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## Preface

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In addition to Daniel Primont's tribute and overview of the contributions of R. Robert Russell to the study of aggregation, efficiency and measurement, this volume consists of nine original papers, which cannot readily be organized into disjoint groups. As Russell pointed out to us when asked how to organize the contributions, defining groups of papers would 'entail serious aggregation error.' We thus chose to include the contributions in alphabetical order by first author's surname.

Most of the papers included here were presented and discussed at a symposium held at University of California at Riverside whose title—Conference on Aggregation, Efficiency and Measurement: In Honor of Professor R. Robert Russell—is the basis of the title of this volume. This conference was the brain-child of Taradas Bandyopadhyay, who is a colleague of Russell. Each of the papers in this volume was reviewed by two anonymous referees, to whom we are very grateful. We would also like to thank Lisa Duke and Xiuying Jin for their help in typesetting the manuscript.

What follows is a brief overview of each paper.

Blackorby and Brett study Pareto optima in an overlapping-generations model. In this setting they find that the standard results that obtain in a static general equilibrium model are overturned. In the usual static model Pareto optimality requires the equality of producer and consumer prices; commodity taxes that create a divergence of producer and consumer prices lead to a suboptimal outcome. However, Blackorby and Brett show that in the OLG model in which the government can levy commodity taxes and make generation-specific transfers almost all Pareto optima will involve commodity taxation, subsidies, and taxes on either savings or on capital inputs. Thus, in the OLG setting the government has an important role to play that it does not have in the one-period static case.

Hudgins and Primont show how the usual comparative static results that arise in a model of competitive profit maximization can be derived when using the directional technology distance function as the representation of the firm's technology. They also provide a summary of the derivative restrictions

that should be satisfied by a directional technology distance function. Many of these restrictions are the standard ones implied by the assumptions of monotonicity and curvature. However, the restrictions implied by the translation property are unique to directional distance functions and they are the focus of a more detailed scrutiny in the final section of their contribution. These derivative restrictions are useful in formulating econometric models of directional distance functions.

Campbell and Marino distinguish three motivations for mergers, namely 1) market power, 2) technological or efficiency gains from shared fixed inputs and 3) managers' own utility. The first two are included in what the authors call synergistic merger. In contrast to synergy, the authors note that managers' utility can be linked to the 'observability problem' which arises from the principal-agent model. The principal may lose observability of the agents as a consequence of merger. They provide testable predictions of when such mergers are profitable despite the observability problem.

Diewert and Mendoza present a sequence of Data Envelopment Analysis (DEA) models that are used to compute various measures of input efficiency that are in the family of Debreu-Farrell measures that were advocated by R. Robert Russell. They theoretically demonstrate two types of Le-Chatelier results for these measures. In particular, they show that if stronger technological assumptions are imposed on the DEA model then measures of technical input efficiency will decrease and they show that if stronger behavioral assumptions are imposed then overall measures of input efficiency will decrease.

Recent Canadian time-series data are used to illustrate these Le-Chatelier effects. Inspired by Mendoza (1989), their analysis is extended to a comparison of three methods for computing annual rates of productivity change and measures of efficiency loss for each year in the 1961–1980 data set using 1) DEA techniques 2) superlative index numbers and 3) statistical estimation of unit profit functions. The strengths and weaknesses of each approach are highlighted. They conclude that the DEA method can be fruitful, particularly when the other two methods are not practical (or possible.)

In their contribution, Färe, Grosskopf and Zelenyuk try to relate four of the many versions of technical efficiency that have been introduced over the years. They discuss the conditions under which the Farrell measure of technical efficiency and the so-called Russell measure yield the same result. They also study the relationship between the directional distance function and what is referred to as the additive measure in the operations research literature, both of which have an additive structure.

In results that would not surprise Russell, for the two 'multiplicative' measures—Farrell and Russell—to yield the same score the technology must be input homothetic with the input component consistent with equal-weighted Cobb-Douglas form. For the directional distance function to yield the same score as the additive measure, technology must be translation input homothetic with the input aggregator specified as an arithmetic mean.

Grosskopf, Hayes and Taylor provide an empirical interlude by applying the decomposition of labor productivity growth (introduced by Kumar and Russell) to U.S. state manufacturing in the 1990s. They find that the three components: technical change (innovation), efficiency change (diffusion) and capital deepening all played a role, with innovation the primary determinant of manufacturing productivity growth in all states. Capital deepening contributed to labor productivity growth in all but three states, and explains at least half of the labor productivity growth in a dozen states.

In a second stage, these components were related to various policy variables; a growing technology sector is a strong contributor to labor productivity growth, while a growing public sector is largely a drag. Improvements in labor force quality appear to have had little impact on the pace of technical change or the diffusion of technology, but capital deepening was significantly greater in states with a more highly educated population.

Daniel Henderson focuses on technical efficiency and measurement, by providing nonparametric techniques to estimate or measure higher-order moments of technical efficiency. The nonparametric approach allows estimation of these moments without restrictive assumptions on the distribution of inefficiency, which plagued earlier efforts in the stochastic frontier literature. He also provides an empirical example; the estimators are applied to a panel of 17 railway companies over a 14 year time period.

In his contribution, Bill Schworm studies intellectual property rights, efficiency and productivity in a model with endogenous innovation. He uses a stylized version of the Rivera-Batiz and Romer model, which allows him to study equilibria under alternative regimes using standard measures of technical and allocative efficiency. This allows him to compare the efficiency of economies with and without patent rights.

Thijs ten Raa continues the technical efficiency theme, starting with a discussion of the difference between the Farrell (1957) and Debreu (1951) efficiency measures. He chooses the Debreu approach and shows how Debreu's efficiency measure for an economy may be disaggregated into production unit inefficiencies. This contribution gracefully touches on all three issues which unify this volume: aggregation, efficiency and measurement.

Aggregation, Efficiency, and Measurement

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