Limited Entry Licensing and Adaptive Management: Insights from Duration Modeling

Martin D. Smith
Nicholas School of the Environment and Earth Sciences
Duke University

Abstract: Although many fisheries around the world have long required explicit licensing for fishery participants, the use of limited entry licensing to control fishing effort has become a common practice in the last two decades. In contrast to Individual Fishing Quotas (IFQs), limited entry is only a step towards rights-based management. The divergence between limited entry and optimal rights-based outcomes will hinge on the input substitution prospects of limited entry licensees and the evolving aggregate fishing power of the fleet. This paper analyzes fleet composition and attrition in an actual limited entry fishery, the California red sea urchin fishery. The paper explores heterogeneity in catch and revenue and how this heterogeneity evolves dynamically. It then uses duration analysis to study individual fisherman attrition. Finally, the paper discusses how fishery managers can adopt an adaptive management framework to use limited entry licensing as well as possible when they are unable to implement more comprehensive rights-based management.

Keywords: limited entry, duration model, adaptive management

Extended Abstract

Although many fisheries around the world have long required explicit licensing for fishery participants, the use of limited entry licensing to control fishing effort has become a common practice in the last two decades. In contrast to Individual Fishing Quotas (IFQs) or Individual Transferable Quotas (ITQs), limited entry is only a step towards rights-based management. Whether or not an IFQ system could achieve the optimum, there generally will still be a divergence between limited entry and optimal rights-based outcomes. The magnitude of this divergence will hinge on the input substitution prospects of limited entry licensees, the changing composition of the fishing fleet, and the rate of attrition of license holders. For mostly political reasons, the movement towards IFQ and ITQ systems has slowed considerably, leaving many fisheries locked into limited entry for at least the next several years (Smith and Wilen, 2002). Even as we begin a long run transition towards more comprehensive rights-based management, it is still important to improve our understanding of limited entry fisheries in the near term.

Economic research on limited entry fishing has assessed limited entry programs (Wilen, 1988; Karpoff, 1990; Dupont, 1990, 1991; Townsend, 1990; Flaaten et al., 1995), simulated limited entry fisheries (Tai and Heaps, 1996), and developed insights for ITQ management based on limited entry systems (Copes, 1986; McCay et al., 1990; Weniger and Just, 1997). Most of the assessment literature has focused on either input substitution or on whether limited entry programs generate rents. Dupont (1990) points out that regulators need to focus on fleet composition and the number of participants as well, although there has been no empirical work on these topics. This paper analyzes both of these issues with an eye towards improving limited entry systems. The paper first explores heterogeneity in catch and revenue and how this heterogeneity evolves dynamically. It then uses duration analysis to study individual fisherman attrition. Finally, the paper discusses how fishery managers can adopt an adaptive management framework to use limited entry licensing as well as possible when they are unable to implement more comprehensive rights-based management.

The California red sea urchin fishery provides a useful empirical setting. This is a relatively new dive fishery in which owner-operators take single-day trips on 10-15 meter vessels. Divers scrape sea urchins into baskets from rocky inter-tidal areas and sell them to processors in northern and southern California ports. In response to declines in catch per unit effort, regulators have implemented size limits, seasonal closures, and beginning in 1989, a limited entry program. In the limited entry program, individual divers hold non-transferable licenses. The program targets 300 licenses in the long run. Whenever the number exceeds 300, one new license can be issued for each ten that are retired. To maintain a license, divers must harvest 300 pounds of urchin at least 20 times over a two-year period.

Over the sample period (1988-1997), divers show substantial variation in participation. While the average number of dives is increasing over this period, the heterogeneity in participation is decreasing based on the coefficient of variation of individual diver trips in each year. We compute Gini ratios for diver catch and revenues to explore this heterogeneity further. The Gini ratios show the same pattern. Over the life of the limited entry program, the fleet is becoming more homogenous. This motivates the need to study attrition and particularly what diver characteristics increase the probability of exiting the fishery.

To study attrition, we use duration modeling. Duration analysis is a statistical technique that can estimate a trend of attrition that is conditional on differences in observable variables across the population. Results show that the probability of exiting the fishery decreases as seasonal revenues and number of ports visited increase. Thus, attrition is lower for more successful divers, and attrition is also lower for more spatially mobile divers.

Applying ideas of adaptive management, first developed by Holling (1978) and in a fisheries context by Walters (1986), we can use duration results to fine-tune limited entry programs. These ideas were developed originally to use policy probing as a means to improve understanding of resource systems, though they are sufficiently general to apply to the behavioral side as well. On the simplest level, we can apply passive adaptive management and use the information gleaned from the urchin fishery experience with limited entry to adjust the rate of new license issues. A more complex approach would apply active adaptive management and use the rate also to probe for information about behavioral responsiveness.

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