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Non-compliance and the quota price in an ITQ fishery

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Abstract

This paper examines the effects of non-compliance on quota demands and the equilibrium quota price in an ITQ fishery. I show that whereas lower quota prices are implied unambiguously by expected penalties which are a function of the absolute violation size, the expectation of penalties based upon *relative* violations of quota demands can, under certain conditions, produce higher quota prices than in a compliant quota market. If there are both compliant and non-compliant firms in the fishery, the result would then be a shift in quota demand from compliant to non-compliant firms, rather than the reverse. The findings are generally applicable to quota markets in other industries, including pollution permit markets.

Keywords: Fisheries management; Quotas; ITQs; Enforcement; Non-compliance; Pollution permits

1. Introduction

The potential for individual transferable quotas (ITQs) to achieve an efficient solution to the problem of regulating the level of harvest in a fishery is well known [2,4,5,7], but to date little attention has been paid to the implications for economic outcomes of non-compliance with quotas. In particular, the effect of non-compliance by some or all firms on the price at which quota is traded does not appear to have been explicitly considered. This is somewhat surprising, since quota prices can send strong signals to managers about the level of profitability in the

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fishery. Indeed, for this reason, Arnason [2] suggests that key fishery management decisions should be based upon observed quota prices.

In the relatively small theoretical literature on the implications of non-compliance for the performance of pollution permit (TDP) markets [1,6,8–10], the expectation of penalties for non-compliance based upon the violation size is taken unambiguously to imply equilibrium (market-clearing) permit prices which are *lower* than if firms are compliant. Although Malik [9] recognises that the equilibrium permit price depends upon how expected penalties change in response to separable functions of both permit demands and emissions levels, he concludes that if expected penalties are a function of the violation size, the equilibrium permit price is lower than in a compliant market. In a more recent paper [10], the same author finds the result that non-compliant firms' permit demands are lower and more price elastic than those of otherwise identical compliant firms (which, for a given total supply of permits, implies a lower permit price) "fairly intuitive, since non-compliance can be viewed as a substitute for the purchase of a permit" (p. 374).

In this paper, I show that this result does not hold in general for different specifications of the violation size. In particular, using the closely analogous setting of an ITQ market, I find that expected penalties which are a function of the *relative* size of violations, i.e., violations expressed as a fraction of quota (permit) demands, can result in equilibrium quota prices which are the same as or even higher than in an industry made up of otherwise identical compliant firms.

The paper is organised as follows. The basic model of firm behaviour in a simple ITQ fishery is set up in Section 2. Assuming all firms are non-compliant, Section 3 firstly rehearses the implications for quota demands and quota prices of expected penalties based upon the absolute size of violations before proceeding to examine the results obtained when expected penalties are a function of relative violations. Section 4 then briefly considers the effect of non-compliance by some firms when others are compliant. Section 5 contains some concluding comments.

2. The basic model

Consider a single species, single product, fishery into which a system of ITQs is introduced. There are n fishing vessels in the fishery, indexed $i = 1, 2, \ldots, n$, each operated as an independent firm. All firms are price takers in both output (catch) and quota markets. For the ith vessel firm, short run *gross* profits, i.e., profits before any payments for quota and/or fines for non-compliance with quotas, are given by $B_i(e_i) \equiv pq_i(e_i) - c_i(e_i)$, where the catch $q_i(e_i)$ is a weakly concave function of fishing effort e_i and variable costs $c_i(e_i)$ are strictly convex in e_i. With a constant output price p (exogenous to the fishery) we then have a (social) benefit function $B_i(e_i)$ that is strictly concave in e_i. Given this, in the absence of quotas short run profits are maximised where $B_i'(e_i^*) \equiv pq_i'(e_i^*) - c_i'(e_i^*) = 0$. Since we assume that catch is a deterministic function of effort, however, for convenience we can treat catch as the choice variable, which simplifies the necessary condition for profit maximisation to $B_i'(q_i^*) \equiv p - c_i'(q_i^*) = 0$.

In a given period, the fishery manager sets a total quota, or total allowable catch (TAC), Ω for the fishery and each firm demands an amount of quota $Q_i^* \geqslant 0$ at market equilibrium, where $\sum_{i=1}^{n} Q_i^* \leqslant \Omega$. A compliant firm, i.e., a firm which always sets $Q_i^* = q_i^*$, will maximise short run