# EXERCISES AND PROBLEMS
# SET 7 (Winter 2007)

## 1. Non-renewable resource exploitation and stock discovery

We wish to compare how a similar increase in the stock of a non-renewable resource can affect its price and extraction paths when it is anticipated versus when it is non-anticipated. Use a four-quadrant graph to analyze this.

a) In the first case, assume that you are now at time $t = 0$ and that the stock size is $S_0$. The stock is anticipated to increase by amount $S_1$ at a future specific date, say at date $t = t_0 > 0$. *(NB Depending on the relative sizes of $S_0$ and $S_1$, there are two cases to consider.)*

b) In the second case, you are now at date $t = 0$ and the change occurs at that same future time $t = t_0 > 0$, but it is a total surprise.

c) Compare the two cases and interpret.

## 2. A tax on the catch in a steady-state fishery

A fishery is being exploited by a single owner. Total harvesting costs depend on both stock levels and harvesting rate in the following general form: $C(S(t), h(t))$, with $C_1 < 0, C_2 > 0$ and $C_{22} > 0$. The unit price of fish is constant and equal to $p$. The owner's discount rate is $r$. The fish stock varies with time according to the following differential equation: $\dot{S}(t) = G(S(t)) - h(t)$. The initial fish stock is $S_0$.

a) Solve for the owner's present value maximizing conditions in steady-state. *(Use the Maximum Principle in continuous time.)*

b) What happens when $r \rightarrow \infty$? Interpret.

c) Assume that the *social* discount rate is equal to $\rho < \infty$ and that $r = \infty$. How can a tax on the catch reestablish a socially optimal stock size?

d) Characterize the steady-state for an open access exploitation. Compare with your answer in b).

e) Characterize the tax rate that would reestablish optimality when the fishery is exploited under open access.

f) Assume now that $h(t) = eE(t)S(t)$, where $E$ is effort and $e$ is a parameter value related to technology. If the unit cost of effort is $c$, then total harvesting cost is now: $C(S(t), h(t)) = \frac{c}{eS}h = c(S)h$, with $c'(S) < 0$. How do your answers in b) and d) compare?