NONRENEWABLE RESOURCE EXTRACTIONS WITH A POLLUTION SIDE EFFECT: A COMPARATIVE DYNAMIC ANALYSIS

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ABSTRACT. In this paper, we present a nonrenewable resource model including environmental pollution as a state variable. The model is analyzed to identify some of the characteristics of the optimal paths. In addition, we present a numerical example on the basis of the algebraic solutions of our qualitative model, and identify some of characteristics of the optimal time paths for two sets of social costs of the pollutant. These results are consistent with the proposition of the previous literature that levying the shadow cost of the pollution stock reduces the consumption of resource; hence, it slows the accumulation of the pollutant in the atmosphere. One quirk in the results, however, is that extractions will persist longer in the higher pollution cost scenario. The costate variable for the resource stock is decomposed into a scarcity effect and a cost effect; and the costate variable for the pollution stock is decomposed into an undesirable abundance effect and a cost effect. Both of these, however, are cost effects.

KEY WORDS: Nonrenewable resource, environmental pollution stock, scarcity effect, undesirable abundance effect, and cost effect.

Introduction. There are few subjects in economics that have been discussed as extensively as the problem of environmental pollution. Following Pigou’s initial insight on this subject [1920], numerous studies have been undertaken to design environmental policies for pollution abatement. In a static model analysis, it has been significantly suggested that if a regulatory agency imposes the value of marginal social