ECN 275/375 Environmental and natural resource economics
Exercise set 16 – Fisheries (2)

Exercise 16.1 – Optimal extinction of a fish species

A fishery is not in steady state, i.e., the optimal effort, E_t^* has not been identified, and hence the optimal harvest may vary over time. Moreover, fish prices, P_t, and effort costs, w_t, are allowed to vary over time when r is the discount rate that is assumed constant over time.

(a) Write down the discrete and continuous versions of the NPV formula for this fishery for infinite time.

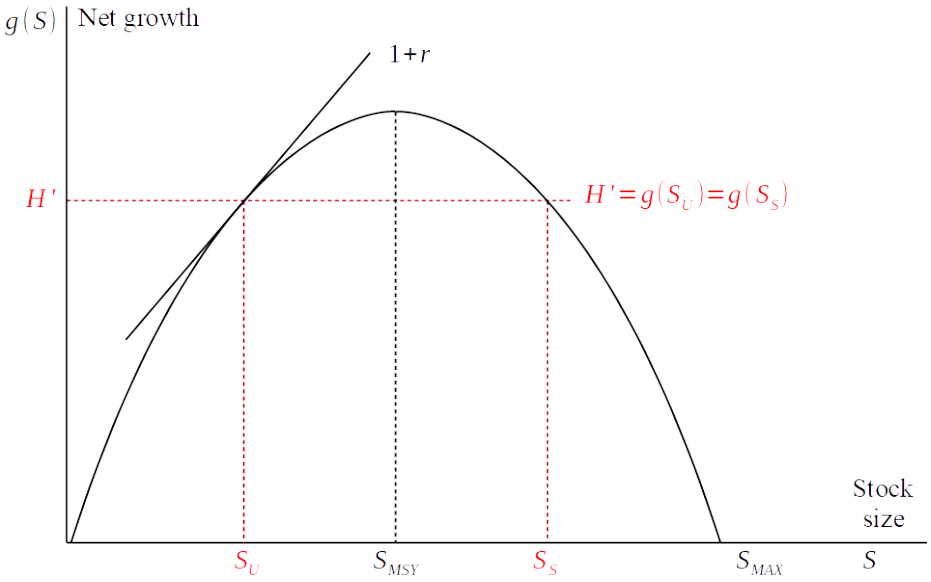
(b) Assume it becomes optimal to harvest a fish species to extinction at some finite time T'. State the verbal condition for fish extinction to be optimal, and write down the mathematical conditions.

(c) The outcome in (b) becomes more likely the higher the discount rate. Explain why this is the case.

(d) Suppose a monopolist controls the fish harvest of a species. How may that reduce the risk of over harvesting and hence extinction.

Exercise 16.2 – Optimal extinction and safe minimum standards

Consider a "standard" bell growth function for a fish species. Assume there is no uncertainty regarding the growth function or the stock size. Let r denote the risk free return on capital, which in discrete time gives the capitalization factor $(1+r)$. The figure below illustrates a situation where the unstable stock-harvest equilibrium, $\{S_U, H'\}$ is marked, and where the capitalization factor line tangents the growth function $G(S)$.



(a) Draw $G'(S)$ and r in the same graph based on the above figure for $S < S_{MSY}$. Based on the graph suggest why the "fish as capital" perspective gives S_U as the optimal stock level.

(b) Explain the result in (a) verbally and mathematically.

(c) Now suppose that a safe minimum standard is set such that $S_{SMS} > S_U$. (i) Show graphically that the economic loss of the safe minimum standard grows as $S_{SMS} - S_U$ grows. (ii) What does that tell about capital losses safe minimum standards.