編號：F 118 系所：資源工程學系丙組 科目：資源管理問題解析

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以下五題（每題20分）取材自 Tom Tietenberg (2006) 所著之 Environmental Natural Resource Economics。請詳讀摘錄之短文後，說明 (1) 短文之中文意義及 (2) 短文之主要資源管理觀念。

(一) Two different types of economic analysis can be applied to increase our understanding of the relationship between the economic system and the environment: *Positive* economics attempts to describe *what is*, *what was*, or *what will be*. *Normative* economics, by contrast, deals with what *ought to be*. Disagreements within positive economics can usually be resolved by an appeal to the facts. Normative disagreements, however, involve value judgments.

Both branches are useful. Suppose, for example, we want to investigate the relationship between trade and the environment. Positive economics could be used to describe the kinds of impacts trade would have on the economy and the environment. It could not, however, provide any guidance on the question of whether trade was desirable. That judgment would have to come from normative economics.

Normative analysis can arise in several different contexts. It might be used, for example, to evaluate the desirability of either a proposed new pollution control regulation or a proposal to preserve an area currently scheduled for development. In these cases the analysis helps to provide guidance on the desirability of a program before that program is put into place. In other contexts it might be used to evaluate how an already-implemented program has worked out. Both of these types of situations share the characteristic that the alternatives being evaluated are well defined in advance. Here the relevant question is: Should we do it (or have done it) or not?

A rather different context for normative economics can arise when the possibilities are more open-ended. For example, we might ask how much should we control emissions of greenhouse gases (which contribute to climate change) and how should we achieve that degree of control? Or we might ask how much forest of various types should be preserved? Answering these questions requires us to consider the entire range of possible outcomes and to select the best or optimal one. Although that is a much more difficult question to answer than one that asks us only to compare two predefined alternatives, the basic normative analysis framework is the same in both cases.

(二) Depending upon the circumstance, we may need to place a value on either a *stock* or a *flow*. For example, the standing forest is a stock of trees, while the harvest of timber from that forest represents one of the service flows. The two are connected in that the value of a stock should be equal to the present value of the stream of services flowing from the stock. If the present value of the stream of services is maximized, then we say the resource is being used efficiently. This is equivalent to maximizing the value of that resource.

Economists have decomposed the total economic value conferred by resources into three main components: (1) use value, (2) option value, and (3) nonuse value. Use value reflects the direct use of the environmental resource. Examples would include fish harvested from the sea, timber harvested from the forest, water extracted from a stream for irrigation, even the scenic beauty conferred by a natural vista. Pollution can cause a loss of use value such as when air pollution increases the vulnerability to illness, an oil spill adversely affects a fishery, or when smog enshrouds a scenic vista.

A second category of value, the option value, reflects the value people place on a future ability to use the environment. Option value reflects the willingness to preserve an option to use the environment in the future even if one is not currently using it. Whereas use value reflects the value derived from current use, option value reflects the desire to preserve a potential for possible future use.

The third and final category of value, nonuse value, reflects the common observation that people are more than willing to pay for improving or preserving resources

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that they will never use. A pure nonuse value is also called *existence value.* When the Bureau of Reclamation began looking at sites for dams near the Grand Canyon, groups such as the Sierra Club rose up in protest of the potential loss of this unique resource. With Glen Canyon already flooded by Lake Powell, even those who never intended to visit recognized this potential loss. Because this value does not derive either from direct use or potential use, it represents a very different category of value.

These categories of value can be combined to produce the total willingness to pay (TWP):

TWP = Use Value + Option Value + Nonuse value.

Since nonuse values are derived from motivations other than personal use, they are obviously less tangible than use values.

(三) This notion gives rise to three alternative definitions of sustainable allocations:

Weak Sustainability. Resource use by previous generations should not exceed a level that would prevent subsequent generations from achieving a level of well-being at least as great. One of the implications of this definition is that the value of the capital stock (natural plus physical capital) should not decline. Individual components of the aggregate could decline in value as long as other components were increased in value (normally through investment) sufficiently to leave the aggregate value unchanged.

Strong Sustainability. According to this interpretation, the value of the remaining stock of natural capital should not decrease. This definition places special emphasis on preserving natural (as opposed to total) capital under the assumption that natural and physical capital offer limited substitution possibilities. This definition retains the focus of the previous definition on preserving value (rather than a specific level of physical flow) and on preserving an aggregate of natural capital (rather than any specific component).

Environmental Sustainability. Under this definition, the *physical* flows of *individual* resources should be maintained, not merely the *value* of the *aggregate.* For a fishery, for example, this definition would emphasize maintaining a constant fish catch (referred to as a sustainable yield), rather than a constant value of the fishery. For a wetland, it would involve preserving specific ecological functions, not merely its value.

It is possible to examine and compare the theoretical conditions that characterize various allocations (including market allocations and efficient allocations) to the necessary conditions for an allocation to be sustainable under these definitions. According to the theorem that is now known as the "Hartwick Rule," if all of the scarcity rent from the use of scarce resources is invested in capital, the resulting allocation will satisfy the first definition of sustainability.

In general, not all efficient allocations are sustainable and not all sustainable allocations are efficient. Furthermore market allocations can be: (1) efficient, but not sustainable; (2) sustainable, but not efficient; (3) inefficient and unsustainable; and (4) efficient and sustainable. One class of situations, known as "win-win" situations, provides an opportunity to increase simultaneously the welfare of both current and future generations.

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(四) Since we have considered similar effects on natural gas, we merely note that price controls have been responsible for much mischief in the oil market as well. A second source of misallocation in the oil market, however, deserves further consideration. Most of the world's oil is produced by a cartel called the Organization of Petroleum Exporting Countries (OPEC). The members of this organization collude to exercise power over oil production and prices.
seller power over resources due to a lack of effective competition leads to an inefficient allocation. When sellers have market power, they can restrict supply and thus force prices higher than otherwise.

Though these conclusions were for nondepletable resources, they are valid for depletable resources as well. A monopolist can extract more scarcity rent from a depletable resource base than competitive suppliers can, simply by restricting supply. The monopolistic transition results in slower production and higher prices. The monopolistic transition to a substitute, therefore, occurs later than a competitive transition. It also reduces the net present value society receives from these resources.

The cartelization of the oil suppliers has been very effective. Why? Are the conditions that make it profitable unique to oil, or could oil cartelization be the harbinger of a wave of natural resource cartels? To answer these questions, we must isolate those factors that make cartelization possible. Though many factors are involved, four stand out: (1) the price elasticity of demand for OPEC oil in both the long run and the short run; (2) the income elasticity of demand for oil; (3) the supply responsiveness of the oil producers who are not OPEC members; and (4) the compatibility of interests among members of OPEC.

(五) As economics can make specific recommendations about the level and structure of water prices, politics can provide insights on the implementation of those recommendations. The implementation process is not always smooth or predictable, as the people of Tucson, Arizona, found out.

In 1976, the city of Tucson faced what it perceived as a water crisis. The development of its service capacity had not kept pace with rapid population growth, and artificially low prices reduced the incentive to conserve. The groundwater supplies on which the city depended were being depleted.

The utility, assisted by a newly elected city council, instituted a new rate structure involving higher water prices overall and more attention to the cost of service in determining the rate structure. An unexpectedly dry year (creating an abnormally high demand), coupled with a newly implemented increasing block rate structure, conspired to ensure that water bills increased tremendously soon after the change. The resulting anger of the residents spawned a recall campaign in which the councillors responsible for the rate increase were retired from office.

Are major changes in prices politically infeasible? The authors of the Tucson study believe not, though they do believe that feasible increases also have to be implemented with greater care. In particular, they believe that local politicians must be willing to take risks, that local residents must be convinced that a real problem exists, and that the burden of the increases must be distributed so no one group is asked to bear too large a share.

Under extreme circumstances, such as extreme drought, cities are more likely to be successful in passing large rate changes that are specifically designed to facilitate coping with that drought. During the period from 1987 to 1992, Santa Barbara, California, experienced one of the most severe droughts of the century. To deal with the crisis of excess demand the city of Santa Barbara changed both its rates and rate structures 10 times between 1987 and 1995 (Loaiciga and Renehan, 1997). Between March and October of 1990, an increasing block rate rose to $29.43 per ccf (748 gallons) in the highest block! Rates were subsequently lowered, but the higher rates were successful in causing water use to drop almost 50%. It seems that when a community is faced with extreme drought and community support for using pricing to cope is apparent, major changes in price are indeed possible.