

Preface

The postulation that individually rational, self-maximizing behaviors bring about group (Pareto) optimality constitutes one of the most appealing characteristics of the perfectly competitive market. The market is often regarded as an effective means to allocate economic resources efficiently. However, in the presence of an imperfect market structure, externalities, imperfect information, and public goods, the market fails to provide an effective mechanism for efficient resource use. Not only have inefficient outcomes appeared, but gravely detrimental events—such as the global financial crisis and catastrophe-bound industrial pollution problem—have also emerged under the current market system. With market failures prevailing, optimization in economic activities is one of the remedies available.

Strategic behaviors in the market are increasingly pervasive, and as a result, game theory has emerged as one of the fundamental tools in pure and applied research in economics. Because economic activities in the modern corporate world are dynamic processes, economic decisions are more appropriately analyzed in an intertemporal framework. Dynamic cooperation suggests the possibility of socially optimal and group efficient solutions to economic decision problems involving strategic action.

In dynamic cooperation, a stringent condition is required for a scheme to be dynamically stable. In particular, the optimality principle must remain optimal throughout the game, that is, at any instant of time along the optimal state trajectory determined at the outset. This condition is known as time consistency. In the presence of stochastic elements, a more stringent condition—that of subgame consistency—is required for a credible cooperative solution. In particular, a cooperative solution is subgame consistent if an extension of the solution policy to a situation with a later starting time, and any realizable state brought about by prior optimal behavior, would remain optimal. The notion of subgame consistency originated in Yeung and Petrosyan (2004), which develops a generalized theorem for the derivation of an analytically tractable “payoff distribution procedure” leading to subgame consistent solutions. Time consistency for the economic optimization problem requires dynamical consistency for all subgames along the group optimal trajectory; then time consistency in this context reflects optimal-trajectory-subgame consistency.

This book provides a treatise on subgame consistent economic optimization. In particular, dynamically stable game-theoretic optimization techniques are developed to establish the foundation for an effective policy menu to tackle suboptimal problems that the conventional market mechanism fails to resolve. The book is expected to be used as an analytical tool for advanced graduate students, game theorists, economists, mathematicians, and researchers in this field.

We are very grateful to our esteemed friends George Leitmann and John Nash for inspiration from their classic work in game theory, on which many of the results in the book are based. Our families have been an enormous and continuing source of encouragement throughout our careers. We thank Stella and Patricia (DY) and Nina and Ovanes (LP), for their love and patience during this and other projects, which, on occasion, may have diverted our attention away from them. We thank Cynthia Yingxuan Zhang for her outstanding research assistance and manuscript formatting. Financial support from the Research Grants Council of the HKSAR (Grant Number 32-07-028), the European Union Research Commission (Contract Number 044287), and HKSYU is gratefully acknowledged.

Finally, we would like to dedicate this text to honor the memory of a pioneering researcher and Nobel Laureate in the field of economic optimization—our late Saint Petersburg colleague Leonid Vitalyevich Kantorovich—in his 100th birthday tribute.

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