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10 Specification Price Indexes from Sears Catalog Data

10.1 Introduction

Chapters 4–9 developed new price indexes for a number of products. In most cases, these chapters included a detailed treatment of measured and unmeasured quality change, as well as a comparison of alternative indexes or data sources. Among these comparisons were those of the Chow, Phister, Dulberger, and *Computerworld* data sets for computers in chapter 6, the Sears catalog and *Consumer Reports (CR)* price indexes for appliances in chapter 7, and the new hedonic, used hedonic, and BLS indexes for automobiles in chapter 8. However careful these chapters may have been, they were limited to a small number of products. Yet the official NIPA deflator for PDE is based on about 150 group or product components of the PPI.

As contrasted with the "narrow but deep" coverage of the previous chapters, this chapter and the next are "broad but shallow," developing new price indexes for a large number of products from data in the Sears catalog and, in chapter 11, from unit value data. The coverage is "shallow" in the sense that there is not the detailed comparison of quality attributes and unmeasured quality change that characterized, for instance, the study of appliances in chapter 7. Nevertheless, for seven products (two types of typewriters, two sizes of outboard motors, and three power hand tools) it is possible to compare the catalog results with indexes of roughly matched models from *CR*. Subsequently, in chapter 12, the indexes developed in this chapter and the next are joined together with indexes from chapters 4–9 to compute new "alternative" price indexes from all the information in chapters 4–11 for many of the individual commodity classes included in the NIPA deflator for PDE.

The main focus of this chapter is on comparisons of mail-order catalog price indexes with PPI commodity price indexes for the same or similar

products.[1] Reassured by Rees's (1961a) finding that his results were similar for prices obtained from the Sears and Wards catalog, I have limited data collection to Sears, which in the postwar period has had substantially greater catalog sales than Wards.[2] Sixty-eight unduplicated Sears catalog price indexes have been compiled for study in this chapter, excluding the five Sears indexes for appliances developed and discussed in chapter 7. A total of 7,242 individual price observations make up the sixty-eight Sears catalog indexes over the thirty-seven-year period 1947–83. Taking account of product categories that are not available for the full thirty-seven-year interval, we have an average of 59.4 product categories per year, 235 observations per year, and 3.3 model observations per product category per year. Just as the NIPA deflator for PDE contains duplication, with eleven PPI indexes used twice, my alternative PDE index developed in chapter 12 also uses eleven of the Sears indexes twice, for a total of seventy-nine Sears catalog indexes excluding appliances.

The focus in this chapter is on the "drift" of the Sears indexes relative to the corresponding PPIs, where drift is defined as the growth rate over specified periods of the log ratio of the Sears index to the corresponding PPI. The methodological section of the chapter discusses alternative interpretations of this drift, including the possibility that the drift represents an estimate of quality change unmeasured by the PPI. The major methodological issues that receive attention are possible sources of secular drift in the prices charged by catalog outlets selling to households relative to manufacturers' prices reported to the PPI, and the possibility that the individual pairings of Sears catalog indexes with PPI commodity indexes may be inappropriate.

The conclusion of the chapter discusses the substantial difference between the average growth rate of the Sears catalog price indexes and that of the corresponding PPIs. This difference is calculated with two weighting schemes. With equal weights for all sixty-eight indexes, the average annual percentage "drift" of the Sears/PPI ratio is −1.30 percent per year, that is, the average growth rate of the Sears catalog price indexes is 1.3 percent per year slower than the corresponding PPIs. When the Sears products are weighted in proportion to their importance in the PDE deflator by the weighting scheme described in chapter 12, the annual rate of drift becomes −1.56 percent per year, implying that the more important products have higher rates of drift than the less important products. Also examined are summary data on the drift over specified subintervals of the full 1947–83 coverage period, and the frequency distribution of the drift for the sixty-eight

1. I acknowledge my debt to Jack Triplett for his close scrutiny of the earlier (1974) version of my work on catalog pricing; the extended discussion of advantages and disadvantages in sec. 10.3 owes much to his earlier critique, as do numerous comments and qualifications in the subsequent sections discussing the detailed product indexes.

2. In the late 1970s, Sears's catalogue sales were at a level of about $3 billion per year, compared to just under $1 billion for Wards. See Hendrickson (1979, 250).

unduplicated Sears/PPI ratios over these subintervals. In attempting to determine whether the resulting drift might be related to the adequacy of adjustments for quality change, the drift is related to the technological complexity of each product and to the extent of model coverage in the catalog. Finally, the chapter, in section 10.16.3, examines implications of the year-to-year behavior of the Sears/PPI ratios for the behavior of transaction prices relative to list prices, and for the efficacy of the Nixon-era price controls.

The new information in this chapter is based on the Sears, Roebuck catalog. Mail-order catalog price indexes have the dual advantages that they are true transaction prices, and that detailed specifications facilitate control for quality change. For a few of the Sears catalog products, there are sufficient observations to estimate hedonic regression indexes. Sears hedonic indexes for refrigerator-freezers, room air conditioners, and washing machines were presented in chapter 7, and outboard motors and gas hot water heaters are discussed in this chapter. For most of the Sears products, however, insufficient numbers of price observations for differing models are published in a given catalog to allow estimation of hedonic regressions. This dictates the use of the conventional "specification" method for the great majority of the Sears-PPI comparisons. As we shall see, an important advantage of the catalog data is that it is possible to implement the specification method in its "pure" form, in the sense that price comparisons for each pair of years refer to models that are identical in all quality characteristics listed in the catalog.

10.2 The Colorful History of the Sears Catalog

While the history of the Sears catalog is interesting in itself, it is of importance for this chapter because of its implications for the relative price of Sears catalog products as compared to the average price of similar products sold by noncatalog suppliers. A central theme of the history is that Sears (and Wards) catalogs became popular as a source of supply for rural residents, because they undercut the high prices charged by the typical rural merchant of the late nineteenth century. By the late 1970s, however, there is direct evidence that the pricing position of the catalog had shifted from below average to average or even above average. Subsequent sections return to the implications of this history for comparisons of catalog prices with PPI commodity price indexes.

While this study concentrates on mail-order catalog listings of durable goods, the variety of products sold is far broader. Catalogs have sold apparel, shoes, and processed foods from the beginning, and from 1909 to 1937 Sears sold cumulatively more than 100,000 complete kits for its "Honorbilt" residential houses. Some of the products were more unusual, as suggested by this letter:

> Dear Montgomery Ward: Do you still sell embalming fluid? I saw it in your old catalog but not the new one. If you do, please send me enough for my husband, who is five foot eleven inches tall and weighs 165 pounds when in good health.

Another time a Montana rancher ordered a wife from Sears. She was supplied when an order clerk quit her job and went West to marry him.[3]

Benjamin Franklin has been called "the father of the mail-order catalog," because he issued in 1744 a list of 600 books he would sell by mail. But the catalog business as we know it today was founded by Charles Thompson in 1866, and the expression "mail-order" is first recorded in the language in 1867. Aaron Montgomery Ward founded his famous firm in 1872 after working as a traveling salesman in rural areas for Chicago dry goods stores and finding that farmers complained bitterly about the prices they were forced to pay for goods at traditional country stores, as well as limited selections and dishonest merchants.[4] Ward's was an idea whose time had come, for the spread of railroads throughout the United States made it possible for Ward and other early catalog operations to bypass the high-markup middlemen and retailers who were responsible for high retail prices.

Much of the early impetus to catalog sales came from established retail merchants like John Wanamaker and R. H. Macy, who established their mail-order departments in 1872 and 1874, respectively. Wanamaker was a leading advocate of improved mail service to facilitate mail-order shipments to rural residents and lobbied to achieve rural free delivery (1896) and the parcel post system (1913). Parcel post raised the previous four-pound limit on mail parcels; no longer would mail-order companies have to cut an overcoat into halves and send it in separate parcels along with needle and thread, as did Wards in the 1870s.

The threat of low-priced mail-order goods was not ignored by local retail merchants. The first mass book burners in American history were the anti-mail-order fanatics of the 1890s. Local merchants tried to persuade local residents to toss their catalogs into a bonfire in the public square every Saturday night. The mail-order merchants struck back with editorials in their catalogs urging sympathy for the local merchants who were honest but just inefficient, since they paid too much for their goods and could not obtain the volume discounts available to the giant mail-order houses.

Richard Sears began with a mail-order watch business in 1887, the success of which was facilitated by the skill of Alvah Curtis Roebuck, a former watch repairer, in organizing an assembly line to assemble inexpensive watches. The full-scale "Sears, Roebuck, and Company" catalog operation began in 1893, fully two decades after Wards, but by 1895 the Sears catalog already

3. Hendrickson (1979, 205–6). This book is the source for many of the details in this section.

4. A storekeeper is said to have enjoined his clerk to "come to the prayers after you have sanded the sugar and watered the molasses."

numbered 507 pages, and its cover proclaimed itself "The Cheapest Supply House on Earth."[5] By 1900, sales reached $11 million (about $150 million at 1982 prices), and Sears passed Wards in sales, a lead it was never to relinquish. Sears overtook the early lead of the older company because of the inspired combination of Richard Sears's promotional genius (which often descended into the sleazy, particularly in his advertisements for patent medicines and "electric belts") and the administrative skill of his new partner Julius Rosenwald, who organized the Sears shipping operation so well that Henry Ford studied it before setting up his first automobile assembly line.[6]

Much of Sears's early success in the late 1890s and early 1900s was due to its drastic price cutting on sewing machines and bicycles. When most other firms were selling sewing machines for $35–$55, Sears began in the $14–$16 range, and soon reduced the price of its most popular model to $12.50. Bicycles sold by local merchants for $75 were undercut by Sears models selling for $14 and $20 (Emmet and Jeuck 1950, 66–71). Sears prices in the postwar era have never been so low relative to the average retail price of other makes.

The rapid growth of the Sears catalog operation witnessed catalog circulation grow from 318,000 in 1897 to 3.6 million in the fall of 1908 and sales grow from $1.4 million in 1896 to $50 million in 1907 (Emmet and Jeuck 1950, table 11, p. 172). This early period culminated with the construction in 1906 of its westside Chicago headquarters and distribution center, a building of awesome proportions even by current standards. The 3-million-square-foot complex was proudly described as "the largest business building in the world,"and boasted a two-block-long railroad yard rolling through its center that connected Sears to every major trunk line emanating from Chicago.[7] More than 7,000 workers operated the miles-long system of conveyor belts and bin sorters that wound through the nine-story facility. The building even including a printing department for printing the millions of catalogs distributed annually, complete with railroad tracks to carry paper straight to the printing presses. The building's water tower, built to a height of sixteen stories in neo-Venetian style, set the design standard for subsequent Sears distribution plants and retail stores, all of which had real or fake towers in the same style until about 1940.[8]

5. The catalog reached 1,200 pp. in 1906, roughly its present size (it peaked at roughly 1,500 pp. in the early 1970s).

6. In 1895, Roebuck insisted on being bought out of his partnership by Sears for the princely sum of $25,000.

7. The quotation is from Worthy (1984, 29), who also records this description from the 1905 Sears, Roebuck catalog: "Miles of railroad tracks run through, in and around this building for the receiving, moving and forwarding of merchandise; elevators, mechanical conveyors, endless chains, moving sidewalks, gravity chutes, apparatus and conveyors, pneumatic tubes and every known mechanical appliance for reducing labor, for the working out of economy and dispatch is to be utilized here in our great Works."

8. Details about the distribution center come from *Crain's Chicago Business,* 21 September 1987, 3, in an article written on the occasion of its closing after eighty-one years in operation.

Sears grew rapidly with the agricultural prosperity that followed the outbreak of World War I, and, by the end of the war, Rosenwald found himself one of the world's wealthiest men. During this period, Rosenwald established a testing laboratory to check on the quality of merchandise being bought by his buyers and introduced review procedures to assess the validity of claims made in the catalog about particular goods. The company came close to bankruptcy during the 1920–21 postwar deflation-depression and was saved when Rosenwald pledged $20 million from his personal fortune as a guarantee to Sears' creditors.[9]

For almost a century, the Sears catalog has been an American institution, reflecting the styles and fashions of each era. Space in the catalog has always been allocated by sales, which allows individual products to appear and disappear faster in a catalog-based price index than in the official BLS price indexes. Using the catalog, for example, one can establish that bosom boards were widely used by women during the 1890s, that pyjamas were introduced about 1908 and twin beds about 1921, and that the last covered wagon was sold in 1924.

By the 1920s, however, the golden age of the catalog was already in decline.[10] Catalog sales depended heavily on farmers and other residents of rural areas and were bound to decline in relative importance as the United States became urbanized and, later, suburbanized. The prescient General Robert Wood, who assumed the management of Sears in 1922, foresaw these trends and decided to use the regional mail-order plants Rosenwald had built as supply bases for a sprawling network of stores. By the end of 1929, there were 324 retail stores, and in 1932 and every succeeding year the volume of retail store sales exceeded that of catalog sales.

As of the late 1970s, 315 million copies of Sears catalogs were printed each year, generating sales of $3 billion per year from 28 million customers.[11] Sears's catalog sales were larger than its next four rivals combined—Wards, Penney, Spiegel, and Alden. Nevertheless, the relative competitive position of the Sears catalog eroded in the 1970s; the number of catalog customers actually declined in 1979 for the first time in twenty-five years. Internally, Sears executives realized that problems with catalog sales were due in part to the rise of new competitors selling more stylish goods at lower prices, and that Sears had deliberately moved its prices from low to upper middle in the

9. The most detailed description of this fascinating episode is contained in Emmet and Jeuck (1950, 211–15). A shorter version is in Weil (1977, 56–58). The net effect of Rosenwald's "gift" was to make him and his heirs even richer, since his contribution was in the form of company stock with an option to repurchase later at a favorable price, and through the purchase of Sears buildings and real estate, which were later repurchased by the company.

10. The main source of the remainder of this section is Katz (1987).

11. Hendrickson (1979, 250). Katz (1987, 198) gives the figure of 350 million catalogs sent to 25 million households during 1979. These figures obviously include a multitude of small specialty catalogs. Distribution in 1988 of the two semiannual general merchandise catalogs was 15 million each, or 60 million copies in total (Barmash 1988).

preceding decade.[12] A Sears executive is quoted as stating in 1979, "The catalog was once the jewel of Sears, but now it's full of last year's goods at next year's prices." So dramatic was Sears's attempt to "trade up" to higher-quality goods, higher prices, and higher markups, that Sears has been called a "traitor to its class" (Weil 1977, 256).

Things went from bad to worse in the 1980s. Catalog sales as a percentage of total Sears retail sales declined from 100 percent in 1924, to 50 percent in 1932, to 22 percent in 1979, to 18.1 percent in 1984, to 15.5 percent in 1987.[13] The absolute level of nominal catalog sales was flat from 1981 to 1987, implying a decline of 20 percent in real catalog sales (deflating by the NIPA implicit consumption deflator). This occurred despite the demise of several important Sears rivals; Montgomery Ward closed its 113-year-old catalog operation in 1985, as did Aldens in 1982. Sears was undermined not just by its own pricing policy, but by an explosion of specialty catalog operations (our household buys from Williams Sonoma and Lands' End but never, ironically, from Sears). Some observers predict that the general catalog, the bible on which this chapter is based, may disappear in the 1990s. A preview may have occurred in 1986, when the "big book" was split into two parts, an annual durable goods catalog and a semiannual "soft goods" catalog.

To a large extent, the difficulties of the catalog mirrored the broader competitive weakness of Sears's retail merchandising operations in competing against an increasing variety of specialty stores that stocked a much deeper selection of goods in a narrow category. Sears has been described as a "sluggish behemoth clashing with smaller, more agile adversaries," and it can no longer boast, as it could fifty years ago, that only Sears extended credit to middle America or backed its merchandise with its own store guarantee.[14] In a broad sense, the struggle of Sears is an inevitable effect of the sovereignty of consumer choice in an affluent society. For the narrower purpose of price measurement carried out in the rest of this chapter, we should note that Sears is not as competitive as it once was. To the extent that the price-quality relation of Sears merchandise has deteriorated relative to that for durable goods retailing as a whole, the Sears catalog indexes will overstate the rate of price increase and understate the downdrift of the ratio of "true" quality-adjusted prices to the PPI.

12. "Awesome in size . . . Sears began trading up its price lines between 1967 and 1973. It raised its markups by selling higher-priced goods and gave up its lowest price lines" (Barmash 1977).

13. The 1924 figure is for the year before the opening of the first retail store; the 1932 figure is for the year given by Hendrickson (1979) that retail stores passed the catalog in sales; 1979 is from *Business Week*, 8 January 1979, 83; 1984 and 1987 are from Snyder and Waldstein (1988, 28).

14. This pessimistic verdict on the future of Sears and the Sears catalog is extracted from Snyder and Waldstein (1988), which is the best available study of the competitive and marketing difficulties of Sears (in contrast to Katz) [1987], which concentrates on the clash of personalities).

10.3 Catalog Price Indexes: Advantages and Disadvantages

This is not, of course, the first study to be attracted by the price and quality information available in mail-order catalogs. W. I. King was the first to use catalog data, constructing a Sears catalog cost-of-living index for 1909–28 that was published in bulletins of the National Bureau of Economic Research.[15] Albert Rees (1961a) published what is probably the best-known comparison of catalog price quotations with official price indexes, in his case the CPI. There is no overlap between the information collected by Rees and by this study, since Rees's concern was with price indexes for selected nondurable goods. One of Rees's main conclusions was that, when "there has been considerable stability in the physical characteristics of commodities over time," the catalog indexes "turn out to be surprisingly good approximations" of BLS indexes "based on much larger samples of outlets and areas" (1961a, 168–69). The presumption in this study is that, if the catalog indexes can come close to the BLS for simple items experiencing quality change, they may do better than the BLS for complex items undergoing continuous quality change, both because the catalogs adjust the model mix faster to reflect market tastes, and because the detailed catalog specifications make it easier to hold constant quality changes.

A closer analogue to this study is the catalog price index for thirty-six clothing items and nineteen home furnishing items developed by Rees (1961b) for the period 1890–1914. As does this study, Rees found a substantial amount of secular drift between his catalog indexes and the BLS WPI, with an average rate of change of the catalog/WPI ratio of -1.40 per year for clothing and -2.14 per year for home furnishings. Rees's study differs from the approach taken in this chapter, in that he did not attempt to match catalog price indexes with WPI indexes on an item-for-item basis, but rather used catalog prices and expenditure survey weights to construct a completely new index that might be compared with the overall WPI for clothing and home furnishings. Because Rees made no attempt to compare identical items, his index might differ from the PPI due to a different selection of items and the earlier introduction of new items. In contrast, the drift in the catalog/PPI ratios recorded in this chapter relates to identical items, within the limits of feasibility in matching catalog products with detailed eight-digit PPI commodity classifications.

10.3.1 Advantages

The purpose of this book is to investigate the behavior of price indexes for durable goods compiled from data sources that are different than those used in compiling the official government price indexes for durable goods. Mail-order catalogs seem ideally suited for this purpose. The following discussion compares catalog price indexes with both of the official BLS price

15. This fact is reported by Rees (1961b, 80).

indexes, the CPI and PPI, although the quantitative results of this chapter are entirely based on comparisons of catalog indexes with corresponding PPI commodity indexes (CPI indexes for selected appliances were compared with catalog indexes for appliances in chap. 7).

Among the advantages of catalog price indexes are the following.

1. Most important, specifications and illustrations published in catalogs allow closer control for changes in quality than in the official price indexes. The continuity of item codes from one catalog to the next is often helpful in following a particular item, and there is usually a long list of specifications that can be checked to ensure that the models being compared are absolutely identical. In contrast, compilers of the PPI must trust the manufacturers who submit mail questionnaires to hold quality constant, and the relatively low frequency of product substitutions in the PPI suggests that specification changes may frequently go unreported (see below).[16] This advantage of catalog indexes needs to be qualified, of course, if the catalogs do not disclose a true change in quality of an item described as identical in two successive catalogs.

2. Leaving aside the small number of hedonic indexes developed from the catalog data, the specification methodology used to compare catalog items over time (discussed in more detail below) ensures that price comparisons are included only for items that are absolutely identical in every dimension reported in the catalog specification. In contrast, most BLS specifications are not as detailed as the printed catalog specifications, and, in contrast to the catalog indexes, both the CPI and the PPI make direct comparisons between nonidentical goods if both fall within the same specification.[17]

3. Related to the first two advantages is the fact that catalog price indexes can in principle be replicated by anyone with access to a library containing historical catalog volumes. In contrast, the submissions by manufacturers to the PPI are confidential, and there is no way that PPI commodity price indexes can be replicated by anyone except BLS employees. For historical periods twenty-five or thirty years ago, even BLS employees may not have access to the original manufacturers' submissions.[18]

16. An exception is the automobile, to which the BLS gives special attention. BLS representatives travel to Detroit to discuss quality changes with manufacturers and see not just illustrations, but the actual models of the cars involved.

17. This statement about the CPI comes from Rees (1961a, 141), who states, "The BLS makes direct comparisons between nonidentical goods if both fall within the same specification." Triplett (1971b, 186, table 6.1) quotes a study showing that, for nonfood items in the CPI in April 1966, more than half of all product substitutions were handled by direct comparison of prices of the old and new model, and well under 1 percent were handled by an "explicit size or quality adjustment." For the PPI, Early and Sinclair (1983, 111) state, that of the 455 cases for 1976 in which nonidentical items were compared in the PPI, 142 of the cases (31 percent) were handled by "direct comparisons," i.e., all the recorded price change was treated as a price change and none as a quality change. See pp. 84–89 above.

18. Nor would a BLS employee have any incentive to study the original manufacturers' submissions, since the PPI and CPI are never revised retrospectively. With the exception of an occasional research study using historical data (e.g., Triplett and McDonald 1977; and Early and

4. The selection of products and individual models sold in catalogs responds automatically to the needs of the marketplace. This has always been true, as in the comment, "space to items always having been allotted on the basis of sales" (Hendrickson 1979, 249). This gives catalog price indexes two inherent advantages over the CPI and PPI, at least prior to the introduction of improved methodology in the CPI in 1978 and in the PPI beginning in 1982. First, for products sold in a large number of models or varieties, "it seems reasonable to assume that the number of different detailed varieties in the catalog will be greatest where the volume of sales is greatest, so that we probably weight the major varieties of an item in rough proportion to their importance" (Rees 1961a, 141). There is no such assurance that product indexes are sales weighted across models within a product category in the pre-1978 CPI, which was based on an expenditure survey taken many years previously that did not reflect the current range of models on the market. This advantage of catalogs is even more true in contrast to the PPI, which prior to 1982 gave equal weight to each price reporter within individual commodity categories.

Second, products tend to be introduced into the catalogs soon after they become marketable, in contrast to the CPI and PPI, which often introduce new products many years after they become commercially important. In fact, given the expense of distributing catalogs, it is likely that the catalog firms wait longer to "take a chance" on new items than do normal retail shops.[19] In this sense, neither the catalog nor the BLS indexes are ideal, and both may be late in the introduction of new products, although in most cases the catalogs move faster than the BLS. This timing factor is one reason for preferring the *CR* indexes for appliances in chapter 7 to either the catalog or the BLS indexes; the first report in *CR* appeared before the earliest appearance in the Sears catalog in most cases, and well before the BLS indexes in every case where there was a difference *(CR* and the Sears catalog beat the CPI for room air conditioners by eleven years, although not the PPI; *CR* beat the PPI by fifteen years on under-counter dishwashers and by ten years on microwave ovens—these last two products are not included in my Sears sample).

Sinclair 1983, all the research effort at the BLS is oriented toward improving the construction of the indexes in the future rather than toward evaluating the behavior of the indexes in the past. This orientation helps explain why it was the BEA rather than the BLS that took the lead in developing the price indexes for computers discussed in chap. 6 above.

19. The fact that Sears, Roebuck followed the market even in its first twenty years is described in this interesting passage from Emmet and Jeuck (1950, 108–9): "The first appearance of any new item in a Sears catalogue had seldom marked the date when that item first became popular. It had simply marked the date when the item had established beyond peradventure that it was here to stay and the date when Sears, Roebuck was able to make satisfactory arrangements with sources for mass delivery of the item. . . . Yet, with due allowance for this time lag, the catalogue offerings of the company have remained one of the best yardsticks in most respects of the needs and wants of the people of this country during the period of Sears, Roebuck's existence. No item could long be in great demand without cropping up in the big book; and, by the same token, few items could hang on in the catalogue for any length of time after the public ceased to fancy them. As that public fancy expanded in scope, as America came of age, . . . the Sears catalogue kept pace, albeit a cautious pace indeed."

Further, for a given product, the selection of models available in catalogs is adjusted with each newly issued catalog to respond to changes in demand, automatically allowing weights on different model types to change (e.g., for refrigerator-freezers from "U-type" to "dual-zone" to cross top to side-by-side arrangements). In contrast, both the PPI and the CPI adhere to fixed specifications over a long period of time, which may lead to disproportionate weight for obsolete items. In discussing the wording on the PPI questionnaire below, I note that manufacturers are instructed to report changes in existing models but not the introduction of additional models. Thus, if an existing model, say an old U-type refrigerator, remains in production without changes, and a new cross-the-top model is introduced, the change is not reported spontaneously by the manufacturer but must be discovered by the BLS commodity specialist. As a result, the old model may be priced after sales have shifted to a new model.

The adherence by the BLS indexes to fixed specifications may also lead to a systematic choice of items that are lower in quality than the typical item actually being sold on the market, and may severely limit the coverage of the BLS indexes to a fraction of the different model types actually being sold on the market.[20] While the new methodology used in the CPI since 1978 and that phased in for the PPI in the early 1980s allow those indexes to respond more rapidly to changes in the marketplace, there have been no retrospective revisions, and, for this reason, these improvements have no bearing on comparisons of catalog indexes with either the CPI or the PPI before 1978 and 1982, respectively.

5. Prices printed in the catalogs are actual transaction prices. If retail and wholesale outlets that compete with catalog firms price items at varying discounts, catalog houses must adjust their published prices to remain competitive. Their prices should therefore be reasonably good proxies for those of their major competitors.

6. Since postage and shipping costs, credit charges, and taxes (except for federal excise taxes) are not included in the published catalog prices, the services provided with each item are held constant. This does not represent any advantage over the PPI, which measures prices at the manufacturers' (not wholesale) level. However, the CPI may reflect a changing mix of services. Although prices in different stores are not directly compared in the CPI, services in the same store may change over time (e.g., Marshall Field's, a full-service department store, eliminated free delivery service in the 1970s

20. As reported by Rees (1961a, 141–42), "It seems probable to us that the selection of specified-in-detail items for the CPI is often at too low a quality level for the index population, probably because the index population moved up to better qualities after the item was specified. In a number of cases we were unable to find any variety of an item in the catalogs of either house whose quality was as low as that specified by the BLS." Rees further reports (142) that rigid adherence to BLS specifications would require excluding a large fraction of the observations that can be collected from the catalog, in one case reducing the sample by a factor of ten.

under pressure from discount-store competition). Also, otherwise identical catalog and CPI indexes can differ, since the CPI includes state and local sales taxes.

Although there are numerous advantages to using mail-order catalogs as a source of data for price indexes, these should not be overstated. For instance, there is no presumption that the catalog price index for a given product in this study is based on more individual models than the PPI. A proliferation of different models and types was a characteristic of Rees's (1961a) study, which made breadth of model coverage a criterion for choosing products to be studied. Here, in contrast, the main criterion is to find as many catalog products as possible that can be compared to the specific PPI commodity indexes used to deflate PDE in the NIPA, and this leads me to develop product indexes with a wide range of model coverage, from one model to more than ten models per product category per year. Subsequently, I shall compare my model coverage with the number of PPI price observations per commodity index.

10.3.2 Disadvantages

The case against reliance on catalog price indexes takes two forms. First, there are clear disadvantages of relying on catalogs. Second, criticisms can be offered of the advantages listed above.

The most serious problem in the use of catalog prices is the possibility of a systematic difference in the secular growth rates of the same product sold by catalog and noncatalog outlets, due, for instance, to differential growth in the efficiency of catalog operations or changes in pricing policies. Regarding efficiency, there are different issues involved in comparing catalog prices with retail prices as recorded in the CPI and with producer prices as recorded in the PPI. For a comparison with the CPI, catalog prices include payment for warehouse and distribution services and would have a slower secular rate of increase than prices of retail competitors if the growth of efficiency in the provision of these services by catalog houses had been relatively rapid. It is hard to believe such a bias could be major, since innovations in warehouse technology are likely to have been adopted by noncatalog competitors. In fact, the bias appears to operate in the opposite direction. The secular rate of decline of prices for three major appliances in the Sears catalog appears to have been slower than for an average of all makes reported in *CR*, as documented above in chapter 7 for washing machines, refrigerators, and room air conditioners. In this chapter, seven new *CR* indexes are developed, and five of these seven also show the same pattern of a slower secular price increase than the equivalent catalog index (leaving aside outboard motors for 1971–75; see sec. 10.8 below). Further, the model-by-model prices recorded by *CR* indicate that Sears and Wards models for major appliances tended to be at the lower end of the price range in the early postwar period but drifted toward the middle of the price range over time. Such behavior is consistent

with the quotes in the historical section (10.2) above, indicating a shift in pricing strategy by Sears in the late 1960s and early 1970s. This evidence suggests the possibility that the downward drift of most Sears catalog indexes relative to comparable CPIs may understate the downward drift of a more representative range of "true" prices relative to the CPI.

These remarks on comparing catalog prices with components of the CPI are relevant for the study of appliances in chapter 7. However, in this chapter, all the comparisons are with the PPI. Here, note that warehouse and distribution services are included in the catalog price quotations but not in the PPI, which for the durable goods categories studied here collects virtually all its price quotations directly from manufacturers. There are numerous reasons why the implicit value-added deflator of the wholesaling and distribution component of the catalog price might rise at a different rate than the manufacturers' price of a given product, including differential improvements in efficiency, a differential component of automation and computerization, a differential share of purchased materials, and so on. All these factors caution us against treating the catalog price indexes themselves as necessarily representing a best estimate of the required "true" price index, and remind us that drift of the catalog indexes relative to the PPI can occur for numerous reasons, not just as the result of different procedures for controlling quality change.

The inclusion of wholesaling and distribution operations in the catalog prices may be an advantage rather than a disadvantage from the perspective of the PDE deflator in the NIPA. Many types of durable goods go through warehouse and distribution channels en route from manufacturer to the business firms that purchase durable goods. While large durable goods built to order (e.g., Boeing 747s) are delivered directly from the manufacturer to the final user, the smaller mass-produced durable goods studied in this chapter may often be sold by wholesalers or other distributive middlemen.

Another inherent problem in using catalog information is the need to match the dates on the catalog price quotations with the corresponding PPIs. Should the prices published in the spring-summer catalog be compared with the PPI for a single month in the spring, for an average of months in the spring and summer, or for some earlier period on the ground that decisions on prices in the spring-summer catalog are made in the preceding autumn? Below, I discuss my selection criterion and compare it to that of Rees (1961a). But, whatever month is selected for the PPI, this issue makes little or no difference for secular comparisons over decades or longer periods.

Some of the advantages of catalog price indexes discussed in the previous section have been called into question. First, the availability of explicit specifications, model numbers, and illustrations in catalogs does not necessarily constitute a unique advantage. Model numbers and illustrated brochures are available for some types of producer durables, and these may be used by BLS commodity specialists. Further, as recognized above, printed specifications and illustrations cannot reveal unreported changes in the quality of

catalog items. In fact, an extreme view might hold that a catalog price index has "no advantage at all" over the PPI in this regard.[21]

To evaluate this skeptical view, it is worth reviewing the source of price data for durable goods in the PPI, discussed previously in section 3.2 and 3.3. Close to 100 percent of price quotations for machinery and transportation equipment are based on reports submitted from producers by mail on a uniform questionnaire form.[22] Identification of quality changes and evaluation of their "value" are left entirely up to the initiative of the producers submitting the price reports, and there is no request on the printed questionnaire that producers routinely submit documentary evidence on the nature or value of changes, whether in the form of brochures, specification lists, or anything else.[23] There is simply a blank space with the instruction, "Commodity description (Please indicate all changes)," and, under the heading "changes," the label "date, nature and value of change."

While there is no documentation of the frequency with which BLS commodity specialists physically examine submitted printed evidence on specification changes, one suspects that such careful scrutiny was relatively rare for products other than automobiles, at least until recently. Section 3.2 cited evidence that virtually no explicit quality corrections were made for durable goods other than automobiles before 1965 and, even in that year, showed that the majority of changes in product specifications were handled by "direct comparison" of new and old models (i.e. by ignoring the quality change), and that virtually none of such changes were handled by explicit adjustments based on cost estimates. Further, as pointed out above, the wording of the questionnaire asks respondents to report changes in existing models but not the introduction of additional models. For this reason, the PPI may continue to price an old unchanged model after sales have shifted to a newly introduced model. Perhaps the best response to the extreme view that BLS commodity specialists regularly review printed specifications and illustrations comes from the BLS itself: "Firms are trusted to make accurate estimates of quality change. The BLS does not normally question their estimates.[24]

A sharp contrast can be drawn between the mail-order catalog price indexes, where all price comparisons are based on an examination of printed specifications and pictures, and the BLS procedures, which depend on the diligence of individual commodity specialists, and which have doubtless

21. "Thus, not only is the picture-specification 'advantage' over WPI prices no advantage at all, but the method of controlling for quality change that it implies is just as inadequate in your data as it is in the WPI" (letter to the author from Jack E. Triplett, 30 November 1977).

22. The "Ruggles report" is cited in the references under its official author, U.S. Executive Office of the President (1977). Data on price reports by type are provided in table I-4 and a sample of the BLS questionnaire, form BLS 47JA, dated January 1976, is included as exhibit I-1.

23. Again, autos are an exception. See n. 8 above.

24. Telephone conversation with Alvin Roark, a machinery specialist in the then WPI (now PPI), 12 July 1973.

varied over time. The Ruggles report noted the dependence of the BLS procedures on possibly dissimilar criteria of the individual specialists, in the context of the choice of individual commodities and particular reporters:

> The determination of both the commodity selection and the price reporter thus in large measure depends on the diligence of the commodity specialist, and the personal contacts which he can build up. Just as in most libraries the collection of books in various areas of specialization is a direct reflection of the scholars working in those areas, so also are the prices collected by the Bureau of Labor Statistics a reflection of the commodity specialists in different areas. [U.S. Executive Office of the President 1977, III-1]

Even as recently as 1976, out of 108,756 price observations, Early and Sinclair (1983) report that only 455 created the need to make a comparison between dissimilar items. As Griliches observed in his comment on their paper (144), "Either many true comparability problems are not reported or the PPI by design excludes most of the rapidly changing commodity areas from its purview. I assume that both are true." The low frequency of product substitutions reported by Early and Sinclair suggests that some specification changes may slip through without being reported on the questionnaires, possibly for the simple reason that reporters do not want to take the time to estimate the value of the changes, as requested. Below, we shall see that the frequency of model changes in the catalog data base is substantially more frequent than is implicit in the PPI.[25]

Another criticism of the preceding section on the advantages of catalog price indexes concerns reproducability, where we need to distinguish two issues. An unambiguous advantage of a catalog price index is that in principle it can be reproduced by anyone with access to the same catalogs. However, there is no guarantee that any such reproduction would inevitably yield an identical index, because subjective decisions must inevitably be made in situations where models change without an overlap model, or when only a subset of available information is used in order to economize on research resources. The methods used to develop the catalog indexes were, however, designed to minimize subjective decisions, since the actual data collection was carried out by a succession of research assistants. Subsequently, the price and quality of individual models are examined over long time intervals to see if the resulting catalog indexes "make sense," particularly when they record

25. The implied frequency of product substitutions for machinery cannot be extracted from the Early-Sinclair paper, which does not report the total number of price observations by industry. However, table IV-1 of the Ruggles report lists 409 "linked series" in 1974 for machinery (SIC 35 and 36) out of 31,441 monthly observations, which translates to 2,620 annual observations. Thus, just 15.6 percent of the 1974 machinery reports involved a product substitution, for an implied frequency of about one every 6.5 years. This figure rises to 22.2 percent when the replacement of discontinued series by new series is included, for an implied frequency of one product substitution per observation every 4.5 years.

a significantly different rate of price change from the closest comparable PPI commodity index.

10.3.3 A Balanced Assessment

Catalog price indexes are clearly no panacea to the age-old dilemma of adjusting durable goods deflators for quality change. Even if catalog prices are fully corrected for quality change, they may not accurately reflect the unobserved "true" quality-corrected price index for all suppliers, because of differences between catalog firms and all firms in the growth of efficiency or in the evolution of pricing policies. The comparison of catalog prices with individual PPI commodity indexes rests in part on a belief in the efficacy of economic competition in keeping catalog prices for a given narrowly defined product roughly in line with what is charged by other suppliers. Even so, the perfect functioning of competition would not prevent drift between the catalog and the PPI commodity indexes in a case where there is a major difference in the secular price trend of the warehousing and distribution services provided by catalog houses and the underlying prices of manufactured goods collected by the PPI, or where the selection of models or types of products sold through catalogs is different from that sold by other outlets, for example, if catalogs typically sell more items that are small or lightweight in order to minimize shipping costs. This difference could make catalog indexes behave differently than the PPI, although there is no presumption for the direction of the drift.

Further, catalog prices may not adequately control for all types of quality change. As noted above, some changes may be introduced without being explicitly acknowledged in the printed catalog descriptions. Further, catalog indexes based on the specification method are subject to all the criticisms directed toward the specification method as used in the PPI. Both types of specification index delete price change when new models are introduced and rely only on unchanged overlapping models; this could impart a downward bias if the timing of price increases typically coincides with the introduction of new models or an upward bias if improvements in performance-price ratios coincide with the introduction of new models, as clearly is the case for electronic computers (chap. 6) and appliances (chap. 7).

Consequently, there can be no blanket claim that the catalog indexes developed here are superior to the individual PPI commodity indexes with which they are compared. This chapter attempts to determine which types of commodities exhibit the greatest drift, and to examine possible generalizations that might explain such drift. For instance, a consistent tendency for technologically complex products to exhibit more of a downward drift of the catalog indexes relative to the PPI than simple products with constant quality characteristics might indicate that the catalog indexes do a better job of correcting for quality change. Also, a tendency for the drift to become smaller or disappear might support the view that quality-change procedures at the BLS have improved over the postwar years. A final question is whether the

drift is greater for products where the catalog indexes are based on a relatively large number of models.

10.4 Catalog Price Index Methodology

10.4.1 Criteria for Selection of Catalog Price Quotations

For any given investment of research resources, there is a trade-off between the number of different catalogs consulted for a given product and the number of separate products that can be included. Since Rees did not comment on any significant discrepancy between prices for a given item in the Sears, Roebuck and Montgomery Ward catalogs, an initial decision was made to limit this study only to Sears (the largest catalog house) and thus to allow time to copy data for additional products and models. This procedure is consistent with Rees's conclusion that too many outlets and insufficient varieties are priced in the official indexes.[26] Sears's catalog sales in the 1970s were triple Wards's and equal in fact to Wards's and the next three competitors combined. To allow time to copy prices for more products, prices were copied only from one catalog per year (spring-summer), even though two catalogs are published annually.[27] This decision has the disadvantage, of course, that the resulting indexes may understate the extent of flexibility in the catalog prices.[28]

Since the primary purpose of this study is a comparison of the catalog prices with PPI indexes for the same products and time periods, a decision was required on the choice of time periods for that comparison. The catalog data in this study were collected from the Chicago-area edition of the Sears, Roebuck spring-summer general catalog.[29] According to a Sears official, however, prices are set long in advance of catalog distribution. Since the catalogs go to press in October of the previous year, and final price decisions are made in October, the most closely comparable PPI indexes would be those for October of the year previous to the date printed on the Sears catalog.[30]

26. "This suggests that too large an amount of resources may be devoted to maintaining large outlet and area samples for some commodities, and that an improvement of the official indexes could be obtained within a fixed budget by reducing the size of outlet samples and increasing the size of samples of items or varieties. . . . if it is cheaper to sample several varieties in one outlet rather than one variety in several outlets (and we suspect that it sometimes is) this again suggests a possible gain from the reallocation of resources devoted to the price statistics programs" (Rees 1961a, 169).

27. The decision to limit indexes to annual observations was also made in order to maintain comparability with the new price indexes developed in other chapters of this book for which only annual observations are available. Few of my data sources allow measurement of intrayear price movements, except for the used car guides.

28. Sears also issues periodic special "sale" catalogs for a subset of items, again indicating that the catalog indexes compiled here understate the true extent of price flexibility.

29. In a very few instances, particular items were not listed in the spring-summer catalog, and prices were substituted from the previous fall-winter edition.

30. These dates for the pricing decision and printing of the catalogs were obtained from a 1973 conversation with J. Karp, an official of the Sears credit department at Chicago headquarters.

However, another interpretation is that the correct PPI is that of the following spring, contemporaneous with the period when the catalog prices are in effect, because of aspects of Sears's pricing strategy that are forward looking. For instance, in some past periods, Sears purchased futures in cotton and rubber to cover their anticipated sales of tires in the following six months. They also owned part of corporations supplying them with products, including appliances, particularly Whirlpool, and arranged to buy forward at a price established for conditions of the following six months.[31] While in some earlier stages of this research PPI prices in year t - 1 were compared with prices in the spring-summer Sears catalog for year t, in the end both were compared in year t. It might have been preferable to use monthly PPI indexes for, say, September or October of the previous year, but monthly data for eight-digit PPI commodity indexes were not as complete as for annual data. This choice to adopt contemporaneous pricing is made partly because it is probably more accurate, and also to simplify the presentation of the results in light of the many indexes in this book developed from sources other than the Sears catalog. While there may be a case for comparing the catalog indexes with a month prior to the beginning of the year when the catalog is in use, there is no such case in the many comparisons involving sources other than Sears discussed in other chapters (e.g., *CR*, unit values, used auto prices, and computer prices). Thus, all PPI series listed in the tables in this chapter and in Appendix B are reported for the same year as published by the BLS.

The selection of products and models is straightforward, except for the fact that products were selected in two stages. Of the sixty-eight unduplicated catalog products, fifty-eight were included in the original 1974 first draft of this study, and were originally collected for the period 1947–70. The point of departure was the list of PPI commodity indexes included in the NIPA index for PDE (listed in App. table A.1). Each such product was included if it was carried in the Sears catalog for most of the 1947–70 period. In cases where the PDE deflator is based on a four-digit or six-digit group index rather than an eight-digit commodity index, an attempt was made to locate Sears products that matched eight-digit commodity indexes within the relevant four-digit or six-digit group. Thus, some eight-digit PPI commodity indexes are used for comparison that are not included in the PDE deflator.

Catalog prices for the original fifty-eight products were gradually updated throughout the late 1970s and early 1980s, and then in the final data collection in 1984–85 an additional ten catalog products were added. The steps taken to develop the additional products were, first, to make a list of new producer

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Another report states that "most price decisions must be made eight months before the general books expire," and implies that the expiration date of the spring-summer catalog is normally 1 July, soon after the fall-winter books are mailed. This would date the price decision for the spring-summer catalog at 1 November of the previous year. See "Catalog Sales Thrive on Inflation," *Business Week*, 20 July 1974, 27.

31. On Sears's pricing policy, the use of futures contracts and forward thinking was stressed in a letter to me from Theodore W. Schultz, dated 17 December 1973.

durable products in the PPI since 1970, and then to check that the product was carried in the Sears catalog from 1970 to 1983 with a sufficient number of year-to-year model matches.

In general, all models listed in the catalog for a given product are included. An exception is made in the case of several products (e.g., auto batteries) where a very large number of closely similar models was listed in the catalog, and to save copying time only a subset was included in this study. Other exceptions were as follows:

1. PVC piping: all sizes of straight lengths of PVC piping were included;
2. Prefabricated metal buildings: the largest size of each building type was included;
3. Chain link fence: a combination of gates, posts, and fabric for various sizes of industrial fence was used;
4. Drill bits: only standard drill bits were included.

10.4.2 Implementation of the Specification Technique

For those products priced by the specification method, price comparisons for each pair of years are facilitated by Sears's policy of carrying several models in each product category. Changes in specifications usually affect only a subset of models in any one year, so for almost every product at least a few identical models are available for a price comparison between a pair of years. Because model changes occur at irregular intervals, the number of price comparisons of identical models for a given product may be on the order of, let us say, ten for a series of years and then collapse to two or three in a year of substantial model changes.

The detailed application of the specification methodology from the catalog price indexes in this study differs from that used by the BLS in the construction of PPI product indexes. For most products, the BLS specifications remain identical over a long period of years, and a "product substitution" is flagged only when the respondent's questionnaire indicates a change in some characteristic. As discussed above, only about one-fifth of the PPI price observations for machinery in 1974 required any substitution at all, and this fraction was even lower in the 1950s and 1960s. In contrast, each pair of years is treated separately in this study, and (with the exceptions noted above) the list of included models is allowed to change annually. Table 10.1 is a schematic representation of the methodology for a hypothetical product, with the models included in this study for each pair of years indicated by boxes.

The asterisks indicate models whose prices might be included in a hypothetical PPI index. Model D represents the type of model that remains in the PPI year after year, as implied by the low percentage of PPI product substitutions that appear to occur each year. The replacement of model A by model F indicates another characteristic of the PPI, that in between major revisions new models are linked into the index only when a respondent flags the disappearance of an old model. The Ruggles report (table IV-1) states, for

Table 10.1 Models Listed in Sears Catalog for a Hypothetical Product by Year

	Years					
	1	2	3	4	5	6
	A*	A*	A*			
	B	B				
	C	C	C			
	D*	D*	D*	D*	D*	D*
		E	E	E	E	
		F	F	F*	F*	F*
				G	G	G
				H	H	H
				I	I	I
						J
Total number of model comparisons included in this study		4	5	3	6	5
Total number of model comparisons included in hypothetical PPI		2	2	1	2	2

Note: Asterisks indicate models whose prices are included in hypothetical PPI index: boxes indicate models whose prices are included in hypothetical catalog index.

instance, that the number of new machinery series in 1974 was 175, almost exactly the same as the number of discontinued machinery series (176).

The advantages of the approach used in this study are the inclusion of extra models that appear and disappear between major PPI revisions (e.g., model E in table 10.1), and the more rapid inclusion of new models. Ideally, this approach should lead to the inclusion of more total models per product, as was true in Rees's (1961a) study. However, several products are included where only one or two models are available, in order to include in the study as many as possible of the PPI products used in the NIPA PDE deflator. Thus, there is no general presumption that the catalog index is based on more models per product category than the PPI. A question for subsequent study is whether the drift of the catalog indexes relative to the comparable PPI indexes is related to the number of catalog model observations per product. Once it was decided to include a catalog product, the procedure was to compare all identical models in every pair of adjacent years. For two models to be considered identical, and thus for their prices to be compared directly, it was necessary that all the following quality characteristics must match exactly: weight, accessories, capabilities, electrical use, dimensions, efficiency ratings, and all other listed characteristics. Identical catalog numbers do not ensure that two products are identical, and so the determining criterion for direct comparison is the exact match of characteristics, not an exact match of model numbers.

Nevertheless, the model numbers are very useful in quickly spotting changes in characteristics in the set of models available in two adjacent years.

Since no information is available on the relative volume of sales for the models of each product, an equal weight is applied to the price change of each model within a product category. Formally, the method used to calculate the price change (p_t) for each of the sixty-eight product categories was

$$p_t = (1/n)\sum_{i=1}^{n}(\log P_{it} - \log P_{i,t-1}), \tag{10.1}$$

where the index i refers to the n individual models within each product category. The price change for each pair of adjacent years (p_t) as calculated in (10.1) was cumulated into a price index in logs by simple addition, and then converted into a conventional price index by taking antilogs. While the use of equal weights for each model may introduce an element of misrepresentation into the indexes, the mix of models that Sears carries for a given product responds to changes in the relative volume of sales. Examples of this response are the shifts from manual to electric adding machines, galvanized to glass-lined water heaters, seven- or 8-inch to 9- or 10-inch power saws, manual-prime to self-priming centrifugal pumps, and so on.

The indexes created from this study have the advantage that they are open to public inspection and can be reproduced by anyone with access to a library that holds back issues of the Sears catalog. To facilitate any such attempt to reproduce our indexes, the Appendix to chapter 10 provides exact model numbers and page numbers in the Sears catalog for each product in the final year covered by the index. The same table lists the average number of models priced per year, the total number of models priced, and the number of quality attributes held constant. In addition, for many products, the text of this chapter describes the characteristics and prices of models available at the beginning and end of the sample period as a cross-check that the secular rates of price change of the new catalog indexes are reasonable.

As stated above, the catalog indexes are subject to the same problem as any specification index, including those compiled by the BLS. Any price change that occurs on the introduction of a new model is deleted, as in the changeover in table 10.1 in year 4 from old models A and C to the new models G, H, and I. If manufacturers typically postpone price increases during the life of a model for the occasion of a new model introduction, then deletion causes the exclusion of major price changes and leads to a downward secular bias in price indexes. If, on the other hand, quality improvements in new models tend to be introduced with no change in price, the deletion technique causes the exclusion of reductions in "true price" and leads to an upward secular bias.

The hedonic technique provides a solution, where sufficient data are available, since all available models can be included, and the hedonic

regression coefficients can be used to establish a value for changes in quality between old and new models of the same product. In this study, hedonic regressions are performed for those products with relatively frequent quality changes. In the extreme case of refrigerators, models tend to be changed completely every year, with virtually no overlap of identical models. No hedonic regressions were performed for those products where insufficient models were listed to provide a sample of at least ten for each pair of years (i.e., at least five in any single year) or for some products with many listed models where quality appeared to remain identical over a long series of years (e.g., the cases of automobile batteries and electric motors). The individual catalog product regressions (for gas hot water heaters, outboard motors, automatic washing machines, refrigerators, and room air conditioners) are described in chapter 7 for appliances and later in this chapter for the other two products.

10.4.3 Weighting Issues and Presentation of Results

The primary discussion of weighting issues in this book is contained in chapter 12, which treats all the issues involved in converting the evidence developed in chapters 4–11 into an alternative version of the PDE deflator, as well as the deflator for consumer expenditures on durable goods. In this chapter, the primary emphasis is on the development of individual catalog/PPI price ratios for as many products as possible, and the discussion is primarily devoted to an examination of the ratios on an individual basis. The overall conclusions of the chapter are summarized by presenting an aggregate of the catalog and PPI indexes, as well as the catalog/PPI ratio, based on both an unweighted and a weighted average, where the latter uses the PDE weights from chapter 12.

The following text sections describe the individual product indexes within each industry group and vary considerably in length and amount of detail, depending on the complexity of the products within each group and the availability, in a few cases, of additional evidence from *CR*. To avoid a multiplicity of tables for the various industry groups and to allow a compact tabular presentation, the supporting tables each cover all catalog products and are grouped together at the end of the chapter for easy reference. Each text section begins by describing the selection of PPI commodity indexes used by the BEA to deflate PDE and indicates the subset of these indexes for which corresponding Sears products are available. The list of the PPIs used in the PDE deflator was obtained from the BEA in 1977 and refers to the PPI commodity indexes available and in use at that time.[32] This complete list, together with the 1967 weight applied to each PPI index, is presented in

32. There is an equivalent list of PPIs in the PDE deflator in 1986, after the late 1985 benchmark revision. There are a few minor additions and subtractions, but the overall list is basically the same. The 1986 list provided by the BEA is much less useful than the one obtained

Appendix A at the end of the book. Table 10.8 below lists each catalog product and the PPI commodity index and (and PPI code number) with which it is compared. At this stage, each section comments on any problems in "matching" the specifications of the catalog and PPI products, as might occur, for instance, if a smaller variety sold by the catalog for home use were compared with a larger-sized PPI product intended for industrial use.

Then each section proceeds to discuss the individual catalog products, with reference to tables at the end of the chapter. The Appendix to this chapter contains details about each Sears product: years covered, average models per year, total models priced, and number of quality attributes held constant. For the final year covered, it also lists the price range of models included, model numbers, and the page number in the relevant catalog. The drift of the catalog/PPI ratios for each product is listed for the full period and three subintervals in table 10.9 below by product category and in table 10.10 below by the size of the drift. For almost all products where the secular downward drift in the ratio of the catalog price index to the comparable PPI index is relatively large, it has been possible to carry out a comparison of "closely similar" models in order to assess the evolution of quality-adjusted prices over long periods of time. Usually the criterion for carrying out such a comparison is that the downdrift averages out to -2.0 percent or more over the postwar period as a whole. This growth rate is sufficient to imply a 1947 Sears/PPI index ratio of 206 on a base of $1983 = 100$.

For further reference, additional tables relevant for the book as a whole, not just this chapter, are contained in appendixes in the back of the book. A complete listing of PPIs used in the PDE deflator is presented as Appendix A. The detailed annual values of all the catalog and PPI commodity indexes covered in this chapter, together with the indexes developed in other chapters, are presented in Appendix tables B.1–B.16.

10.5 Office, Computing, and Accounting Machinery

In its 1986 benchmark revision of the NIPA, the BEA reorganized the listing of the industry subgroups of PDE and promoted the office, computing, and accounting machinery (OCAM) component to the first-listed category, thus reflecting its rapidly growing importance. By far the most important product within OCAM is the electronic computer and its associated peripherals, and these were subjected to a full-scale study in chapter 6. The other PPI commodity indexes used in the PDE deflator for noncomputer OCAM are two eight-digit commodity indexes for electric and manual typewriters, and

in 1977, because the 1986 list lacks the PPI code numbers of the specific PPI indexes used and contains no information on what was done to deal with the historical disappearance of specific PPI indexes and the initiation of new indexes.

two six-digit group indexes for calculating and accounting machines. Four related products were sold in the Sears catalog over most or all of the postwar period—ten-key adding machines, cash registers, manual typewriters (both standard and portable), and electric portable typewriters—and a fifth product, the electronic calculator, that was carried in the catalog beginning in 1970.

There are several comparability problems in matching the catalog indexes for these products to individual PPIs. These are evident in table 10.8, which lists the precise PPI commodity indexes matched with each Sears catalog product. For ten-key adding machines, there is an exact match only for 1961–75. Before that date, the PPI did not price ten-key machines, and it was necessary to substitute the PPI for full-keyboard adding machines (which are much inferior because they do not allow for touch adding and have long been obsolete). After 1975, the eight-digit PPI index for ten-key machines was discontinued, requiring a switch to the six-digit PPI index for "computing and related machines." The PPI for cash registers begins only in 1961, and before that date the same six-digit group PPI was substituted. The Sears indexes for manual and electric typewriters are matched with PPI eight-digit indexes for manual and electric typewriters, with the PPI for manual portable typewriters used throughout and with a switch from the PPI for "electric typewriters" to that for "portable electric typewriters" when the latter index commences in 1969. For this product, then, we have a very close match, since Sears sold primarily portable manuals (some standards before 1965) and only portable electrics. Finally, the Sears and PPI indexes for electronic calculators are matched only through 1980, after which the PPI was not published, and the six-digit group index was substituted.

10.5.1 Case Study: Ten-Key Adding Machines

Of the first four products, the most rapid downward drift of the catalog/PPI price ratio is for the ten-key adding machine, and a brief case study for this product demonstrates a few of the details of the method. As shown in table 10.8, the annual rate of drift for ten-key adding machines during 1947–60 is −5.3 percent and for 1960–73 is −2.5 percent. The drift is a similar −2.8 percent per annum for 1973–83. The PPI rises slightly from 104 in 1948 to 109 in 1970, while the catalog index declines from 353 in 1954 to 100 in 1970 (on a base 1972 = 100). One possible source of the drift is the oft-cited lag in the introduction of new products in the PPI. There was no separate index for ten-key adding machines in the PPI before January 1960, and prior to that date the PPI (and NIPA) represents all electric adding machines by an index for the obsolete full-keyboard models, which accounted for only 24 percent of sales in 1960, compared to 76 percent for the ten-key models.[33] The catalog index

33. The equivalent sales ratio in 1953 was fifty-four to forty-six in favor of full-keyboard models. The source for these figures on the value of production is *Current Industrial Reports*, the basic source of the unit value data discussed in chap. 11.

is available over the full 1947–83 period. Among the quality characteristics held constant are the ability to multiply and subtract directly, number of columns listed, whether electric or manual, presence of clear key, repeat key, nonadd key, and metal casing. Although no single model can be traced through the entire thirty-seven years, it is possible to find identical models in each pair of adjacent years and to construct a chain index.

The decline in the catalog index by a factor of four is supported by a comparison of nearly identical models. A ten-key electric adding machine with seven digits of display was listed for $285.69 in 1953 and $64.44 in 1970. The only appreciable difference between the two machines was the replacement of metal by plastic casing, which the 1959–60 comparison indicates accounted for no more than $29 of the total $221 drop in price. Although the failure of the PPI to register a price decline before 1960 can be attributed to the pricing of an obsolete model, the behavior of the PPI between 1960 and 1970 is more puzzling. The PPI fell from 1960 to 1970 by just 20 percent, while the catalog index fell by 58 percent. Yet we can find an identical Sears model sold in the two years that registers a decline of 46 percent.[34] Supporting the view that the catalog index is closer than the PPI to the true price of noncatalog suppliers, a unit-value index for ten-key adding machines has a 1960 index value of 189 on a base 1970 = 100.[35]

Over the longer period 1947–83, the linked PPI used here for ten-key adding machines declines only from 104 to 81 on a 1972 base. Perhaps for no other comparison in this chapter is the evidence against the PPI and in favor of the catalog index as compelling. Opening the 1947 catalog, we find listed a ten-key *manual* adding machine listing nine columns for $108.65.[36] Yet for only $67.99 a 1983 customer could purchase a full-fledged printing electronic calculator, offering not just addition but subtraction, multiplication, division, a four-function memory, percentage and square-root keys, a gross margin key, and four decimal settings. In between, in 1970, a ten-key electronic adding machine with automatic multiplication, but no division and no memory, sold for $177.95.

For the years when the PPI for cash registers is available, 1961–76, there is a negative drift in the catalog/PPI ratio of −4.1 percent per year. The drift may reflect in part the relatively late shift (1974) of the PPI from the obsolete electromechanical cash register to the more modern electronic variety. The catalog-PPI comparison for this product is an example of an inexact match due to the difference in varieties sold in the catalog and priced by the PPI. The most expensive Sears cash register sold for only $260 in 1970, much less than

34. The 1960 model sold for $119.95 and the 1970 model for $64.44.

35. This unit-value index was created as part of an earlier unpublished study. The methodology is discussed in chap. 11 of this volume, which reports an updated subset of indexes from that earlier study and plots the unit-value index for ten-key adding machines as fig. 11.5.

36. See spring 1947, 565. The only other notable listed feature is "auto ribbon reverse." There is no mention of the facility to list a debit balance or the availability of a two-color ribbon.

the $4,000 that was a typical price for the typical large electromechanical variety of that era. Below, I discuss some of the common technical improvements shared by cash registers and typewriters in recent years.

10.5.2 Case Study: Typewriters as Viewed through Forty Years of *CR*

For manual typewriters, the catalog/PPI ratio (summarized in table 10.9 and App. table B.1) drifts downward at an annual rate of −2.1 percent between 1948 and 1973 but is flat thereafter. The downdrift of the ratio of electric typewriters is at an annual rate of −4.4 percent between 1958 and 1973 and −1.1 percent thereafter. Thus, the catalog index, like the other indexes in this industry group for calculators and cash registers, yields a downdrift relative to the PPI.

We have already in chapter 7 made extensive use of *CR* as a source for the development of price indexes for appliances, and there we concluded that *CR* is superior to the Sears catalog as a source because of both its wide range of brands covered and its provision of qualitative evaluations of quality change. All the price indexes based on *CR* data in chapter 7 uniformly exhibit a downdrift relative not just to the CPI and PPI, but also to the equivalent Sears catalog index. This section develops a *CR* index for electric typewriters that agrees closely with the Sears index prior to 1979 but declines much faster than the Sears index after 1979. In contrast, the *CR* index for manual typewriters declines more slowly than the catalog index between 1957 and 1972.

The *CR* matched model index is computed by linking the reported prices in successive *CR* articles on portable typewriters. The method is exactly that followed in chapter 7 on appliances: for each chronological pair of *CR* articles, the models listed are reduced to a subset that has roughly the same quality characteristics. For the next pair of *CR* articles, different models may be compared to hold quality constant, since for typewriters, as for many products, quality is steadily upgraded. For instance, the 1968-vintage electric typewriters compared with the earliest 1957 model have manual return, but those compared with the 1977 models are limited to those with power return.

The distinction between "rough matching" and "exact matching" of models is helpful in gaining insight into the differences that emerge between the catalog and the *CR* indexes. It is impossible to prevent a gradual improvement in quality across vintages in the *CR* indexes, since the reports are published with a gap of several years, over which one model is typically replaced by another with an upgraded mix of features. Because the catalog indexes are developed year by year, in contrast, it is possible to obtain exact matches. Specific examples are provided below to illustrate how this process works in the case of typewriters, and how the radical innovations introduced with electronic typewriters have reversed the relation between the catalog and the *CR* indexes.

The right-hand column of table 10.2 lists the quality dimensions where improvements occur in *CR* across models whose prices are compared directly.

Table 10.2 **Comparisons of "Closely Similar" Model Typewriters from *Consumer Reports*, 1948–87**

	Years (1)	Number of Models (2)	Average Price (3)	Price Change (4)	Description of Models Compared (5)
Manual portables:					
1.	1948	4	91.33	30.5	"Convenient" margin-setting device, flexible
	–1957	10	123.95		tabulator, adjustable paper guide, "heavyweight" (16–23 pounds), 9½-inch platen, no horizontal half spacing. 1957 models same as 1948, except that most 1957 models have touch control, 2-color and stencil selection.
2.	1957	10	123.95	−8.7	Same as above, except most 1960 models
	–1960	13	113.61		have "convenient line adjustment," erasure plate, paper support, and most permit horizontal and vertical half spacing.
3.	1960	13	113.61	−1.8	Same as above, except some 1966 models
	–1966	9	111.53		have two removable keys. One has 19 type styles.
4.	1966	9	111.53	−5.0	Same as above. 1972 average price excludes
	–1972	9	105.90		Canadian models. Most models have typing pressure control. Every model can use two-color ribbon.
5.	1972	9	105.90	25.9	Excludes models with page-end indicator,
	–1979	3	133.33		jammed-type key, ribbon cartridge, repeat-space feature.
Electric portables (typebar):					
6.	1957	1	209.50	−31.5	Manual carriage return, manual backspace,
	–1968	5	143.57		no horizontal or vertical half spacing, 9½-inch platen (three 1968 models have one changeable type key, one has vertical half space).
7.	1968	1	209.50	18.5	Power carriage return and backspace,
	–1977	4	248.33		horizontal half space, 11.7–12.8-inch platen. Excludes models with automatic vertical spacing or index key, extra repeat keys, page-end indicator.
8.	1977	1	255.00	15.7	Only models with spool ribbon, adjustable
	–1982	1	295.00		tab, no half spacing, no page-end indicator. 1982 model has built-in cover-up ribbon.
9.	1982	7	337.29	−20.8	All models have adjustable tabs and
	–1984	2	267.00		self-correction but lack automatic repeat return or index key. Excludes machines weighing more than 30 pounds.
Electronic portables:					
10.	1982	4	600.00	−18.1	All models have daisy-wheel element and are
	–1984	7	491.28		self-correcting. All 1984 models have a memory of between 10 and 20 characters, while *CR* makes no mention of any memory on 1982 models.

Table 10.2 (continued)

	Years (1)	Number of Models (2)	Average Price (3)	Price Change (4)	Description of Models Compared (5)
11.	1984	4	572.50	−62.3	All models are of "medium" size and have daisy-wheel element and full-line memory capability for correction but no further text memory. All models lack visual display and spell checker. Some 1987 models have the following features not mentioned in 1984: variable pitch, word correct, line-by-line mode. Three 1987 models lack automatic underlining.
	−1987	3	214.00		

Source: Consumer Reports, November issues of the following years: 1948, 1957, 1960, 1966, 1968, 1972, 1977, 1979, 1984, 1987.

The most difficult comparison is for electric typewriters between 1978 and 1982, since no models in the earlier year but all models in the later year have some form of self-correction. To make any comparison at all over this period, it is necessary to narrow the many models listed in each report down to a single model in each year that represented the closest possible comparison of quality, and yet the otherwise identical 1982 model offered a built-in correction ribbon, while the 1978 model did not.

One emerges from these comparisons with the impression of a great acceleration in the pace of quality change in the 1970s and particularly in the 1980s. Between the late 1940s and the 1970s, quality improvements in manual typewriters were relatively minor, whereas in the case of electric typewriters many new convenience features became available, but at a substantial cost, so that the average price of machines listed increased much more than the matched model index. These quality changes pale beside the dramatic improvements in electronic machines, which exhibit a price decline over 1982–87 at an annual rate of 24 percent, comparable to the price decline for computer processors over this period. Electronic typewriters were first featured by *CR* in 1982 and were rated as greatly superior to, albeit much more expensive than, the electric "typebar" models that then dominated sales. These early electronic models were relatively crude by later standards, lacking memory capability or visual display, much less such advanced computer-like features as spell checkers. By 1987, each leading brand name sold a product "line," with numerous models available in a whole hierarchy of quality characteristics; the bottom-of-the-line models selling in 1987 for about $225 had numerous features that were unavailable on the 1982 models selling for $600. Fortunately, this gap is bridged by a 1984 report that allows the comparison of almost identical models.

The *CR* pairwise comparisons are linked together into a price index in table 10.3. In addition to showing a much faster decline than the PPI over 1982–87

Table 10.3 **Alternative Price Indexes for Portable Typewriters, Selected Years, 1972 = 100**

	Manual			Electric/Electronic			Average		
	Sears (1)	*CR* (2)	PPI (3)	Sears (4)	*CR* (5)	PPI (6)	Sears (7)	*CR* (8)	PPI (9)
1948	121	86	69	. . .	. . .	63	117	93	66
1957	147	117	101	. . .	136	85	142	127	93
1960	139	107	116	129	125	89	134	116	103
1966	116	105	107	99	106	96	108	106	102
1968	110	103	106	96	93	99	103	98	103
1972	100	100	100	100	100	100	100	100	100
1977	125	118	126	122	110	123	124	114	125
1979	135	126	133	123	120	140	129	123	137
1982	150	. . .	154	145	130	142	148	133	148
1984	. . .	. . .	. . .	146	106	131	149	108	137
1987	. . .	. . .	. . .	74	57	132	76	58	138

Sources: Sears and PPI, 1947–83, see App. table B.1. No PPI for electric portables or even for typewriters is published after 1984. PPI is extended for 1984–87 using 11-93-02, "typewriters, word processors, and parts." *CR* index from table 10.2. Index for average in cols. 7–9 is computed by applying equal weights to the manual and electric indexes.

(with annual rates of −24.3 percent vs. −1.5 percent), the *CR* index exhibits a substantial drift over 1957–68 (showing an annual decline of −2.4 percent vs. an increase of 1.1 percent for the PPI). The major disagreements between *CR* and Sears are for portable typewriters during the period 1960–72 and for electric and electronic typewriters after 1979.

Regarding the first period, the Sears index exhibits a decline of 28 percent during 1960–72, while the *CR* index declines by only 6 percent. To choose between the indexes, we can examine the characteristics of individual models. In 1957, Sears sold a 9.5-inch platen model with a full tabulator for $86.50, whereas in 1972 for 20 percent less ($68.99) a model of the same size and weight was available with several extra features, including buttons to set the tabs on the keyboard instead of reaching behind the machine, and both horizontal and vertical half spacing. For $88.99 in 1972, one could buy from Sears a heavier machine with a 12.6-inch platen offering horizontal and vertical half spacing, platen release, and a key to clear jams, all of which were unavailable on the 1957 machine. The slower decline of the *CR* index is mainly due to the failure to control for all the extra features that were added over time, but also may be partly due to shifts in the mix of relatively high-priced and low-priced models.

In the 1980s, the electronic revolution led to a drastic decline in the prices of constant-quality machines. Sears sold its first electronic model in 1983 and its last nonelectronic electric model in 1986. By early 1986, electronic typewriters accounted for virtually all business typewriter sales and more than half the 2.6 million typewriters sold annually in the United States. One of the major factors accounting for the decline in price of electronic models was an order-of-magnitude reduction in the number of moving parts, from 4,000 to

700.[37] In dropping conventional models, Sears reflected the verdict of the marketplace as succinctly summed up by *CR* (November 1987, 683): "The manual typewriter and the old-fashioned electric typewriter—the kind that's basically a manual typewriter with a power assist—are moribund products, with a slimmer and slimmer slice of the market each year. In their place: the electronic typewriter."

The reason for the much slower decline in the Sears index than in the *CR* index is clear: in the Sears catalog, the turnover of electronic models was so rapid between 1983 and 1986 that the adjacent-year Sears comparisons are largely based on obsolete electric models that then subsequently disappear from the catalog in the following year. Because of rapid model turnover, there are few adjacent-year comparisons of electronic models available, at least if we adhere to the rigid criterion that catalog models must be absolutely identical in all listed characteristics. However, if we apply to the catalog the same criterion as to *CR*, that models be "roughly" similar, we can compare models that are excluded from the catalog index. For instance, a 1983 electronic model selling for $544.99 can be compared to a 1987 model selling for $197.99.[38] A catalog index for electric and electronic typewriters that includes nine additional "roughly similar" model comparisons over the 1977–87 decade has a 1987 index number (1972 = 100) of fifty-seven, which is identical to the 1987 *CR* index number and can be contrasted with seventy-four for the basic catalog index displayed in table 10.3.

10.5.3 Electronic Calculators and Conclusions Regarding Office Machinery

Of all the products in this category, that which shows the largest rate of drift is the electronic calculator. The PPI for an electronic calculator was available only between December 1969 and April 1981 and, over that time interval, declined in price only from 115 to 41 (1972 = 100).[39] In contrast, the catalog index for an electronic calculator declined from 329 in 1970 to 24 in 1983. Once again, though, it is possible to find evidence in *CR* that the Sears index declines too slowly. Over the period 1973–82, the Sears index declines from 100 to 24 (1972 = 100), for an annual rate of change of −15.9. *CR* published reports on hand-held electronic calculators in 1973, 1975, and 1983 that yield an annual rate of price change of −27.1 percent, and even this takes no

37. Facts in these two sentences come from "Smith-Corona Is Typing in Black Ink Again," *Business Week*, 9 June 1986, 70.

38. Both have full-line memory, a vertical index key, and automatic centering. The 1987 machine lacks automatic underscoring available on the 1983 machine, but the 1987 machine has an extra feature called "Word Correct." *CR* (November 1987, 689) reports paying just $165 for the 1987 model 53002, recorded in my catalog index at its list price of $198 (both prices plus shipping).

39. All Sears observations are for nonprinting electronic calculators. Unfortunately, the PPI for nonprinting calculators, introduced in December 1969, was discontinued in 1976, requiring the substitution of the PPI for printing electronic calculators after that date. The latter index was subsequently discontinued, requiring the substitution of the six-digit group index for calculating and accounting machinery after 1980.

account of the improvement in quality that occurred when the replacement of LED by LCD displays eliminated the need for frequent battery recharging.[40]

Furthermore, even these dramatic changes understate the decline in price that occurred when the rotary electric calculator was replaced by the earliest electronic calculators in 1968–70. Instead of treating the initial price change from roughly $1,000 for the rotary electric model to roughly $250 for the earliest electronic models as a price decline, the PPI staff linked the two indexes, that is, the price change in the transition between the old and the new types of calculators was ignored. Leaving aside entirely the ability of modern electronic calculators to do scientific calculations, to use one or more electronic memories, and to perform calculations instantly (in contrast to the need to wait for the "clunk-clunk" calculations of the rotary electric models), and to be completely portable, the price of bare-bones nonprinting machine capable of performing multiplication and division has fallen since 1968 by roughly a factor of 100, from $1,000 to $10. Because Sears did not sell four-function calculators before 1970, much of this drastic decline in price is excluded from the aggregate PDE index developed in chapter 12.

Overall, a sample selection bias causes the catalog indexes for the noncomputer component of the OCAM category greatly to understate the error in the PPI. The improvement in performance made possible since 1970 by electronics is not adequately captured by the catalog indexes, because Sears did not sell full-sized electronic cash registers or typewriters, and hence these are not included here. In 1986, one could purchase a modern IBM office electric with automatic correction for about $600 or for $1,000 one with multipage memory and a host of automatic features. An equivalent IBM memory typewriter in 1978 cost $5,500, was much larger, heavier, more difficult to use, and lacked many features available on the 1986 machine.[41] A key aspect of unmeasured quality improvement in this section concerns reliability: the electronic revolution reduced the number of moving parts on an IBM Selectric by a factor of ten and increased reliability by a factor of ten. An IBM executive recently stated that "with these new approaches, based on our statistics, we have achieved near lifetime performance. That is a significant quality jump."[42] Similarly, there has been a ten-fold improvement in the frequency-of-repair record of Xerox photocopying machines.[43] Overall, this detailed study of the industry groups provides evidence that the specification

40. In the 1973 report, the average price of nine models is $108.67. All have eight digits, a decimal point, a constant K function, and no memory. In the 1975 report, the average price of three models is $46.66. All have eight-digit red LED displays. Only models lacking independent memories are included; all included models have "totalizing memory," absent in 1973. In the 1982 report, the average price of the two models with no or limited memory was $9.46.

41. Prices quoted are both IBM machines purchased by the business office of the Econometric Society at Northwestern University.

42. "For Better Products, Use Fewer Parts," *New York Times,* 26 June 1988, Sunday Financial sec., 2.

43. Photocopying machines are a separate category of PDE and are not covered directly by alternative price information in this book. However, App. C uses the average of the alternative price information for noncomputer office machines as a proxy for the missing alternative price of

method, by pricing only identical models, may miss quality improvements that are introduced on new models that provide additional features at the same or a reduced price.

10.6 Communication Equipment

Fully 96 percent of the weight attributed to the communication equipment category of PDE is allocated to telephone transmission and switching equipment. Several alternative indexes for such equipment were examined in chapter 9. The small remaining weight is allocated to home electronic equipment. I have developed two catalog indexes for comparison with the PPI, a matched model index of television sets already discussed above in section 7.9, and a similar matched model index for radio sets introduced here.

The catalog index for radio sets is based on an average of 3.3 models per year for the full period 1947–83. The eight-digit PPI commodity index for table radios is published only during 1953–72 and is supplemented before 1953 and after 1972 with appropriate PPI group indexes for radio receivers. Both the catalog and the PPI indexes for radios decline on average over the postwar period; the annual rate of price change is −1.9 percent for the catalog index and −1.4 percent for the PPI. The rate of drift of the catalog/PPI price ratio is a relatively small 0.2 percent per annum 1947–60, −0.7 percent per annum 1960–73, and −1.1 percent per annum 1973–83.

It is not surprising to discover that no comparison of closely similar models in 1947 and 1983 is possible for radio receivers, since quality characteristics changed so much between those dates. However, there is substantial evidence to support the catalog index, which falls by 49 percent over that time interval, implying that a radio priced at $30 in 1983 would have cost $60 in 1947. First, consider this comparison of 1947 and 1983 radio sets. In the 1947 catalog, we find for $25.50 an AM-only table radio with a plastic case, a four-inch speaker, and slide-rule tuning. In 1983, one could purchase for $29.95 a clock radio with not just AM but also FM, a three-inch speaker, solid-state chassis, slide-rule tuning, tone control, AFC, and a wood-grained vinyl overlay on the plastic case.

For the first half of the postwar period, it is possible to gain further insight on radio prices from *CR*. The price of a five-tube radio with a four-inch speaker declined from an average of $18.20 for thirty-one models in 1949 to $12.98 for fourteen models in 1966, or a decline of 33.8 percent as compared to a decline of 32 percent for the Sears catalog index. However, the *CR* comparison significantly understates the "true" decline in price for several reasons:

1. List prices are published in both years, but the 1966 report states that "discounts are generally available," whereas the 1949 report makes no mention of discounts (this is not a defect of the catalog index).

photocopying equipment, and for this reason the improving repair record is relevant. For anecdotal evidence on improving repair records, see chap. 12, n. 8.

2. Ten of the thirty-one models in 1949 were rated "not acceptable" because of "poor speech reproduction," and four more were so rated because of "short circuit hazard." In 1966, only one model out of fourteen was rated not acceptable, in that case because of a shock hazard.
3. Of the seventeen acceptable 1949 models, eight were rated "poor" or "poor-to-fair" in music reproduction, whereas only one 1966 model was rated "poor-to-fair."
4. Eleven of the seventeen acceptable models in 1949 were rated "poor" in interference rejection, and two more were rated "very poor." In 1966, no model rated below "fair" in this characteristic.
5. Unfortunately, the ratings do not directly compare models of different vintages. However, the qualitative descriptions of quality have a distinctly different tone in the 1949 and 1966 reports. In the earlier year, the ratings include the following comments: "music somewhat distorted," "objectionable hum," "an almost total lack of sibilants in speech reproduction."[44] The 1966 report states, "Our test results showed that an inexpensive AM radio can be of reasonably good quality. In fact, it is our opinion that many of the relatively low-priced sets are good enough to satisfy most listeners."

Unfortunately, these differences in quality cannot be quantified, because there were no models available in 1949, even at the high end of the price range, that provided all the advantages of inexpensive 1966 models. This comparison stands as evidence that the Sears indexes may understate the secular upward drift in the PPI. A similar tendency is exhibited by *CR* ratings of AM-only portable radios. At first glance, the decline in portable radio prices appears smaller than that of the Sears table radio index, with respective 1950–64 declines of 5 and 13 percent. But during this period, a revolution in operating efficiency occurred. The average battery cost per hour declined from $0.0764 to $0.01, which at a listening rate of one hour per day for three years would yield a saving of $72.70. This, when added to the 1950 price, implies an "adjusted" 1950–64 price decline of 67 percent. This too is an understatement of quality improvement, since fully half the 1950 models were rated "not acceptable" because of shock hazards or "very weak sound even when tuned to nearby stations."[45]

10.7 Fabricated Metal Products

The NIPA PDE deflator for the "fabricated metal products" category is based on fourteen different PPI indexes for barrels, steam and hot water

44. This comparison is based on *CR* (November 1949, 515–16; July 1966, 351). All models with special features are excluded, e.g., those with wood cabinets, short-wave tuners, clocks, and three-gang tuners in 1949, and all transistorized models in 1966.

45. These comparisons are based on *CR* (November 1950, 481–84; November 1964, 550–53). Since the 1964 reports are confined to medium-sized models, those identified as "small" in the 1950 report are excluded from the price comparison.

equipment, storage tanks, valves, and office safes. Sears catalog data have been gathered for hot water heaters, water storage tanks, brass gate valves, steel safes, and several additional products that seem to fall naturally in this category: warm air furnaces, prefabricated metal buildings, chain link fencing, and PVC (plastic) plumbing pipe. While the last listed is not, of course, made of metal, its inclusion allows us to make a modest allowance for the possibility of substituting plastic for metal that has occurred during the postwar period. All these catalog indexes are compiled by the specification technique, with the single exception of gas hot water heaters, where the hedonic technique is used. There are only minor comparability problems in associating each catalog index with a PPI eight-digit commodity index. The brass gate valve prices are generally for half- or three-quarter-inch models, while the PPI specification is for one inch. The PPI for PVC piping begins four years later than my catalog index, and I have substituted a PPI index for copper pipe to cover this interval. Otherwise, the only noncomparability problems may be those of size. Sears probably sells a smaller size of some of these products than is priced by the PPI, particularly in the case of water storage tanks.

Overall, the drift of the indexes in this industry group is smaller than in the case of office machinery. As shown in table 10.9, only one of the ten catalog indexes exhibit an annual rate of drift of -2.0 percent or greater, and five exhibit a positive drift. One of the three products exhibiting relatively rapid negative drift is the gas hot water heater, the subject of a hedonic regression study described below. The other two are brass gate valves and steel safes. For valves, the Sears index yields a 1983 index value of 219, compared to 57 in 1947; the figures for the PPI are, respectively, 212 and 33. Did the price of such valves increase by a factor of 3.8 or 6.4? In the 1947 catalog, we find a price of \$1.59 for three-quarter-inch brass gate valves; the price of a similar three-quarter-inch valve in 1983 was \$7.99, or 5.0 times as much. This ratio is roughly halfway between that for the Sears and PPI indexes. Why does this discrepancy occur? In 1970, the Sears price ratio to 1947 is 1.7, which is approximately reflected in a price increase of an identical valve from \$1.59 to \$2.39. The discrepancy occurs in 1973–74, when there is a complete switchover of models and a direct comparison of prices is made. This is an example showing that the specification method can yield a downward-biased index, for here the model substitution was accompanied by a price increase for a product that was "roughly similar." This is exactly the reverse of the case of electronic typewriters discussed above.[46]

46. This is an example where a long-departed research assistant made a decision that is different than the one I would have made. It was not feasible to rework the catalog indexes for every such case. Instead, I stress the virtue of the thirty-six-year comparisons of closely similar models as a cross-check on the overall plausibility of the results. I can also offer as an offsetting bias for the gate valve index the availability in the 1983 Sears catalog of a plastic gate valve, which

For steel cabinet safes, the 1947 and 1983 Sears models cannot be compared directly. The Sears index exhibits a 1983/1947 ratio of 3.5 and the PPI of 5.7. One can find roughly similar models in 1947 ($72.50) and 1983 ($259.99), yielding a price ratio of 3.6, much closer to the Sears index than to the PPI.[47]

The hedonic regressions for gas hot water heaters are carried out for all thirty-five pairs of adjacent years between 1947 and 1983 (the thirty-five individual sets of regression coefficients are not displayed here in order to save space).[48] The dependent variable is the log of the Sears catalog price, and the independent variables are the logarithms of each listed specification that differs among models. For instance, only some models were glass lined before 1957, and so this characteristic is a variable in the regressions only before that date, but after that date all models were glass lined, and this variable is then collinear with the constant term and cannot be included. The specifications listed in the catalog shifted over the postwar period; at first, heating power was measured by gallons per hour, which could be raised 60 degrees in temperature, then those that could be raised 100 degrees, and after 1961 by BTU. Other explanatory variables include tank size, presence of two stages, three stages, power miser, liquid propane fuel capability, and the time dummy that measures price change between adjacent years. While the coefficients on some of the independent variables are not statistically significant, the significant variables are of the expected sign and reasonable magnitude. The number of observations grows over time, starting at two in 1947–48 and reaching twenty-nine in 1982–83. In the 1970s and 1980s, the R^2 is in the range of 97–99 percent, and almost all variables are significant in almost every pair of years.

The coefficients on the time dummy variables can be cumulated into the Sears hedonic index summarized in table 10.9 and listed annually in Appendix table B.3. The 1987/1947 price ratio is 1.31 for the catalog index and 2.31 for the PPI. A comparison of closely similar models in 1947 and 1983 suggests that even the catalog index overstates the rate of price change: a glass-lined thirty-gallon model with a twenty-eight gallon per hour recovery rate and no relief valve sold for $87.50 in 1947 and $89.99 in 1983. The 1970/1947 ratio is 0.67 for the hedonic index, 1.01 for the PPI, and 0.68 for an identical model. For this product category, then, it appears that the difference between the hedonic index and the PPI is greatest after 1973.

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could perform the same service (in conjunction with plastic pipe) for $2.89 instead of $7.99 for the brass model. Allowing for this substitution would bring the 1983/1947 ratio down to 1.8.

47. One should note that the 1983 model is somewhat smaller, having 3,360 interior cubic feet vs. 4,410 for the 1947 model. The problem seems to involve substitutions before 1970, since the 1983/1947 Sears index ratio of 1.9 is roughly validated by a 1970 model with 3,744 interior cubic inches selling for $129.95 (yielding a 1983/1970 ratio for the models cited of 2.0).

48. The twenty-three regressions for 1947–70 were presented in the 1974 first draft of this book, and a copy of that table is available to anyone who is interested.

A similar comparison suggests that the specification index constructed for gas warm air furnaces may overstate the rate of price change. The Sears specification index exhibits a 1976/1951 ratio of 1.39. However, it is possible to find virtually identical models selling for $229.50 in 1950 and $209.95 in 1976, for a ratio of 0.91.[49] Overall, these model comparisons lead to the conclusion that the catalog index probably does not substantially overstate or understate the rate of price increase in this category. There is modest evidence of overstatement for brass gate valves and steel safes, and modest evidence of understatement for hot water heaters and warm air furnaces.

10.8 Engines and Turbines

By far the most important products in this category are turbines and boilers used in electricity generation, the subject of chapter 5. Gasoline and diesel engines are treated in chapter 11. The only Sears catalog index for this industry group is a hedonic regression index for outboard motors.

The format of the regression equations is the same as for gas hot water heaters. Again, there are thirty-five regression equations for all pairs of adjacent years between 1947 and 1970. The dependent variable is the logarithm of price, and the explanatory variables are the logs of horsepower, fuel capacity, and fuel use (starting in 1973), as well as dummy variables for one or two gears shifted forward and one gear shifted in reverse, electric starting, and the time dummy that measures price change between adjacent years. For each pair of adjacent years, several equations were estimated with different subsets of the explanatory variables, since multicollinearity prevented inclusion of all variables. The particular equation selected was that with the highest R^2, unless one or more variables had coefficients that were insignificant or had the wrong sign, and in these cases the equation with the next lowest R^2 was chosen. Once again, the detailed regression results are not presented here to save space.[50]

In most years, the coefficient on horsepower is the most significant statistically and is relatively stable in size, ranging from 0.40 to 0.60. Coefficients on the other variables vary in their level of significance and fall within the range of 0.10–0.30 when significant. In most years, a price index controlling for horsepower alone would not have adjusted adequately for quality change, since the presence of gear shifting, electric starting, and a larger fuel tank each add from 10 to 30 percent to price.

The 1983/1948 ratio for the Sears hedonic price index is 3.65 and that of the PPI is 5.11. Much of this difference occurs in the first decade of the period, during which the respective increases in the hedonic and PPI indexes

49. The 1950 model has 80,000 BTU output, a five-inch flue, and a ⅙ hp motor; the 1976 model has 80,000 BTU output, a four-inch flue, and a ⅙ hp motor.

50. See n. 42 above.

are 3 and 43 percent. The catalog models listed in 1948 and 1958 are not identical, so that no straightforward comparison is possible. A 5.5-horsepower model sold in 1948 for $129.95 and 1958 for $199.50, but the 1948 model had no gear shift, and a 6.5-pint fuel capacity that allowed cruising for only 1.25 hours at full speed, whereas the 1958 model was equipped with both forward and reverse shift, and had a thirty-six-pint fuel capacity that allowed cruising for four hours at full speed. Since the average estimated coefficient on fuel capacity in the 1950s is about 0.20, the 5.5 times increase in fuel capacity on this model alone would account for a doubling of price, not to mention the contribution of the gear shift. Thus, if anything, the hedonic index appears to overstate the increase in "true" price in this period.

Other comparisons over longer periods can also be made. A 7.5-horsepower model with forward shift but no reverse or electric start was priced at $149.50 in 1950 and $199.50 in 1970, for a 33 percent increase in price, compared to the 60 percent increase registered by the hedonic index and 75 percent for the PPI. Unfortunately, no comparisons are possible between 1970 and 1983. In the latter year, all engines larger than 3.0 horsepower had electric start, and all smaller engines had at least one forward gear, while, in the former year, no engines had electric start, and all small engines lacked gears. The closest available comparison is between 1968 and 1983 for 7.5 horsepower engines, which yields a 1983/1968 price ratio of 1.87, compared to the Sears hedonic index of 2.60 and the PPI ratio of 3.10.[51]

As in the case of typewriters, it is possible to link together successive *CR* articles on outboard motors into a price index for "roughly matched" models. The details of the comparisons made are listed in table 10.4. The main obstacle is the extreme irregularity of the *CR* publication schedule: there were yearly articles between 1953 and 1956, then every other year, then nothing between 1960 and 1968, then frequent articles, and then nothing at all after 1975.[52] Because of frequent publication, the comparisons in the mid-1950s are of exactly identical models, down to the brand name and model name. However, subsequently, the models are only "roughly similar," owing to *CR*'s practice of reporting only on newly introduced models, and owing to the long gap between articles on models of a given size after 1958. Since prices of models sold through catalogs (not only Sears and Wards but also Western Auto) were considerably lower than the list prices of "brand names" like Evinrude and Mercury during the 1950s and 1960s, the prices of catalog models were not compared with those of noncatalog models.

51. The 1968 model had a price of $289, 7.5 hp, two forward gears, and no electric start. The 1983 model had a price of $540, 7.5 hp, one forward gear, and was equipped with electric start. A scan of the Sears data for this size class reveals a premium for electric start in 1968 of 40.1 percent and for a second forward gear of 26.5 percent in 1972.

52. In addition to the years listed in the notes to table 10.4, additional articles were published in 1952 and 1959, but these issues were missing from our library when this study was carried out. A careful search of the annual indexes in the November issues for each year between 1976 and 1987 uncovered no article on outboard motors over that long interval.

Table 10.4 **Comparisons of "Closely Similar" Model Outboard Motors from *Consumer Reports*, 1953–75**

	Years (1)	Number of Models (2)	Average Price (3)	Price Change (4)	Description of Models Compared (5)
Small motors (5–16 hp):					
1.	1953	2	238.75	−0.1	Two models newly introduced in 1953,
	−1954	2	238.50		identical in 1954, one 3.0 hp and one 10.0 hp.
2.	1954	8	217.18	4.1	All selected models have identical brand
	−1955	8	226.14		names, model names, and hp in both years. Hp of models included: 3.0, 5.5, 7.5, 10, 12, 15. All models but 3 hp have one forward gear, neutral, and reverse; 3 hp models have pivot.
3.	1955	3	245.58	1.6	As above, with three identical models of 3.0,
	−1956	3	249.52		7.5, and 15 hp, all equipped with manual start.
4.	1956	2	269.50	0.2	As above, with two identical models of 5.5
	−1958	2	270.00		and 10 hp, all equipped with manual start.
5.	1958	1	230.00	2.2	No models rated in 1960 larger than 7.5 hp.
	−1960	1	235.00		Identical 5.5 hp model, same brand name, model name. Ratings indicate a 5.0 hp ("Gale") model with the same brand name in each year changed a defective fuel tank configuration that was criticized in 1958.
6.	1960	3	162.16	−10.0	Few models can be compared, because most
	−1971	3	146.00		have auxiliary fuel tanks in 1971 but not in 1961. Compared are 5.0 hp and 3.5 hp noncatalog models, and a 3.0 hp catalog model.
7.	1971	5	331.00	37.5	Models compared are one of 7.5 hp, three of
	−1975	5	455.00		6.0 hp, and one of 4.0 hp. All models compared have same brand name and hp, have manual start and same gear-shift equipment and fuel tank size.
Medium-size motors:					
8.	1954	2	506.50	5.6	Identical brand names, model names, both
	−1955	2	535.00		25 hp, one-speed forward and reverse, and equipped with electric start.
9.	1955	2	535.00	−2.8	All 25 hp with electric start, 1956 models
	−1956	2	520.00		are all newly introduced with different brand names than 1955 models, but to maintain comparability no catalog models are included.
10.	1956	0	. . .		No models listed in both years with the
	−1958	0			same hp.

(*continued*)

Table 10.4 (continued)

	Years (1)	Number of Models (2)	Average Price (3)	Price Change (4)	Description of Models Compared (5)
11.	1956	2	645.26	6.9	Two models, one 33 hp and one 40 hp in each year, both with electric start and without remote controls.
	–1968	2	690.00		
12.	1968	4	809.30	33.9	Four models, one 50 hp, one 45 hp, and two 40 hp in each year, all including electric start and optional battery-charging system (if not standard) and one-lever remote control.
	–1973	4	1083.50		

Sources: Consumer Reports, June 1953, July 1954, June 1955, 1956, 1958, May 1960, June 1968, 1971, 1973, July 1972, 1975.

Table 10.5 **Alternative Price Indexes for Outboard Motors, Selected Years, 1972 = 100**

	Sears (1)	*CR* (1971 = 100) (2)	PPI (3)
1953	71	81	60
1954	75	81	63
1955	70	85	63
1956	75	85	65
1958	75	85	73
1960	77	87	71
1968	101	84	84
1971	98	100	99
1973	109	127	101
1975	122	179	139

Sources: Sears and PPI indexes from app. table B.3. *CR* indexes from table 10.4, with changes between successive *CR* articles converted into annual percentage rates and then averaged for the small and medium models with equal weights.

As shown in table 10.4, this exercise is carried out separately for "small" and "medium" outboard motors. Over time, the average size of outboard motors purchased increased, from 3.6 horsepower in 1941, to 12.9 hp in 1955, to 30 hp in 1967.[53] This suggests that the weights should gradually shift toward larger models, but, unfortunately, we do not have sufficiently detailed and continuous market share information to carry out this refinement. Instead, the annual percentage change over each interval in the small and medium categories is averaged with equal weights and cumulated into the index that is displayed in table 10.5. There, the comparison with the Sears catalog index and the PPI yields very different results before and after 1971. In the earlier

53. The figures for 1941 and 1955 are from *CR* (June 1956, 276), and for 1967 from *CR* (June 1968, 292).

period, the *CR* index increases less (23 percent for 1953–71) than the PPI (65 percent), with the Sears index (38 percent) somewhat closer to the *CR* index. This is the "typical" pattern that we found in chapter 7 for appliances. Yet, after 1971, the *CR* index shows an explosive price increase relative to either the Sears index or the PPI.

Why does the Sears index increase so slowly from 1968 to 1975? The *CR* index for this period is based on articles for medium-sized models in 1968 and 1973, and for small models in 1971 and 1975. Unfortunately, no Sears (or other catalog) models were included in the 1973 report, so we are limited for a comparison to the 1971 and 1975 articles. Here, we find two Sears models listed in 1971 (3.0 and 5.5 hp) and six in 1975 (5.0, 5.5, 7.0, 7.5, 9.9, and 15 hp). There is overlap only for the single size category of 5.5 hp, and here we find a modest price increase of 29 percent, as compared to 24 percent for the catalog index.[54] Looking at the hedonic data, we find virtually identical models of 3.0, 5.0, and 7.0 hp in 1971 and 1975, with an average price increase of 26 percent. Perhaps the main reason for the discrepancy is simply a lag in Sears's pricing decisions. Note in Appendix table B.4C that the catalog index lagged behind the PPI by about a year, finally catching up in 1982.

A central quality characteristic that is not held constant in the index for electric motors is fuel consumption. Since fuel consumption is listed in the Sears catalog beginning only in the early 1970s, it is not possible to create a time series of this characteristic for the whole postwar period. A spot check of several models indicates that, at least on the limited selection of small models offered by Sears in 1983, fuel consumption was the same as on similarly sized models in 1976.

CR articles on outboard motors substantiate a significant improvement in fuel economy for the medium-size motors that dominated the value of sales at that time. Over the period 1968–73, it is possible to match exactly by horsepower and brand name one model of 50 hp and two of 40 hp. These register an improvement in fuel economy of 42 and 23 percent, respectively. The increases in list price are, respectively, 24 and 12 percent, as compared to 20 percent for the PPI and −3.5 percent for the Sears hedonic index. But if we were to add the value of the 1968–73 fuel saving to the price of the 1968 *CR* models, the price change would be converted into −20 percent for the 50 hp model and −19 percent for the 40 hp model.[55] For the light motors tested in 1975, we find no improvement in fuel economy over 1971.[56] For earlier periods, the first report to list fuel

54. From $170 to $219. Other than the gearshift difference noted in the text, both models have 0.7-gallon integral fuel tanks.

55. For the Mercury 50 hp models, the 1968 and 1973 prices are $870 and $1,080, and the miles per gallon figures "top speed, normal load" are 3.6 and 5.1. For two 40 hp models in 1968 and three 40 hp models in the same years (Johnson and Evinrude) the figures are $695, $778, 4.3, and 5.3. I assume 100 hours of operation per year for ten years at an average speed of 15 mph and a fuel price of $0.40, leading to an undiscounted fuel saving for the 50 hp models of $490 and for the 40 hp models of $263.

economy was published in 1958. Comparing three models in 1958 and 1968 of 35 hp motors and one of 40 hp, we find almost identical fuel economy, indicating that the improvement between 1968 and 1973 may have been a special one-time event.[57]

Overall, rough matches of individual Sears models over long periods of time support the verdict of the Sears hedonic index that the PPI substantially exaggerates the rate of price increase for outboard motors. While raw price comparisons from *CR* are closer to the PPI than the Sears hedonic index during the 1968–75 period, these do not take account of major improvements in fuel economy and other important dimensions of quality change, particularly reliability.[58] Further, even in the 1954–68 period, when the *CR* index increases more slowly than the PPI, there were numerous quality improvements that received explicit mention in *CR* articles, including self-winding starters, reductions in noise and vibration, and greater convenience in operation.[59]

10.9 Metalworking Machinery

The PDE for the "metalworking machinery" industry group includes seven PPIs for various groups of machines (two three-digit, one four-digit, and four

56. To control for different loads on the *CR* tests, I measure mpg at constant speed, 7.0 mph for four models of 6.0 hp and 6.5 mph for five models of 4.0 hp. The mpg figures for the 6 hp engines improved from 7.5 to 8.0 but for the 4 hp engines declined from 12.0 to 11.3.

57. The loads defined as "light" and "heavy" in the *CR* tests are not held constant over time. To assess the meaning of the loads, I inspected the maximum speeds of motors of a given horsepower and concluded that a "medium" load in 1958 was equivalent to a "light" load in 1968 for a 35 hp motor. The mpg figures compared are thus those reported for the light load in 1968 and the average of the light and heavy load for 1958 (when mpg for medium load was not reported). The resulting average mpg figures for the four models are 5.57 in 1958 and 5.40 in 1968.

58. Comments relevant to unmeasured quality improvement in *CR* (November 1972, 408–9) are as follows: "Since [1968] outboard motor manufacturers have been busy eliminating overboard unburned fuel drains—long a wasteful characteristic of two-stroke cycle outboard engines. We can only conclude that the manufacturers' efforts have not only improved fuel economy but have helped to reduce water pollution. . . . The electronic ignition systems of the 2-stroke motors, together with their 50:1 gas-to-oil ratio seem to have pretty well eliminated chronic spark-plug fouling and—if our experience can be considered typical—increased the overall reliability of the outboard." In the June 1973, report, we read on 384 that "spark-plug servicing is not the frequent nag that it used to be." The July 1975, report (430) comments that "no motor was observed puddling unburned fuel overboard by way of the exhaust— a common sight some years back."

59. Comments on the evolution of quality over time are as follows: "Subtle improvements made over the years within the engines make for smoother operation and generally greater reliability. Other improvements are more obvious—for example, self-winding starters, now standard equipment on almost all motors" (July 1954, 305). "Today's outboards are generally more convenient to operate; starter cords and knobs are of better quality, controls are generally simpler. . . . considerable improvement has also been made in hood design" (June 1955, 261). "In the opinion of CU's consultants, vibration is no longer a serious problem in outboard motors, because so much has been done toward isolating the engine from the boat by means of shock-absorbing mountings" (June 1956, 280). "That oil requirement is notably lower than it was for the outboards we reported on in 1959" (June 1968, 292).

six-digit indexes), but no index at the detailed eight-digit product level. Comparability problems are aggravated by the failure of the PPI to publish any six-digit or eight-digit indexes for metal-cutting machine tools (drill presses, lathes, etc.) until 1972. Given Sears's prominence as the dominant seller of power tools for home use, we have an embarrassment of riches in this category, and this study treats fourteen different Sears products, the most of any industry group.[60] For eleven of the fourteen products, it is possible to locate comparable eight-digit PPI product indexes that allow a close match (e.g., "light-duty ¼ inch drill," "home-utility ½ inch drill," "power saw, light duty"). No PPIs are available before 1972 for drill presses, lathes, and free-standing power saws, requiring the use of the overall average index for metalworking machinery. While this lack of a close match between the catalog index and the PPI for these three products may seem to create a problem, actually we find that the secular drift of the Sears/PPI ratio is less than for some products with very closely matched PPIs (e.g., quarter-inch home-utility light-duty hand power drills).

As shown in table 10.9, the tendency for the Sears indexes to exhibit a slower secular price increase than the PPI is quite pervasive across the fourteen product groups, with ten increasing more slowly, two slightly more rapidly, and two about the same. Six of the fourteen Sears indexes exhibit a downward drift relative to the PPI of more than 2 percent per annum over the entire postwar period. These are the free-standing power saw, the two indexes for power drills, the acetylene cutting tool and single-stage welding outfit, and the power saw blade.

A comparison of closely similar models at or near the beginning and end of the sample period can be made for some of the products where the Sears and PPI indexes diverge substantially, although in some cases a better match is possible between an early year and a middle year like 1968 or 1970. An identical free-standing power saw increased in price between 1948 and 1969 by 28 percent, as compared to 32 percent for the Sears index of all power saws, and 120 percent for the PPI used in the NIPA to deflate power saws.[61] After 1969, the catalog index and PPI agree fairly closely. An identical hand power drill declined in price between 1949 and 1967 by 15.4 percent, as compared to an increase in the catalog index of 1 percent and an increase in the PPI of 36 percent.[62] We can also compute a price decrease of 32 percent between 1947 and 1970 for nearly identical models (the PPI increased 38 percent between these years).[63]

60. In a poll taken in 1988, an amazing 52 percent of those surveyed nationwide selected Sears as "the best place to buy home improvement goods" (see Snyder and Waldstein 1988, 18).

61. The models compared both have a ten-inch blade, a 1 hp motor, no speed adjustment, no blade guard, and a twenty-by-twenty-seven-inch work space. The maximum cutting depths were 3.38 and 3.25 inches in 1968 and 1947, respectively.

62. Both models are half-inch hand power drills, with a no-load speed of 450 rpm, and appear from catalog illustrations and specifications to be identical in all other respects.

63. The 1947 model was an unadorned quarter-inch model selling at $21.50; single-speed quarter-inch models were offered in the 1970 catalog at $8.33 for "light duty" and $14.69 for

The other products with a relatively rapid downward drift of the catalog index relative to the PPI are acetylene welding outfits and power saw blades. For an acetylene cutting tool, the catalog index registers an increase of 56 percent between 1947 and 1970, in contrast to that of 77 percent for the PPI; we find an identical tool in the 1970 catalog at 56 percent more than in 1947, except that the 1970 model was equipped with a tip, and the 1947 model was not. There is also a discrepancy over the period 1976–83, when the increase in the catalog index of 35 percent contrasts with the 70 percent increase for the PPI. In the catalog, we find the same model exhibiting an increase of 33 percent over this interval.[64] For the welding outfit, the 1947–69 increases in the Sears index and PPI are 68 and 158 percent, respectively, and the Sears index is based on a single identical model throughout. In the early 1970s, there are many substitutions in the Sears index, but the identical model increased in price between 1976 and 1983 by 45 percent, as compared to 42 percent and 66 percent for the catalog and PPI indexes, respectively. For circular saw blades of the 1947–67 period, the increases in the catalog and PPI indexes are −44 and 1 percent, respectively, as compared to an increase for an identical Sears model of −11 percent.[65] Frequent model substitutions prevent a comparison for closely similar models after 1975.[66]

Portable electric power tools constitute one of the few categories where it is possible to compare the Sears catalog indexes with prices for a wider variety of models from *CR* over a substantial portion of the postwar period. The details of the comparison of "roughly similar" models from *CR* are displayed in table 10.6 for three products, power drills, finishing sanders, and saber saws. The technique is exactly the same as for typewriters, discussed above in section 10.6. In each pair of years when a *CR* report was published, the list and quality ratings of all models were compared until a subset could be located that had roughly the same quality characteristics. In the case of power drills, the major criterion of comparison was output under load, while for sanders and saws it was speed of operation. In the later years, when variable-speed models began to replace single-speed models of drills and saws, these were treated as separate products. Likewise, three-eighths-inch drills were treated separately from quarter-inch drills (the latter disappeared in the early 1970s). Over time, *CR* changed its method of listing these quality

"medium duty." For only a bit more than the 1947 price, $24.69 would buy a variable-speed three-eighths-inch model.

64. This is model 54407 (changed to 54408 in 1982, with no change in listed specifications), which sold for $39.95 in 1976 and $52.99 in 1983.

65. A cross-cut eighteen-gauge six-inch diameter circular saw blade cost $2.35 in 1947 and $2.09 in 1967.

66. For instance, the only listed ten-inch circular saw blade in the 1983 catalog sold for $24.99, 3.5 times the 1947 price, as compared to an increase in the Sears index of just 1.8 times. Yet the 1983 blade is listed as "diamond ground with carbon tips," two characteristics absent in both 1947 and 1970. Note that the 1983/1947 ratio for these two blades is still well below the PPI ratio of 5.5 times.

Table 10.6 **Comparisons of "Closely Similar" Model Power Tools from *Consumer Reports*, 1954–87**

	Years (1)	Number of Models (2)	Average Price (3)	Price Change (4)	Description of Models Compared (5)
Small power drills:					
1.	1954	3	26.65	−6.0	Single-speed ¼ inch, produced 100–120
	−1958	7	25.10		watts under load.
2.	1954	2	34.98	7.0	Single-speed ¼ inch, produced 150–175
	−1958	13	37.50		watts under load.
3.	1958	7	25.10	−36.6	Single-speed ¼ inch, produced 100–120
	−1966	2	17.41		watts output under load, defined as "adequate" in the 1966 rating system.
4.	1958	1	37.50	−16.0	Single-speed ¼ inch, produced 150–175
	−1966	3	31.94		watts output under load, defined as "high" in the 1966 rating system.
5.	1966	4	28.07	−89.2	Single-speed ¼ inch, rated "fairly high" for
	−1971	2	11.50		output under load in both years.
6.	1966	2	32.73	−17.4	Variable-speed ⅜ inch, rated "high" for
	−1971	2	27.50		output under load in both years.
7.	1971	6	14.67	21.8	Single-speed ⅜ inch, rated "fairly low" for
	−1975	4	18.25		output under load in both years.
8.	1971	2	27.50	38.4	Variable-speed ⅜ inch, rated "high" for
	−1975	5	40.60		output under load in both years.
9.	1975	4	18.25	−11.6	Single-speed ⅜ inch, rated "fairly low" for
	−1979	4	16.25		output under load in 1975 and "fair" in 1979; rpm under load limited to range 600–750.
10.	1979	1	45.00	25.8	Variable-speed ⅜ inch, rated "very good"
	−1982	5	58.25		for output under load; rpm under load limited to range greater than 800.
Finishing sanders:					
11.	1959	5	42.77	−63.1	For 1959 included models rated as sanding
	−1965	5	22.75		14–17 grams per 10 minutes, described as three times as fast as by hand. For 1965 included models described as "fairly slow," which is shown in a table to be defined as three times as fast as by hand.
12.	1965	5	38.62	−40.5	Includes models rated as sanding "fast" in
	−1971	4	25.75		both years.
13.	1971	4	25.75	18.6	Orbiter models only; includes models rated
	−1978	4	31.00		sanding "fast" in 1971 and as "very good" in 1978.
Saber saws:					
14.	1964	9	42.76	0.9	Single speed; includes only models
	−1967	6	43.13		check-rated in both years.
15.	1967	6	43.13	14.8	Single speed; includes models check-rated in
	−1972	1	50.00		1967 and rated in top category in 1972.

Table 10.6 (continued)

	Years (1)	Number of Models (2)	Average Price (3)	Price Change (4)	Description of Models Compared (5)
16.	1972	1	50.00	−118.2	Single speed; rated in top category in both years.
	−1976	3	15.33		
17.	1972	2	45.00	−71.6	Two speeds; took only non-Canadian model in top category in 1972 and top half of listed models in 1976.
	−1976	4	22.00		
18.	1972	3	40.33	14.8	Variable speed; took those listed in top rating category in 1972 and those rated as having "fast" speed in 1976 (the highest listed category).
	−1976	4	46.75		
19.	1976	3	15.33	31.5	Single speed; top-rated category in both years; excluded two models described as "commercial" in 1984 (both had prices over $100).
	−1984	1	21.00		
20.	1976	4	22.00	60.6	Two speeds; top-rated category in both years.
	−1984	3	40.33		
21.	1976	4	46.75	54.1	Variable speed, included all models rated as having "very good" speed in both years.
	−1984	6	80.33		

Source: Consumer Reports, selected issues from the years listed.

attributes, usually beginning with specific quantitative measures ("17 grams of wood sanded in 10 minutes") and later shifting to relative ratings ("fast" and later "very good"). Fortunately, there were in-text remarks, and for drills an explicit table, allowing the translation of the quantitative measures into the qualitative categories, as, for instance, when in 1966 a table lists "fast" as describing drills with 150–175 watts of output under load.

Unfortunately, it was not possible to control for several important quality attributes. By 1971, all power drills were double insulated, a safety feature to which *CR* attached considerable importance in its 1966 article but that was not mentioned in the 1954 or 1958 articles. In 1975, all variable-speed power drills were reversible, whereas in the 1971 article none were reversible. By 1975, some power drills began to offer a second handle. Similarly, all power saws were double insulated by 1972, and in 1984 seven of those listed had a scrolling feature. Other extra features listed for some models in the 1984 report were trigger switches that could be locked at any speed and antisplinter slots.

An important quality improvement that can be quantified in the first half of the period is a reduction in weight. *CR* states in several articles that weight is a disadvantage for power hand tools (holding performance constant), and it explicitly lists the presence of metal rather than plastic cases as a disadvantage of particular models in its 1982 report on drills. From the listed weights, we can calculate a decline in weight of one-third from 4.3 to 2.8 pounds between 1954 and 1971 for quarter-inch drills with the same output under load and a

Table 10.7 **Alternative Price Indexes for Power Tools, Selected Years, 1972 = 100**

	Power Hand Drills			Finishing Sanders			Saber Saws		
	Sears (1)	*CR*[a] (2)	PPI (3)	Sears (4)	*CR*[a] (5)	PPI (6)	Sears (7)	*CR* (8)	PPI (9)
1954	105	219	99	. . .	. . .	. . .	. . .	. . .	. . .
1958	116	220	102	. . .	. . .	. . .	. . .	. . .	. . .
1959	. . .	. . .	. . .	106	282	109	. . .	. . .	. . .
1964	. . .	. . .	. . .	. . .	. . .	. . .	88	86	117
1965	. . .	. . .	. . .	93	150	110	. . .	. . .	. . .
1966	82	171	95	. . .	. . .	. . .	. . .	. . .	. . .
1967	. . .	. . .	. . .	. . .	. . .	. . .	88	86	110
1971	92	100	109	100	100	101	. . .	. . .	. . .
1972	. . .	. . .	. . .	. . .	. . .	. . .	96	100	101
1975	94	136	129	. . .	. . .	. . .	. . .	. . .	. . .
1976	. . .	. . .	. . .	. . .	. . .	. . .	119	56	120
1978	. . .	. . .	. . .	84	120	136	. . .	. . .	. . .
1979	86	136	169	. . .	. . .	. . .	. . .	. . .	. . .
1982	. . .	176	222	. . .	. . .	. . .	. . .	. . .	. . .
1984	. . .	. . .	. . .	. . .	. . .	. . .	210[b]	91	183

Sources: Sears and PPI, 1947–83 (see App. table B.5). *CR* indexes from table 10.6.

[a]Base year for *CR* drill and sander indexes is 1971 rather than 1972.

[b]Sears index shown is for 1983.

further decrease from 4.0 to 3.2 pounds between 1971 and 1982 for variable-speed three-eighths-inch models having a similar performance rating.

The *CR* comparisons are converted into index numbers in table 10.7. When price comparisons of several varieties are available for the same pair of years, the logarithmic change in price of each variety is given the same weight, and the average change is converted into an index by taking antilogs. The growth rates between the earliest and latest *CR* article are as follows:

	Sears	*CR*	PPI
Power drills (1954–79)	0.1	−1.9	2.2
Finishing sanders (1959–78)	−0.8	−4.5	1.2
Saber saws (1964–84)	4.9	0.3	2.3

For drills and sanders, the results display the same pattern as we found in chapter 7 for appliances, and in section 10.6 for electric/electronic typewriters, and that is a slower rate of price increase (or faster decline) in the *CR* index than in the catalog index, which in turn grows slower than the PPI. In the case of saws, the Sears index increases faster than the PPI over the particular years shown, even though over the full postwar period it displays a downdrift relative to the PPI. This occurs because the Sears index is at its minimum relative to the PPI in the year that the *CR* index begins, 1964. Also,

the Sears index is for circular power saws, not for saber saws, which might explain some of the difference.

An obvious qualification to this section is that many products sold by the metalworking machinery industry are industrial-use metal-cutting and metal-forming tools that are much larger than anything sold in the Sears catalog or rated by *CR*. The mere difference in size does not necessarily indicate that the PPI is more accurate for large industrial machines than for small machines intended for home use. We have found in this section a fairly consistent downward drift in the Sears and *CR* indexes relative to the PPI, even when the latter is very precisely and narrowly defined to cover the same exact product as is sold by Sears or covered by *CR* (e.g., "home-utility light-duty power hand drills").

In fact, there is every reason to think that the PPI is severely biased upward in the late 1970s and throughout the 1980s for large machine tools, simply because of the revolution created by numerically controlled machine tools. First-generation machine tools developed in the 1960s began to be replaced by second-generation tools that combined traditional machines with minicomputers in the late 1970s.[67] Since machine tools are now part traditional machine and part computer, we would expect their "true" price to behave as a weighted average of the rising prices of machines and the rapidly declining prices of computers. Indeed, there are scattered remarks to this effect in the press. A 1978 article commented that the declining prices of computers had allowed the price of electronic equipment to decline to 15 percent of the cost of a computerized machine tool, compared with 50 percent in the late 1960s (Salpukas 1978, F-12). Any attempt to measure price changes for large-scale machine tools would be very difficult. Just as for some products it is necessary to take account of improved energy efficiency, for machine tools account needs to be taken not only of improved reliability but of the lower level of skills needed by operators.[68]

10.10 General Industrial Equipment

Sears catalog products are available in PPI categories representing about 45 percent of the 1967 weight in the PDE deflator applied to general industrial equipment. Excluded are industrial-process furnaces and ovens and industrial material handling equipment. There is no obvious reason to consider the included products as more or less technically complex than the excluded products, and no way to appraise the bias introduced by partial coverage. Sears coverage is particularly good in the categories of air compressors and centrifugal pumps, with year-to-year comparisons based on as many as eleven models of the former and thirteen of the latter.

67. "Machine Tools Keep Humming," *Business Week*, 29 May 1978, 84.
68. See the source cited in n. 67.

The match between the Sears products and the PPI is very close in this group. There is no problem with a larger size being priced by the PPI, since PPI eight-digit indexes are defined by size and are available for relatively small sizes, for example, 5 hp stationary air compressor and ninety-gallon-per-minute centrifugal pump.[69] Despite this close match, the downdrift of the catalog indexes relative to the PPI for air compressors, pumps, and fans is one of the most rapid recorded in this chapter. For each product, the downdrift is more rapid before 1960 than afterward, but is still significant after 1973.

A comparison of closely similar models can be provided to lend credence to the catalog index. Stationary air compressors show a dramatic contrast between the catalog index and PPI over 1947–70, with respective price increases of 17 versus an incredible 272 percent. Over this period, one can compare models registering a 29 percent price increase in a larger size category and a price decline of 26 percent in a smaller category, and in the second case the smaller model is significantly improved in quality in 1970 relative to 1947. Over 1970–83, the respective increases of the catalog index and PPI are 122 and 171 percent. Individual models in the larger size category increased in price by 30 and 84 percent, respectively.[70]

In the case of centrifugal pumps, the 1947–70 increase in the PPI was 122 percent, in contrast to a 3 percent decline registered by the catalog index. An identical model fell in price over the same period by 19 percent. For the more recent period, the catalog index increases by 116 percent from 1970 to 1983 and the PPI by 154 percent, yet it is possible to find a model with significantly improved quality selling for 111 percent more.[71]

Propeller fans exhibit a postwar downdrift of the catalog index relative to the PPI throughout all subintervals of the postwar period. Between 1948 and 1970, the Sears index increased by 22 percent and the PPI by 134 percent. A thirty-inch one-speed Sears attic fan increased in price over the same interval by 27 percent but delivered 20 percent more air per minute. Between 1970 and 1981, the respective figure for the Sears index and PPI are 121 and 194 percent. A similar thirty-inch fan increased in price over the same interval by 100 percent.[72]

69. These particular indexes are available since 1972 and 1974, respectively.

70. The larger category refers to a stationary model of 1.5 hp and 5.3 cfm (cubic feet per minute) air delivery in 1947 for $310.00, 1.5 hp and 5.0 cfm in 1970 at $399.95, and 6.6 cfm for $519.99 in 1983. The smaller category refers to a portable model of 0.5 hp and 1.2 cfm for $169.50 in 1947, 0.75 hp and 2.2 cfm for $124.95 in 1970, and 0.5 hp and 2.5 cfm for $229.99 in 1983.

71. A 5 hp model providing an output of 100 gallons per minute is listed at $235.95 in 1947 and $189.95 in 1970. A 5 hp model providing an output of 132 gallons per minute is listed at $399.95 in 1983 and ninety-one gallons per minute for $279.95.

72. All are thirty-inch one-speed models, delivering 6,500 cfm in 1947 for $54.95, 7,800 cfm in 1970 for $69.95, and 7,800 cfm in 1981 for $129.99. Interestingly, the weight of the unit fell from 100 to 49 pounds between 1947 and 1983.

10.11 Electrical Transmission, Distribution, and Industrial Equipment

The PDE deflator for electrical equipment is based on fourteen PPI six-digit and eight-digit indexes for welding machines, electrical direct measuring instruments, electric motors, transformers and power regulators, and switchgear equipment. Welding machines are included in the metalworking machinery category discussed above. This leaves ten unduplicated Sears catalog products to be compared with the closest available PPIs, covering direct measuring instruments, electric motors, and a variety of electric switches and panelboards.

There are several comparability problems in developing ratios of the catalog products to the closest available PPI. There are no published PPI eight-digit indexes for specific direct measurement instruments, requiring that each of the three catalog instrument indexes be compared to the PPI six-digit group index for "direct measurement electric instruments." For the other seven catalog products, there are specific eight-digit PPI product indexes available that make a relatively good match. The comparison is particularly close for electric motors, panelboards, and indoor safety switches.

Of the ten ratios that can be computed from the catalog and comparable PPIs, one exhibits a positive drift of 1.6 percent per annum, two exhibit a small rate of positive drift of 0.5 percent per annum, while the remaining seven exhibit negative drift, and this is at a rate greater than −2.0 percent per year for three products. In order of decreasing drift, the top five products are tachometers, electronic auto testers, circuit breakers, panel-style ammeters, and indoor safety switches. These range from relatively simple products that have changed little over time—circuit breakers and safety switches—to the auto testers where the electronic revolution had completely changed the nature of the product.

For tachometers, the 1947–83 increases in the catalog index and PPI are, respectively, 22 percent and an incredible 442 percent. While the items priced in the catalog changed substantially over time, it is possible to compare items having a 1976 price just 38 percent higher than the 1951 price, in contrast to the 171 percent increase registered by the PPI over this period.[73] Electronic auto testing outfits, with a catalog index rising 33 percent between 1947 and 1983, are compared with the same PPI group index, which rises by 442 percent. Here we find no contest between the clumsy seven-gauge 1947 tester and the 1983 professional electronic analyzer capable of performing thirty different tests for a price 46 percent lower.[74] Another comparison is between

73. The 1951 model ($39.95) has a four-inch dial and a range from 0 to 5,000 rpm. The 1976 model ($49.99) is solid state, has a 3.5-inch dial and a range from 0 to 8,000 rpm.

74. The seven-gauge output in 1947 was priced at $186. The "professional" thirty-test analyzer in 1983 was listed at $99.99 and the plain seventeen-test "analyzer" at $69.99. The eight-test 1983 meter was priced at $39.99.

a 1947 generator tester with dual meters that displayed only the generator's amps and volts with, for a 1983 price only 16 percent higher, an eight-test meter capable of testing rpm, dwell, alternator/generator, voltage regulator, point resistance, and battery voltage. There seems little doubt that the matched-model Sears index overstates the true increase in price for this product. Model substitutions are too frequent to allow a comparison of panel-type ammeters for the full postwar period, but for the shorter period 1947–67 Sears sold exactly the same model with a twenty-year price increase of just 10 percent (over which period the comparable PPI rose by 105 percent).

Comparisons are easier for simple indoor electric safety switches. Over 1947–83, the catalog index rises 314 percent and the detailed PPI eight-digit index for exactly the same product 644 percent, more than twice as much. Identical Sears thirty-amp two-fuse switches increased in price over the same period by 336 percent (the catalog index increases less than this switch because of the presence for part of the postwar period of other models that exhibited a smaller price increase). For circuit breakers, the Sears and PPI indexes increase between 1947 and 1967 by 155 and 550 percent, respectively. It is actually possible to find a single-pole fifteen-amp circuit breaker in the 1983 catalog for only 5 percent more than the same product in 1947.[75] The Sears index increases more than this, because it is based on larger 60 and 100 amp multibranch breakers.

While the catalog index covers only relatively small items sold directly to consumers, we should recall that evidence was provided in early hedonic research of a marked bias in the PPI for large electrical transformers and other apparatus. I have linked together a hedonic regression index created by Irving Kravis and Robert Lipsey (1971) for power transformers over the period 1957–64 with a regression index for 1954–57 developed by Charles Dean and Horace DePodwin (1961) using a similar methodology.[76] Both the Kravis-Lipsey and Dean-DePodwin studies were notable for their use of prices paid by buyers instead of list prices charged by sellers. Their linked regression index declines by 57 percent over a decade in which the PPI index increases by 6 percent; the annual rate of drift of their index relative to the PPI is very high, −9.2 percent per annum, which is higher than for any other product studied in this chapter, with the single exception of electronic calculators. Unfortunately, evidence on large electrical apparatus is not available for the years since 1964, and even the Kravis-Lipsey evidence has the disadvantage that it is based on export prices, not domestic prices, and could be expected to differ from the PPI for that reason alone. I doubt that the export-domestic distinction could come close to explaining the drift of the Kravis-Lipsey index

75. The price in 1947 was $4.75 and in 1983 was $4.99.
76. The Kravis-Lipsey index is reported in (1971, table 13.28, p. 418, eq. 12).

relative to the PPI, since there is no apparent reason why such a divergence should have happened in this period, which is entirely one of fixed exchange rates when there were no changes in exchange rates between the United States and its major trading partners.

10.12 Furniture and Fixtures

The NIPA PDE deflator for the "furniture and fixtures" industry group combines four PPI three-digit and four-digit group indexes for household and commercial furniture, general millwork, and metal doors. Since most of the NIPA weight in this group is allocated to a PPI group index that includes just a few types of basic metal commercial furniture, matched model catalog indexes were developed for these items, while wood commercial and household furniture was excluded. Catalog indexes were developed for six products. Four of these—steel desk, swivel office chair, fluorescent lighting fixtures, and filing cabinets—exactly match eight-digit PPI commodity indexes (which are not used directly in the PDE). Two other products—typewriter tables and card files—are included as well.

The comparability of the catalog indexes and the eight-digit PPIs for the first four of these products is quite close, although we must recognize that furniture comes in many sizes and styles, so that the catalog indexes must be constructed with more than the usual attention to careful matching of models in pairs of adjacent years. For the other two products, the match is less close. Typewriter tables are compared to the four-digit group index for metal commercial furniture, and card files to the PPI for filing cabinets.

All six catalog indexes rise more slowly than the comparable PPIs. The annual rate of drift ranges from -0.1 percent for steel desks to -2.0 percent per year for office swivel chairs. The rate of drift for typewriter tables is quite rapid through 1967 (see App. table B.8), and in fact the Sears index registers only a small increase of 11 percent between 1947 and 1967, as contrasted to an increase of 77 percent in the PPI. We find exactly the same model sold in the 1948 and 1966 catalogs for \$5.29 and \$4.89, respectively.[77] The story is similar for card files, with all the downdrift concentrated in 1947–70, over which period the catalog index increased by just 33 percent, in contrast to 125 percent for the PPI. Two models of card files were priced and were identical throughout the 1947–70 period, so that a comparison of similar models yields the same increase as the matched-model index.[78] For fluorescent lighting fixtures, the 1947–83 increase is 111 percent for the catalog index and 294 percent for the PPI, yet the 1983 catalog contains a chain fluorescent

77. The model is 26.5 inches in height, 14 × 35 with shelves up, 14 × 18 with shelves down, has no drawer and no brakes.

78. A recheck of the 1947 and 1970 catalogs indicates that four rather than two identical models can be compared, with an overall price increase of 33 percent.

worklight, with two forty-watt bulbs and "rapid start" selling for only 19 percent more than the same fixture in 1947 without rapid start.[79]

Steel metal desks are the product exhibiting the closest price increase of the catalog index and the PPI over the 1950–83 interval, 324 and 345 percent, respectively. Yet an inspection of the 1950 and 1983 catalogs shows that similar steel desks could be purchased at a price increase in the latter year of just 132 percent.[80] For filing cabinets, the respective increases of the catalog index and PPI over the interval 1950–83 are 206 and 415 percent. One can find essentially identical models in 1950 and 1983 exhibiting a price increase of just 120 percent.[81] This result is particularly interesting, since filing cabinets are a familiar product that has remained essentially untouched by technological change for many decades. Finally, the respective catalog and PPI increases over 1950–83 for swivel office chairs are 129 and 342 percent. One can find a 1982 model of roughly the same size and weight of a 1952 model at a price that is 80 percent higher (for this interval, the increases of the catalog index and PPI are 93 and 255 percent).

10.13 Agricultural Machinery (Including Garden Tractors and Excluding Farm Tractors)

The PDE deflator for agricultural machinery (excluding tractors) is based on eleven six-digit PPI group indexes for the different major types of agricultural machinery. We have nine catalog products, four of which are tractor-drawn apparatus, with good representation in most of the PPI categories but none at all in the most important, combines and other harvesting machinery. This section also discusses a tenth Sears product, garden tractors (the hedonic price index for full-scale farm tractors was developed in chapter 9).

The match between the Sears and PPI indexes is quite close, since eight-digit PPI product indexes are available for comparison with all but one of the Sears products. Overall, except for garden tractors, the ratio of the Sears index to the PPI exhibits less of a tendency to drift downward than in any of the other industry groups covered in this chapter. The annual rate of change of the ratio ranges from 1.6 to −1.7 percent, with moderate positive drift for five products, no drift for one, and moderate negative drift for five.

79. The respective prices are $15.95 and $18.99. The only difference evident is that the 1947 model is fifty inches long, versus forty-eight inches in 1983. Bulbs are included in both cases.

80. Both the 1947 and 1983 are 30 × 60 inch steel desks with a file drawer and lock. The top of the 1947 model is linoleum and that of the 1983 model is walnut-grain plastic. The prices are $94.50 and $219.99.

81. Both are two-drawer metal file cabinets with a lock and built-in card holders on the front of each drawer. The 1983 model is superior both because it is eighteen inches deep as contrasted to sixteen inches for the 1947 model, but also because the listing describes "large rollers," in contrast to no mention of rollers in 1947.

This leaves garden tractors, where the downdrift of the Sears/PPI ratio is relatively rapid. The 1949–83 increase in the Sears index is only 43 percent, as contrasted with 276 percent for the PPI. No direct comparison is possible, since the sole 1949 model was a 1.6 hp "walk-behind" recoil-start model sold without tires (!) for $182.50, while in 1983 the smallest model was a 16 hp riding tractor with tires, electric start, and a variable three-speed transmission for $1,999.99. However, in between there is a comparison that dramatizes the slow rate of price increase for this product. The first riding model introduced by Sears at $615.00 in 1954 had 6 hp and recoil start; in 1977 for $789.00 one could purchase an 8 hp model with electric start, four-speed transmission, and "auto-type differential." This increase of 28 percent over 1952–77 for what is clearly a superior model contrasts with the respective increases of the catalog index and PPI of 27 and 114 percent, respectively.

10.14 Construction Machinery (Except Tractors)

The NIPA PDE deflator is based on nine PPI indexes; five of these are four-digit group indexes, one is a six-digit group index, and three are eight-digit commodity indexes for "tractors other than farm." This category is probably the one covered in this chapter for which the coverage is most inadequate. We face the same problem as for agricultural machinery, but in a more aggravated way: the largest and most complex items included in the NIPA deflator are not listed in the Sears catalog. We have two products, a post-hole digger and a roto-spader, for which the PPIs are in a four-digit category allocated 18 percent of the 1967 weight in the PDE deflator. Also included is a portable concrete mixer, and three products previously described in section 10.11 on general industrial equipment, stationary air compressors, centrifugal pumps, and chain hoists.

The comparability of the catalog indexes and PPIs is mixed at best. Both the post-hole digger and roto-spader are compared to the closest available PPI eight-digit index, that called "trencher." The portable concrete mixer is compared to a PPI eight-digit index, which presumably prices much larger units. On the other hand, the catalog indexes described above for air compressors, pumps, and chain hoists are matched quite closely.

The ratio of the catalog index to the PPI for all three of the new products introduced in this section exhibits a downdrift over the postwar period. The annual rate of drift is a relatively rapid −3.3 percent for the post-hole digger (1956–83) and −3.0 percent for the roto-spader (1948–81) but a negligible −0.8 percent for the portable concrete mixer. The catalog index and PPI for post-hole diggers increase by very different percentages, 128 and 461, over the 1956–83 interval. One can find almost identical models listed in 1956 and 1976 exhibiting a price increase of 39 percent over that interval, as compared

to 30 percent for the catalog index and 149 percent for the PPI.[82] For roto-spaders over the interval 1948–80, the catalog indexes and PPI increase by 123 and 422 percent. For this product, the catalog index seems to overstate the price increase implied by a comparison of similar models. Between 1948 and 1970, the catalog index is almost constant when the PPI nearly doubles, yet one can compare a 1948 model of only 2 hp having a cut width ranging from fourteen to twenty-one inches and priced at $137.95 with a 1970 model of 3.5 hp having a cut width of from eleven to twenty-two inches and priced at $117.88. The same 1970 model was available in 1976 for $194.95, a price increase of 41 percent over the inferior 1948 model, in contrast to 1948–76 price increases of 77 and 196 percent for the catalog index and PPI. This kind of difference suggests that the price per unit of quality must have fallen substantially when new models of this product were introduced, since the Sears index is based only on the prices of identical models.

Mention should be made here of the Early and Sinclair (1983) hedonic regression study of power cranes (hydraulic, truck, and crawler). Their results yield a hedonic price index for all three types of cranes for the period 1971–77 that is essentially indistinguishable from the PPI for the same product. This small tidbit of evidence supporting the PPI does not detract from the large number of indexes developed here that differ from the PPI. Of the products discussed in this book, that closest to power cranes is tractors, for which hedonic price indexes were developed in chapter 9. We find less than a 2 percent difference in the 1971–77 increase of the PPI tractor index and the new tractor index (see App. table B.12), suggesting that the PPI could well be right for some products in this period but misleading for other products and over longer periods.

10.15 Service-Industry Machinery and Electrical Equipment, n.e.c.

The industry-by-industry examination concludes with the two final industry categories, service-industry machinery and electrical equipment "not elsewhere classified." This section is short, simply because most of the Sears catalog indexes used in these two categories have already been discussed. Fully 64 percent of the 1967 weight in the service-industry machinery category of PDE is allocated to PPI product indexes that we have already examined. About 43 percent of the weight is allocated to five major household appliances that we studied in chapter 7 (washers, dryers, refrigerators, room air conditioners, and under-counter dishwashers). Another 18 percent is allocated to products examined previously in this chapter (power sanders, pumps and compressors, and domestic water heaters). Most of the remaining

82. A 3 hp, one-man digger, two-cycle engine, at $114.95 in 1956 and $159.95 in 1976. There was a model change in 1970, but the models overlapped and sold for within 2 percent of the same price in that year.

weight is allocated to a four-digit group code for "food products machinery" and a six-digit group for coin-operated vending machines.

This section develops only two new indexes for minor appliances, commercial vacuum cleaners and automatic coffee makers, that had new eight-digit PPI product indexes introduced in the early 1970s, thus allowing a close comparison with Sears catalog prices. The match between the catalog and the PPI product definitions is exact for coffee makers but not for vacuum cleaners, since unfortunately the PPI for vacuum cleaners was published in some but not all years over the 1972–83 interval. The resulting Sears/PPI ratios show a negligible downdrift for vacuum cleaners but a significant downdrift for automatic coffee makers at a rate of −7.0 percent per annum over 1972–83. The Sears index registers a 14 percent decline, while the PPI more than doubles. An examination of the catalog suggests a partial explanation, as this product category appears to be one in which old-fashioned electric perk coffee makers increased in price, while the more modern automatic drip models introduced in the early 1970s have fallen in price. For instance, a 1975 four- to eight-cup electric perk model can be matched exactly with the same model in 1983 at a price 48 percent higher. Yet over the same interval it is possible to find automatic drip models that declined in price 22 percent while improving in quality.[83]

In the electrical equipment n.e.c. category, 25 percent of the 1967 weight in the PDE deflator is allocated to PPIs for which we have already developed alternative indexes, including water heaters, lighting fixtures, major appliances, vacuum cleaner, and small electric appliances. The only new product introduced in this section is storage batteries, which receive a 1967 weight of 17 percent. The Sears catalog index for automobile replacement batteries is matched with the PPI for precisely the same product. The 1948–83 drift of the Sears/PPI ratio is a positive 0.8 percent per annum, and this occurs entirely in the last two years (1981–83), when the PPI falls while the Sears index increases rapidly. Perhaps it is fitting that we end with this product, which shows that the Sears/PPI drift can go in either direction.

10.16 Behavior of the Average Sears/PPI Ratio

10.16.1 Alternative Average Indexes

The study of Sears catalog price quotations summarized in this chapter has compiled sixty-eight unduplicated product price indexes based on 7,242 unduplicated price observations for adjacent-year price changes of individual models. This works out at 196 observations per year, and 3.3 models per

83. In 1975, a ten-cup automatic drip model with no water-level indicator or on-off switch was priced at $29.49, while a ten-cup automatic drip model with 1983 with water-level indicator, signal light, and off-on switch sold for $22.99.

Table 10.8 **Sears Products and Corresponding PPIs by Component of NIPA PDE Deflator**

Sears Products (1)	PPI Code by Year (2)	PPI Description (3)
Office, computing, and accounting machinery:		
1. 10-key adding machine	1947–60: 11-53-02	10-key adding machine
	1961–76: 11-93-01-07	Adding machine, electric, 10 key
	1977–83: 11-93-01	Calculating and accounting machines
2. Cash register	1953–59: 11-93-01	Calculating and accounting machines
	1960–76: 11-93-01-06	Cash register, electro-mechanical
	1977–78: 11-93-01-11	POS cash register, electric
	1979–83: 11-93-01	Calculator and accounting machines
3. Manual typewriter	1948–83: 11-93-03-13	Typewriter, manual portable
4. Electric typewriter	1958–68: 11-93-03-12	Typewriter, electric
	1969–83: 11-93-03-14	Typewriter, portable electric
5. Calculator	1970–76: 11-93-01-03	Calculator, electronic, nonprinting
	1979–80: 11-93-01-05	Calculator, electronic, printing
	1981–83: 11-93-01	Calculating and accounting machines
Communication equipment:		
6. Radio receiver	1947–52: 12-5	Home electronic equipment
	1953–72: 12-51-01-02	Radio, table
	1973–83: 12-51	Radio receivers
Fabricated metal products:		
7. Gas warm air furnace	1951–83: 10-62-01-42	Warm air furnace, steel, forced air, gas
8.*Gas hot water heater	1948–67: 10-66	Water heater, domestic
	1968–83: 10-66-01-13	Water heater, domestic, gas
	1948–80: 10-72-01-01	Pressure tank, above ground
9. Water storage tank	1981–83: 10-72	Metal Tanks
10. Brass gate valve	1947–82: 11-49-01-02	Gate valve, brass or bronze, one inch
	1983: 11-49-02-01	Gates, globes, angles, and checks
11. Steel safe	1947–83: 11-93-05-21	Safe, cabinet-type
12. PVC piping	1967–69: 10-25-02-52	Copper water tubing, straight lengths
	1970–78: 07-21-01-02	Rigid PVC pressure pipes
	1979–83: 07-21	Plastic construction products
13. Electric furnace	1972–82: 10-62-01-59	Electric furnace, forced-air, ten kilowat
14. Electric hot water heater	1968–83: 10-66-01-01	Water heater, domestic
15. Prefabricated metal building	1961–81: 10-74-01-45	Metal building, steel, rigid frame
	1982–83: 10-79	Prefabricated metal buildings
16. Chain link fence	1955–83: 10-88-06-13	Chain link fencing
Engines and turbines:		
17.*Outboard motor	1948–83: 11-94-02-11	Outboard motor, 5–15 hp.
Metalworking machinery:		
18. Drill press	1947–72: 11-3	Metalwork, machinery and equipment
	1973–83: 11-37-12	Drilling machines
19. Metal lathe equipment	1947–71: 11-3	Metalwork, machinery and equipment
	1972–83: 11-37-14	Lathes
	1977–83: 11-3	Metalwork, machinery and equipment
20. Free-standing power saw	1947–83: 11-3	Metalwork, machinery and equipment
21. ¼ inch hand power drill	1947–79: 11-32-02-21	Drill quarter inch
	1980–83: 11-32-02	Home utility line, electrical
22. ½ inch hand power drill	1947–79: 11-32-03-02	Drill half inch
	1980–83: 11-32-03	Industrial line, electrical
23. Hand power saw	1947–82: 11-32-02-23	Circular saws
	1983: 11-32-02	Home utility line, electrical
24. Hand electric sander	1947–83: 11-32-02-24	Sanders, orbital
25. Transformer arc welder	1947–83: 11-33-01-01	Arc welder, transformer type
26. Acetylene welding torch	1947–82: 11-33-04-52	Welding torch, blow type
	1983: 11-33-04	Gas welding, machine and equipment

Table 10.8 (continued)

Sears Products (1)	PPI Code by Year (2)	PPI Description (3)
27. Acetylene cutting tool	1947–83: 11-33-04-53	Cutting tool, blow type
28. Acetylene single-stage welding outfit	1947–83: 11-33-04-54	Flame cutting machine
29. Drill bit	1947–83: 11-35-01-03	Twist drill
30. Power saw blades	1947–82: 11-35-01-29	Power saw blades, hack
	1983: 11-35-03	Metal working power saw
31. Micrometer caliper	1947–83: 11-35-02-42	Micrometer caliper
General industrial, including materials handling, equipment:		
32. Stationary air compressor	1947–70: 11-41-03-03	Stationary air compressor, 75–125 hp
	1971–83: 11-41-03-01	Stationary air compressor, 5 hp
33. Centrifugal pump equipment	1947–70: 11-41-02-08	Centrifugal pump, 3,000 gpm
	1971–72: 11-41-02-21	Centrifugal pump
	1973–83: 11-41-02-04	Centrifical pumps, 90 gpm
34. Differential chain hoist	1948–77: 11-44-94-01	Hand chain hoist, spur gear
35. Propellor fan	1948–83: 11-47-01-11	Propellor fan
36. Fire extinguisher	1947–83: 15-99	Fire extinguisher
Electrical transmission, distribution, and industrial apparatus:		
37. Tachometer	1947–83: 11-72-01	Electrical (direct measurement) instrument
38. Electronic auto tester	1947–83: 11-72-01	Electrical (direct measurement) instrument
39. Panel-type ammeter	1947–83: 11-72-01	Electrical (direct measurement) instrument
40. Fractional HSP electric motor	1947–82: Average of 11-73-01-05, 11-73-01-06	A-C fractional electric motor
	1983: 11-73-03	Fractional HP motors and generators
41. Voltage regulator	1947–80: 11-74-01-21	Feeder voltage regulators
	1981–83: 11-74	Transformers and power regulators
42. Fusible-type panelboard	1950–83: 11-75-01-01	Panelboard, distribution, fusible
43. Circuit breaker-type	1954–83: 11-75-01-02	Panelboards, lighting, circuitbreaker
44. Indoor safety switch	1947–83: 11-75-02-12	Safety switch, a-c, 3 pole, 60 A
45. Circuit breaker	1947–83: 11-73-03-21	Air circuit breaker, a-c
46. Outdoor power switch	1947–64: 11-75-02-12	Safety switch, a-c, 3 pole, 60 A
	1965–74: 11-75-04-51	Disconnect switch, 600 A
	1975–82: 11-75-04-53	
Furnitures and fixtures:		
47. Typewriter table	1947–83: 12-22	Metal commercial furniture
48. Card file	1947–78: 12-22-01-21	Metal filing cabinets
49. Fluorescent lighting	1947–60: 12-22	Metal commercial furniture
	1961–80: 10-83-01-31	Commercial fluorescent, non–air handling lighting fixtures
	1981–83: 10-83-03-23	Commercial fluorescent fixtures, recessed non-air
50. Steel desk	1947–67: 12-22	Metal commercial furniture
	1968–76: 12-22-01-01	Clerical and secretarial desks
	1977–79: 12-22	Metal commercial furniture
	1980–83: 12-22-03-21	Desks and extensions
51. Filing cabinet	1950–79: 12-22-01-21	Metal filing cabinet
	1980–83: 12-02-02-01	Vertical filing cabinets
52. Office swivel chair	1947–83: 12-22-01-11	Office swivel chair
Tractors:		
53. Garden tractor	1949–83: 11-11-05-22	Garden tractor, riding type

(*continued*)

Table 10.8 (continued)

Sears Products (1)	PPI Code by Year (2)	PPI Description (3)
Agricultural machinery, except tractors:		
54. Tractor-drawn plow	1948–83: 11-12-01	Plow
55. Tractor-drawn harrow	1948–82: 11-12-02-13	Harrow, disc drawn
	1983: 11-12-03	Planting, seeding, and fertilizing machinery
56. Seeder	1947–83: 11-12-03-22	Drawn corn planter
57. Manure spreader	1950–83: 11-12-03-25	Manure spreader, PTO driven
58. Tractor-drawn cultivator	1949–72: 11-12-04	Cultivators
	1973–82: 11-12-04-36	Cultivators, rear mounted, 4 row
	1983: 11-12-04	Cultivators
59. Sprayer	1947–61: 11-12-05	Sprayers and dusters
	1962–82: 11-12-05-44	Field sprayer, tractor mounted
	1983: 11-12-05	Sprayers and dusters
60. Tractor-mounted mower	1949–83: 11-12-07-62	Mower, mounted
61. Portable farm elevator	1947–67: 11-12	Agricultural machinery, except tractors
	1968–75: 11-12-09	Farm elevators and blowers
	1976–83: 11-12-09-81	Farm elevator, portable, double chain
62. Poultry brooder	1947–77: 11-13-01-03	Gas poultry brooders
	1978–83: 11-13-01	Poultry equipment
Construction machinery, except tractors:		
63. Post-hole digger	1956–83: 11-23-01-01	Trencher
64. Roto spader	1948–81: 11-23-01-01	Trencher
65. Portable concrete mixer	1947–83: 11-27-01-11	Portable mixers, 3.5 cubic feet and over
[32] Stationary air compressor	1947–70: 11-41-03-03	Stationary air compressors, 75–125 hp
	1971–83: 11-41-03-01	Stationary air compressors, 5 hp
[33] Centrifugal pump	1947–70: 11-41-02-08	Centrifugal pump, 3,000 gpm
	1971–72: 11-41-02-21	Centrifugal pump
	1973–83: 11-41-02-04	Centrifugal pump, 300 gpm
[34] Differential chain hoist	1948–83: 11-44-94-01	Hand chain hoist, spur gear
Service industry machinery:		
[7] Gas warm air furnace	1951–83: 11-62-01-42	Warm air furnace, steel, forced air, gas, 72–88 thousand BTU
[8] Gas hot water heater	1948–66: 10-66	Water heaters domestic
	1967–83: 10-66-01-13	Gas water heaters, domestic
[24] Hand electric sander	1947–83: 11-32-02-24	Orbital sanders
66. Commercial vacuum cleaner	1972–81: 12-43-01-11	Canister, tank, and other general purpose vacuum cleaners
	1982–83: 11-68-01-11	Commercial and industrial vacuum cleaners and parts
67. Automatic coffee maker	1972–83: 12-44-01-13	Automatic coffee maker
Electrical equipment, n.e.c.:		
68. Replacement auto battery	1948–83: 11-79-01-01	Storage battery, automotive, 12-volt, replacement
[37] Tachometer	1947–83: 11-72-01	Electrical (direct measurement) instrument
[38] Electronic auto tester	1947–83: 11-72-01	Electrical (direct measurement) instrument
[39] Panel-type ammeter	1948–83: 11-72-01	Electrical (direct measurement) instrument

Table 10.8 (continued)

Sears Products (1)	PPI Code by Year (2)	PPI Description (3)
[49] Fluorescent lighting fixtures	1947–60: 12-22	Steel furniture and store fixtures
	1961–80: 10-83-01-31	Commercial fluorescent non-air handling lighting fixtures
	1981–83: 10-83-03-23	Commercial fluorescent fixtures, non-air
[66] Commercial vacuum cleaner	1972–81: 12-43-01-11	Canister, tank, and all general purpose vacuum cleaners
	1982–83: 11-68-01-11	Commercial and industrial vacuum cleaners

Note: Brackets indicate a product appearing for the second time. The number inside the bracket is the chronological number of its first appearance. No product appears more than twice.

*Indicates hedonic.

Table 10.9 **Growth Rates of Ratio of Sears Indexes to Corresponding PPIs, 1947–83 and Subintervals, by NIPA PDE Order**

	Annual Growth Rates			
Sears Products[a]	Full Period of Data (1)	1947–60 (2)	1960–73 (3)	1973–83 (4)
Office, computing, and accounting machinery:				
1. 10-key adding machines	−3.6 (1947–83)	−5.3	−2.5	−2.8
2. Cash registers	−2.3 (1953–78)	1.2	−4.1	−2.5
3. Manual standard typewriters	−1.3 (1948–83)	−2.5	−1.7	0.8
4. Standard electric typewriters	−2.2 (1958–83)	−15.1	−2.7	1.1
5. Electronic calculators	−12.7 (1970–83)	[b]	−34.0	−6.3
Communication equipment:				
6. Radio receivers	−0.5 (1947–83)	0.2	−0.7	−1.1
Fabricated metal products:				
7. Gas warm air furnaces	0.2 (1951–83)	1.1	−0.7	0.7
8.*Gas hot water heaters	−1.6 (1947–83)	−1.2	−1.9	−1.7
9. Water storage tanks	0.2 (1948–83)	0.7	0.7	−1.0
10. Brass gate valves	−1.4 (1947–83)	−4.7	0.3	0.5
11. Steel safes	−2.2 (1947–83)	−3.3	−2.6	−0.4
12. PVC piping	0.8 (1967–83)	[b]	−3.1	3.1
13. Electric furnaces	−1.3 (1972–82)	[b]	−0.7	−1.3
14. Electric hot water heaters	1.4 (1968–83)	[b]	3.2	0.5
15. Prefabricated metal buildings	0.6 (1961–83)	[b]	−0.1	1.5
16. Chain link fences	−0.2 (1955–83)	−1.1	−0.3	0.3
Engines and turbines:				
17.*Outboard motors	−0.9 (1948–83)	−2.1	−0.1	−0.7
Metalworking machinery:				
18. Drill presses	−1.0 (1947–83)	−2.6	0.4	−0.8
19. Metal lathes	−0.2 (1947–83)	1.2	−0.1	−2.1
20. Free-standing power saws	−2.3 (1947–83)	−4.5	−2.0	−0.1
21. ¼ inch hand power drills	−2.0 (1947–83)	−1.2	0.1	−5.8
22. ½ inch hand power drills	−2.3 (1949–82)	−1.0	−2.5	−3.5

(*continued*)

Table 10.9 (continued)

Sears Products[a]	Annual Growth Rates: Full Period of Data (1)	1947–60 (2)	1960–73 (3)	1973–83 (4)
23. Hand power saws	−0.4 (1947–83)	−2.8	0.4	1.9
24. Hand electric sanders	−1.3 (1947–83)	0.1	0.0	−4.9
25. Transformer arc welders	0.0 (1947–83)	3.9	−0.5	−4.4
26. Acetylene welding torches	−1.4 (1947–83)	−3.6	1.0	−1.6
27. Acetylene cutting tools	−1.5 (1947–83)	−2.0	0.5	−3.6
28. Acetylene single-stage welding outfits	−2.0 (1947–83)	−4.0	0.0	−2.2
29. Drill bits	0.4 (1947–83)	−4.0	3.7	1.6
30. Power saw blades	−2.5 (1947–83)	−6.9	2.0	−2.7
31. Micrometer calipers	0.7 (1947–83)	−0.3	1.3	1.3
General industrial, including materials handling, equipment:				
32. Stationary air compressors	−3.8 (1947–83)	−4.5	−4.9	−1.4
33. Centrifugal pumps	−2.8 (1947–83)	−6.9	0.0	−1.1
34. Differential chain hoists	−0.5 (1948–83)	−0.8	−0.6	0.0
35. Propellor fans	−2.7 (1948–83)	−3.2	−2.9	−2.0
36. Fire extinguishers	−0.9 (1947–83)	0.2	0.1	−3.6
Electrical transmission, distribution, and industrial equipment:				
37. Tachometers	−4.1 (1947–83)	−5.6	−4.1	−2.2
38. Electronic auto testers	−3.9 (1947–83)	−3.9	−3.5	−4.3
39. Panel-type ammeters	−1.8 (1948–83)	−2.7	−1.8	−0.8
40. Fractional HSP electric motors	0.5 (1947–83)	1.5	0.9	−1.4
41. Voltage regulators	0.5 (1947–79)	−3.7	1.6	7.0
42. Fusible-type panelboards	1.6 (1950–83)	4.2	1.2	−0.5
43. Circuit breaker-type panelboards	−0.7 (1954–83)	−2.3	−0.6	−0.2
44. Indoor safety switches	−1.6 (1947–83)	−4.4	0.5	−0.8
45. Circuit breakers	−2.5 (1947–83)	−1.7	−3.6	−2.2
46. Outdoor power switches	−0.2 (1948–82)	−1.3	3.1	−3.3
Furnitures and fixtures:				
47. Typewriter tables	−1.0 (1947–83)	−3.3	−1.5	2.6
48. Card files	−1.0 (1947–78)	−3.7	−0.9	5.7
49. Fluorescent lighting fixtures	−1.5 (1947–83)	−3.9	0.9	−1.6
50. Steel desks	−0.1 (1950–83)	1.6	−0.5	−1.3
51. Filing cabinets	−1.6 (1950–83)	−1.8	−2.6	0.0
52. Office swivel chairs	−2.0 (1949–83)	−4.3	−0.5	−1.4
Tractors:				
53. Garden tractors	−2.8 (1949–83)	−4.7	−1.0	−3.1
Agricultural machinery, except tractors:				
54. Tractor-drawn plows	0.7 (1948–83)	−4.5	5.7	0.5
55. Tractor-drawn harrows	0.9 (1948–83)	1.0	0.8	0.9
56. Seeders	−1.2 (1947–83)	−1.8	−1.2	−0.3
57. Manure spreaders	0.1 (1950–83)	−0.5	−0.6	1.5
58. Tractor-drawn cultivators	−0.9 (1949–83)	−1.0	0.2	−2.1
59. Sprayers	1.6 (1947–83)	0.7	1.7	2.6
60. Tractor-mounted mowers	−1.7 (1949–83)	−2.6	−0.3	−2.5
61. Portable farm elevators	0.5 (1948–83)	−2.6	0.3	4.5
62. Poultry brooders	−0.2 (1947–83)	−3.1	−0.3	−3.5

Table 10.9 (continued)

Sears Products[a]	Annual Growth Rates: Full Period of Data (1)	1947–60 (2)	1960–73 (3)	1973–83 (4)
Construction machinery, except tractors:				
63. Post-hole diggers	−3.3 (1956–83)	−3.2	−2.6	−4.4
64. Roto spaders	−3.0 (1948–81)	−3.7	−2.3	−2.9
65. Portable concrete mixers	0.8 (1947–83)	−0.1	−0.2	3.4
[32] Stationary air compressors	−3.8 (1947–83)	−4.5	−4.9	−1.4
[33] Centrifugal pumps	−2.8 (1947–83)	−6.9	−0.0	−1.1
[34] Differential chain hoists	−0.5 (1948–83)	−0.8	−0.6	0.0
Service industry machinery:				
66. Commercial vacuum cleaners	0.4 (1972–83)	[b]	2.7	0.2
67. Automatic coffee makers	−7.0 (1972–83)	[b]	−0.8	−7.6
[7] Gas warm air furnaces	0.2 (1951–83)	1.1	−0.7	0.7
[8]* Gas hot water heaters	−1.6 (1947–83)	−1.2	−1.9	−1.7
[24] Hand electric sanders	−1.3 (1947–83)	0.1	0.0	−4.9
Electrical equipment, n.e.c.:				
68. Replacement auto batteries	0.8 (1948–83)	−0.4	0.6	2.5
[37] Tachometers	−4.1 (1947–83)	−5.6	−4.1	−2.2
[38] Electronic auto testers	−3.9 (1947–83)	−3.9	−3.5	−4.3
[39] Panel-type ammeters	−1.8 (1948–83)	−2.7	−1.8	−0.8
[49] Fluorescent lighting fixtures	−1.5 (1947–83)	−3.9	0.9	−1.6
[66] Commercial vacuum cleaners	0.4 (1972–83)	[b]	2.7	0.2

[a]Entry number from table 10.8.

[b]No data for this subinterval.

*Indicates hedonic.

Table 10.10 **Growth Rates of Ratio of Sears Indexes to Corresponding PPIs, 1947–83 and Subintervals, in Ascending Order**

Sears Products	Annual Growth Rates: Full Period of Data (1)	1947–60 (2)	1960–73 (3)	1973–83 (4)
5. Electronic calculators	−12.7 (1970–83)	[b]	−34.0	−6.3
67. Automatic coffee makers	−7.0 (1972–83)	[b]	−0.8	−7.6
37. Tachometers	−4.1 (1947–83)	−5.6	−4.1	−2.2
38. Electronic auto testers	−3.9 (1947–83)	−3.9	−3.5	−4.3
32. Stationary air compressors	−3.8 (1947–83)	−4.5	−4.9	−1.4
1. 10-key adding machines	−3.6 (1947–83)	−5.3	−2.5	−2.8
63. Post-hole diggers	−3.3 (1956–83)	−3.2	−2.6	−4.4
64. Roto spaders	−3.0 (1948–81)	−3.7	−2.3	−2.9
33. Centrifugal pumps	−2.8 (1947–83)	−6.9	0.0	−1.1
53. Garden tractors	−2.8 (1949–83)	−4.7	−1.0	−3.1
35. Propellor fans	−2.7 (1948–83)	−3.2	−2.9	−2.0

(*continued*)

Table 10.10 (continued)

Sears Products	Annual Growth Rates: Full Period of Data (1)	1947–60 (2)	1960–73 (3)	1973–83 (4)
30. Power saw blades	−2.5 (1947–83)	−6.9	2.0	−2.7
45. Circuit breakers	−2.5 (1947–83)	−1.7	−3.6	−2.2
2. Cash registers	−2.3 (1953–78)	1.2	−4.1	−2.5
20. Free-standing power saws	−2.3 (1947–83)	−4.5	−2.0	−0.1
22. ½ inch hand power drills	−2.3 (1949–82)	−1.0	−2.5	−3.5
4. Standard electric typewriters	−2.2 (1958–83)	−15.1	−2.7	1.1
11. Steel safes	−2.2 (1947–83)	−3.3	−2.6	−0.4
21. ¼ inch hand power drills	−2.0 (1947–83)	−1.2	0.1	−5.8
28. Acetylene single-stage welding outfits	−2.0 (1947–83)	−4.0	0.0	−2.2
52. Office swivel chairs	−2.0 (1949–83)	−4.3	−0.5	−1.4
39. Panel-type ammeters	−1.8 (1948–83)	−2.7	−1.8	−0.8
60. Tractor-mounted mowers	−1.7 (1949–83)	−2.6	−0.3	−2.5
8.*Gas hot water heaters	−1.6 (1947–83)	−1.2	−1.9	−1.7
44. Indoor safety switches	−1.6 (1947–83)	−4.4	0.5	−0.8
51. Filing cabinets	−1.6 (1950–83)	−1.8	−2.6	0.0
27. Acetylene cutting tools	−1.5 (1947–83)	−2.0	0.5	−3.6
49. Fluorescent lighting fixtures	−1.5 (1947–83)	−3.9	0.9	−1.6
10. Brass gate valves	−1.4 (1947–83)	−4.7	0.3	0.5
26. Acetylene welding torches	−1.4 (1947–83)	−3.6	1.0	−1.6
3. Manual standard typewriters	−1.3 (1948–83)	−2.5	−1.7	0.8
13. Electric furnaces	−1.3 (1972–82)	[b]	−0.7	−1.3
24. Hand electric sanders	−1.3 (1947–83)	0.1	0.0	−4.9
56. Seeders	−1.2 (1947–83)	−1.8	−1.2	−0.3
18. Drill presses	−1.0 (1947–83)	−2.6	0.4	−0.8
47. Typewriter tables	−1.0 (1947–83)	−3.3	−1.5	2.6
48. Card files	−1.0 (1947–78)	−3.7	−0.9	5.7
17.*Outboard motors	−0.9 (1948–83)	−2.1	−0.1	−0.7
36. Fire extinguishers	−0.9 (1947–83)	0.2	0.1	−3.6
58. Tractor-drawn cultivators	−0.9 (1949–83)	−1.0	0.2	−2.1
43. Circuit breaker-type panelboards	−0.7 (1954–83)	−2.3	−0.6	−0.2
34. Differential chain hoists	−0.5 (1948–83)	−0.8	−0.6	0.0
6. Radio receivers	−0.5 (1947–83)	0.2	−0.7	−1.1
23. Hand power saws	−0.4 (1947–83)	−2.8	0.4	1.9
16. Chain link fences	−0.2 (1955–83)	−1.1	−0.3	0.3
19. Metal lathes	−0.2 (1947–83)	1.2	−0.1	−2.1
46. Outdoor power switches	−0.2 (1948–82)	−1.3	3.1	−3.3
62. Poultry brooders	−0.2 (1947–83)	−3.1	−0.3	−3.5
50. Steel desks	−0.1 (1950–83)	1.6	−0.5	−1.3
25. Transformer arc welders	0.0 (1947–83)	3.9	−0.5	−4.4
57. Manure spreaders	0.1 (1950–83)	−0.5	−0.6	1.5
7. Gas warm air furnaces	0.2 (1951–83)	1.1	−0.7	0.7
9. Water storage tanks	0.2 (1948–83)	0.7	0.7	−1.0
29. Drill bits	0.4 (1947–83)	−4.0	3.7	1.6
66. Commercial vacuum cleaners	0.4 (1972–83)	[b]	2.7	0.2
40. Fractional HSP electric motors	0.5 (1947–83)	1.5	0.9	−1.4
41. Voltage regulators	0.5 (1947–79)	−3.7	1.6	7.0
61. Portable farm elevators	0.5 (1948–83)	−2.6	0.3	4.5
15. Prefabricated metal buildings	0.6 (1961–83)	[b]	−0.1	1.5
31. Micrometer calipers	0.7 (1947–83)	−0.3	1.3	1.3
54. Tractor-drawn plows	0.7 (1948–83)	−4.5	5.7	0.5

Table 10.10 (continued)

Sears Products	Full Period of Data (1)	Annual Growth Rates 1947–60 (2)	1960–73 (3)	1973–83 (4)
12. PVC piping	0.8 (1967–83)	[b]	−3.1	3.1
65. Portable concrete mixers	0.8 (1947–83)	−0.1	−0.2	3.4
68. Replacement auto batteries	0.8 (1948–83)	−0.4	0.6	2.5
55. Tractor-drawn harrows	0.9 (1948–83)	1.0	0.8	0.9
14. Electric hot water heaters	1.4 (1968–83)	[b]	3.2	0.5
42. Fusible-type panelboards	1.6 (1950–83)	4.2	1.2	−0.5
59. Sprayers	1.6 (1947–83)	0.7	1.7	2.6

[a]Entry number from table 10.8.

[b]No data for this subinterval.

*Indicates hedonic.

product. In this section, I discuss the average growth rates of the Sears indexes and the counterpart PPIs, which are, for the most part, closely matched to cover the same products. Two weighting schemes are used. The first simply averages the yearly growth rates of the sixty-eight Sears product indexes and cumulates them into the "unweighted" Sears catalog index. The same is done for the sixty-eight corresponding PPIs, and the unweighted Sears/PPI ratio is calculated. The second is a Törnqvist index of the sixty-eight Sears and PPI growth rates, applying the weighting scheme developed below in chapter 12. There the annual Sears and PPI price index growth rates within each major PDE category (i.e., metalworking machinery) are weighted with the current share of nominal PDE in that category to total nominal PDE in the thirteen categories for which we have Sears catalog data. As in any Törnqvist index, nominal value shares for the average of the current year and most recent year are averaged and applied to the current year's growth rate. Within each of the thirteen PDE categories, the Sears and PPI indexes are weighted with the weight allocated to each particular covered product within the PDE deflator. Weights allocated to uncovered products are omitted. Thus, imagine that, in the PDE deflator within category 1 (say, metalworking machinery), a weight of 0.2 is allocated to product A, 0.1 to product B, 0.4 to product C, and 0.3 to product D. Imagine also that we have a Sears price index for products A and B, a price index from some other chapter of the book for product C, and no new information on product D. Then the Törnqvist index developed for this chapter will average together price changes for products A and B only within category 1, allocating weights of 0.1/0.3 and 0.2/0.3, with the remaining 0.7 weight unallocated.

The result of these two alternative weighting schemes is shown in table 10.11, where all figures shown are average annual logarithmic rates of growth, converted into percentages. The overall annual rate of drift of the

Table 10.11 **Annual Growth Rates of Sears Catalog and PPI Indexes, Alternative Weighting Schemes and Selected Intervals, 1947–83**

	1947–60	1960–73	1973–83	1947–83
Unweighted averages:				
68 Sears indexes	1.18	1.27	6.49	2.69
68 Matched PPIs	3.49	1.90	7.32	3.98
Difference, Sears/PPI	−2.30	−0.63	−0.83	−1.29
Törnqvist indexes:				
68 Sears indexes	0.76	−0.16	4.08	1.35
68 Matched PPIs	3.01	1.01	5.24	2.91
Difference, Sears/PPI	−2.25	−1.17	−1.16	−1.56

Sears/PPI ratio is −1.29 percent for the unweighted indexes and −1.56 percent per year for the Törnqvist indexes. As is evident in the behavior of the Sears and PPI indexes themselves, the Törnqvist method allocates more weight to those products that have less inflation in *both* the catalog indexes and the PPIs, in addition to yielding a greater average annual rate of drift. This occurs because there is a relatively large number of products (twenty-three out of the sixty-eight total) in two relatively small industries that have relatively rapid inflation and small drifts—the agricultural machinery industry (average Törnqvist PPI inflation = 5.49 percent per annum over 1947–83; drift = 0.70 percent per annum) and metalworking machinery industry (average Törnqvist PPI inflation = 4.58 percent; drift = −1.15 percent).

10.16.2 Determinants of the Drift

Could the drift between the catalog indexes and the corresponding PPIs be related to the technological complexity of products? If the problem with the PPI is a failure to control adequately for quality change, then this should be a more important problem for complex than for simple products. Another hypothesis, suggested by critics of earlier versions of this work on catalog price indexes, is that the drift results from mismatch between the catalog indexes and the PPIs. The PPI, it could be claimed, often prices items that are larger and of a heavier, industrial grade than the items intended for home and farm use that are sold by Sears.

To test these two hypotheses, I estimate a cross-sectional regression for the sixty-eight products, giving equal weight to each observation. The variable to be explained is the annual percentage rate of drift of the Sears/PPI ratio for each product over its full period of availability (recall that some Sears indexes begin after 1947 or end before 1983). Three explanatory variables are defined for each product. First is an index of technological complexity (TC), which assigns a "grade" to each of the sixty-eight products. Products with few or no moving parts (e.g., drill bit or chain-link fence) are assigned 1. More complex products lacking engines, motors, or heating devices are graded 2 (e.g., typewriter table, card file, and fire extinguisher). Products primarily

involving a heating device are graded 3 (e.g., hot water heater, furnace, and arc welder). Products primarily involving an engine or motor are graded 4 (e.g., power drill, power saw, and centrifugal pump). Products receiving the top grade of 5 involve both a motor or an engine and additional complexity in the form of moving parts and additional functions (e.g., garden tractor, drill press, metal lathe, and electric typewriter). To provide an additional dimension of complexity, a second variable (ED) was defined as a dummy for electronic components during part or all of the period. Products rated 1 rather than 0 for the ED variable were ten-key adding machine, cash register, electric typewriter, electronic calculator, and electronic auto tester. Then to test the hypothesis that the drift results from poor matching of Sears products with the corresponding PPIs, an index of the closeness of the Sears-PPI match (M) is developed. This starts at a grade of 1 for poor matches, where a Sears product is compared with a four-digit PPI group index rather than a specific six-digit or eight-digit product index. Examples are drill presses, metal lathes, and auto testing equipment. Grades of 2 or 3 are given where there is a presumption that the PPI typically prices larger items than are sold by Sears (e.g., water storage tanks). Grades of 4 or 5 are given for very close matches, where the Sears index corresponds exactly to a six-digit or eight-digit PPI that is specified to be in the same price range sold by Sears. Examples of products receiving grades of 5 include radio receivers, chain link fence, outboard motors, quarter-inch hand power drills (the PPI is explicitly for "home utility use"), differential chain hoist, fire extinguisher, indoor safety switch, filing cabinet, garden tractor, and replacement auto battery.

The estimated regression equation explaining the drift in the Sears/PPI ratio (S_i/I_i) is

$$(10.2)\quad 100{*}d\log(S_i/I_i) = \underset{[0.21]}{0.21} - \underset{[-2.28]}{0.44TC_i} - \underset{[-3.36]}{2.77ED_i} - \underset{[-0.15]}{0.03M_i};$$
$$R^2 = 0.25,\ S.E.E. = 1.87,$$

where t-ratios are shown in parentheses. Evidently, technological complexity and electronic components both contribute to a downdrift of the Sears indexes relative to the corresponding PPIs. It is also interesting that there is absolutely no relation between the closeness of the Sears-PPI match and the drift of the Sears/PPI ratio. The coefficients imply that the average annual percentage rate of drift for the simplest nonelectronic product is predicted to be -0.23, for the most complex nonelectronic product -1.99, for an average electronic product -3.88, and for the most complex electronic product -4.76.

10.16.3 Time Series Properties of the Sears Indexes

Several questions might be asked about the time series relation between the Sears index and the PPI. Is the average Sears index more or less volatile over the business cycle than the PPI? Does the adjustment of the typical Sears index typically lag behind changes in the PPI? Figures 10.1 and 10.2 present

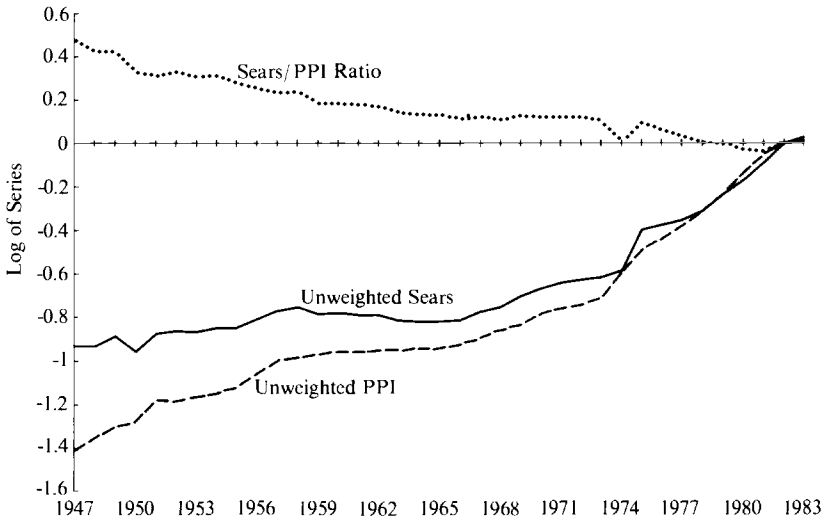

Fig. 10.1 Comparison of price indexes, unweighted, 68 products, Sears and corresponding PPI, 1982 = 1.0

time series plots of the unweighted and Törnqvist indexes, including the Sears catalog and corresponding PPI, and the Sears/PPI ratio, all in log form on a base of 1982 equals unity. The main features evident in the figures are, first, the downdrift of the Sears/PPI ratio, which is fastest in the early period 1947–62, then slackens off, and then speeds up again, particularly for the Törnqvist version in figure 10.2. The two most interesting aspects of the Sears indexes that leap out from the page are their absolute drop in 1950, perhaps responding to the 1949 recession, and their decline relative to the PPI in 1974. This latter episode is probably an artifact of the price control period, since the controls were lifted in May 1974, too late to affect the prices in the spring-summer catalog used for the index. Thus, the great leap of the Sears price indexes in 1975 combines into one year the inflation of both 1974 and 1975.

Is there a systematic cyclical response of the Sears indexes relative to the corresponding PPIs? This question is addressed by regression equations in which both versions of the average Sears index, unweighted and Törnqvist, are explained by current and lagged values of the PPI, by time trends, and by the same cyclical indicator used in chapter 11 to analyze the time series properties of the unit value indexes, that is, the detrended ratio of unfilled orders to capacity in the nonelectrical machinery industry.

Since the issue of cyclical volatility is a minor side issue in connection with the Sears indexes, the reader is referred to chapter 11 for a discussion of the background of the debate over spurious cyclical rigidity in the PPI, and for details of the definition of the cyclical variable. Table 10.12 presents the

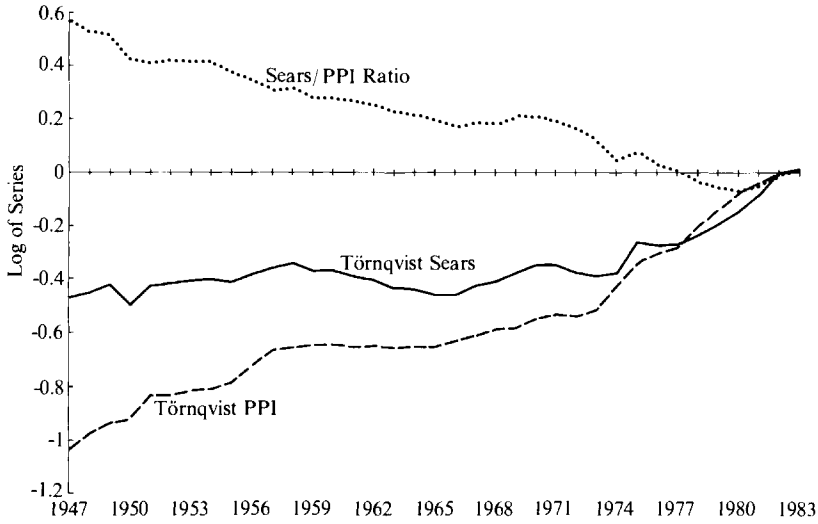

Fig. 10.2 Comparison of Törnqvist price indexes, Sears and corresponding PPI, 1982 = 1.0

regression results. The explanatory variables are listed in columns 1–9. First comes a constant, then the current and two lagged values of the corresponding PPI (unweighted or Törnqvist), then a time trend broken at 1969, then both the level and the first difference of the detrended ratio of unfilled orders to capacity in the nonelectrical machinery industry, and finally a dummy variable to capture the effect of the end of price controls in 1974. The dummy variable is defined as minus one in 1974 and one in 1975, so that no long-run effect is allowed on the Sears/PPI ratio, but only an additional lagged adjustment for Sears beyond that present in normal years.

Two versions of the equations for each index are exhibited in table 10.12. The first version is unrestricted. The second restricts the sum of coefficients on the current and lagged PPI variables to unity. The PPI coefficients on the unrestricted version sum to about 0.7, indicating a systematic tendency for the Sears index to respond less to basic inflationary forces than the PPI. This result misinterprets the downdrift of the Sears/PPI ratio by a mixture of a below-unity elasticity of the PPI response and low coefficients on the trend terms. The restricted versions are preferable, since they force the long-run response of the Sears index to the PPI to have a unitary elasticity and correspondingly allocate more of the downdrift of the Sears/PPI ratio to the time trend terms. The 1974–75 dummy terms are quite strong statistically for the unweighted series, but weak for the Törnqvist series.

Finally, the cyclical effects are very weak. If anything, there is slight evidence in the unrestricted versions of a negative cyclical effect for the change in the demand variable. This implies that the Sears index responds less

Table 10.12 **Regression Equations Explaining Time Series Behavior of Sears Catalog Indexes, 1949–83**

		PPI at Lag			Time Trend		Unfilled Orders Capacity					
	Constant (1)	Current (2)	One (3)	Two (4)	1949–68 (5)	1969–83 (6)	Level (7)	Change (8)	Dummy 1974–75 (9)	$\bar{R}^2$	S.E.E.	Durbin-Watson
Unweighted series:												
Unrestricted	27.16**	0.16	0.73**	−0.21	−0.43**	1.23*	0.85	−0.03*	4.64**	0.997	1.96	1.00
	[5.36]	[1.04]	[2.71]	[−1.12]	[−4.76]	[2.61]	[0.41]	[−2.41]	[2.87]			
Restricted	−1.50	0.61**	0.33	0.06	−0.81**	−1.37**	3.20	−0.03	5.42*	0.992	2.98	0.39
	[−0.56]	[2.94]	[0.83]	[0.22]	[−8.03]	[−4.68]	[1.01]	[−1.65]	[2.21]			
Törnqvist series:												
Unrestricted	30.90**	0.14	0.30	0.26	−0.85**	−0.38	−0.18	−0.04*	3.35	0.957	3.02	0.58
	[2.85]	[0.51]	[0.75]	[0.93]	[−5.54]	[−0.62]	[−0.05]	[−2.15]	[1.43]			
Restricted	1.59	0.46	0.19	0.35	−1.17**	−2.02**	1.50	−0.04	3.26	0.945	3.38	0.39
	[0.50]	[1.69]	[0.43]	[1.15]	[−9.77]	[−8.00]	[0.40]	[−1.87]	[1.24]			

Note: Construction of detrended unfilled orders-capacity variable discussed in chap. 11 in connection with table 11.1, which presents similar regressions explaining the ratios of unit value indexes to the corresponding PPIs. 1974–75 dummy defined as minus one in 1974, one in 1975, and zero otherwise. *t*-ratios are in parentheses.

*Indicates significance at the 5 percent level.

**Indicates significance at the 1 percent level.

to cyclical ups and downs of demand than does the PPI. The advantage that the Sears price quotations represent true transaction prices may be offset by the time delays in printing the catalogs and the fact that the printed price lists are "locked in" for six months. This reduces the incentive to catalog firms to respond promptly to temporary shifts in demand that may have disappeared by the time the catalog is printed and distributed.

10.17 Conclusion

This chapter has developed sixty-eight new price indexes from Sears catalog price quotations covering the postwar interval from 1947 to 1983. The indexes are based on an average of about three models per product index per year, and the number of models per product varies from as few as a single model to as many as ten or more. Each Sears product is chosen so that it may be compared to a detailed PPI commodity price index that is used in the construction of the NIPA deflator for PDE, and the overall conclusions of the chapter relate to the behavior of the individual Sears/PPI ratios for the sixty-eight products, and to two averages for the sixty-eight products.

Of the sixty-eight product groups, forty-nine exhibit a secular downdrift in the Sears/PPI ratio, one exhibits no net change, and the remaining eighteen exhibit a secular updrift in the ratio. The sixty-eight products are listed in order of the drift in table 10.10, from that with the largest negative drift through that with the largest positive drift. Not only do far more products exhibit a negative drift, but the negative drift tends to be larger. Only three products have a positive drift greater than 1.0 percent per annum, but thirty-four products have a negative drift of more than 1.0 percent and eighteen more than 2.0 percent. Two averages are computed of the sixty-eight Sears indexes and corresponding PPIs. The first applies equal weights to each product. The second is a Törnqvist index based on the weighting scheme described in chapter 12 based on the weight allocated to each product's PPI in the construction of the official PDE deflator. The annual rate of change of the unweighted Sears/PPI ratio is -1.29 percent and for the Törnqvist index is -1.56 percent.

The Sears indexes tend to increase at a slower rate than the PPIs because the PPI makes inadequate allowance for quality change. A cross-sectional regression for the sixty-eight products shows that the Sears/PPI drift tends to be greater for products of greater technological complexity, and products that incorporate electronic components. An alternative hypothesis, that the Sears/PPI drift occurs mainly or entirely in products where the Sears product specifications are poorly matched to the PPI specifications, receives no support at all in the regression analysis.

A central feature of this chapter, which both contributes to its length and contributes valuable insights on the history of technological change and product improvements, is the set of "comparisons of closely similar models"

that serve as a cross-check on the Sears indexes. Each comparison is documented in footnotes with details of price and quality. Looking back through the text, we can find twenty-nine such comparisons for twenty-three of the sixty-eight products over one or more long intervals ranging from a decade to the full thirty-seven-year span of the study. Of the twenty-nine comparisons, fully sixteen indicate a long-term decline in price of the quality-matched model relative to the catalog index of more than 10 percent, whereas only four indicate a long-term increase in price of more than 10 percent. For these twenty-nine comparisons, the unweighted price increases are 215 percent for the PPI, 84 percent for the catalog index, and 65 percent for the matched model comparisons. Taking out the two products where the matched model comparisons seemed to indicate a downward bias in the Sears indexes, we have average increases of 194 percent for the PPI, 71 percent for the catalog index, and just 42 percent for the matched model comparisons. The conclusion implied by these comparisons is that the catalog index is biased upward by missing price decreases that occur with the introduction of new models.

Equally important as a check on the catalog indexes, and an indication that they are biased upward, is the development of seven new *CR* indexes for typewriters, outboard motors, and small power tools. With the exception of outboard motors in the 1971–75 period, the new *CR* indexes generally increase less or decrease more than the corresponding catalog indexes, strengthening the overall conclusion that the significant downward drift of the catalog indexes relative to the PPI documented in this chapter actually understates the secular upward bias in the PPI.

Appendix

(Table 10A.1 follows on pp. 487–89.)

Table 10A.1 Details on Sears Products Observations by Order of Appearance on NIPA PDE List

Sears Products (1)	Years Covered[a] (2)	Average Models per Year (3)	Total Models Priced (4)	Number of Attributes Held Constant (5)	Final Year Covered		
					Price Range (6)	Model Range[b] (total models) (8)	Page(s) of Catalog (9)
Office, computing, and accounting machinery:							
1. 10-key adding machines		2.1	22	5	118	5807 (1)	675
2. Cash registers	1953–78	1.3	7	7	240	5964 (1)	1029
3. Manual typewriters	1948–83	2.7	35	9	77–147	5210–50 (2)	673
4. Electric typewriters	1958–83	3.8	39	10	200–295	5390–62 (4)	672
5. Electronic calculators	1970–83	6.3	25	6	18	58087 (1)	675
Communication equipment:							
6. Radio receivers		3.5	47	12	20–70	24041–2411 (5)	703
Fabricated metal products:							
7. Gas warm air furnaces	1951–83	3.1	34	5	580–730	76262–124 (4)	1014
8.*Gas hot water heaters		10.4	79	6	130–340	33214–664 (29)	959
9. Water storage tanks	1948–83	3.1	16	9	90–195	2950N–52N (4)	964
10. Brass gate valves		1.8	4	4	8	1775 (1)	958
11. Steel safes		1.8	22	5	260–360	6558–60 (2)	661
12. PVC piping	1967–83	6.6	8	3	1.6–13	59001–23111 (8)	970
13. Electric furnaces	1972–82	5.4	6	8	300–420	58751–58756 (5)	1089
14. Electric hot water heaters	1968–83	7.3	53	8	130–360	31194–156 (16)	957
15. Prefabricated metal buildings	1961–83	7.5	83	5	130–1,180	60815–60849 (7)	897
16. Chain link fencing	1955–83	8.1	12	3	2.2–21	9852–17537 (8)	967
Engines and turbines:							
17.*Outboard motors	1948–83	6.6	48	6	230–1,050	58513L–635N (7)	630
Metalworking machinery:							
18. Drill presses		1.9	11	5	100–280	1197–21381 (3)	831
19. Metal lathes	1947–76	2.9	10	5	320	2142 (1)	659
20. Free-standing power saws		4.2	34	7	95	10916C (1)	824
21. ¼ inch hand power drills	1947–83	1.8	14	8	45–60	1024–1051 (2)	830
22. ½ inch hand power drills	1949–83	2.3	15	8	90–150	1149–2711 (2)	831
23. Hand power saws		2.9	33	6	55	1091 (1)	824
24. Hand electric sanders		3.2	26	7	85	2264 (1)	828

(*continued*)

Table 10A.1 (continued)

Sears Products (1)	Years Covered[a] (2)	Average Models per Year (3)	Total Models Priced (4)	Number of Attributes Held Constant (5)	Final Year Covered: Price Range (6)	Final Year Covered: Model Range[b] (total models) (8)	Final Year Covered: Page(s) of Catalog (9)
25. Transformer arc welders		3.5	26	6	100–200	20143–20137 (2)	837
26. Acetylene welding torches		1.2	6	1	240	5441 (1)	837
27. Acetylene cutting tools		1.1	5	1	53	54408 (1)	837
28. Acetylene single-stage welding outfits		1.1	6	1	240	5446 (1)	837
29. Drill bits		3.1	12	2	18–23	6830–09 (2)	830
30. Power saw blades		2.4	19	3	17–38	32489–3257 (4)	824
31. Micrometer calipers		2.6	14	4	80–160	40185–40186 (3)	820
General industrial, including materials handling, equipment:							
32. Stationary air compressors		5.5	44	6	1,680–2,150	17515–317 (3)	854
33. Centrifugal pumps		6.5	31	6	145–280	2600–10 (4)	966
34. Differential chain hoists	1948–77	2.1	7	4	140–250	78703–05 (3)	703
35. Propellor fans		1.9	16	5	230–250	64066–77 (2)	1003
36. Fire extinguishers		8.5	56	11	10–85	58033–5808 (5)	817
Electrical transmission, distribution, and industrial apparatus:							
37. Tachometers		1.7	27	6	22–40	2177–2195 (2)	571
38. Electronic auto testers		2.0	30	5	40–100	2161–21040 (3)	616–17
39. Panel-type ammeters	1948–83	1.0	9	2	10	2176 (1)	819
40. Fractional horsepower electric motors		4.3	37	3	80–130	1216–1215C (5)	836
41. Voltage regulators	1947–78	1.3	8	3	10–12.3	1492–1487 (2)	686
42. Fusible-type panelboards	1950–83	2.8	6	2	16	51281 (1)	819
43. Circuit breaker-type panelboards	1954–83	3.7	5	4	5–12.5	5330–53321 (3)	818
44. Indoor safety switches		2.1	3	2	13	5230 (1)	818
45. Circuit breakers		3.7	15	3	60–130	5470–5202 (4)	818
46. Outdoor power switches	1948–82	2.0	5	2	30	5109–5131 (2)	819
Furnitures and fixtures:							
47. Typewriter tables		1.6	15	6	38–60	5401C–5405C (3)	670
48. Card files	1947–78	2.1	5	4	16–24	63052–6 (3)	1024
49. Fluorescent lighting fixtures		2.6	18	4	16–35	89013C–8903C (3)	1022
50. Steel desks	1950–83	1.5	11	8	110–220	77051N–77054N (3)	663
51. Filing cabinets	1950–83	6.1	25	5	50–150	60141N–60702N (8)	660
52. Office swivel chairs	1949–83	1.2	13	4	120	7720N (1)	663

Tractors:							
53. Garden tractors	1949–83	2.0	32	7	2,000	25372N (1)	882
Agricultural machinery, except tractors:							
54. Tractor-drawn plows	1948–83	2.5	16	3	330	26291N (1)	882
55. Tractor-drawn harrows	1948–83	2.3	16	7	220–870	26294–80853 (4)	882–83
56. Seeders		2.5	19	5	180–600	78266–78303 (8)	884
57. Manure spreaders	1950–83	3.4	25	2	180–600	78266–78303 (8)	884
58. Tractor-drawn cultivators	1949–83	2.2	20	4	70–200	29085–26293 (3)	879–83
59. Sprayers		3.8	37	2	80–970	1512–46134 (9)	884
60. Tractor-mounted mowers	1949–83	2.2	25	4	490–1,150	25364–26511 (3)	882
61. Portable farm elevators	1948–83	1.9	9	2	400	78911 (1)	834
62. Poultry brooders		3.4	20	2	15–280	88028–88031 (6)	921
Construction machinery, except tractors:							
63. Post-hole diggers	1956–83	2.0	12	2	22–450	72005–72026 (3)	921
64. Roto spaders	1948–76	3.5	35	7	295–680	29944–25237 (2)	770–71
65. Portable concrete mixers		2.3	16	5	450–540	7575–7595 (2)	953
[32] Stationary air compressors		5.5	44	6	1,680–2,150	17515-317 (3)	854
[33] Centrifugal pumps		6.5	31	6	145–280	2600–10 (4)	966
[34] Differential chain hoists	1948–77	2.1	7	4	140–250	78703–05 (3)	703
Service industry machinery:							
66. Commercial vacuum cleaners	1972–83	2.8	31	5	265–390	22961L–23991L (4)	724
67. Automatic coffee makers	1972–83	1.7	19	4	17–50	67129–67952 (4)	806–7
[7] Gas warm air furnaces	1951–83	3.1	34	5	580–730	76262–124 (4)	1014
[8]* Gas hot water heaters		10.4	79	6	130–340	33214–664 (29)	959
[24] Hand electric sanders		3.2	26	3	85	2264 (1)	828
Electrical equipment, n.e.c.:							
68. Replacement auto batteries	1948–83	5.7	24	4	38–71	4334N–4362N (4)	609
[37] Tachometers		1.7	27	6	22–40	2177–2195 (2)	571
[38] Electronic auto testers		2.0	30	5	40–100	2161–21040 (3)	616–17
[39] Panel-type ammeters	1948–83	1.0	9	2	10	2176 (1)	819
[49] Fluorescent lighting fixtures	1948–83	2.6	18	4	16–35	8903C–89013C (3)	1022
[66] Commercial vacuum cleaners	1972–83	2.8	31	5	265–390	22961L–23991L (4)	724

Note: Brackets indicate a product appearing for the second time. The number inside the bracket is the chronological number of its first appearance. No product appears more than twice.

[a]When no entry in this cell, the period spans 1947–83.

[b]Model numbers indicate the first-listed and last-listed model in the final year covered. Numbers listed out of sequence indicate that models are listed out of sequence in the catalog.

*Indicates hedonic.