Preface

This book presents applications of optimal control theory and dynamic game theory in a broad range of problems associated with environmental economics. The book consists of 15 chapters, roughly half of which are based on research presented at the "12th Viennese Workshop on Optimal Control, Dynamic Games and Nonlinear Dynamics", which was held at the Vienna University of Technology (TU Wien) from May 30th to June 2nd, 2012. The workshop, which hosted more than 200 participants, was organized by Gustav Feichtinger, Josef L. Haunschmied, and Alexander Mehlmann, and two editors of this book, Gernot Tragler and Vladimir M. Veliov (all from TU Wien).

While that workshop provided the motivation to produce this book, the book cannot be considered as the proceedings thereof. Rather, for the purpose of providing a broader view of late-breaking applications of dynamic optimization in environmental economics, the chapters that stem from selected presentations at the workshop have been complemented by chapters from distinguished invited scientists in this field. The chapters are collected in two parts of the book and are ordered alphabetically according to the name of the first author within each part.

The first part, "Interactions between economy and climate", addresses the "economy $\mapsto$ pollution $\mapsto$ climate change $\mapsto$ economy" circle. The eight chapters in this part cover a variety of different approaches to modeling the feedbacks between the environment and the economy. For instance, some contributions describe the environment by its quality, concentration of pollutants, temperature, or a renewable resource stock, while others involve the environment only implicitly, represented by tax levy on emission or emission caps. Environmental policy instruments that are considered for the purpose of diminishing the climate change include (public) abatement, cap-and-trade, taxes, R&D, or technological change in several variants (e.g., exogenous versus endogenous, directed versus undirected).

The second part of the book, "Optimal extraction of resources", deals with optimal or rational utilization of renewable and non-renewable resources. The problems described in the seven chapters in this part include commercial fishery, forest management and biodiversity under climate change, the effects of resource exploitation

and landowning on growth, export and import of fossil fuels, and harvesting of size-structured biological populations.

From a methodological perspective, the authors use various types of models and, therefore, various tools to analyze them appropriately. For instance, we find optimal control models in cases of a central planner, and dynamic games in cases of competing decision makers. While most of the models are deterministic, some also include stochastic uncertainties. In addition to standard problem formulations that rely on ordinary differential equations, there are also size-structured and spatially distributed systems. The tools used to analyze the problems include, but are not limited to, Pontryagin's maximum principle, nonlinear model predictive control techniques, nonlinear programming and the Karush-Kuhn-Tucker (KKT) theorem, the computation of Nash and Stackelberg equilibria, solution of Hamilton-Jacobi-Bellman equations, and numerical solution techniques such as the "Escalator Boxcar Train". Not only are some of the solution procedures innovative and sophisticated, but we also find complex solutions involving multiple equilibria and indeterminacy.

This book will be particularly interesting for economists, engineers, environmental managers, and applied mathematicians working on all kinds of dynamic optimization problems related to the interaction between environment, resources, and economic growth.

Finally, we wish to express our sincere gratitude to all of the authors of this book for their contributions, and the referees for their constructive suggestions on how to improve the individual chapters.

Vienna, Austria
November, 28, 2013

Elke Moser
Willi Semmler
Gernot Tragler
Vladimir M. Veliov

http://www.springer.com/978-3-642-54085-1

Dynamic Optimization in Environmental Economics
Moser, E.; Semmler, W.; Tragler, G.; Veliov, V. (Eds.)
2014, XI, 355 p. 67 illus., Hardcover
ISBN: 978-3-642-54085-1