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## Preface

This book has been in the works for many years. Its first draft was completed in June 1974, and was widely circulated for review and comment at that time. The long delay since that time has numerous causes, of which a principal culprit is the author's "other life" as a practicing macroeconomist. A large number of theoretical and empirical papers on macroeconomic issues emerged during 1974–88 while the durable goods project was fermenting in the back room.

But the delay has not been in vain. In recompense for the fourteen-year time lag since the first draft, the data coverage has been extended almost as much, by thirteen years from the initial termination year of 1970 to the new termination year of 1983. Much more important is the greatly expanded scope of the study. First, the study now has a coherent theoretical framework that extends earlier work on capital goods deflators. Because of the important changes in energy prices that have occurred since the 1974 version, it seemed appropriate to place major emphasis on improvement in the energy efficiency of capital goods. Extending the standard view that prices of different models of capital goods reflect their relative marginal products, the new theory shows that prices of different models of capital goods should reflect their relative contributions to net revenue, that is, to a firm's gross revenue minus variable operating cost. At the measurement level, this theoretical approach requires that price changes be adjusted for quality change, those adjustments taking the form not just of changes in performance but also of changes in energy use and in the frequency of repair. Quality adjustments for energy efficiency are undertaken here for commercial aircraft, electric utility generating equipment, household appliances, television sets, automobiles, and railroad equipment.

The 1974 version was heavily dependent for its price data on the Sears catalog. In this version, a bit less than half the weight in the final producers'

durable equipment (PDE) deflator is carried by catalog data. Detailed studies of numerous major types of producer durables have been added, partly for their intrinsic interest, and partly to deal with the criticism that the 1974 results were too dependent on small items purchased from the Sears catalog by households, and that such results could not be extrapolated to the industrial sphere. New studies include chapter-length treatments of commercial aircraft, electric utility generating equipment, electronic computers, telephone transmission and switching equipment, and railroad equipment. Another important addition is a set of fifteen new product studies based on data and quality evaluations in *Consumer Reports*. Half these are used as the primary indexes for electric appliances, reflecting the judgment that they have broader brand-name coverage than the catalog indexes for the same products, and the other half are used to confirm and complement the catalog indexes for typewriters, outboard motors, and home power tools.

Thus, the delay in finishing the second version of the book has yielded as its benefit not just the increase in years covered, from twenty-four to thirty-seven, but also the theoretical contribution, the multidimensional treatment of quality change, and the greatly increased reliance on data sources other than the Sears catalog. The net result is a study that is significantly deeper, broader, and more convincing than the original draft.

Since this is a book about quality change and technological progress in durable goods, a word is in order about the change in the production technology of this book between the 1974 and 1988 versions. The draft of the first version was typed on a Smith-Corona portable typewriter and retyped in its entirety, often several times, by a secretary using an IBM selectric typewriter. Any change that I might have contemplated, particularly an extra paragraph early in a chapter, required extensive retyping by the secretary and a difficult cost-benefit calculation as to whether it was really worth it. Technology was a barrier to improvements in substance. In contrast, the new chapters written in 1988 were composed and printed at the level of professional typesetting inside my home by a 386 "clone" personal computer, a Hewlett-Packard laser printer, and WordPerfect 5.0. Revisions could be made instantly and chapters reprinted at the rate of eight pages per minute, all without any involvement of a secretary.

Despite recent technological advances that convert academic research and manuscript production into a cottage industry, no project of this scope and duration can be accomplished alone. I am grateful above all to the ongoing financial support of the National Science Foundation, and to the help of James Blackman and Dan Newlon through the years and more recently of Lynn Pollnow. For partial released time support during 1980–81 I thank the Guggenheim Foundation and during 1984–85 the Sloan Foundation, and particularly Al Rees, for an Officers Grant. Rees's original work on catalog price indexes in the Stigler committee report (National Bureau of Economic Research 1961) and in the context of his path-breaking (1961b) book on real

wages during 1890–1914 continues to be an inspiration to me both for its substance and care in execution. The appendix notes to chapter 10, giving the detailed sources of the catalog price indexes, are explicitly modeled on an appendix in Rees's (1961b) book.

Most of the aforementioned financial support provided funds to support graduate student research assistants. A long line of students dating back to the early 1970s has carried out the tedious and demanding work of collecting the primary data developed in this study, including the data from thirty-seven years of Sears catalogs, census *Current Industrial Reports*, used auto and tractor manuals, prices of a multitude of electronic computer models from several sources, and plant-by-plant data on electric utility plant equipment costs and operating characteristics.

In this long list of students, at the very top as *primus inter pares* is Gabriel Sensenbrenner, without whose intense interest in and devotion to this project over the past three years little progress would have been made in translating this great body of data into a coherent set of results. Gabriel is unique in my experience in his curiosity and his ability to grasp broad ideas while making the smallest details come out right, not to mention his stamina to endure eighty-hour weeks. Gabriel also deserves special acknowledgment for his intense effort in the project on computer prices to convert recalcitrant data into coherent results.

Deserving to be singled out as well is James Wilcox, who worked on this project in the late 1970s and developed the new measures of automobile fuel economy that he published in 1984 and that are utilized in chapter 8 here. Peter Fisher did the final round of collection of catalog, automobile, and unit value data and, perhaps more important, transferred most of the catalog data from a pile of loose worksheets onto neat accounting pads suitable for inspection by curious outsiders.

Other students helping on the project, in rough chronological order, were Thomas Henrion, Gary Ericksen, Hans Genberg, and John Kienitz, all at the University of Chicago over the period 1969–73, and, at Northwestern since then, Dana Johnson, Ross Newman, George Kahn, Tim Stevens, and Janet Willer. In the final stages, George Williams did careful work in collecting and reentering for the full postwar period all the detailed product-by-product PPI data, and Dan Shiman was indispensable in converting previously written manuscript chapters from various obsolete technologies into WordPerfect 5.0, and again in reformatting the manuscript to meet the style requirements of the University of Chicago Press.

Projects like this need not only research assistant help but outside scrutiny, criticism, and encouragement. At the top of my list are Zvi Griliches and Robert Lipsey. Zvi's career has been an inspiration for me, and he has provided encouragement and chapter-by-chapter, version-by-version criticism since the beginning, culminating with his role as NBER staff reader of the final version. Robert Lipsey's gentle nagging was instrumental in my

finishing the 1974 draft, and his detailed comments on that draft and inspection of the new data printouts at various stages since then led to many improvements. Useful suggestions also came in letters on the 1974 draft from Phil Cagan, Dale Jorgenson, John Kendrick, Sherwin Rosen, and Theodore Schultz. Helpful comments since then have come from George von Furstenberg, Martin Marimont, and F. Lee Moore. John Early of the Bureau of Labor Statistics (BLS) answered particular questions about the anomalous behavior of several specific PPIs. Important sets of detailed comments on specific chapters were received from Pete Dyvsand of the Boeing Company on aircraft, Franklin M. Fisher on computers, Brent Upson of General Motors on automobiles, and D. H. Clark and J. H. Seltzer of the Cummins Engine Company on diesel engine prices. Ken Flamm commented on the use made of his own work on computers and telecommunications equipment.

Reserved for last, but by no means least, is the contribution of Jack Triplett, at the BLS for most of the time span of this project and now chief economist at the Bureau of Economic Analysis. While an unfortunate adversarial tone entered into exchanges with Triplett early on, the substance of these exchanges has made an enormous difference to the scope, methodology, and detailed implementation of this project. Specific mention should be made of Triplett's criticism of earlier versions of my theoretical framework (chap. 2), my descriptions of what the BLS actually does (chap. 3), and the computer research (chap. 6). Perhaps most helpful of all were extremely long and detailed letters in the late 1970s on the automobile and Sears catalog research (chaps. 8 and 10). More than anything else, it was a desire to meet the challenge of Triplett's skepticism by expanding the scope of the project and fixing up the results at the level of detailed implementation that delayed the book for so long, and accordingly he deserves much of the credit for the improvement that has resulted.

Finally, a large bouquet to my wife Julie for listening endlessly over the years to my promises to finish what she cleverly called the "NEVER" book "very soon," and for her patience and support in the summer of 1988, when the challenge of pulling all this together glued me to my computer for many long nights and weekends.

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Evanston, Illinois  
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