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## The Problem of List Prices in the Producer Price Index: The Steel Mill Products Case

Thomas Betsock and Irwin B. Gerduk

The failure of list prices to reflect the reality of transaction price movement in the steel industry, especially over the course of the business cycle, was a problem that had long been recognized by the Bureau of Labor Statistics (BLS). When the Bureau began to publish steel industry price indexes under its revision methodology for the producer price index (PPI) in July 1982, it hoped to overcome this well-known weakness as well as others, including the bias due to the reliance on “volume sellers.” The introduction of the new indexes occurred in the closing months of the deep 1981–82 economic recession. However, the attempts by BLS to improve the type of steel price reported in the 1980s were largely unsuccessful. The problem of obtaining valid price indexes became acute as the domestic steel industry’s output and employment crumbled over the period from 1982 to 1985 and discounting below list became intense. In January 1986, the major steel producers raised net transaction prices while substantially lowering list prices. The latter was reflected in a 4.2 percent decline in the index for PPIR (Producer Price Index Revision) Code 3312. These divergent movements were sufficiently severe to cause the credibility of the index to be questioned.

This paper is a case study of the problems encountered in obtaining transaction prices for the PPI. It seeks to provide some insight into the issues and problems encountered by statistical agencies. What makes this case study interesting is its apparent simplicity. The steel index problems were well known before BLS instituted its revision methodology. There were no theoretical measurement issues involved. This paper not only discusses the July 1982

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revision but also reviews the changes in price collection procedures made for the most recent sample of the steel industry, the results of which began publication in January 1990. The subsequent index movement provides definitive proof that the pricing problems have been fully resolved.

Section 8.1 summarizes PPI index methodology. Section 8.2 provides an overview of the issues involved in steel industry pricing. Section 8.3 deals with practical operating problems faced by BLS following the introduction of the 1982 sample. Section 8.4 describes the approach taken to resolve the pricing problem in the industry resampling completed in January 1990 and looks at the results obtained from the new sample.

### 8.1 Index Methodology

The PPI measures average changes in price received by domestic producers for their output in the following sectors of the economy: (1) agriculture; (2) fishing; (3) forestry; (4) mining; (5) manufacturing; and (6) gas and electric services. In addition, the PPI is expanding coverage into the transportation, communication, and services sectors. Imports are not within the scope of the PPI because the index is limited to the output of domestic industries.

There are three primary systems or structures of indexes within the PPI program: stage-of-processing indexes; indexes for the net output of industries and their products; and commodity indexes (U.S. Department of Labor 1988). The stage-of-processing structure organizes products by class of buyer and degree of fabrication. The entire output of various industries is sampled to derive price indexes for the net output of industries and their products. The commodity structure organizes products by similarity of end use or material composition.

The PPI is a modified Laspeyres index and is based on the fixed input-output price index (FIOPI) model (Archibald 1977). The assumptions of the model, which govern the conceptual design of the PPI, include perfect competition, fixed technology, profit maximization, and fixed quantity and type of inputs. In addition, the Laspeyres approximation to the FIOPI holds fixed output quantities at the base period levels. PPI procedures, however, allow for periodic reweighting to a new weight base. Currently, the index uses value of shipments data from the 1987 Census of Manufactures to weight the index.

The Laspeyres index is obtained by multiplying the current period and the base period prices of each item by the quantity of that item shipped in the base period:

$$I_c = \frac{\sum P_{ic}Q_{ib}}{\sum P_{ib}Q_{ib}} \times 100,$$

where  $\sum$  = the sum over all the items in the index,  $I_c$  = index in the current period,  $P_{ic}$  = current period price of the  $i$ th item,  $P_{ib}$  = base period price of the  $i$ th item, and  $Q_{ib}$  = base period quantity of the  $i$ th item.

Most data used to calculate the indexes are obtained through the systematic

sampling of four-digit SIC industries. The PPI revision involved probability sampling of approximately five hundred industries in the mining and manufacturing sectors in the period 1978–85. Final publication of the completed revision occurred with the release of the January 1986 index. At roughly seven-year intervals, each industry will be sampled in an ongoing index maintenance program. By the summer of 1990, we were over two-thirds through our second cycle of probability sampling. BLS uses probability-proportionate-to-size (PPS) sampling techniques first to select sample units and second to select unique items within the unit for inclusion in the sample. Sample units are separate profit-maximizing centers engaged in one predominant economic activity. They consist of one or more operating establishments. Item selection involves selecting a unique product or other revenue-generating activity with unique terms of sale. An iterative PPS random selection technique based on sales revenue is used by BLS at this stage (U.S. Department of Labor 1986).

The price of the selected item should represent revenue received by the producer at the time of the sale in the base period and should reflect subsequent month-to-month movements. To achieve this, a continuous “price basis” must be established. This requires holding the physical characteristics of the product unchanged or adjusting for quality changes should they occur. In addition, all terms of transaction, such as the shipment size or type of buyer, must be specified and held unchanged in subsequent months. Any change in terms of transaction must be either adjusted for, if possible, or linked out of the price series. The latter procedure treats the price difference as a quality difference, and no change is shown in the index.

BLS strongly encourages cooperating companies to supply actual transaction prices at the time of shipment. Prices are normally reported monthly by mail questionnaire for the Tuesday of the week containing the 13th. Price data are always provided on a voluntary and confidential basis; no one but sworn BLS employees is allowed access to individual company price reports. The Bureau publishes price indexes instead of unit dollar prices. All producer price indexes are routinely subject to revision once, four months after original publication, to reflect the availability of late reports and corrections by respondents.

Weights used in the PPI come from two sources. Item weights are derived from the sample unit’s value of shipments and are equal to

$$1/p \times 1/n \times \text{MHF} \times S,$$

where  $p$  = the reporting unit’s probability of selection,  $n$  = the number of items for which BLS tried to obtain prices initially, MHF = multiple hit factor (when the same item is selected more than once),<sup>1</sup> and  $S$  = the reporting unit’s value of shipments.

1. The “multiple hit factor” indicates the number of times a unique item is selected when the BLS agent visits the company and is given access to the company books.

Weights for cell indexes are derived from the Census of Manufactures. Item weights affect the calculation at the cell index level, that being the most detailed index level. The aggregation of many cell indexes to calculate a higher level index also utilizes weights from the Census.

## 8.2 Pricing Steel in the 1980s

In 1978, BLS undertook a fundamental revision of the PPI. Work in the iron and steel area (SIC codes 3312, 3315, 3316, and 3317) began in 1981 (the appendix lists the SIC structure, major product lines, and commodity groupings affected by this initiative). The specific goals for this sector were improved sampling techniques to select producers, products, and transactions and greater efforts to obtain actual transaction prices. The latter was a commitment to a greater effort to secure such prices rather than a change in methodology.

At the outset, the American Iron and Steel Institute (AISI), acting primarily on behalf of the larger steel companies, indicated that companies would be extremely hesitant to provide the necessary data needed for PPS sampling procedures. AISI and BLS agreed to retain Price Waterhouse to secure the desired information from most of the larger steel companies, who were generally members of AISI. BLS trained Price Waterhouse personnel in PPS sampling techniques, which Price Waterhouse used to obtain revenue data by product and to select the number of items within product lines for inclusion in the index. For the Price Waterhouse segment of the sample, BLS field office personnel were relegated to the role of collecting the detailed product specifications and terms of transaction for the preselected products. Data for the remainder of the industry, mainly the smaller companies, were collected entirely by BLS.

The major benefit of the new sampling was that a much broader array of steel items was selected for pricing; this would reduce the volume-seller bias found in the old index. However, at this stage, the prices obtained continued to be primarily book prices in the critical product areas of flat-rolled carbon steel. Flat-rolled carbon steel includes such products as hot-rolled carbon sheet, cold-rolled carbon sheet, galvanized sheet, carbon plate, strip, and tinplate. These products are made mainly by the large, integrated mills and account for nearly 40 percent of the weight of the overall steel index.

The question may be asked, Why did BLS accept the use of list prices in the steel industry index not only for the 1982 revision but also for earlier periods? Despite repeated requests for transaction prices, nearly all the major steel companies adamantly refused to provide anything but book prices. At the time of the 1981–82 revision, the major steel companies sold a much wider product range than they do now, and not to have had their price data would have produced serious gaps and rendered many PPI cells unpublishable. At that time, a strictly transaction price index would have been a reflec-

tion of price movement in only a few areas, such as concrete reinforcing bar, where transaction prices could readily be obtained by BLS.

The Bureau felt that it had to accept book prices if it was to meet user demands for a continually published steel index. While recognizing that an index based on book prices would fail to capture discounting in recession years, BLS thought that such an index would at least track the trend in prices over a long period of years.

There was some support for such reasoning from the Stigler-Kindahl study on industrial pricing, in which a supposedly transaction price index for steel was constructed in the years 1957–66. Comparing their index with the BLS index for finished steel products, Stigler-Kindahl found that “the BLS and the [Stigler-Kindahl] prices of steel products move together so closely that a description of one is a description of the other. . . . Neither index displays a noticeable cyclical movement in either expansion or contraction” (Federal Trade Commission 1977, 172).

But contrary evidence came from a 1977 Federal Trade Commission (FTC) report on the steel industry that concluded that “the BLS data are not reflective of post-1967 actual prices on a cyclical basis.” The FTC report cited numerous trade journal articles about steel price discounting during business slumps. One study cited in the FTC report constructed an index, based on trade journal articles, of percentage discounts from list in 1973–75. For major mills, this study concluded that, while there was no discounting in all of 1974 and in the first quarter of 1975, large discounts appeared subsequently: a 12 percent average in the second quarter, 13 percent in the third quarter, and 5 percent in the fourth quarter (Federal Trade Commission 1977, 193).

On the basis of this report and our own reading of trade journal articles, it did not seem entirely unreasonable in 1981 to accept once more a list price index. If BLS was implicitly thinking in terms of a mild recession, a list price index, although inaccurate on a month-to-month basis during a steel slump and early recovery period, at least at some point in the expansion would get close to a correct transactions price level. In addition, there was no alternative if the Bureau was to publish. Steel discounting in 1981, when most of the work for the first revision was done, appeared from press reports to be in the 5–10 percent range. However, neither the Bureau nor forecasters generally anticipated the prolonged steel industry recession that was to occur and was to result in a distortion of BLS steel price measurement.

From January 1982 through 1986, record losses aggregating \$11.7 billion were recorded by the steel industry. From 1982 through 1987, approximately 440 steel manufacturing and related facilities closed. Average annual employment declined from 390,000 to 175,000 during this period. Raw steel production fell from 121 million tons to 86 million tons.<sup>2</sup>

2. Income, employment shipments, and production data based on selected AISI annual statistical reports and Census reports.

In 1984, the Reagan administration adopted a policy of negotiating voluntary restraint agreements (VRAs) with countries whose exports to the United States had allegedly increased through subsidies, dumping, or other unfair trade practices. Import penetration had reached a record level by this date, accounting for nearly 27 percent of apparent steel consumption in 1984. Twenty countries negotiated VRAs with the United States. The program's goal of limiting imports to 20.2 percent of domestic consumption was not realized since other countries increased their shipments in this period. Imports were still 23.6 percent of consumption in 1986. Additionally, duties on many products were increased, and orderly marketing agreements were negotiated with seven countries.

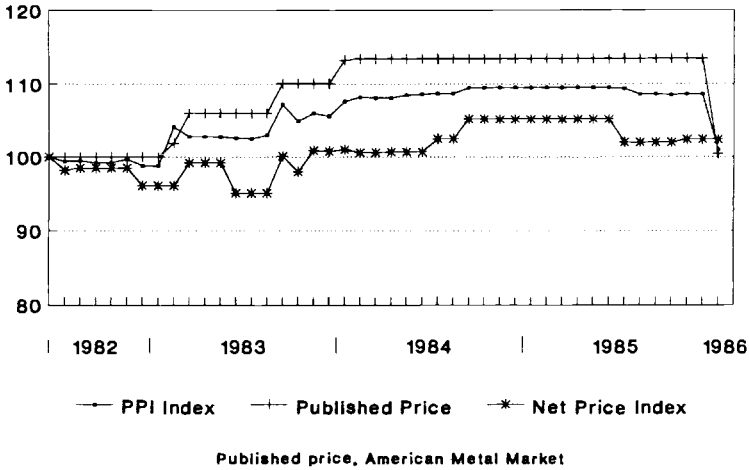
To compete, U.S. integrated mills were forced to modernize or close obsolete facilities. For example, continuous cast steel, which was only 20 percent of raw steel in 1980, accounted for over 60 percent in 1988. Labor productivity improved by over 30 percent from 1980 to 1988. Foreign investment in U.S. steel operations, either through joint ventures or through outright purchase, funded much of the capital improvement. Perhaps the major structural change in the industry was the growth of the minimill sector, which wrested control of the hot-rolled bar, light structural, rebar, and wire rod markets from both the big domestic firms and import competition.

Again, it should be noted that the problem of unrepresentative book prices occurred chiefly in the carbon flat-rolled products area, which is dominated by the large, integrated producers. Certain areas of the index, such as merchant bar, rebar, light structurals, and most of the stainless steel indexes, were based heavily or entirely on net transaction prices. Nearly two-thirds of the price quotes collected in SIC 3312 for the first sample were for net transaction prices, but these carried less than half the index weight. The higher-level index was inaccurate chiefly because of the uncooperative price-reporting policies of the integrated mills.

According to a *Wall Street Journal* story in September 1985, the major producers, led by U.S. Steel Corporation, were preparing to revise book prices to be effective in January 1986 (Russell 1985). The adjustment was to be accomplished through a formula that both lowered the book price and significantly reduced discounts. Net transaction prices were thought to be as much as 30 percent below book prices by late 1985. Data presented in figure 8.1 strongly support this.

Figure 8.1 provides three different measures of steel prices. First is the price series published in the *American Metal Market's* annual statistical report, converted to index numbers to reflect book price movement for standard carbon steel products. Second is the PPI index for this group of products, which reflects a mixture of list and transaction prices but is heavily weighted toward list prices. Finally, we prepared an index for those steel items in the PPI based on actual transaction prices.

While this graph is only suggestive of the problem, it is clear that list price



**Fig. 8.1 Three measures of price movement of hot-rolled carbon sheet: Published prices, PPI index, net prices**

displayed a clear upward bias from mid-1982 to December 1985. The January 1986 list price adjustment appears to have reestablished the list/net transaction price relation that existed in June 1982. A note of caution is in order. The net price index reflects very few observations, and each price quote reflects one negotiated price transaction for the month.

While it was widely anticipated in the press that a downward realignment of list prices would occur in January 1986, it was also anticipated that U.S. Steel would simultaneously attempt to increase transaction prices (Larue 1985). Import prices were expected to increase because of the strength of the dollar in late 1985. Several major domestic producers felt that domestic transaction prices could be raised in tandem with import prices. Since price leadership was common in the industry, U.S. Steel was expected to raise its transaction prices, with some but not all major producers following in January. If this happened, the PPI steel index would be falling at a time when market prices were believed to be increasing. In fact, our steel mill index, SIC 3312, fell by 4.2 percent in January 1986.

### 8.3 Operational Issues and the 1986 Price Adjustment

As the January 1986 day of reckoning approached, it became clear that BLS had to resolve the issue of reflecting short-term index accuracy versus correcting the index level. This section will clarify the options available and illustrate why any solution was bound to be less than satisfactory.

Once there is an upward bias in the index, there can be no painless solution. Many of the integrated mills changed their pricing structures in January 1986



by lowering list prices. While list prices were lowered, however, market prices were actually rising as discounts were reduced. As reported by Mark Russell (1985) in the *Wall Street Journal*, an example of how U.S. Steel would adjust prices is as follows:

U.S. Steel's pricing system would work in this way: Highest quality cold-rolled sheet, for example, now has a list price of \$563 a ton. But with discounts a typical customer can buy that ton of steel for at least \$100 less than list. Under the new U.S. Steel system, that ton of steel would list for \$503 or \$40 more than the current discounted price. To determine the new discount, the difference of \$40 is multiplied by 40%, which yields \$16; that is added to the old discounted price, making the new price \$479 a ton, or a 3.5% increase.

There were two theoretical options open to BLS. The first option was to show the market price movement from December 1985 to January 1986, which was thought by industry experts to be an overall price increase. This would have provided short-term accuracy by reflecting the discount reductions that, according to press reports, occurred in January. But this option was unrealistic since we could not obtain net transaction prices. Indeed, BLS had made a second, and again unsuccessful, effort earlier in 1985 to persuade the major steel companies to report market prices. More important, while this option would have provided an accurate one-month measure of price change had we been able to obtain market prices, the January transaction price increases would have further elevated an already upwardly biased index level.

BLS decided instead that the better choice was to correct the index level by using the list prices reported in January 1986, which reflected very large list price reductions by the integrated mills, thereby reducing the upward bias caused by tracking book prices from July 1982 to December 1985. As a result, the steel mill product index (commodity code 1017) dropped from a level of 104.3 in December 1985 to 99.5 in January 1986. The index reflected a substantial one-month decline when, in fact, market prices were actually rising. Index level decreases were concentrated in those indexes covering sheet and plate.

#### **8.4 The Recent Resampling of the Steel Industry**

The primary goal for the current steel index, which began publication in January 1990, was to gather only net transaction prices. We decided not to accept book prices, despite the risk of not publishing certain indexes. Fortunately, the major steel companies were now generally willing to provide net transaction prices. The collection process, conducted by the two national office steel analysts and a small number of BLS field personnel, generated some interesting reactions from company personnel. In some cases, the same individuals who nine years before had insisted on providing book prices are now

providing net transaction prices, freely conceding that only the latter can accurately reflect steel price movement. Companies have generally provided this price data with little hesitation. While in 1981–82 nearly every major steel company insisted on using book prices, the current sample has only one company that refused because of our insistence on net transaction prices.

It is difficult to account for the turnaround in the steel industry's willingness to provide transaction prices. Possibly, after years of seeking trade protection and other government assistance, the industry has a greater respect for good economic data. Possibly, various refinements in BLS collection techniques helped. Data collection for this sample was handled by a smaller staff, which was generally better informed of steel pricing problems than was the case in 1981–82. The use of average prices lagged one month helped, although this option existed for the 1981–82 sample and was insufficient to gain cooperation. Certainly, much of our success with the current sample is due to the improvement in automated record-keeping systems at most of the companies. Several reporters told us that records of net transaction prices were not available, at least not on a timely basis, in 1982.

The use of lagged average prices is a necessary compromise if we are to obtain net transaction prices from the major mills. As noted in section 8.1, BLS generally prices specific transactions as of the specific pricing date and asks that these prices be returned for processing within two weeks. The major steel mills, most of which were generally being asked to price a large number of items, simply could not work that quickly, forcing us to accept a one-month lag in their prices.

We found that the most obtainable price was an average price. Many company marketing departments, through which we generally collect prices, often produce average net transaction price reports for specific products. Companies liked the average pricing option since it required no additional formatting of price records and avoided revealing any buyer-specific details. BLS finds average pricing acceptable since each reported price generally reflects scores or even hundreds of transactions of a unique item and reflects all discounts and surcharges applied to that transaction. The drawback to average pricing is that it may involve a mix of types of buyers. But, on the basis of our early meetings with the companies, we believe that the buyer mix for specific products is fairly constant, at least over the length of time a particular sample is asked to supply data.

The results of the current revision have been good. Of the eighty-two companies in the SIC 3312 sample, sixty-nine are providing us with price data. Six companies refused to cooperate at the outset, half as many as in the 1982 sample. Two companies have since requested to leave the program. The remaining sample units that are not supplying prices are the result of closings, mergers, or misclassifications.

Two-thirds of the carbon sheet producers, representing over two-thirds of the index weight for this sector, are providing us with net transaction price

data. One producer of carbon sheet would provide us only with list prices and so was excluded from the program. Two other carbon sheet producers initially agreed to cooperate but then decided that they had insufficient staff to assemble the data.

Cooperation by specialty steel mills and minimills remains good, with over 90 percent of these sectors' respective index weights represented in the index. All are providing net transaction prices.

Figure 8.2 tracks the annual movement of SIC code 3312311 (hot-rolled carbon sheet) since the June 1982 base date. The index plainly shows the artificial increase caused by list prices from 1982 to 1985, the downward adjustment of January 1986, the subsequent increase in list prices that occurred in the 1987–89 steel recovery, and the decrease in steel transaction prices that began in late 1989 and has continued with only slight interruptions into the spring of 1992.

The 1990s may have ushered in a new era in steel price reporting. Figure 8.3 shows the monthly movement of the BLS index for hot-rolled carbon sheet since December 1989 and the contrasting movement of book prices. The book prices are not now being reported to BLS but are taken from *American Metal Market*, a trade source. They represent a nonsystematic sampling of those major producers presumed to be price leaders by the press. In the latter part of the 1980s, most of the large producers of sheet steel were still reporting book prices to BLS. In December 1989, the book price for hot-rolled carbon sheet was \$445 per ton. Three subsequent increases in book prices—in January 1990, January 1991, and October 1991—brought the book price to \$495. In the meantime, however, the transactions prices, which were being reported to BLS, were showing a general downward drift. In October 1991,

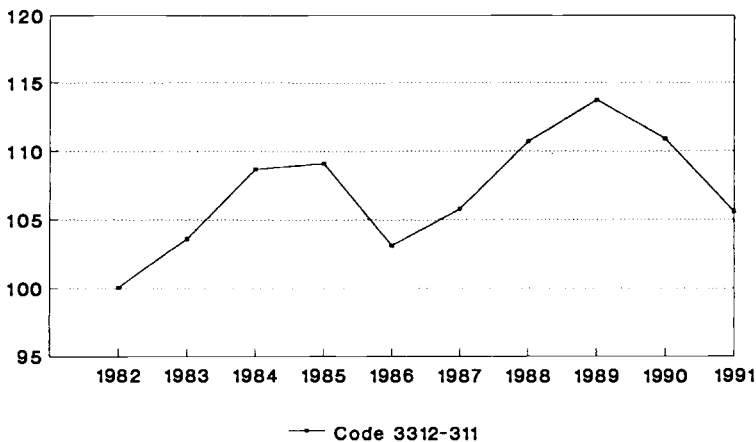


Fig. 8.2 Index of hot-rolled carbon sheet prices, annual average, 1982–91

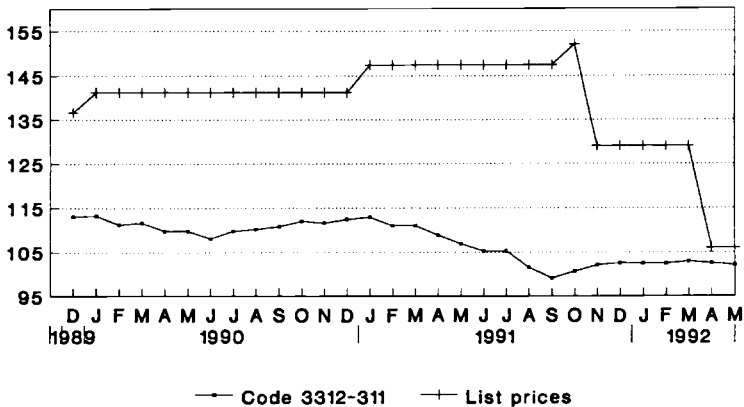


Fig. 8.3 List and transaction prices, hot-rolled carbon sheet, December 1989–May 1992

they were some 12 percent below their December 1989 level, a sharp contrast with the 10 percent rise shown by book prices over the same period.

In November 1991, two of the major mills lowered their book price to \$345 per ton, a reduction that was repeated by the remaining integrated steel companies in April 1992. Transaction prices rose a little in the fall of 1991 but were little changed in the first five months of 1992. The levels of the two indexes in the spring of 1992 were quite close, but the change in the nature of reporting by steel producers spared BLS a repetition of the January 1986 experience.

Most of our other indexes for flat-rolled carbon steel—hot-rolled strip, cold-rolled sheet and strip, hot-dipped galvanized sheet, and plate—show similar downward movements for the past two years. Electrogalvanized sheet prices have also fallen, although this decline has been somewhat moderated by the greater prevalence of contract pricing. Tinplate, which is sold to the relatively stable can stock market, has maintained its price level.

## 8.5 Conclusion

The analysis presented in this paper shows that list prices are unsuitable for use as proxies for net transaction prices for measuring month-to-month price change in the steel industry and are of questionable value for measuring long-term price movement. Figure 8.1 shows a consistent upward bias in list prices, which eventually forced a steep adjustment. The case study shows that users cannot have confidence in a price-reporting system characterized by dramatic adjustments to list prices to correct for a large multiyear unidirectional bias. Since the mission of a statistical agency is to provide comprehensive

index coverage with suitable quality, the use of net transaction prices is clearly needed.

Analysis of index behavior subsequent to the resampling of the steel industry completed in 1990 shows that we have finally turned the corner on index quality in steel pricing. Whether a changing mix of customers will become a serious problem in the future remains an unknown. The one-month lag referred to earlier appears to have been a necessary trade-off if we are to secure discount reporting. This lag, which primarily affects flat-rolled carbon products, will be deemed acceptable if there is widespread user confidence in index accuracy. The statistical agency must choose a strategy and implement it with little opportunity to experiment or second-guess itself.

The major lesson learned from this has been that there can be no substitute for transaction prices. This lesson has had a substantial effect on our sampling strategies and procedures, reflecting a heightened awareness of the unsuitability of accepting list prices for the index. This is having a significant effect in the PPI's initiative in obtaining prices in the service sector.

## Appendix

### SIC Structure

#### 3312: Blast furnaces and steel mills

33121: Coke oven and blast furnace products

33122: Steel ingots and semifinished shapes and forms

33123: Tin mill products, hot-rolled sheet and strip

33124: Hot-rolled bars, plates, and structural forms

33125: Steel wire

33126: Steel pipe and tubes

33127: Cold-rolled sheet and strip

33128: Cold-finished bar

#### 3315: Steel wire

#### 3316: Cold-rolled sheet, strip, and bars

#### 3317: Steel pipe and tubes

SIC's 3315, 3316, and 3317 differ from 3312 in that they involve production of goods from purchased material. (The industry definitions derive from the 1987 SIC manual put out by the Office of Management and Budget. The four-digit industries are further defined into five-, seven-, and sometimes nine-digit categories on the basis of Census of Manufactures data.)

### Commodity Index

#### 1017: Steel mill products

Code 1017 encompasses SIC codes 3312, 3315, 3316, and 3317. For example, production of cold-rolled carbon sheet would fall under commodity

code 101707 and also under either 33127, if the company both melted and rolled the metal, or 33167, if the company rolled sheet from purchased slab.

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