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Productivity Growth in the Supply Chain—Another Source of Competitiveness for Aquaculture

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Introduction

Productivity growth has been the main engine of growth in salmon aquaculture and other aquaculture species where production has increased substantially. This process is well documented at the producer level in Asche (1997), Tveteras (2002), and Anderson (2002). A central argument for the successful growth in aquaculture has been increased control of the production process that allows market-oriented production and sales. However, with the exception of Zidac, Kinnucan, and Hatch (1992), little attention has been given to how these potential advantages have been exploited in the supply chain. Still, for increased aquaculture production productivity, growth in the supply chain is as equally important as productivity growth at the production level. A consumer only cares that a product has become less expensive, not at which level in the supply chain the productivity improvement caused the lower price to take place.

A main reason why productivity growth in the supply chain has received little attention is lack of data downstream. It is, in general, not too difficult to access data to conduct studies at the production level, the trade level, and even the retail level. However, it is very hard to match the data at one level in the supply chain with data at a different level. Furthermore, it is also very difficult to acquire data on other variables that influence intermediary firms' behavior. The few recent studies that investigate any issues in the supply chain focus on price transmission (Guillotreau, Le Grel, and Simioni 2005; Jaffry 2004; Asche, Jaffry, and Hartman 2007).

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In this paper we will make descriptive comparisons that highlight the potential for productivity growth in the supply chain by comparing margins in the supply chain for one important aquaculture species, fresh salmon, with one important harvested species, fresh cod. This will illustrate some of the potential that control of the supply chain gives to aquaculture relative to wild fisheries.

The Margin for Fresh Salmon and Cod

During the last two decades, farmed salmon has grown into the most important fresh species in most western European countries, as measured by quantity consumed or sales value. This growth has been fueled by a productivity growth at the production level that makes current production cost a quarter of what it was in real terms in the mid-1980s. It has also led to a number of innovations in distribution and logistics with the first priority to bring high-quality fish to the market with a high degree of reliability. Later, the focus shifted to reducing the cost of bringing the fish to the market in a wider variety of product forms. While there is only anecdotal evidence, there are strong indications that this has allowed for exploitation of economies of scale and scope in transportation, distribution, and logistics. In supply chains for farmed salmon, producers and buyers can plan future transactions together with a higher degree of certainty than is the case in harvesting sectors because of a higher degree of control over the production process. This has contributed to investments in cost-saving processing technologies and cost-saving contractual arrangements.

Cod is among the most important wild species in Western Europe, and it is also one of the largest species when it comes to fresh consumption, at about 100,000 tons. The leading suppliers are Iceland and Norway. However, there are also substantial supplies from EU fishermen. The supply chain for fresh cod is, in most cases, still a traditional seafood supply chain. The cod chain has more stages than the salmon chain and the market clears between independent intermediaries at each stage. The only exception is some supplies from Iceland, where one copies the mode of overseas exports of salmon producers and airfreight the cod to markets in the UK and the USA.

Our data sets start in 1993 and are monthly for the period 1993–2002. At this point, most of the important innovations in the salmon supply chain were already in place. In particular, there were regular routes by ship and trucks for Norwegian fresh salmon to most of Europe, and processors, like the smoking houses, had already established just-in-time logistics systems. Hence, we will not provide information about the most important innovation processes, but a comparison between two different supply chains with very different organizational structures.

While we do not have the opportunity to investigate productivity in the supply chains for salmon and cod as such, we can compare the margins. This will give an indication of the efficiency of the supply chains. We chose to compare the supply chains for whole, fresh fish, as this is one of the most important fresh product forms. More importantly, it is the product form where price is least influenced by processing. For salmon, we use the Norwegian producer price (from the Norwegian Seafood Federation) and the retail price in UK (from the Seafish Authority). For cod, we use Norwegian producer prices (from the Norwegian Raw Fish Association) and retail prices in the UK (from the Seafish Authority). We use Norwegian producer prices for salmon and ex-vessel prices for cod, as the distance in the supply chain will not influence the margin. One may of course question the use of the Norwegian producer price for the supply chain in the UK. Although some Norwegian salmon is present most of the time, Scottish salmon dominates this market. However, it should not matter much, as the correlation is very high and the Law of One Price seems to hold (Asche,

Jaffry, and Hartman 2007), but with a slightly higher price paid to Scottish producers due to lower transportation costs (and then a somewhat lower margin).

In figure 1 we show the producer and retail prices for fresh salmon. The average price at the producer level is 2.34 GBP/kg, and the average price at the retail level is 4.31 GBP/kg. The producers' share of the retail value is mostly in the range of 50–60% (with an average of 54.1%). The average margin is 1.97 GBP/kg, and it has a weakly increasing tendency. In the last year of our sample (2002), the average margin is 2.29 GBP/kg, 16.3% higher than the average in the sample.[1]

In figure 2 we show the ex-vessel price and retail price for fresh cod. The average price at the ex-vessel level is 1.97 GBP/kg, and the average price at the retail level is 5.86 GBP/kg. Here we see that prices have not exhibited the downward trend we saw for salmon. The most important issue is the producers' share of the retail value, which mostly is in the range of 15–30% (with an average of 20.3%). This average margin is 4.66 GBP/kg, and it has an increasing tendency. In the last year of our sample (2002) the average margin is 5.86 GBP/kg, 25.5% higher than the average in the sample.

The substantial difference in the margins is evidence that the supply chain for salmon has a different structure then the chain for cod. Furthermore, there is little doubt that it is more efficient. If the margin in the cod supply chain could be reduced to about 100% above what the fishermen receive so that the price only

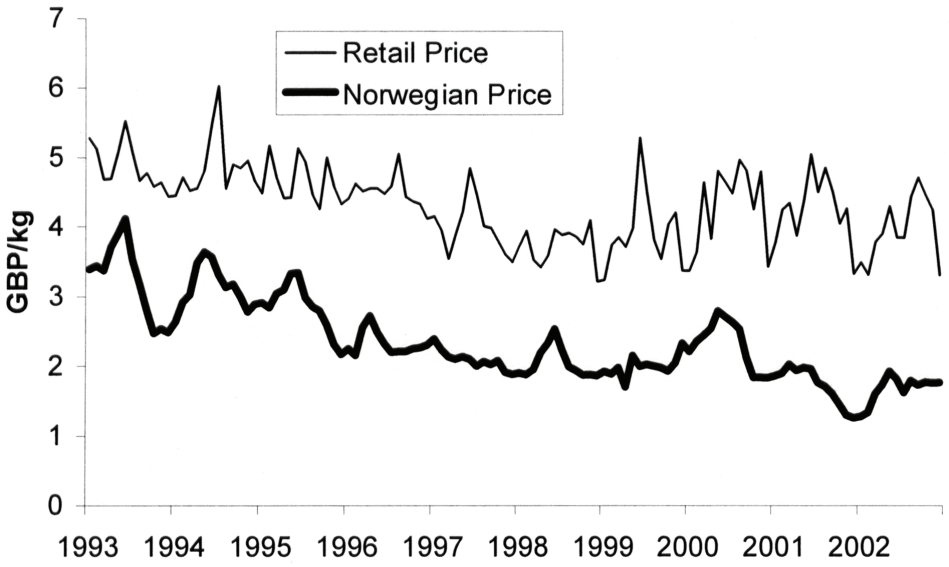

Figure 1. Norwegian Producer Price and UK Retail Price for Whole, Fresh Salmon

[1] We have not been able to find comparable figures for wild Alaska salmon. We have access to ex-vessel prices and US wholesale prices for chum (lowest price 6-9 lb. at Seattle) from Urner Barry *Seafood Price-Current* as used by Knapp, Roheim, and Anderson (2007). They indicate that the fishermen receive about 30% of the wholesale price. With a normal markup at stages further downstream in the chain, this suggests a fairly low share to the fishermen. However, as these prices are for frozen fish, processing costs certainly distort the potential comparison.

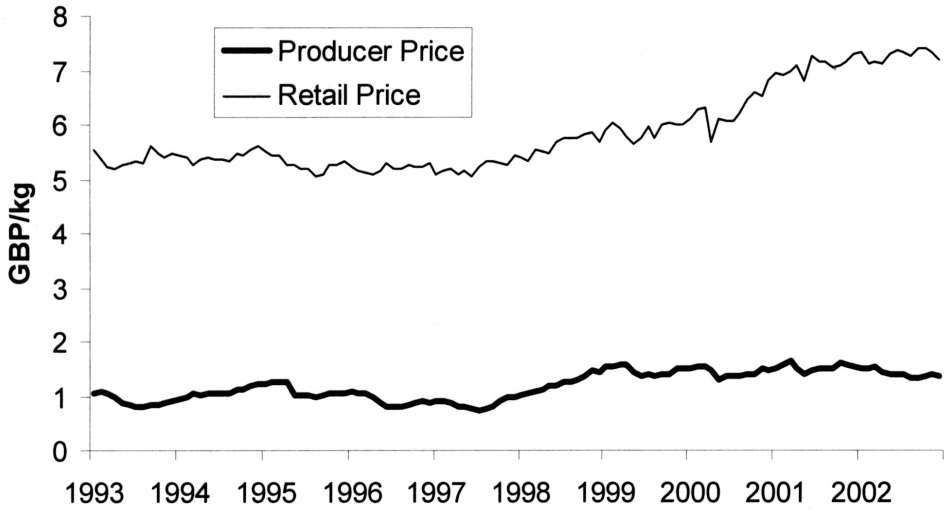

Figure 2. Norwegian Ex-vessel Price and UK Retail Price for Whole Fresh Cod

doubled from the producer to the consumer, this would dramatically increase cod's competitiveness. One may say that this does not matter much since the cod stocks are given and supply cannot increase. However, the high margin certainly reduces the price to the fishermen and, as such, reduces their income and indicates a form of market-based rent dissipation. Furthermore, the high margin also increases the scope for cod aquaculture to succeed, since the cod farmers need not be competitive at the ex-vessel level if they can compensate for higher production costs by more efficient distribution.

It is also worthwhile to note that the margins for both species are higher in the final year of the sample than the average margin. If one adjusts for inflation, the margin still has a small positive trend, although still more for cod than for salmon. While this may lead one to question whether innovations occur, one can still conclude that they most likely do. The main reason for the increasing margin is that labor is an important cost component in both value chains, and as wage levels increase in both countries, this can counter the cost-reducing effect of innovations. Still, it is most likely the different structure of the supply chain for salmon that allows this to influence distribution cost to a lesser degree.

Concluding Remarks

There are a number of reasons why the margin for cod is so much higher than that of salmon. The cod fisheries are still highly seasonal, giving poor capacity utilization in the supply chain. Seasonal variation in the supply of salmon is much smaller, and much larger volumes make this even less important, giving much higher capacity utilization. Moreover, the larger degree of predictability also provides better opportunities to exploit economies of scale and scope if they are present. The most efficient primary processing salmon plants currently process about 40,000 tons a year. The largest primary processing plants for cod receive a mixture of species and

still process less than third of this volume, despite having a similar potential capacity. The cod supply chain is brought into action when the fishermen find it necessary or convenient to land the fish. The supply chain for salmon responds to market demand and can adjust to peak load problems if there are any. The onshore part of the supply chain for cod starts when it is convenient for the fishermen to land the fish. The supply chain for salmon starts where communications are best in the region in question. The average shelf life of fresh cod is shorter than for salmon, and it is further shortened by the fact that the fish spend several days at sea before they land, while salmon is not slaughtered until it reaches the processing plant. Furthermore, there is a higher variation in cod quality due to variations in treatment on board and limited coordination between the stages of the supply chain.

There is little doubt that control of the supply and the volumes of salmon have made it much better positioned to exploit the opportunities the supermarket chains are offering. Certainly, aquaculture, and particularly, salmon, has also been helped by the growth of retail outlet chains that emphasize efficient logistics and distribution more than traditional value chains. Large supermarket chains currently comprise 60–90% of seafood sales in most western European countries (see Murray and Fofana (2002) for a discussion of the UK market). Hence, this is the prevailing market structure that any seafood supplier of significant volume must access.

In total, these points and many others indicate why farmed fish has a major advantage over wild-caught fish also in the supply chain. This further adds to the competitiveness of farmed fish relative to wild fish in addition to the productivity growth in the production process itself. It also indicates some of the potential for increased competitiveness of farmed fish in the developing world, as many producers in developing countries are still, to a large extent, using more traditional organized supply chains in which they are losing the potential advantages of farmed fish.

A final issue worth discussion is the impact of management systems. Anderson (2002) indicates that the main difference between fisheries and aquaculture is the degree of control with the production process. Accordingly, one would expect that management systems that give fishermen a higher degree of control with their activity, such as rights-based systems like individual transferable quotas (ITQs), also make more efficient supply chains possible. There is substantial evidence that such management systems generate lower harvesting costs, which can be interpreted as productivity growth, and also higher prices because of the better marketing opportunities due to the improved management system (Casey *et al.* 1995). They also provide better opportunities for more efficient supply chains due to longer harvesting season and better handling of the fish. However, most of the sparse evidence available indicates that management systems do not impact the structure of the supply chains to a large extent for most species. For instance, Gudmundsson, Asche, and Nielsen (2006) do not find substantial differences with respect to the fishermen's share of frozen cod fillets from an ITQ managed fishery in Iceland and frozen Nile perch fillets from a weakly managed fishery in Tanzania, although there are other differences. Furthermore, Icelandic cod fishermen do not seem to obtain better prices than Norwegian cod fishermen, despite the much weaker rights of the Norwegian fishermen. A main reason for the lack of better margins in well-managed fisheries is most likely the lack of control that is still present due to seasonality, etc., and as such in the terminology of Anderson (2002), even an ITQ-managed fishery has limited control over growth and harvest. However, Iceland's cod fishery also provides an interesting example of how limited control can be utilized, in that currently a substantial share of the cod landings are exported in the higher-valued fresh category. This is possible because of a more moderate seasonality and because the exporters have created a logistic system that utilizes the same air freight that salmon exporters use to reach overseas markets.

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