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Färe, Rolf, Shauna Grosskopf. Intertemporal Production Frontiers:with Dynamic DEA. Boston: Kluwer Academic Publishers, 1996, 208 pp.

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References

Bernardo, J., and A. Smith. *Bayesian Theory*. New York: John Wiley and Sons, 1994.

Poirier, D. *Intermediate Statistics and Econometrics*. Cambridge MA: The MIT Press, 1995.

Zellner, A. *An Introduction to Bayesian Inference in Econometrics*. New York: John Wiley and Sons, 1996.

Färe, Rolf, and Shawna Grosskopf. *Intertemporal Production Frontiers: with Dynamic DEA*. Boston: Kluwer Academic Publishers, 1996, 208 pp., $79.95.

This volume is a natural successor to Färe and Grosskopf's previous titles. Its main contribution is the extension of the tools they introduced in their previous work to a dynamic framework—a much needed extension if the tools of production theory are to be useful in capturing the characteristics of most production processes. Production processes, in general, take place over time, decisions in one period are linked to those in the previous and successive periods, and the final objective is that of optimization of this process across all periods involved. A static framework is misleading given that not all aspects of the problem are dealt with.

Economic theory has acknowledged the importance of time and has provided a set of models in which optimal consumption and production vectors include bundles at different time periods. In general, these models will also provide an optimal path for these variables to a global optimum or a steady state. Most of us are familiar with Sargent's contributions where the presence of a dynamic production process is unavoidable. We have struggled to formalize the notion of an aggregate production function and its properties. In my opinion, Färe and Grosskopf's contribution adds to our understanding of dynamics in economic theory by providing a consistent and specific conceptualization of the production process where multiple products are produced by multiple production units in multiple periods. In particular, their description of the dynamic production process is extremely useful for those of us concerned with the firm's process of optimization over time in an environment where many firms coexist in producing multiple products.

The book consists of six chapters. Chapters 1 through 4 address static production processes. These chapters summarize material presented previously in other books and papers. Dynamic production processes are addressed in the last two chapters.

In chapter 1, the authors describe the content and objective of this volume. Their purpose is to extend the efficiency measurement literature to intertemporal models implemented with data envelopment analysis (DEA). Their intent is to address dynamics with simple tools, from a practitioner's point of view instead of as production theorists. With such a purpose in mind they introduce the concept of networks, budget reallocation over time, and intermediate products.

Chapter 2 contains static production structure concepts necessary to understand this volume.

Chapter 3 presents the concepts of distance function and uses them in the construction of a Malmquist productivity index. Technologies change exogenously through time, and the series of static technological changes is captured by the rate of growth implied by this index.

Chapter 4 decomposes the technical change component of productivity growth to include input and output biases and embodied technical change. This chapter relies heavily in previous work by Grifell-Tatje and Lovell (1994), later extended by the authors. It would be helpful to the reader if the definition of Hicksian biases was presented. Also the decomposition presented in equation 4.2.14 is not clear and a graphical interpretation would be welcomed. In particular, it would be very helpful in the interpretation of the magnitude effect versus the biases.

Chapter 5 summarizes concepts of indirect production models. They extend these concepts to intertemporal budgeting. It is here that the authors for the first time give the problem a dynamic flavor. It is done in a very simple, clean, and original way. The cost indirect output set contains all those output vectors that are technically and economically feasible. Time is considered explicitly by allowing borrowing and lending from other periods to modify the firms' budget constraint. Shortcomings of the approach in this chapter include failure to incorporate the rate of return on capital, restricting borrowing and lending to adjacent periods only, and an inability of this model to choose the optimal amount of borrowing and lending.

Chapter 6 is the essence of this book. The authors' presentation of dynamic production processes rests on their notion of product technology, time substitution, and time-intermediate products. The product technology is defined as a Cartesian product of static technologies and inherits the properties of these technologies. When an input-output bundle belongs to the product technology, the output vector in a particular period can be produced by that period's input vector using the same period's technology. Time substitution of inputs specifies when inputs are used in the dynamic production process and how much of them is used in each subperiod. Time-intermediate

products, those products that are outputs in one subperiod but inputs to the next, constitute the final concept that allows generalization of the product technology to what the authors called "basic dynamic technology." Three maximization problems are presented. The first is the maximization of multiperiod scalar output given data on inputs which are restricted in terms of their aggregate value. Multiple outputs are allowed in the problem stated as a maximization of intertemporal revenues given inputs. Lastly, a dynamic activity analysis problem that incorporates multiple outputs given multiple inputs, multiple production processes and multiple time periods in the presence of intermediate inputs is presented in equation 6.3.1 and illustrated in section 6.5. A network model is formalized in terms of DEA and applied to an efficiency comparison of cow/calf operations in ten western states with the objective of measuring how far from the frontier each operation is. The framework presented in this chapter allows, in addition to multiple production subperiods and intermediate products, multiple outputs and multiple production units in a simple DEA framework. It is a true generalization of the frontier approach to calculation of production technologies. Although some of the concepts in this chapter had been developed earlier in Shephard and Färe (1980) and Färe (1988), the treatment has been extended considerably and it is easier to read.

One important feature of this volume is the presentation of examples in each chapter. This is consistent with the authors' intentions to write a self-contained book for the practitioner. The examples are interesting and very enlightening, although there is no mention of the software used, nor an example of the code. For example, the application in chapter 6, the most important in the text, discusses at length (three pages) kernel estimation procedures used after the DEA results are obtained instead of devoting attention to the procedures used (and the code) in the activity analysis application.

Although I would have liked to see where this approach fits conceptually in the general literature on dynamic economic processes, how it compares practically to dynamic programming approaches and what type of econometric approaches would be appropriate to model the dynamic technology, I welcome this volume as an important step in the process of generalizing efficiency analysis to more realistic situations. This volume should be read by all professionals interested in intertemporal production processes, the theory of the firm, and the measurement of its performance.

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References

Färe, R. *Fundamentals of Production Theory.* Berlin: Springer-Verlag, 1988.

Grifell-Tatje, E., and C.A.K. Lovell. "A New Decomposition of the Malmquist Productivity Index." Department of Economics, University of Georgia, Athens, 1994.

Shephard, R.W., and R. Färe. *Dynamic Theory of Production Correspondences.* Cambridge MA: Oelgeschlager, Gunn and Hain Publishers, 1980.

Power, Thomas Michael. *Lost Landscapes and Failed Economies: The Search of a Value of Place.* Washington DC: Island Press, 1996, xiii + 304 pp., price unknown.

In this insightful book, the author, Thomas Michael Power, describes well the conflicts between those who would employ extractive uses of natural resources for making a living and those who would protect the environment.

> Conflict over environmental issues continues to build across the United States. In our nonmetropolitan areas, politics is still personal and natural resources still play an important economic role, so that at times the conflict resembles a civil war. On the environmental side, animal species that once symbolized huge ecosystems—the grizzly bear, the salmon, and the wolf—are on the verge of extinction, and mountains, rivers, deserts, and prairies face threat of irreparable modification. On the resource-industry side, ways of life that have supported generations of families are threatened: logging, mining, and farming, and the manufacturing activities built around them (p. 1).

The author shows that local economies are becoming less dependent upon extractive industries, going on to argue that protecting the environment can enhance the community's economic base. Environmental protection is presented as creating consumer goods and as an engine for local economic development.

In the preface the author gives up his status as a disinterested observer. Other than overstating his arguments in a few places and laying blame for bad behavior (threats of violence, p. 3) primarily at the feet of extractive industry advocates, his personal position does not interfere "much" with his arguments. Remaining neutral on these topics can be most difficult. Having been raised in a family dependent upon extractive industries, I understood well one side of the issues. However, my understanding