A Dynamic Model of Fishing Cruise Duration

Keita Abe

Ph.D. Candidate, Department of Economics, University of Washington

Abstract

In many fisheries, particularly high seas fisheries, effort is controlled primarily by scaling estimated fleet capacity to available biomass. Capacity is traditionally estimated by relating inputs to outputs, with gaps between maximum harvest and actual harvest ascribed to technical inefficiency; precaution often dictates managing for maximum technical efficiency. I demonstrate that cruise-level production is determined not only by use of quasi-fixed inputs, but rather by dynamic consideration of the rate at which fish is caught, balancing the quantity and quality of fish to maximize their cruise level revenue. This response is modeled as a daily optimal stopping problem, with the state variables representing the decreasing freshness of fish caught on each previous day of the cruise. I estimate trip duration decisions based on unusually detailed daily logbook data on a Japanese longline fleet. The dynamic discrete choice problem is modeled with a conditional choice probability (CCP) estimator, which estimates the reduced form of CCP and transition probabilities in the first step to calculate the continuation value, and estimate the structural parameter using the calculated continuation value in the second step. The predictability is improved avoiding over-fitting in flexible logit to estimate CCP in the first step with a machine learning method, elastic-net logit estimation. The results show harvesters are particularly sensitive to freshness deterioration after 20 days, and are more likely to terminate their fishing cruise when more fish is caught 20 or more days ago. This suggests that catching power defined by quasi-fixed inputs is not fully utilized due to a dynamic consideration of fish quality, and that a management strategy based solely on technical efficiency will systematically over-predict actual catches.