ECONOMICS 472

Economics of Renewable Resources
Final Examination

April 10, 2013   **Time: 2 hours**

Answer any THREE questions. Do not attempt to answer more than three questions. The three questions that you answer will be given equal weight.

1. Economists regard all natural resources as "natural" capital. Consequently, in studying the economics of the management of these resources, economists are compelled to bring to bear both the theory of capital and the theory of investment. While the two theories are closely linked, there is a difference between the two. What question is the theory of capital designed to answer? What question is the theory of investment designed to answer?

The World Bank/FAO publication, *The Sunken Billions*, to which we referred many times, argues that many of the world's capture fishery resources were over exploited in the past *and must* be rebuilt, if they are to make their full economic contributions to the world economy. Discuss how the theories of capital and investment could be applied in designing a rebuilding for any one of these hitherto overexploited capture fishery resources, e.g., Southern bluefin tuna.

2. (a) Consider now a newly planted stand of trees. The trees are to be grown for their commercial value alone. What decision rule should be employed for determining the "optimal" investment in the trees – the optimal rotation – given that the stand of trees is being managed on a Single Rotation basis? Explain.

(b) Now suppose that the stand, to be used for the commercial value of the trees alone, is, instead to be managed on a Multiple Rotation basis, rather than a Single Rotation basis. What impact would managing the stand on a Multiple rotation, as opposed to a Single Rotation, basis upon the optimal rotation period? Would it be correct to say that the opportunity to use the forest land over and over again for growing trees, under Multiple Rotation, would lead to the rotation period being longer than it would be under a Single Rotation basis? Explain fully.

(c) Stands of trees are not always managed for the commercial values of the trees alone. Non-market values (what your text refers to as non-timber values) can prove to be very important. After listing some of the non-market values that can arise from stands of trees, show that, if the stand is being managed on a Single Rotation basis, it is possible, once non-market values are taken into account, that the optimal time of rotation will be: t = ∞ , i.e. it is optimal the never to cut down the trees on the stand.

3.   According to the dynamic (capital-theoretic) economic model of the fishery studied by you, a positive investment in a fish resource will have a payoff in terms of additional sustainable resource rent. Assume for the moment that the sustainable resource rent arises from commercial additional values alone. There are then seen to be two components to the additional sustainable resource, with the first being the impact of the resource investment upon sustainable harvests. The second is captured in what we have referred to as the Marginal Stock Effect, which may, or may not be positive. What exactly is meant by the term Marginal Stock Effect?

It has been argued that, if sustainable resource rent is based upon commercial values alone, and if the Marginal Stock Effect, as defined by you, is equal to zero, a social manager might rationally decide to drive the resource to the brink of extinction. How is this possible? Explain.

In point of fact, in many countries, Canada being one of them, the social manager does not, in managing fishery resources, focus on commercial values alone. The fishery resources are seen to have a so called "existence value" over above the commercial value of the harvests.   What is meant by the term "existence value"?   On what grounds can it be argued that, if the existence values of fishery resources are deemed to be positive, as they are in Canada, the social manager would *never* drive the resource to the brink of extinction? Explain.

4.   What, we have termed Limited Entry Type 1 schemes in fisheries, in which the limited number of vessels compete among themselves for the shares of the TAC, or equivalent thereof, have usually produced disappointing results.   As Bruce Turris pointed out in his lecture, the B.C. groundfish fisheries provide vivid examples.   Why have such straightforward management schemes produced such negative results?

The alternative used in the B.C. groundfish fisheries consist of ITQ schemes. Explain the basic nature of such schemes. It used to be believed that ITQ schemes are unworkable in multi-species fisheries.   On what grounds does Bruce Turris (along with others) argue that ITQ schemes do, in fact, come into their own in multi-species fisheries? Explain fully.

5.   International fisheries, those exploited by two or more states, invariably involves a strategic interaction between/among those states. For this reason, economists studying the economic management of such fisheries, are compelled to apply the theory of strategic interaction better known as the theory of games. In applying the theory of competitive (non-cooperative) games to non-cooperative management of international fishery resources, economists predict that such non-cooperative management carries with it the risk of very inferior outcomes. Why is this so? Confine your discussion to transboundary fish stocks.

If cooperation does matter in the management of international fisheries, then economists must bring to bear the theory of cooperative games. They give preference to the theory of cooperative games developed by John Nash. The biggest problem is bringing stability to the cooperative fishery management arrangement. According to Nash, what are the two fundamental conditions that must be met, if the solution to any cooperative games is to prove to be stable? Explain.

What, in the context of an international fisheries cooperative game, is meant by the concept of "side payments". What role can side payments play in the fulfilling of the aforementioned two fundamental conditions? On what grounds can it be argued that side payments are likely to be particularly important, if the states sharing the fishery resource have different resource management objectives? Explain, confining yourself, once again, to the case of transboundary fish stocks.

Some of the Following Equations May Be Useful to You

1. $\quad \dfrac{p\,V\prime(t)}{pV(t)-C} = \delta$

2. $\quad F'(x*) + \dfrac{\chi'(x*)-c'(x*)F(x*)}{p-c(x*)} = \delta$

3. $\quad F'(x*) + \dfrac{c'(x*)F(x*)}{p-c(x*)} = \delta$