THE USE OF UNIT VALUES TO MEASURE DEVIATIONS OF TRANSACTION PRICES FROM LIST PRICES

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The results reported in the Searle report have stimulated me to carry out an extensive study of unit value indices, based on a much more extensive body of data and much improved procedures as compared to the preliminary evidence contained in my "Measurement Bias in Price Indices for Capital Goods," published in this journal in June, 1971. Once again, the new study confirms the hypothesis that transaction prices of capital goods exhibit procyclical fluctuations relative to list prices. Machinery prices appear to have been considerably more flexible downward during the period of weak investment demand between 1957 and 1963 than indicated by the Wholesale Price Index (WPI), and more flexible upward during the subsequent expansion during 1963–69. This brief paper is a summary of the study. A complete and detailed report of results is contained in my forthcoming monograph, *Measurement of Durable Goods Prices*, to be published by the National Bureau of Economic Research.

METHODOLOGY

The main innovations in the study are as follows:

1. With a few exceptions the study is based on product groups for which the Census reports unit value data divided into explicit size classifications.

2. Data are collected and analyzed for each year available for all capital goods; previous studies have been concerned with only a few products and, in most cases, only for scattered Census years. In 1967 over $6 billion of products are included, equal to 28 per cent of investment in the covered industries, and over 5,000 observations are included.

3. Single identical size classifications cannot be adequately analyzed for a string of successive years. Instead, the study is conducted for 23 separate *pairs* of years, with the restriction that size boundaries must be homogeneous for any pair. Then the resulting rates of change for year-pairs are chain-linked into indexes.

4. An adjustment is devised to correct unit values for individual size groups for shifting product mix *within* the group, based on shifts in product mix in adjacent size classes.

5. Four separate unit value indexes are calculated for each product, at differing levels of aggregation. Tests indicate that the differences among the four indexes are consistently related to changes in the average size of products. An implication is that shifts in product mix are likely to be an insurmountable handicap in the many product groups for which no detailed size-class information is available.

TESTS OF CYCLICAL BEHAVIOR

The hypothesis of procyclical movements in the unit value/WPI ratio for each product group is tested by two methods, multivariate regressions and the

NBER "cycle-average" technique. Both tests confirm the hypothesis of procyclical movements.

1. The aggregated unit value/WPI ratio for all product groups is significantly related to both cyclical variables used in the study, (a) the ratio of unfilled orders to capacity in nonelectrical machinery, and (b) the aggregated utilization rate for the products in the study (calculated for each product as the ratio of real output to trend).

2. The influence of unfilled orders/capacity occurs both in the current year and with a two-year lag. Thus a major conclusion is that discounting off list prices becomes more pervasive if a recession lasts several years than if the recession is short. Firms may prefer to forego sales rather than cut prices if a recession is short and business is expected to improve soon, but discounting appears to become more important when slack business conditions drag on for several years, as between 1958 and 1963. One of the reasons previous investigators have failed to confirm the procyclical hypothesis is a limited view of the business cycle which does not allow for lagged effects.

3. Industry group and product group regressions confirm the aggregate results. At least one cyclical variable has a significantly positive coefficient in 33 of the 52 product groups, and in eight of the nine industry groups.

4. The NBER cycle-average technique confirms the regression results. One test was a computation of the number of cycle comparisons in which the rate of change of the unit value/WPI ratio increased in an expansion compared to the previous contraction or decreased in a contraction compared to the previous expansion. Excluding products in one "problem industry" which uses inappropriate WPI indexes, the expected procyclical relationship occurs in 105 out of a possible 148 comparisons. The average rate of growth in all expansions exceeds that in all contractions in 29 out of 40 product groups.

5. If the change in average size is accepted as a proxy for unmeasured quality change, there appears to be no procyclical variation in average quality. Thus the alternative hypothesis, that the procyclical movement in the unit value/WPI ratio reflects procyclical quality change rather than discounting off list prices, is rejected.

Secular Change: Unit Values as Signals

1. The aggregated unit value/WPI ratio for all product groups declines at an average secular rate of 0.5 per cent, indicating the possibility of an upward secular bias in the WPI despite the fact that it attempts to correct for changes in quality in addition to overall size, whereas the unit value indexes correct only for changes in a single size dimension.

2. Detailed case studies of two products, diesel engines and adding machines, indicate that the unit values in these cases are much better indicators of secular price change than the WPI, based on comparisons with price quotations obtained directly from firms and from the Sears–Roebuck catalogue. The secular upward bias in the WPI is 4.5 per cent per annum for diesel engines and 6.3 per cent per annum for adding machines.

3. The inaccuracy of the WPI in these cases remains a mystery to be resolved by its compilers at the Bureau of Labor Statistics. The most plausible explanation is that the WPI reports prices for particular models with rising relative prices which have become obsolete and are losing their share of the market to newer models.

Concluding Evaluation of Unit Value Indexes

The controversy over the use of unit values as a replacement for WPI quotations has developed in two stages. First the 1961 Stigler report recommended their widespread use and published study papers which contained a few comparisons of unit values and the WPI. In contrast, the Searle report summarized in this issue recommended against unit values on the grounds that the product mix problem is insurmountable. Previous conclusions of a secular downward drift in unit values relative to WPI quotations in the 1958–63 period were rejected as due to a decline in average size.

The results of my study imply that neither side is correct. The test of aggregation bias indicates that unit values can be seriously misleading unless explicit size-class information is available for fairly narrow classes. But if this size-class information is available, unit values can serve two useful functions. First, their historical behavior provides valuable information on the importance of deviations between transaction and list prices. Second, and just as important, marked deviations between the secular rate of growth of unit values and the WPI indexes serve as a "signal" that further research is necessary. In some cases the WPI may be more accurate and may be confirmed by outside data, and in some cases the unit values may be confirmed. But the important function served by unit value data is to pinpoint the areas where further research is likely to have a high benefit-cost ratio.

The Administered Price Controversy

The prices of heterogeneous capital goods appear to have been significantly more flexible during the long 1956–63 slump in capital goods output than is indicated by the present official deflators for producers' durable equipment. As a corollary to this result, real output in investment goods industries did not decline during this period by as much as the official indexes indicate. Discounting appears more important in this study than in Stigler–Kindahl's recent analysis of buyers' prices for crude and intermediate materials, suggesting that the WPI may be more accurate for crude than for finished products. Another implication is that the ratio of producers to consumers good prices is more cyclically variable than appears in the official statistics.

An indirect but untested implication of the study is that finished good prices in the Great Depression of the 1930's may have been more cyclically variable than indicated by the official statistics. Unfortunately, sufficiently detailed unit value data are not available for these years. But our case study of adding machines again confirms the usefulness of mail-order catalogue prices as a cross-check on government prices indexes, and alternative price indices for the pre-World War II period based on mail-order catalogue prices should be high on the future research agenda of economic historians and national income accountants.