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Economically sensible caps on ITQ-holdings

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Introduction

- Caps (upper limits) on ITQ-share holdings are imposed in many ITQ fisheries
  - E.g. Canada, Iceland, New-Zealand, Chile & Norway
- Reducing caps further or imposing them in other ITQ-fisheries is being considered
  - E.g. Iceland & USA
- Potentially a significant economic impact

  => important to study the associated economics

Rationale for caps
(as far as I can see)

1. To prevent monopolistic behaviour in
   - output markets (fish)
   - input markets (labour etc.)
   - ITQ markets (quotas)
2. To limit size, profits of fishing companies

   (Reason unclear; Politics; limit socio-political power of fishing companies; general dislike of big business and ITQs; envy?)

Here only consider only rationale #1

The setting

1. A fishery managed by ITQs
   - Authorities set TACs: Q
   - Firms hold/buy quotas: $q(i)$
   - Harvests cannot exceed quotas; $h(i) \leq q(i)$

   $\Rightarrow$ ITQ rental price: s. Note $s(Q; x, \mathbf{p})$

2. Fishery profit functions:

   $$\pi(h(i), x, \mathbf{p}; i) - s \cdot h(i), \; i = 1, 2, \ldots I$$

   $h(i)$: harvest

   x: biomass

   $\mathbf{p}$: vector of input and output prices

Monopolistic behaviour

Alter prices by limiting quantity (or vice versa)

Note: Both output and input (monopsony) prices

Under ITQs a firm will only affect prices by withholding quota from fishing!

The other method, throwing fish away, is less economical

Notation

Withheld quota: Δ (≥ 0)

Firm's actual harvest: $q-\Delta$ (≥ 0)

Total harvest: $H=Q-\Delta$

$\therefore$ Input and output prices: $\boldsymbol{p}(Q-\Delta)$

Quota prices: $s(Q-\Delta)$*

* Quota rental price depends on marginal profits of harvest which falls with the harvest volume.

The firm's maximization problem:

$$\underset{q,\Delta}{Max} \int_0^{\infty} \left(\pi(q-\Delta, x, \boldsymbol{p}(Q-\Delta); i) - s(Q-\Delta)\cdot q\right)\cdot e^{-r\cdot t} dt$$

$$s.t.\ \ \dot{x} = G(x) - Q + \Delta$$

$$q\text{-}\Delta \geq 0,\ \Delta \geq 0,$$

Basic necessary condition for withholding quota:

$$\left.\frac{\partial H}{\partial \Delta}\right|_{\Delta=0} = -\pi_p \cdot p_H - \pi_{h(i)} + s_H \cdot q + \sigma(i) > 0$$

Shadow value of biomass to fisher *i*

Simplifying observations

S-1 $\pi_p = h(i)$ [Output price; Hotelling's lemma]

S-2 $\pi_w = -z(i)$ [Input prices; Hotelling's lemma]

S-3 $\pi_{h(i)} = s$ [Quota rental price; Property of ITQ-system]

S-4 $p_H \equiv E(p,H)\cdot\frac{p}{H}$, $w_H \equiv E(w,H)\cdot\frac{w}{H}$, $s_H \equiv E(s,H)\cdot\frac{s}{H}$ [definition of elasticities]

S-5 $q(i)=h(i)$ [Evaluated at $\Delta=0$]

S-6 $\sigma(i) \approx \frac{h(i)}{H}\cdot s$ [Property of ITQ systems if TAC is optimal]

Necessary condition for withholding quota, $\Delta>0$

$$\alpha(i) \equiv \frac{q(i)}{Q} > \frac{1}{1+E(s,H)+\left(\beta(i)\cdot E(w,H)-E(p,H)\right)\cdot\frac{p}{s}}$$

Cost-revenue ratio

Inferences

- The (numerically) higher the elasticity of output and input prices with respect to harvest, the **lowe**r is the critical size of the firm.
- The (numerically) higher is the elasticity of the quota rental price with respect to harvest the **higher** is the critical size of the firm.
  - The quota is valuable => withholding it is costly
- The higher the p/s ratio, i.e. the lower the marginal profits of fishing, the **lowe**r is the critical size of the firm.

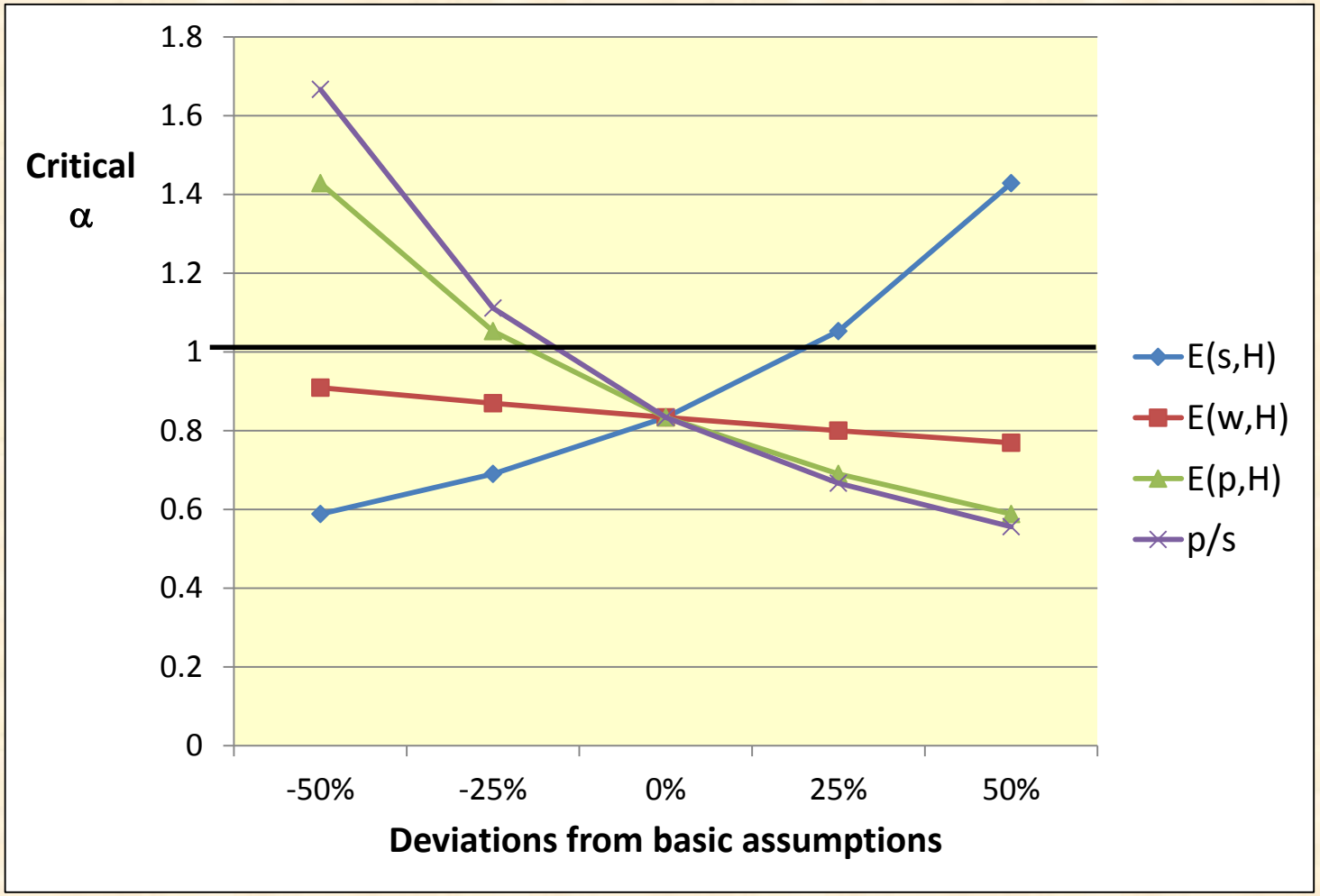
A numerical example

Reasonable values for the parameters		
Parameter	Assumed values	Comments
$E(p,H)$	-0.5	This is equivalent to $E(H,p)$= -2
$E(w,H)$	0.2	
$E(s,H)$	-1	
p/s	2	
β	0.5	Note that 1-β = profits/revenues

Critical size

$$\hat{\alpha} = 0.83$$

Sensitivity analysis for $\hat{\alpha}$



Conclusions 1

Having market power in an ITQ fishery does not imply it is profitable for the firm to use this market power.

- The reason is the $E(s,H)$
- Basically the benefits must exceed the price of quota
- This is different from normal monopolies

$\Rightarrow$ Not sufficient to merely study market power to set sensible size caps**!**

Conclusions 2

The critical size of firms (i.e. before withholding quota becomes profitable) is a complicated function

- Involves several elasticities and quantities

$\Rightarrow$ To determine a sensible cap on firm ITQ-holdings is a complicated empirical exercise

Conclusions 3

The empirical quantities determining the critical firm size evolve over time

$\Rightarrow$ Need to update studies (and rules) frequently

Conclusions 4

When is it beneficial to impose caps on ITQ-holdings?

1. Firms exceed the critical size
2. Social costs of larger firms (monopoly costs) exceed social benefits (efficiency gains)
3. Enforcement costs are less than the benefits of enforcement

So, even if $\hat{\alpha} < 1$, it is not necessarily a good idea to impose a cap on ITQ-share holdings!

END

The critical firm size

(If $\alpha(i) > \hat{\alpha}(i) \Rightarrow$ withhold quota)

$$\hat{\alpha}(i) = \frac{1}{1 + E(s,H) + \left(\beta(i) \cdot E(w,H) - E(p,H)\right) \cdot \frac{p}{s}}$$

Cost-revenue ratio

Note that

1. $E(s,H) < 0 \Rightarrow$ increases $\alpha(i)$
2. $\beta(i) \cdot E(s,H) - E(s,H) > 0 \Rightarrow$ decreases $\alpha(i)$