Individual Quota Management and the Speed of Fishing Vessels

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1. Background and Question

Individual quota (IQ) management is a management method that aims to reduce fishing competition by allocating total catch quotas to fishermen and vessels in advance. Previous research shows that IQ management has led to stock recovery [1], longer fishing seasons [2], and reduced fishing trips during bad weather[3] in overseas fisheries. However, it is not clear whether the transition to IQ management will have the same effect in Japan's fisheries, where fishing competition has been suppressed to some extent by the voluntary efforts of fishermen. The objective of this study is to verify whether IQ management is effective in Japan's fisheries.

The research subject is the North Pacific large and medium-scale purse seine fishery. This fishery has been under an official IQ system since the 2021 fishing season (Nov-Mar). In this fishery, fishers have been voluntarily setting catch limits by vessel and period for some time, and in the 2019 fishing season in particular, a vessel-specific catch limit was set for the entire mackerel fishing season. This can be seen as the year in which *de-facto* IQ management was introduced. In the 2020 fishing season, the method of determining catch quotas began to reflect past catch results. From the 2021 fishing season, the fishery shifted to official IQ management.

2. Data and Method

We use the Automatic Identification System data provided by Global Fishing Watch. The dataset covers the period 2018/4/1 to 2022/12/31, and it includes the latitude and longitude of each vessel every few minutes to a few hours. We calculate the speed of each vessel by dividing the distance between two consecutive locations by the corresponding time interval.

Our primary identification strategy is a difference-in-discontinuity design where we compare vessel speed in-seasons (Nov-Mar) and off-seasons (Apr-Oct) before and after the IQ management was introduced.

$$\ln(Speed_{it}) = \alpha_i + Inseason_t + f(t) + \sum_{k=2019}^{2022} \rho_k Inseason_k * Fishingyear_k + \beta X_{it} + \varepsilon_{it} \qquad (1)$$

where α_i are vessel-fixed effects; $Inseason_t$ is a dummy that takes 1 if in season; $f(t)$ is a quadratic function of daily time trends; $Fishingyear_k$ is a dummy that takes 1 in fishing year k

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(July–June); and X_{it} is a vector of control variables. ρ_k captures the difference in speed between in-seasons and off-seasons, relative to the base year of 2018.

A crucial assumption for our identification strategy is that vessels do not change their speed during off-seasons in response to IQ management (i.e., no spillover). We believe this is a reasonable assumption, firstly because there is a high degree of uncertainty in fisheries so the scope for such adjustments is limited. The second reason is that fish is a fugitive resource, which means vessels' priority is to get to the fishing ground earlier than others. This incentive does not change whether the mackerel fishery during Nov–Mar is managed under IQ or not.

As a robustness check, we employ a triple-difference design where we compare the difference-in-discontinuity estimate for one-boat purse seine vessels above with that for two-boat purse seine vessels. Two-boat purse seine vessels operate in the same area and target the same fish species as one-boat purse seiners, but they are not managed under the IQ system.

3. Results and Discussion

Fig. 1 demonstrates that the IQ management reduced the vessel speed from 2020. Treating 2020 as the first year of IQ management, Table 1 Columns 1–2 shows that the vessel speed decreased by 1.51–1.95%. Triple difference estimates in Columns 3–4 are consistent with these results. Overall, our analyses suggest that IQ management reduced vessel speeds, which imply the mitigation of the race to fish.

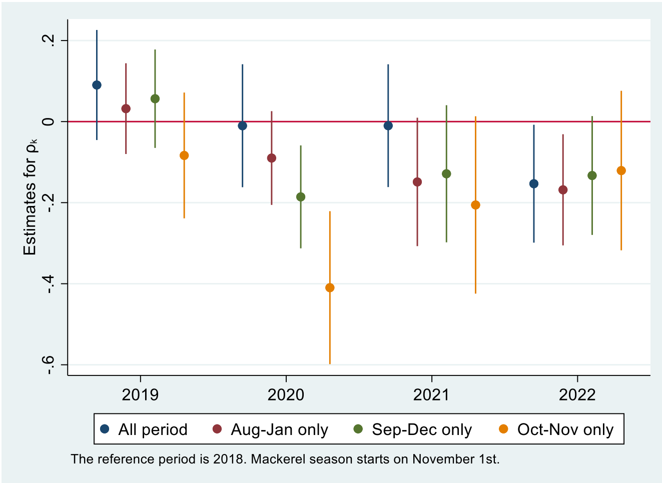

Fig.1 Difference-in-discontinuity estimates for different time windows.

Table 1 Econometric results

	Dif-in-Discontinuity		Triple-difference	
	Aug-Jan	Sep-Dec	Aug-Jan	Sep-Dec
One-boat PS X In-season	-0.151***	-0.195***		
	(0.039)	(0.035)		
One-boat PS X In-season X After2020			-0.087	-0.171***
			(0.061)	(0.062)
N	16514	12480	21936	15972

Notes: Clustered standard errors at the vessel level are in parenthesis. ***, **, and * mean statistical significance at the 1 %, 5%, and 10% levels, respectively.

4. Reference

1. Costello, C., Gaines, D. S. & Lynham, J. Can catch shares prevent fisheries collapse? Science (80-.). 321, 1678–1681 (2008).

2. Birkenbach, A. M., Kaczan, D. J. & Smith, M. D. Catch shares slow the race to fish. Nature 544, 223–226 (2017).

3. Pfeiffer, L., Petesch, T. & Vasan, T. A Safer Catch? The Role of Fisheries Management in Fishing Safety. Mar. Resour. Econ. Ahead of P, 000–000 (2021).