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Progress in Natural Resources Economics, Anthony Scott, Editor

F. J. Anderson

PROGRESS IN NATURAL RESOURCE ECONOMICS

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This book is an interim report on a government-supported research program in natural resources economics at the University of British Columbia covering the period 1976 to sometime in 1982. The papers collected here are divided into five sections: macroeconomics, renewables, nonrenewables, empirical testing, and institutions/ideologies.

The macroeconomic section consists of an overview of the macroeconomics and energy model (MACE) developed by John Helliwell and his associates. The general characteristics of MACE are described along with sample simulations of the dynamic impacts of energy price changes and energy projects on inflation and real GNP in the Canadian economy. An appendix lists the model's variables and documents its detailed structure. With reservations (centered on MACE's production functions and its tendency to predict declines in real GNP in Canada in response to world oil price increases, the reverse of the responses typical of other OECD energy exporting countries), Lawrence Klein's discussion of the Helliwell *et al* paper is supportive.

The renewables section contains three papers, two of them on fisheries models. The Clark-Munro-Charles contribution reviews optimal fishery exploitation under certainty with malleable capital and then moves on to extensions, examining the effect on adjustment to optimal stocks when the rate of disinvestment in extraction capital is constrained and the effect of uncertainty. The uncertainty discussion is extended in the comments by Daniel Spulber. The second fishery paper, by James Wilen, argues that the recent 200-mile national fisheries jurisdictions implies that research should shift to an examination of efficiency in securing the total allowable catch and away from concern with interactions between total catch and the underlying stock. Wilen explores static noncooperative games in which each fisherman maximizes profit subject to regulatory restrictions and the conjectured catches of other fishermen with rent dissipation as the result. The amount of rent dissipation is a function of the parameters of the game, including the choice of regulatory instruments. The discussant, Colin Clark, argues that Wilen's framework should be elaborated to allow for dynamic interactions among fishermen and regulators. The third paper in the renewables section, by Philip Neher, proposes connections between a comprehensive optimal model of utilization of resource stocks and the rules-of-thumb that often characterize

actual resource management decisions. Just as the maximum sustained yield forester is unconsciously solving the Faustmann rotation problem with a zero discount rate and zero regeneration cost, so other rule-of-thumb managers may be solving a "phantom" resource allocation rule with particular parameter values and restrictive assumptions.

The nonrenewables section opens with contributions by Pierre Laserre and William Schworm on the influence of capital inputs on extraction decisions. Here, again, capital is nonmalleable and cannot exit the extraction process abruptly after it has entered. Provided it is optimal to install all extraction capital at the outset, Hotelling's nonincreasing rule for the rate of extraction from the mine holds up. If adjustment costs are a positive convex function of investment, the mining firm will generally build its extraction capital stock up slowly so that extraction increases in the early stages of the mining plan. If the firm can anticipate its future extraction plans, it could have a large enough capital stock in place at the beginning of extraction to validate the Hotelling rule (though this would require the firm to carry costly capital prior to the commencement of mining). Laserre and Schworm confirm R.L. Gordon's earlier (1966) result that an increase in the rate of interest has ambiguous results on the rate of depletion: an increase in the rate of interest lowers the opportunity cost of current extraction and hastens depletion (Hotelling) but it also adds to extraction costs and these additions are discounted in the future so depletion may be less rapid. Lewis and Slade reexamine the impact of tax-price policy variables on optimal extraction rates with a fixed extraction horizon. V.K. Smith's critique focuses on the restrictive aspects of their Cobb Douglas technology, the smoothness of the extraction cost function as depletion proceeds, and the fixed horizon assumption. The final paper in this section, by Eswaran and Lewis, asks how market structures in extractive sectors evolve given that dominant and fringe firms place differing values on the additional units of *in situ* resources that emerge from the exploration process. When deposits are large, the cartel may buy them up; when deposits are small, the fringe firms are likely to outbid the cartel. In the discussion, Dasgupta demonstrates that the cartel is likely to acquire the new deposits if their number is small.

In the empirical section, Russell Uhler examines reserves supply behaviour for the Alberta natural gas industry. Uhler distinguishes between the economics of discovery and the economics of reserves "appreciation"—additions to reserves following discovery. Gas discovery volumes respond positively to lagged gas prices and, since 1958, negatively to cumulative discovery volume. Appreciation of gas reserves is responsive to the wellhead price of gas. In the second paper, Campbell and Wrean model planned extraction from one operating and four prospective uranium mines in Saskatchewan. The presence of corporation and mining

taxes alters extraction rates planned with only slight effects on social (pre-tax) NPVs while capturing around 70 percent of the economic rent. Paul Bradley uses his empirical knowledge of mining to cast doubt on some of the revered theory of optimal extraction: nonmalleable capital tends to produce level rates of extraction; mines can be built smaller than optimal size with little sacrifice of NPV and this places less capital at risk; the best deposits are not necessarily mined first either within the mining firm or socially. Differential rents are important.

In the institutions/ideologies section, Berndt describes as sympathetically as possible that engineering cult called Technocracy involving an energy theory of value and energy certificates as a replacement for money. Anthony Scott's paper introduces the reader to the complexities of property rights in natural resources involving exclusivity, rights to enforce exclusive use, transferability of rights, areal definitions of property, uses to which property can be put, the duration and timing of rights and responsibilities, and the payments associated with their exercise. In an extended discussion, Vernon Smith reiterates Scott's view that property rights do not necessarily evolve in efficient directions and offers his own contribution to an efficient property rights package: certificates of ownership for live fish, water, and other rule of capture resources. All in all, this book is quite a read, and most informative.

F.J. Anderson
Professor of Economics
Lakehead University