ABSTRACT

ESSAYS ON THE INTERTEMPORAL ALLOCATION OF NATURAL RESOURCES IN THE PRESENCE OF ENVIRONMENTAL AMENITIES

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The dissertation consists of three essays whose common theme is the allocation of natural resource use over time in the presence of environmental amenities.

The *first* essay consists of a modification of a classic problem in forestry economics, that of determining the optimal rotation period for a forest managed for timber production, to include the benefits of carbon uptake in wood, and the costs of subsequent carbon oxidation from wood products. When carbon values are included the private rotation age, determined by timber value only, is generally less than the socially optimal rotation age. The essay gives conditions under which a forest is harvested sooner, later, or not at all, and proposes appropriate societal intervention to insure that the private landowner harvests at the socially desired time.

Despite the large literature that has evolved since Hotelling wrote his seminal paper on the optimal depletion of exhaustible resources, there remains considerable confusion about the time path of scarcity rent and price when costs tend to rise with depletion. The *second* essay shows that Hotelling's fundamental results of rising scarcity rent and price paths are sustained and that the path of scarcity rent converges on the r-percent rule provided the objective function is concave. Nonmonotonic or declining scarcity rent paths found in the literature are shown to be due to assumptions that lead to

nonconcave objective functions typically associated with models of economic, rather than physical, depletion.

The *third* essay discusses the timing of resource use given trade liberalization in raw materials and resource based commodities when there are environmental benefits that flow from the resource stock. The results indicate that trade usually leads to an increase in the aggregate amount of resource use but that the initial rate of resource use under trade is uncertain when compared to autarky. Results strongly depend on the class of preferences considered. An example is provided where the shadow price of the resource falls with unanticipated trade liberalization and provides a possible explanation for the empirically observed failure of exhaustible resource prices to satisfy Hotelling's rule.