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Fisheries management and the value chain: The Northeast Atlantic pelagic fisheries case

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ABSTRACT

We develop a model to identify the welfare-optimal management of fisheries that operate in the global economy. Historically, fisheries economics has mainly focused on the loss of rent due to fleet overcapacity and less on the potential welfare gain by having a broader approach to fisheries management. The purpose of this paper is to address this gap. The model is applied to the pelagic fisheries of the Northeast Atlantic and considers the whole value chain, identifying resource rent and consumer and producer surpluses. The results show that the sum of the resource rent and the producer surplus in the harvest sector in 2007 was 32% of the landing value, compared with the maximum economic yield of 49%. Hence, the fisheries were quite well managed. To achieve the maximum sum of the resource rent and the producer surplus in the harvest sector, the fleet must be reduced from 156 vessels to 80 vessels. However, it must only be reduced to 93 vessels if the objective is to maximize economic welfare. The analysis shows that the main source of welfare improvement through the improved management of the North Atlantic pelagic fisheries is linked to the harvest sector (rent and producer surplus gains) and, to a lesser degree, to value chain gains. However, consumers will gain by moving from rent maximization to welfare maximization as long the fish stocks are above MSY levels.

1. Introduction

With the improvement in fisheries management in recent decades and the ever-increasing world trade in fish, an increased research focus is needed on value creation in the entire fish value chain and on how fisheries should be managed to maximize their contributions to welfare. Historically, fisheries economics has mainly focused on the loss of rent due to fleet overcapacity and less on the potential welfare gain by having a broader approach to fisheries management see e.g., Anderson (2002) and Clark (2005). The purpose of this paper is to develop a model to identify the welfare-optimal management of fisheries that operate in the global economy and to apply it to the pelagic fisheries of the Northeast Atlantic. The welfare optimum includes all contributions of the value chain and is the sum of the resource rent and consumer and producer surpluses all through the value chain.[1] Hence, the analysis adopts a welfare economic perspective. Account is taken that fish are sold in internationally integrated markets, that value

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[1] Since fish meal and oil is used as feed in aquaculture, like salmon farming in Norway, aquaculture could also have been included in the analysis. We have, however, chosen not to include aquaculture in order to focus on the main issues in fish processing. Including aquaculture is also potentially important, but this issue is left for future research. In aquaculture production, the main cost item is feed and some of this comes from the fleets considered in this paper. However, an important part of the feed is also imported from Peru and Chile. Furthermore, vegetable based feed is used increasingly in Norwegian salmon farming, in order to make feed cheaper and to avoid the fish meal trap. Often, feed in salmon farming consist only exclusively of fish meal and oil only in the last 3–4 weeks of the life of the salmon. These considerations are interesting subjects for future research.

chains are international, with value also added in importing countries, and that fishing quotas can be traded across countries. The approach is standard welfare economics, and a comparative-static bio-economic model of primary fishing, supplemented by a partial equilibrium model of the value chain, is applied.

Given the competitive structure of fish processing, wholesaling and retailing, one may expect that the harvest sector accounts for most of welfare creation in the value chain. The reason is that there is free entry and exit in the secondary industries, whereas entry is limited to the harvest sector. Conversely, the substantial price increases through the value chain, up to 10-fold from the original purchase to the final sale in the case of herring from the Northeast Atlantic, suggest substantial downstream welfare contributions.

The implications of the globalization of fish markets and of the impact of globalization on management are important. Fish products are heavily traded, value chains cross borders, and most fish markets are internationally integrated. If policies do not take account of price changes originating with management, effort levels will not be optimal. This is also the case if rents and producer surpluses are only maximized in primary fishing, while welfare generation elsewhere in the value chain is neglected. The generation of consumer surplus (CS) is the largest for the maximum sustainable yield (MSY), as opposed to the maximum economic yield (MEY), in primary fisheries. The issue of international trade in fishing rights is also important, as an international optimum can only be achieved if countries with a comparative advantage in fisheries fish the most. Furthermore, potential gains might be lost in the pelagic fisheries of the Northeast Atlantic because optimization focuses on the harvest sector and largely ignores welfare gains through the value chain in other countries.

Clark and Munro (1980) find that monopsonists may manage fisheries in a socioeconomically optimal manner, given restrictive assumptions. McEvoy et al. (2009), who examine the welfare effects on fishermen of an individual transferable quota system (ITQ) when the processing sector is imperfectly competitive, find that fishermen might suffer wage reductions, with associated welfare losses. This paper identifies the welfare optimum for the whole value chain under perfect competition in the world market and applies the model to the pelagic fisheries of the Northeast Atlantic.

The empirical part of the paper is based on data and knowledge from 2007; see Nielsen et al. (2010). Since then, Iceland and the Faroe Islands have increased their mackerel fishing within their own extended economic zones, causing the mackerel stock to migrate northwestwards.

The paper is organized as follows. In section two, the model of optimal fisheries management is developed. In section three, the pelagic fisheries of the Northeast Atlantic are described, and in section four, the model is operationalized. The fifth and sixth sections provide data and results, and section seven discusses the importance of dynamics. A final section concludes the paper.

2. A model of optimal fisheries management

Optimal fisheries management involves maximizing welfare throughout the fish value chain as a net surplus valued at the opportunity cost of production factors. It consists of resource rent in the harvest sector, producer surplus in both the harvest sector and intermediate industries (processing and trade) and consumer surplus. Resource rent is the sustained economic return a society obtains from owning a stock, measured as the net surplus that, at a given point in time, remains for the remuneration of capital and labor above the rate achieved in other businesses. Economic theory suggests that resource rent in open access fisheries has a tendency to dissipate and that fisheries operate at a level at which profits correspond to profits earned in other activities (Copes, 1972). Producer surplus, also known as infra-marginal rent, is generated due, e.g., to heterogeneity of capital and labor (Flaaten et al., 1995). Producer surplus is the sum of the differences between the price received for a good and the prices at which individual firms are willing to sell the good. The price at which firms are willing to sell a good is determined by production costs, with remunerations of capital and labor valued at their opportunity costs. Consumer surplus is determined without subtracting consumer surplus on other goods that could have been produced if production factors had been used in other businesses. This corresponds to the assumption that price flexibility in other sectors is zero.

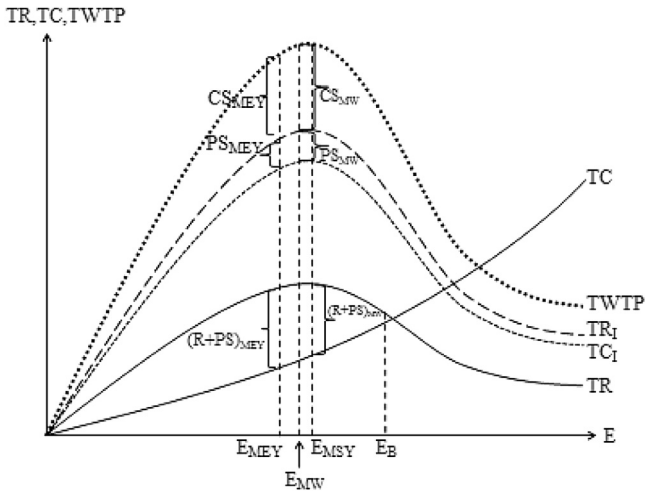

Fig. 1. Determination of maximum welfare of the existence of one fish stock.

Optimal fisheries management is the level of fishing effort that maximizes the total welfare of the complete value chain. Optimal effort is determined in a simple comparative-static bioeconomic model of primary fishing, where catches are used as raw material in processing, and processed products are traded and bought by final consumers.[2] Fishing effort determines catches, which again determine the supply of raw material. These processes, then, determines trade and consumption. An overview of the model is given in Fig. 1 for one stock. E is effort; $TWTP$ is total willingness of consumers to pay; MW is maximum total welfare; TR and TC are total revenue and total costs, respectively, in the harvest sector; TR_I and TC_I are total revenue and total costs, respectively, in the intermediate industries, with the costs of capital and labor being in alternative use.

The lower part of Fig. 1 presents the basics of fisheries economics, i.e., total revenue increasing with the sustainable yield until the MSY is reached and decreasing afterwards, total cost increasing globally in E, and the bionomic equilibrium at E_B, with MEY corresponding to the maximum of the resource rent plus the producer surplus in the harvest sector $(R+PS)_{MEY}$ where marginal cost equals marginal revenue (Gordon-Schaefer model, Gordon, 1954; Schaefer, 1957). Separation between resource rent and producer surplus in the harvest sector is not addressed in this paper because the empirical model relies on account data that has only been available for the whole fleet in each country, whereas separation requires access to account data for individual vessels. The central part of Fig. 1 shows total revenue for intermediate firms, determined as an upward shift of the total revenue curve of fisheries at a level represented by the price premium. The total cost curve for intermediate firms is assumed to follow the firms' total revenue curve, as total costs are determined by production levels rather than

[2] See Section 7 for discussion of the dynamic case.