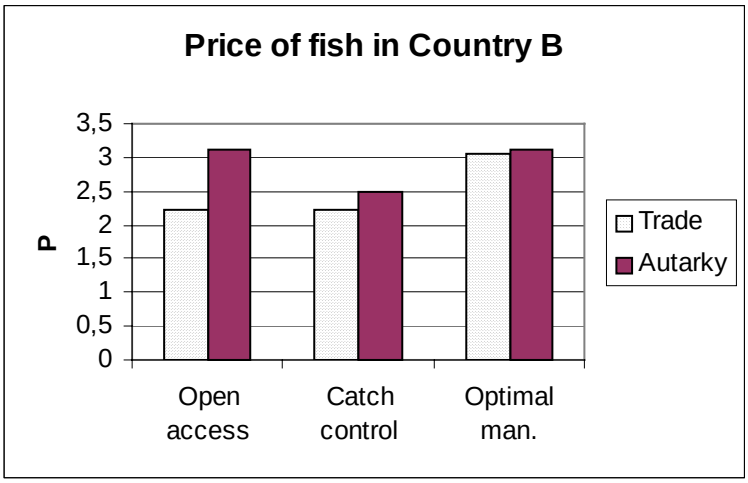
***Autarky***

In the absence of trade, we can find the three variables *X*, *L* and *P* for each country from Equation (2), (7) and (16). We continue to assume $q_A = 1$, which with open access in autarky gives maximum sustainable yield $X_{msy} = 0.25$, cf. Figure A1. Hence we set $\overline{X}_A = 0.25$. The meaningful level of $\overline{X}_B$ depends on the productivity parameter $q_B$. Here we shall use for comparison the value $q_B = 1.6$. This is in the range that would produce biological overexploitation under open access and result in an equilibrium catch $X = 0.16$ in the absence of trade. We assume that catch control succeeds in avoiding a decimation of the stock that results in such a low catch and that the catch is set higher, or $\overline{X}_B = 0.2$. Note that $\overline{X}_B < \overline{X}_A$ is necessary in order to get any trade.

**Trade**

Equilibrium with trade can be determined in much the same way as above. We still have the same 11 variables, but instead of the two variants of Equation (6) we now have fixed quantities of $X$ in both countries.

**Figure A5**




Figures A5 – A7 compare the results with and without trade, for Country *B*, under open access and catch control, as well as optimal management, which will be discussed below. The results of opening up for trade are similar with open access and catch control; the price of fish falls in Country *B*, which imports fish, and the amount of fish consumed in Country *B* increases. A noteworthy difference between open access and catch control is that the consumption of fish in Country *B* in the absence of trade is considerably higher with catch control than under open access and the price correspondingly lower. This is due to the fact that catch control manages to prevent the biological overfishing which occurs under open access. That there is waste under catch control will become clear when we consider optimal management, to which we now turn.

***Optimal management***

With optimal management, the use of factors of production is given by setting the value of the marginal product of labour equal in both sectors of the economy. This is equal to one by definition in the "other goods" sector. From Equation (6) we get

$$(17) \qquad P\frac{\partial X}{\partial(1-L)} \equiv Pq\left[1-2q(1-L\right]=1$$

which gives us three equations ([2], [6] and [17]) to solve for the three variables $P$, $X$ and $L$ in each country under autarky. With trade we have the same 11 equations as before, except that (17), which comes in two varieties, one for each country, must now be used instead of Equations (11) and (12).

**Figure A6**

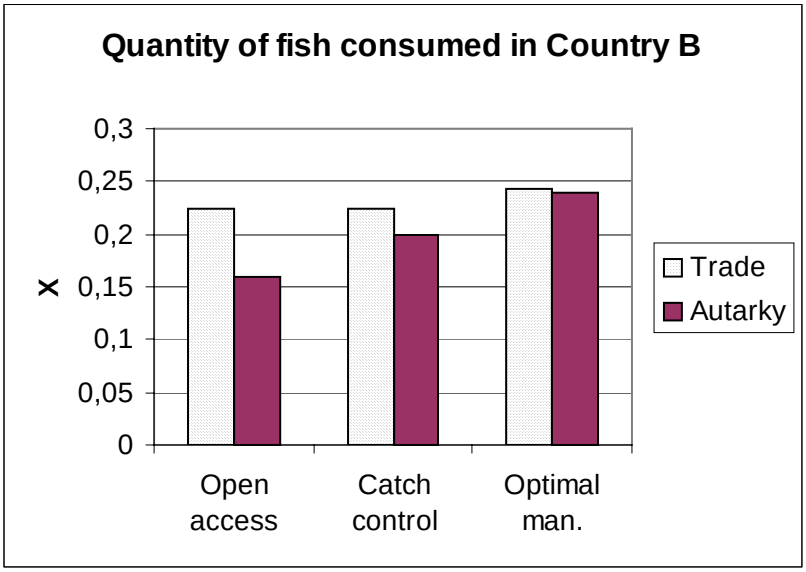
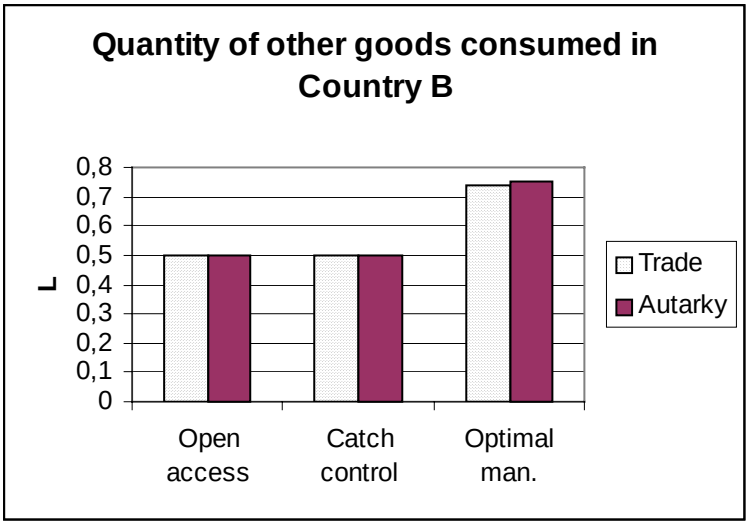



**Figure 7**




The solution under autarky in countries *A* and *B* compared with open access is interesting, and is shown in Table A1 for the same numerical values of the parameters as under catch control. Country *B* gets 50% more of fish and of other goods in the optimal solution than under open access, but the relative price of fish is the same as under open access, since the consumption of both fish and other goods has increased in the same proportion. Country *A* actually has slightly less fish in the optimal solution than in the open access solution but much more of other goods. The price of fish is therefore higher in the optimal solution, because fish has become more scarce relative to other goods; the gain lies exclusively in getting more of other goods which are relatively cheaper to produce. Under open access fish is relatively cheap because other goods are relatively scarce and not because fish is absolutely plentiful. In a real world situation, this price effect of optimal management would not be prominent, as less wasteful use of factors of production in fishing would affect many different goods and services, and the price of each would hardly change much, but the increase in the production of other goods and services could nevertheless be substantial.

**Table A1**

| | Country A | | Country B | |
|---|---|---|---|---|
| | *Open access* | *Optimal man.* | *Open access* | *Optimal man.* |
| *Fish* | 0.25 | 0.22 | 0.16 | 0.24 |
| *Other goods* | 0.5 | 0.67 | 0.5 | 0.75 |
| *Price of fish* | 2 | 3.0 | 3.125 | 3.125 |

We can now compare all three regimes. Figures A5 – A7 show the results under all three regimes for Country *B*. One thing to note is that with optimal management it is Country *B* that still imports fish, despite being more productive at fishing. This happens because Country *B* has a relatively large supply of other goods, because it does not need to use as much of its productive resources in its fishing industry[1], and is therefore more interested in buying fish from Country *A* and export some of its plentiful other goods. The gains from optimal management lie mainly in increased production of other goods, due to the elimination of the waste of factors of production in the fishing industry. We can also note that the open access and the catch control regimes are not very different in this respect; with catch control factors of production are still being used excessively in the fishing industry, which is why there is about the same quantity of other goods in both regimes, but depletion of the fish stock is prevented under catch control so there is more fish around.

*Fishing from a shared stock – open access*

It is possible to use the above framework to analyse the effects of opening up for trade when countries fish from a common stock. In order that there be any effects of trade the countries must differ somehow in economic terms. To keep within the above framework, it will be assumed that they differ with respect to fishing efficiency, so that Country *A* is more efficient than Country *B* ($q_A > q_B$). Under autarky they could fish simultaneously from a common stock, but their domestic prices would differ. With trade, the more efficient country would out-compete the other and be the only supplier of fish. Otherwise the solution of the model follows the same lines as above.

Figures A8 – A13 show the solution for some key variables with trade as a percent of the autarky values. In figures A8 – A10 we have $q_A = 0.5$, and in Figures A11 – A13 we have $q_A = 0.7$. With the lower value there will be an increase in the total catch as a result of letting the more efficient country catch the fish whereas with the higher value this will result in overexploitation and a fall in the long term supply of fish. Otherwise the effects of opening up for trade are qualitatively similar. The price of fish falls in the less efficient country and rises in the country that will be the sole supplier of fish after opening up for trade. Nevertheless, the utility level rises in the country that starts to import fish after trade has been allowed while in the other country the utility level falls. Hence the potential fish exporter will in fact lose from opening up for trade irrespective of what happens to the total catch; all trade does for this country is to entice it to waste its resources unnecessarily in the fishing industry.

1. Note that we have set $q_B = 0.16$ so Country B is technically more effective than Country A ($q_A = 1$).

**Figure A8**

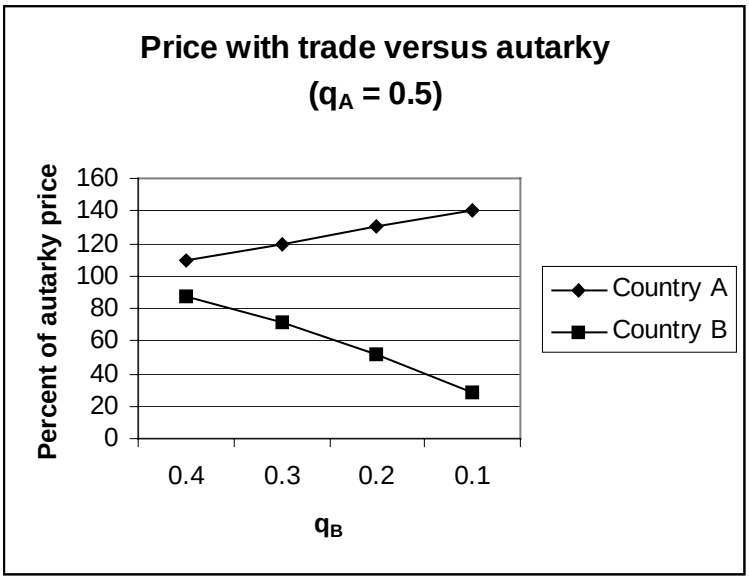



**Figure A9**

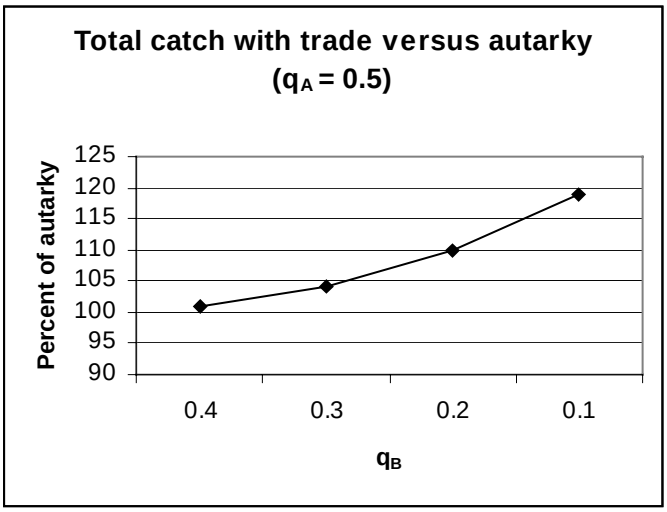


**Figure A10**

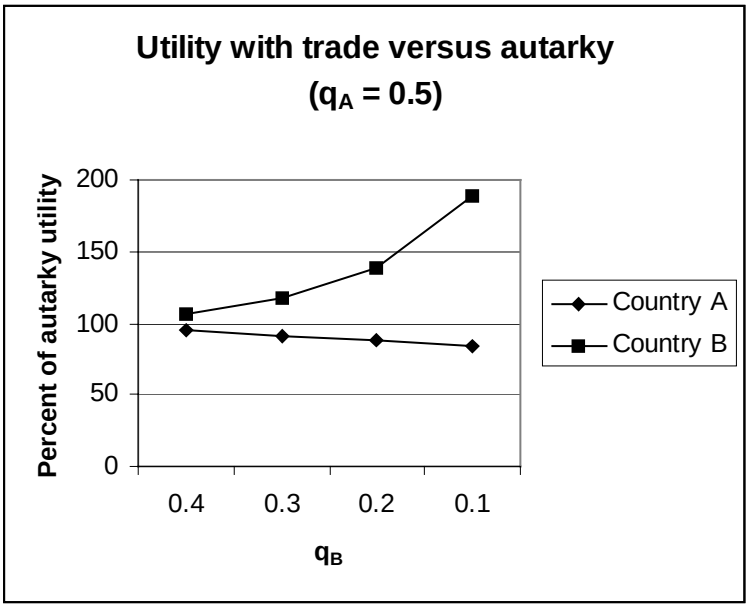



**Figure A11**

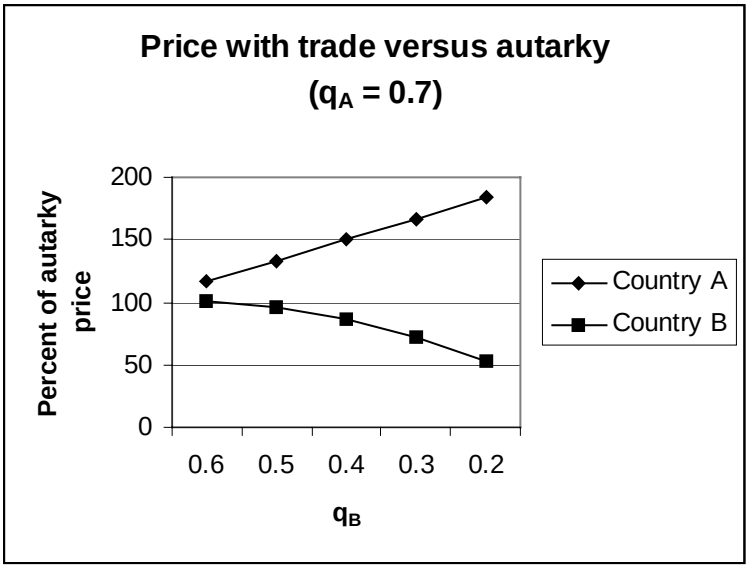


**Figure A12**

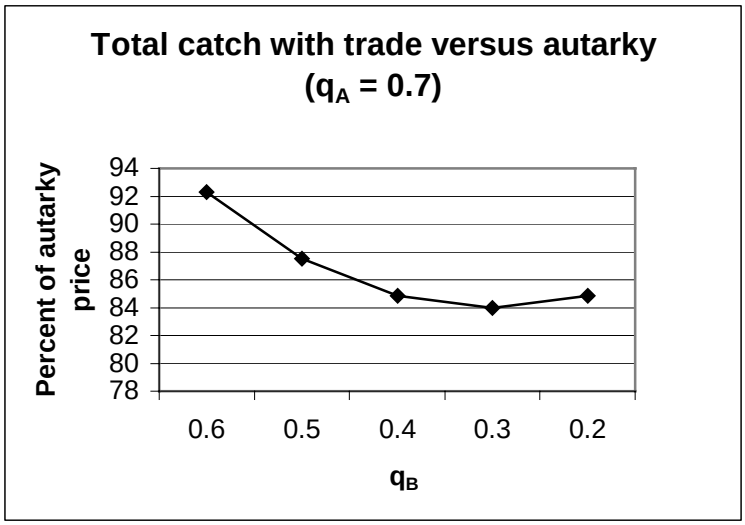



**Figure A13**