Distributional Effects of Natural Resource Privatization: A Dynamic Analysis

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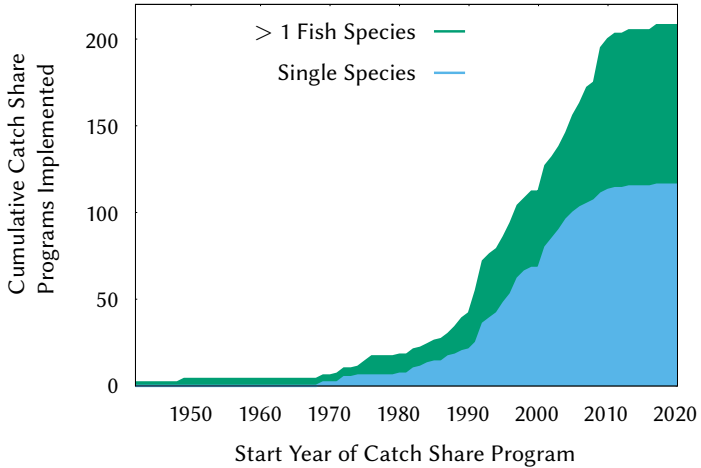
Advantages and Disadvantages of Strong User Rights in Fisheries
Copenhagen, October 18, 2023

Catch share programs in fisheries world wide

Kroetz et al. (REEP, 2022)



Rights-based fishery management

- huge efficiency gains
- often opposition of fishers (e.g. US Sustainable Fisheries Act, 1996, with temporary ban on ITQs)
- currently implemented in $\sim$20% of fish stocks globally
- if implemented, most often
  - by grandfathering of rights (Arnason 2002)
  - only active fishers can hold rights (e.g. Australia, Denmark, Iceland)

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  - only active fishers can hold rights (e.g. Australia, Denmark, Iceland)
- study welfare and distribution of rents in natural resource harvesting
  (Turvey AER 1964, Copes ManSch 1972, Anderson CJFAS 1980, Jensen et al. FishRes 2019, Quaas et al. ERE 2018, Kroetz et al. REEP 2022)

Comparative analysis of open access/common pool vs. private property

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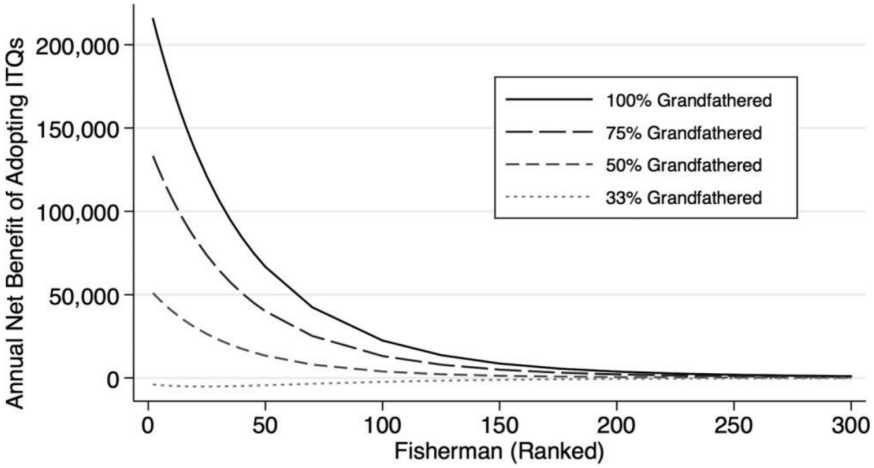
- Karpoff (JPE 1987), Johnson and Libecap (AER 1982): High-skilled incumbents are better off under open access than under private property rights
- Grainger and Costello (MRE 2016):
  - 'highliners', i.e. highly skilled fishers, earn high inframarginal rent under common-pool management
  - privatization is Pareto-improving with a sufficiently high fraction of grandfathering

Common pool vs. private property rights for Gulf of Mexico red snapper fishery (Grainger and Costello MRE 2016)



Contribution

- dynamic analysis including transition dynamics and discounting
- endogenous harvest quantity and endogenous number of resource harvesters
- heterogeneous skills in resource harvesting (q_i)
- heterogeneous income opportunities outside resource harvesting (w_i)

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- questions
  1. How does the distribution of use rights affect the preferred management from the point of view of resource harvesters?
  2. Under which conditions, esp. on the distribution of use rights, do resource harvesters gain or lose when privatizing the resource?
  3. Can grandfathering always achieve a Pareto improvement?

Model

- continuum of individuals i, with total mass N,
  - $\phi(q_i, w_i)$ joint distribution of harvesting skill q_i and alternative income opportunity w_i
  - inelastically supply one unit of labor
  - work in resource harvesting or in a private project according to

$$\underbrace{(p-\tau)}_{\substack{\text{net resource}\\ \text{price}}} \cdot \underbrace{\overbrace{q_i}^{\text{skill}} \cdot x}_{\substack{\text{catch per}\\ \text{unit of effort}}} \gtrless \underbrace{w_i}_{\substack{\text{alternative}\\ \text{income opportunity}}} \tag{1}$$

- quota lease price τ for TAC H determined by quota market equilibrium

$$H = \iint q_i \cdot x \cdot \mathbb{I}_{w_i \leq (p-\tau)\, q_i\, x} \cdot \phi(q_i, w_i)\, dq_i\, dw_i \tag{2}$$

- dynamics of resource stock

$$\frac{dx}{dt} = g(x) - H \tag{3}$$

Management scenarios

- Efficient management – maximize social surplus

$$\max_{H} \int_0^{\infty} e^{-\delta t} \iint \Big\{ \underbrace{p\, q_i\, x\, \mathbb{I}_{w_i \leq (p-\tau)\, q_i\, x}}_{\text{resource harvesters}} + \underbrace{w_i\, \mathbb{I}_{w_i > (p-\tau)\, q_i\, x}}_{\text{others}} \Big\} \phi(q_i, w_i)\, dq_i\, dw_i\, dt \quad (4)$$

subject to

$$H = \iint q_i \cdot x \cdot \mathbb{I}_{w_i \leq (p-\tau)\, q_i\, x} \cdot \phi(q_i, w_i)\, dq_i\, dw_i \quad (2)$$

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- Preferred management for harvester i with catch share endowment $\alpha_i \geq 0$

$$\max_H \int_0^\infty e^{-\delta t} \Big\{ \underbrace{(p-\tau)\; q_i\, x\, \mathbb{I}_{w_i \leq (p-\tau)\, q_i\, x}}_{\text{harvesting}} + \underbrace{w_i\, \mathbb{I}_{w_i > (p-\tau)\, q_i}}_{\text{other occupation}} + \alpha_i\, \tau\, H \Big\} dt \tag{5}$$

subject to

$$H = \iint q_i \cdot x \cdot \mathbb{I}_{w_i \leq (p-\tau)\, q_i\, x} \cdot \phi(q_i, w_i)\, dq_i\, dw_i \tag{2}$$

$$\frac{dx}{dt} = g(x) - H \tag{3}$$

Simplifying assumptions

- logistic growth of resource $g(x) = r\,x\,\left(1 - \frac{x}{K}\right)$
- $q_i = q$ for all i
- w_i Pareto distributed on $[0, \bar{w}]$, cumulative distribution function $\Phi(w_i) = N\left(w_i/\bar{w}\right)^{\epsilon}$

Management scenarios under simplifying assumptions

- Efficient management – maximize social surplus

$$\max_{H} \int_0^{\infty} e^{-\delta t} \left\{ p\,H + \frac{\epsilon}{1+\epsilon}\, N\, \bar{w} \left(1 - \left(\frac{H}{N\, q\, x} \right)^{1+\epsilon} \right) \right\} dt \tag{6}$$

- Preferred management for harvester with lowest outside option, $w_i = 0$, with catch share endowment $\alpha_i \geq 0$

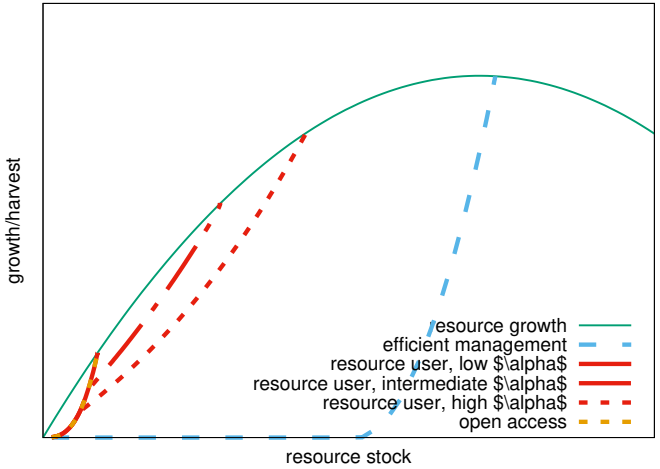
$$\max_{H} \int_0^{\infty} e^{-\delta t} \left\{ (p - \tau)\; q\, x + \alpha_i\, \tau\, H \right\} dt \tag{7}$$

subject to

$$H = N \left(\frac{(p - \tau)\, q\, x}{\bar{w}} \right)^{\epsilon} q\, x \tag{2}$$

$$\frac{dx}{dt} = r\, x \left(1 - \frac{x}{K} \right) - H \tag{3}$$

How does the distribution of use rights affect the preferred management from the point of view of resource harvesters?



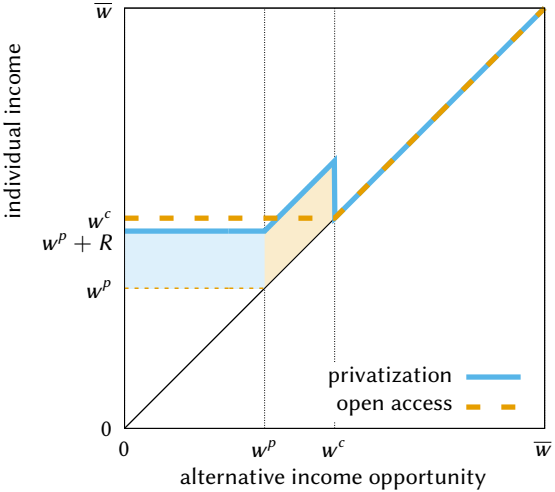
How does the distribution of use rights affect the preferred management from the point of view of resource harvesters?

1. The harvest quantity preferred by the permanent resource harvesters is always larger than socially optimal.
   Intuition: Opportunity costs are lower for the permanent resource harvester than for society.
2. The harvest quantity preferred by the resource harvesters monotonically decreases with the catch share endowment α.
   Intuition: Resource rent becomes relatively more important for the permanent resource harvesters the higher α_i is.
3. If the catch share endowment falls below a threshold $\underline{\alpha} > 0$, open access, i.e. no quota restriction at all, is preferred by the permanent resource harvesters.

Under which conditions, esp. on the distribution of use rights, do resource harvesters gain or lose when privatizing the resource?

- For all $\alpha > 0$ there exists a $\delta_2(\alpha) \leq \delta_1(\alpha)$ such that some resource harvesters prefer open access over privatization if the discount rate exceeds $\delta_2(\alpha)$.

Can grandfathering always achieve a Pareto improvement?



Can grandfathering always achieve a Pareto improvement?

- Income of remaining resource harvesters with grandfathered private property rights lower than under open access if and only if

$$\frac{\overline{w}}{K}\left(2 + r\,\frac{\overline{w}}{K}\right) > 1 \tag{8}$$

  - maximum return on private project, $\overline{w}$, large relative to resource carrying capacity K: flat distribution of income opportunities outside resource harvesting, thus many leave resource harvesters after privatization
  - intrinsic growth rate of resource, r, large: very productive resource sustains high inframarginal rents also under open access

Conclusions

- If income opportunities outside resource harvesting are heterogeneous, some resource users may prefer open access over economically efficient management.
- Even full grandfathering of resource use rights does not assure that economically efficient management is a Pareto improvement over open access.
- With a sufficiently large labor market / sufficiently equally distributed alternative income opportunities, the transition towards economically efficient management with grandfatherd use righs is a Pareto improvement.

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