CONSIDERATIONS ON THE CHOICE OF PRICES OR UNIT VALUES AS DEFLATORS FOR THE CENSUS BENCHMARK PRODUCTION INDEXES

REPORT OF THE SUBCOMMITTEE ON PRICES

Interagency Committee on Measurement of Real Output, Washington, D.C., U.S.A.

Editors Note: In view of the recent publication of *Indexes of Production*, 1967 by the U.S. Bureau of the Census, it seemed useful to the Editors of the *Review of Income and Wealth* to print the following report which summarizes the considerations involved in the choice of prices or unit values as deflators for value data in preparing the Census benchmark production indexes. We also publish a critical evaluation of the subcommittee report by Robert J. Gordon, which summarizes the relevant portions of a monograph in preparation for the National Bureau of Economic Research. Space precludes the publication of two detailed appendixes to the subcommittee report. The appendixes are summarized here, and may be obtained from their authors on request.

INTRODUCTION

Partly in consequence of worldwide inflation, considerable attention has been given in recent years to the question of the accuracy of price indexes. The *Review* has had several articles on this subject. Two articles in particular in this *Review*[1] have mentioned a study prepared under U.S. Government auspices which undertook a detailed comparison of wholesale price indexes and unit value data from U.S. Census of Manufactures in order to evaluate the relative accuracy of these two sources of price data. In this issue of the *Review* there is presented a summary of this study together with references to the basic underlying work done, thus providing to interested readers a more complete presentation than has hitherto been available.

This report was originally prepared by a task force under the aegis of the U.S. Federal Government's Interagency Committee on Measurement of Real Output. A major effort was devoted to improvement of deflators for use in measurement of changes in output mostly at quinquennial (benchmark) periods associated with the U.S. Census of Manufactures.

The report is based on a comparison of detailed (7-digit) unit value data from the Census of Manufactures and price data from the Wholesale Price Index measuring the change from 1954 to 1958 and from 1958 to 1963. Evidence is produced on the validity of both sets of measures of price change. Problems discussed include product mix changes, which affect unit values, and differences between list and transaction prices, which affect wholesale price indexes.

The report was used to set guidelines in developing deflators for the Census benchmark production indexes for 1967. It is being published at this time in

[1]See following articles in this *Review*: R. J. Gordon, "Measurement Bias in Price Indexes For Capital Goods", Series 17, No. 2, June 1971; J. Popkin and R. Gillingham, "Comments on 'Recent Developments in the Measurements of Price Indexes For Fixed Capital Goods'," Series 17, No. 3, September, 1971.

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recognition of strong interest in measurement and analysis of changes in prices and real output.

Members of the Committee which prepared the report are:

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Jack J. Gottsegen	OBE
Edward D. Gruen	Census
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In addition, Alexander J. Yeats of FRB was co-author with Cornelia Motherall of Appendix A and Mary E. Lawrence of BLS was co-author with Edward D. Gruen of Appendix B.

Milton Moss, Former Chairman
Interagency Committee on Measurement
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SUMMARY

The recommendations contained in this memorandum are specifically addressed to the pricing problems faced by the Bureau of the Census in connection with development of deflators for measuring production change in the manufacturing and mining sectors. To aid in choosing between price data (largely from the BLS industrial price program) and the unit-value data derived from Census product and value data, some specific criteria or guidelines are listed below. The discussion does not deal with weights for price indexes, form of index (Paasche, Laspeyres, Edgeworth, etc.), and a host of other conceptual topics related to production measurement. The committee may wish to review such concepts at some time, but the immediate task requires some working proposals at the most detailed level for which price, quantity, and value data are collected.

The Subcommittee recommends that more extensive use be made of specification price data than heretofore, largely because unit value measures tend to be affected by changes in product mix. The limitations of price data, based on narrowly defined specifications, as deflators for all of the commodity detail compiled by the Census Bureau are, however, recognized. Specific criteria are presented to guide the choice between price and unit value data under different sets of circumstances. The Subcommittee's opinion is that general guides indicating what choices should be made under the more important and frequently occurring conditions are more helpful to the operating agencies than detailed rules.

The Subcommittee also recommends systematic comparisons of price and unit value data, tests of alternatives, and documentation of results. These additional notes would provide users of these indexes with statements of limitations, permit adjustments if desired for their own purposes, and provide useful guides for future calculations.

The problem of measuring quantity (physical) changes included in reported or published values has been dealt with differently by various governmental agencies. In the past, the Federal Reserve Board and the Census Bureau have generally used the unit-value data whereas OBE, generally, has used BLS price indexes calculated from data reflecting the specification method of pricing. This subcommittee believes that—where no major conceptual or practical data considerations are important—the various agencies should agree to use the same basic data where the problem to be solved is virtually identical.

There was agreement that the most desirable index for use as a deflator should: (1) reflect transaction prices (varying with changing discounts and terms of sale), (2) be correctly weighted to eliminate the effects of market shifts (type of customer as well as geographical location), (3) be adjusted for quality changes, and (4) be unaffected by changes in the production mix. While neither unit-values nor price indexes, as currently computed, incorporate all of the attributes of a good deflator, the Subcommittee's recommendations gave consideration to which prices more closely approach the "ideal".

The Subcommittee also had to recognize the characteristics of the Census value, quantity, and derived unit-value data, as well as those of the prices in the BLS program. The Census commodity (7-digit) categories generally include items whose specifications are broader than those on which BLS price data are based. Thus, on a prima facie basis, the Census unit-value data may be subject to bias arising from changes in product mix over time; by the same token, the BLS price indexes may be unrepresentative of a group of products because specification of the items priced may be too narrow.

The Subcommittee had no factual information to judge the extent to which Census product lines varied in product mix from one Census period to another and in particular what the composition of the 1967 Census commodity categories would be. It did note, however, that in constructing the 1958–63 *Indexes of Production*, Census substituted price indexes for unit values for a large number of products. In total, price indexes were used for 15 percent of the shipments values for products compared with about 47 percent based on unit values.[2] (Other sources and types of data and indirect representation account for the remaining 38 percent.) However, for some major industry groups, more than 30 percent of the values were deflated by price indexes.

The Subcommittee also noted that the respondent coverage and number of the Census 7-digit commodity lines for which detail is reported have varied with time. Because of the Census Bureau's administrative policies, an increasing number of small size establishments file reports on which the respondent is not required to report product detail including quantities. Furthermore, Census has placed greater reliance on the reporting of product class (5-digit rather than 7-digit) unit values with its introduction of a "tie line" technique. Under this approach, only 5-digit quantity and value data are reported in the quinquennial Census whenever detailed (7-digit) data are collected for the quarterly or annual surveys, Current Industrial Reports. In those instances where the Current

[2]1963 Census of Manufactures, Vol. IV, *Indexes of Production*, page A-2, Table A-1.

Industrial Reports call for quantity data only, the unit-value information is available only for a combination of specific 7-digit products.

Also, 1967 Census of Manufactures procedures provide for estimating data from administrative records for establishments of small companies, typically those with fewer than 10 employees. Thus, for such establishments no product information is available and the 1967 product data will contain an increasing proportion—significant for some industries— for the category "not specified by kind". Lastly, the increasing complexity of manufactured products (e.g., instruments, equipment and electronic systems) also adversely affects the validity of derived unit values. This growing complexity of products also places some burdens on the price indexes with respect to maintaining representativeness and adjusting for quality change.

The unit-value data, on the other hand, may represent actual transaction prices more accurately than some of the price indexes because the unit values are derived to a large extent from quantities and actual sales whereas some price indexes (although net of the more usual discounts) may not reflect change in special terms of sale. In short, it was recognized that in some instances the BLS price data fail to measure the true transaction price change (free of all discounts and special rebates, etc.). The problem, then, is to find a practical working solution to optimize the use of all available price data, with consideration given to their limitations.

SPECIAL STUDIES

For assistance in arriving at the solution, the Subcommittee undertook two studies. One of these, prepared by the Federal Reserve Board representatives,[3] summarizes at the major group level comparisons made at the 7-digit product level of matched WPI and Census deflators. This study suggested that any gains in precision which may arise because unit values reflect a comprehensive universe representing actual transaction prices are offset by problems of product and transaction mix. This arises because a 7-digit Census product may include a relatively wide range of specifications and transaction types. This mix may change markedly from Census year to Census year.

The other study,[4] in depth, of 25 items, at the 7-digit product level, showed a "persistent tendency of unit values between 1958 and 1963 to reflect shifts in product mix, usually to the lower end of the quality- or price line". Census data were not suited to the task of establishing the representativeness of the BLS price sample nor to confirm the assumption that transaction prices are reported to Census (and not to BLS) although this is not ruled out. Also, the 25 products were chosen to represent problems—not to represent the WPI or Census unit-value measures in general. Furthermore, in computing the 1958–63 production

[3]Appendix A: *A Study of Differences between Census and Price Index Deflators*, a paper prepared by Cornelia Motheral with the assistance of Alexander J. Yeats, both of the Business Conditions Section, Federal Reserve Board.

[4]Appendix B: *A Study of Census Unit Value Relatives and Comparable Wholesale Price Indexes for Selected Manufactured Products*, 1958–1963, a paper prepared by Edward D. Gruen, Industry Division, Bureau of the Census and Mary E. Lawrence, Office of Prices and Living Conditions, Bureau of Labor Statistics.

indexes, many unit values had been rejected as being invalid because of the recognized product-mix problem.

RECOMMENDATIONS

It is recognized that the two studies are indicative rather than conclusive. Nevertheless, both contain indications concerning the short-comings of unit values derived from commodity quantity and value data. These indications, as well as the general recognition that the specification method of pricing is conceptually the most appropriate method to obtain measures of price changes, leads the Subcommittee to conclude that specification-price data (such as those from the BLS Wholesale and Industrial Price Index Programs and other similarly constructed data) should be used more extensively as deflators in the absence of positive evidence of their unsuitability in individual instances. This recommendation represents a change in order of preference from the present practice which provides for using unit values except where they seem unreasonable.

There are circumstances, however, when unit-value indexes may be preferred to price indexes, either directly priced or directly imputed.[5] The discussions below also indicate when the alternative to price indexes may be chosen because of the need to consider "trade-offs", and what procedures should be followed when there are no series of prices or unit values. When the guidelines cannot be applied with precision, the Committee urges that the reasonableness of the deflated values be evaluated as to consistency with other series on production and productivity.

A. Criteria for Using Unit Values in Lieu of Specification Pricing or Direct Imputation

Unit values should be substituted for price series only when the unit values selected are representative of a central tendency, *and* when one or more of the conditions listed immediately below pertain: (If the unit values are unsatisfactory also, however, section B below, should be considered.)

1. Production is *Seasonal* and *Erratic*

In those instances where the seasonal pattern of production is extreme and changes from year to year, the WPI price should either be weighted with monthly output data or unit value substituted, if the unit values are satisfactory in other respects.

2. WPI Prices Fail to Reflect True Movements of *Transaction Prices*

There are areas in the WPI where BLS has been particularly unsuccessful in obtaining price reports which reflect change in transaction prices. These areas have been tentatively identified by BLS.[6] One recommendation of the task force which prepared the detailed analysis is that in such areas where differences between unit-value relatives and price indexes exceed 5 percent, special studies

[5]A direct imputation is one for which judgment has been explicitly reached that the price of an unpriced product tends to move with the price of a specific other product.

[6]In addition, Professor George J. Stigler, of the University of Chicago, is completing an independent study of this subject. His results may identify additional areas for consideration.

Editor's Note: This study has since been published. See George J. Stigler and James K. Kimdall, *The Behavior of Industrial Prices*, NBER General Series 90, National Bureau of Economic Research, New York 1970.

should be undertaken to determine whether the granting of discounts and allow-ances below list (or their reduction or removal) accounts for the disparity.

3. WPI Based on *Secondary Sources*

In a number of instances—especially among chemicals and petroleum products—the WPI price data are based on trade publication sources. Inasmuch as these vary in reliability, the assessment of the BLS should be obtained and, where indicated, unit values substituted if reliable.

4. WPI Based on *Prices Other than F.O.B. Factory* (Such as Delivered Prices)

In a few instances, the WPI prices are based on delivered prices (including transportation) instead of f.o.b. factory prices. In these instances, unit values may be introduced if valid.

5. WPI *Unrepresentative* of Heterogeneous Census Product Line

The WPI series may be deemed unrepresentatative if the Census product is so broadly defined or heterogeneous that the WPI price changes (direct or directly imputed) seem likely to fail to reflect price changes for most of the value of items included in the Census category. (This situation is likely to arise especially in connection with the 7-digit "n.e.c." categories). Another illustration of un-representativeness may occur when the consuming market priced by price indexes may not apply to the Census product, as, for example, original vs. replacement auto parts.

6. *Unpublished* WPI

An unpublished WPI may be suspect because it is withheld. However, there are reasons, other than statistical, for non-publication of data. Consulta-tion with the BLS should provide information on the validity of any unpublished series.

7. WPI *Not Available*

If no price index is available, the unit values appear to be the obvious choice. Even here, however, consideration might be given to directly imputed series or specification pricing from other sources if the unit-value series itself is suspect.

B. *Prices Index and Unit Values Unsuitable—"Trade-Offs"*

A unit-value index would be considered unsuitable generally, if there has been a marked shift in product mix or when such shift is suspected because a product line includes a wide range of differing products, or of package sizes, or of large and small items. On the other hand, a unit-value index might be con-sidered valid if the 7-digit product is narrowly defined as to product description and terms of sale.

In those instances where neither the WPI nor Census unit values are suitable, a "trade-off" is in order. Thus, if the product-mix change is severe and use of unit values results in invalid measurement of price change, the use of a WPI may be warranted even though the latter may not be strictly representative of Census commodity descriptions. Or unit values subject to a small amount of product shift may be preferable to some WPI pricing where the transaction price problem is severe.

It is in this area where the reasonableness of results should provide guidance. If unit-value series based on broad aggregates are in a doubtful status, other unit values may be derived, e.g., from a group of identical establishment reports or use of middle quartiles, etc., to provide a useful measure of price change. The reasonableness of decisions should be checked by ascertaining the effect of the choice on related production or productivity estimates.

C. Price Index and Unit Values Unavailable

In these cases, a comparison of the imputation pattern of the WPI with that of the Census may reveal a WPI price series which may be used. It is likely that the price trends implied for the "directly imputed" WPI *items* may be useful in the absence of unit values. For many broad imputations in the WPI, however, as in the Census data, the imputation decisions are based on assumptions that the price movements of similarly classified goods are similar. In the absence of any evidence, there *may* be justification for moving the price by the trend for the next higher price category from the WPI, or the next higher industry unit value change, whichever provides more reasonable results.

The Subcommittee recognizes the Census need to deflate non-priced items in the product class by product-class deflators based on aggregates of products for which there are deflators. However, this practice may be followed as an automatic procedure only when the unpriced product other than n.s.k.'s total $20 million or less, or 20 percent or less of the product class total, whichever is higher. If the unpriced products represent higher amounts, efforts should be made to derive indexes which reflect price movements of the unpriced items. Imputations based on similarity in marketing generally are to be preferred to those based on similarity of materials used in manufacture, although relative importance of material cost, overhead, labor and profits should be taken into account in arriving at the imputation decision.

These observations also apply to even greater degree to the imputation of entire 5-digit price trends from 4-digit trends.

The use of data of other agencies (U.S. Tariff Commission, Bureau of Mines, etc.) cannot be justified solely by the absence of information from Census or BLS. The same criteria for unit values derived from Census data or for BLS price data should apply to those derived from published data originating from other agencies.

Price-index-type estimates should be constructed for value categories for which valid price information is unavailable. This might be done by constructing indexes from price-trends of components.

TEST, EVALUATION, DOCUMENTATION

It is assumed that an agency following the proposed criteria would be working on the unit-value side only with products for which quantity and shipment data meet publication quality standards for the base and selected periods and which met tests of comparability (in terms of unit price distributions and amount of change between the two years and other general comparability tests).

This Subcommittee supports the proposal of its task force on price-unit value comparisons that much can be learned from a systematic comparison of unit values and prices if records are maintained documenting the reasons for choosing unit value or price data. To the extent possible, the Subcommittee urges tests of alternatives to show what the choices were and what the effects on the index of output or productivity were.

Submitted by

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NOTE

This report as originally submitted included two appendexes not included here. *Appendix A, "A Study of Differences between Census and Price Index Deflators"*[7] tested two hypotheses.

Hypothesis 1. That the differences between the Census deflator and deflators based on the Wholesale Price Index was accounted for by the greater number of products covered by the Census. This hypothesis was found to be false. Most of the Census-WPI difference reflected different price indications for products covered in both systems.

Hypothesis 2. That the differences between deflators reflected divergence between list and transactions prices, with transactions prices (net of all discounts and special rebates) being more fully reflected in the Census data. To test this hypothesis, two sets of regressions were run—one simply relating the difference between WPI and Census to the production or shipments change (acting as a demand proxy) as measured by the Census quantity index, and a second relating the difference to quantity-change, concentration ratios and firm sizes.

It was anticipated that the *greater* the demand for the product relative to the other products in its industry group, the *less* would be the difference between the price index and the unit value index (indeed, the difference might well be negative): that the manufacturers of the products which were declining relative to other products in the group would have the greatest need to make special concessions that would be reflected in a transactions price measure. But in most industry groups, a positive difference between the price index and the unit value index was associated with a relatively *large* increase in demand as measured by

[7]By Cornelia Motheral and Alexander J. Yeats of the Federal Reserve Board.

the Census quantity of output. One of the two exceptions was food manufacturing, and since the behavior of the prices of manufactured foods is strongly influenced by farm prices, this exception may be made consistent with the findings in the other industry groups by the assumption that a cobweb mechanism is at work. The other important exception is the electrical machinery industry, in the 1954–58 period only.

It was also anticipated that industry concentration would have an effect on price/unit value index difference—that products whose output was concentrated in the hands of a few producers would be more likely to be characterized by special concessions not reflected in price index quotations. But in only 5 industry groups was concentration significant in its effect on the price/unit value difference, as measured by the T-test; introducing concentration brought to 12 the number of industries in which quantity increase was significant, and increased the average amount of the difference explained in those industries to 30 percent. The improvement was particularly marked in the tobacco and petroleum refining industries, where the effect of concentration on the deflator differences was in the expected direction. But in the other three industries where concentration appeared to be significant, it had a negative sign—that is, the greater the concentration, the smaller the deflator difference.

Three explanations have been advanced for the failure of the deflator differences to live up to what was expected of them.

1. Quantity change is not an unambiguous measure of demand change. Quantity increase will be accompanied by declining unit cost and relatively declining price at least up to the optimal operating rate. (This has been said of capacity utilization as a price-explaining variable and seems to be equally true of quantity of output).

2. Transactions pricing policies are affected not only by the present state of demand but by knowledge of coming additions to capacity; the example given is the paper industry, in which it is claimed that price concessions were greater in 1963 than 1958 in spite of apparently higher demand pressures, because of large imminent additions to capacity.

3. Whatever effect transactions prices have on the comparison are being submerged in the product mix problem. As deLeeuw showed in the 1954 Census index volume, several types of errors in output measurement, of the sort that can be caused by product mix shift within a Census line, tend to cause inverse correlation of price and production indexes and to originate or increase a Paasche-Laspeyres index divergence. The relatively strong correlations of deflator difference and quantity change are not inconsistent with a hypothesis that the WPI quotations are correct and that the Census quantities and resulting unit values are affected by both random errors and some systematic shift toward the lower end of Census product lines.

Explanation ♯3 is quite attractive to some of those who have worked with these Census product statistics and are aware of the possibilities of product mix shift. In compiling the 1958–63 indexes, an effort was made to eliminate more of the extreme cases of product mix shift through the rejection of extreme

unit value changes, and these efforts may well be reflected in the lesser Paasche-Laspeyres divergence and the lesser correlation between output change and deflator difference in that period; of course, to the same extent the advantages of transactions pricing are foregone.

If explanation #3 is accepted, that implies a recommendation to rely on WPI deflators to a far greater extent in the future—perhaps, as has been suggested, to use WPI except where it seems unreasonable, rather than the past practice of using unit value except where it seems unreasonable. The main argument advanced against this is the coverage argument, advanced this time for the matched products—that the WPI quotation is not likely to be representative of the Census product, since it directly represents such a small part of the output of that product. It was hoped that the more detailed studies in Appendix B would shed more light on this.

Appendix B, "A Study of Census Unit Value Relatives and Comparable Wholesale Price Indexes for Selected Manufactured Products, 1958–63"[8] undertook a study of 25 7-digit Census products which might illuminate the different characteristics of specification prices and unit values. Some were products for which data in successive censuses had been difficult to reconcile. Others had consistently shown a wide spread between unit values and specification prices in benchmark periods. Published wholesale price indexes (WPI) for 1963 (1958 = 100) differed from comparable unit value relatives (UVR's) for all 25 products and were higher for 19 (see Table). Patterns of differences were sought in a series of comparisons of the most detailed price data in Census and BLS records. Detail was not consistently available for all products.

(1) As a test of product mix in Census data, UVR's based on published product data were compared with relatives for the central 75 percent of Census reports. The latter moved substantially closer to the WPI's for about half of the products.

(2) The WPI sample changes between 1958–63 were examined for reasonableness and for their effect on the WPI-UVR differences. Indexes based on raw data for 1958 and 1963 were lower for 13 of the 22 products, reflecting the need to maintain the index level when specifications of lower quality were introduced or substituted. When compared with UVR's the raw data indexes reduced differences only slightly.

(3) To isolate the effect of complete Census coverage, price indexes for the BLS reporters were matched with their comparable unit value relatives. Company differences exceeded those for the universe and extreme variation among 7-digit product UVR's for various plants of some companies suggested product mix at the plant level.

(4) Information about selected products were presented in a section of products notes; information for 23 products for which analysis could be made is summarized below:

2011631/2013631, hams and picnics—There is potential bias in unit value relatives based on combined data for primary products made in two in-

[8]By Edward D. Gruen, formerly of the Census, and Mary E. Lawrence of the Bureau of Labor Statistics.

dustries. Bias can result from a change in each industry's relative output of products (hams and picnics in this instance) as well as from a shift in relative demand for the products.

2026212, whole milk—Unit value relatives and WPI's may be noncomparable for apparently homogeneous products. The unit values cover packaged whole milk and are subject to regional variations in butterfat content and price. The WPI covers Department of Agriculture quotations for "most common grade," dealer to retailer, delivered. The WPI may be biased by the inclusion of mark-up and transportation charges, if they move independently of the product.

2051111, white pan bread—The level of the price index was 8.3 points higher than the UVR. Based on a comparison of BLS and Census data for the WPI sample cities, 1.7 points were estimated as due to different coverage; a product shift in the 4 cities accounted for 2.8 points; and the balance was due to a combination of product mix in the remaining universe and some unrepresentativeness in the WPI sample.

2211731, 2261731—finished cotton broadwoven fabrics—The UVR'S for both the universe and the central 75 per cent of the array were atypically higher than the WPI, reflecting a shift in volume production from cheap corded print fabrics to relatively expensive cotton specialty fabrics between 1958 and 1963.

22960—tire cord and tire fabrics—The UVR, covering the mix of rayon, nylon and polyester fabrics, was biased upward by a shift in volume production from rayon to the higher priced fabrics, chiefly nylon. The WPI, covering rayon only, also had an upward bias, indicated by a decreasing price trend in nylon tire yarn which determines the price of the fabric. (Nylon tire fabric is not priced since, unlike rayon, its production is largely integrated with tire manufacturing.)

2431611, softwood molding—WPI had an upward bias owing to an unsatisfactory sample prior to 1960. The bias in the UVR could not be evaluated owing to the multi-modal distribution of plant unit values.

2621552—wood bond paper—The Census unit value index was 6.4 index points lower than the WPI. Although there is qualitative information which points to the failure of the WPI to pick up all applicable discounts, an establishment-by-establishment check (Census vs. BLS sample) shows a closer trend than a comparison of national averages, except for one company. A sample problem may be involved.

2819131, ammonia; and 2819211, calcium hypochlorite—The WPI's for these products, based on trade paper quotations, were higher than the UVR's. Owing to the relative simplicity of the products, special discounting in the chemical industry in 1963 was assumed.

2841322, soap chips and flakes—The UVR was presumed to be biased downward owing to misclassification as detergents of some large companies'

soap products in 1963. The WPI was presumed to have an upward bias since it does not sample the low-priced soap products of small companies which had an increasing relative importance in the 1963 Census data.

3021011, canvas footwear, bals—The UVR was pulled down by the average prices for low and high-cut shoes reported to Census by some manufacturers. Production of the cheaper low-cut variety had increased sharply by 1963.

3111137, finished leathers, uppers—The WPI-UVR spread for leather uppers was less than 1 per cent owing to a stable product mix in the Census data, confirmed by data published by the National Footwear Manufacturers Association, Inc.

3141410, women's shoes—The WPI-UVR spread for women's shoes was relatively narrow (1.8 points). However, an upward bias was seen in both the measures. The UVR covered all types and price lines of women's shoes and reflected the decreasing domestic production of lower priced shoes which has been replaced by imports. The WPI although based on company reports of average daily transactions probably did not cover the large volume discounts to chain stores.

3312319, hot rolled strip, carbon—The WPI, based on list prices, exceeded the UVR. Part of the difference could be due to special discounting not reflected in the list prices. However, there was a shift in product mix even in this relatively homogeneous product. Sales of coils were advancing relative to the high priced cut lengths in 1963.

3452113, standard nuts; 3452133, machine screws—Both the mix and frequency of change in the quality of these products precludes an adequate WPI sample and ensures product mix change in the unit value relative. This is particularly true of machine screws which are affected by the frequent design changes in automobiles.

3519100, gasoline engines—The product demonstrates the inevitable mix in a nonhomogeneous 7-digit product for which detailed data are not published in the Census owing to their inclusion in current reports. Unit value relatives for the three horsepower classes covered by the WPI sample exceeded the WPI's by from 2 to 18 points, indicating a quality increase in each class. However, the UVR of Census data for all sizes combined was lower than the WPI by 6 points. The composite unit value was pulled down by increased production of smaller engines which accounted for about 87 per cent of quantities and 45 per cent of value in the 1963 statistics.

354013, freight elevators, electric—A tri-modal distribution of establishment values for this product in 1963 resulted in a unit value relative of 84.8 compared with 101.1 for the WPI. The product is an extreme example of the probability of bias in unit values for highly fabricated products.

3561415, air compressors, stationary, 16-100 H.P.—The lower levels of the UVR—30.7 points lower than the published WPI and 16.8 points for

matching establishments—reflected a relatively larger increase in production at the lower end of the class.

3561416, air compressors, stationary: 101-250 H.P.—There were quality improvements over the period in three of the four WPI specifications. The quality adjustments in the price series may account for the price index being lower than the unit value relative.

3633155, electric dryers—With a WPI reporter sample representing 90 per cent of the universe, the WPI-UVR trend difference could be estimated more closely than for most products. The WPI was a net 8.2 index points higher than the UVR. Adjustments for quality changes in the WPI sample accounted for + 8.5 points. Changes in the mix of companies and internal weights between censuses accounted for an additional + 7.6. Offsets of − 3.7 represented different coverage and of − 4.2, different movements of prices and unit values for the WPI company sample.

3983061, book matches—The UVR of 94.0 for the universe compared with one of 62.5 for the central distribution and a WPI of 65.5. The higher unit value was apparently the effect of inconsistency in the unit (case or millions of matches) reported to Census in 1958 and 1963.

The authors summarized the study as follows:

1. One fairly clear pattern is the evidence of product mix in the Census data. This theme runs through the comments on the statistical tables and the product notes alike. Both product mix, *per se*, and changes in mix or quality are provided for in the WPI procedures for sampling and quality adjustments. However, the problem of change in the mix or quality cannot be dealt with in the Census unit values, due to the almost universal nonhomogeneity of the 7-digit product, as currently defined in the Census of Manufactures.

2. The persistent tendency of unit values to reflect shifts in product mix usually to the lower end of the quality or price line between 1958, a year of recession, and 1963, a year of near full employment, is moderated for some products when the tails of the unit value distribution are omitted and the relatives are computed from the central 75 per cent of the array.

3. Census records are not detailed enough to establish the representativeness of a WPI price sample nor to confirm the *prima facie* assumption of complete coverage and reporting of transaction prices to Census. (The quality of WPI sampling and Census coverage alike still rest with the expertise of the responsible agency staffs and the good faith of the respondents. These matters are beyond the scope of this study.)

4. BLS price records do provide a documented record of quality changes in the sample and an appraisal of the sample itself, based on information which is necessarily more detailed than that reported to Census. This includes an assessment of whether WPI price series are based on transactions and, more importantly from the BLS standpoint, the importance of transaction prices to any given product.

5. Comparison of BLS and Census price detail at the plant level is not a feasible approach to the selection of deflators for benchmark or other large-scale programs. In terms of information gained, an inordinate amount of resources were consumed in locating Census plant reports and tracing the effect of WPI sample revisions over a 5-year span.

TABLE 1

CENSUS UNIT VALUE RELATIVES (NATIONAL AVERAGES) AND
COMPARABLE WHOLESALE PRICE INDEXES FOR 25 CENSUS PRODUCTS, 1963
(1958 = 100)

| Codes | | Census Description | Indexes | | Differ- |
Census (1963)	WPI (1967)		WPI	Census Nat. Avg.	ence
2011631⎱ 2013631⎰	02-21-04-23; 24	Ham, smoked, except canned Ham, smoked, picnic	82·1	85·4	− 3·3
2026212	02-31-01-01; -02; -03; -05; -07	Whole milk	113·6	96·3	+17·3
2041118	02-12-01-01; -02; -03	Wheat flour	106·9	1	1
2051111	02-11-01-01; -02; -03; -04	White bread	110·5	102·2	+ 8·3
2211731⎱ 2261731⎰	03-12-01-15; -17; -19	Cotton broadwoven fabrics, plain, dyed and finished	98·6	114·3	−15·7
2296032	03-34-01-41	Rayon tire cord	91·9	2	2
2431611	08-21-01-82	Softwood moulding	127·5	100·7	+26·8
2621552	09-13-01-31	Wood bond paper	104·6	98·2	+ 6·4
2819131	06-52-01-05	Ammonia	103·0*	94·4	+ 8·6
2819211	06-11-03-49	Calcium hypochlorite	128·3	90·4	+37·9
2841322	06-71-01-06; -46	Soap, household chips and flakes	99·6	91·2	+ 8·4
2851355	06-21-01-21	Prepared paint, enamel	102·6	101·2	+ 1·4
2851481	06-21-01-01	Interior water-type paint	104·1	100·8	+ 3·3
3021011	07-13-01-01	Canvas footwear, bals	111·3	93·8	+17·5
3111137	04-21-02-31; -41; -51; -61	Leather, uppers, finished	113·6	114·0	− 0·4
3141410	04-32	Women's shoes	110·2	108·4	+ 1·8
3312319	10-13-02-68	Hot rolled strip	103·3	98·1	+ 5·2
3452113	10-81-01-16	Standard nuts	132·5	82·0	+50·5
3452133	10-81-01-21	Machine screws	141·4	107·7	+33·7
3519100	11-94-01-02; -03; -04	Gasoline engines	104·9	98·9	+ 6·0
3534013	11-42-01-01	Freight elevators	101·1	84·8	+16·3
3561415	11-41-01-41	Air compressors, 16–100 h.p.	111·0	80·3	+30·7
3561416	11-41-01-42	Air compressors, 101–250 h.p.	102·9	107·4	− 4·5
3633155	12-41-02-32	Electric driers	96·1	87·9	+ 8·2
3983061	15-92-01-06	Book matches	65·5	94·0	−28·5

*January, 1959 = 100.

[1]The Census product was redefined between 1958 and 1963.

[2]Value of shipments data not available in Census.