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The Nature of the Price Indexes

THE UNIQUE PRICE

There is a pervasive belief that each standardized industrial commodity normally has one price at a given time. This belief may stem from the well-known proposition of economic theory that under competition (of buyers *or* sellers) only one price can survive in a market, although in a fuller and more accurate version one must add, *for an identical transaction.* The belief is certainly fostered by the statistics of prices; the Bureau of Labor Statistics does not report and does not discuss the dispersion of industrial prices at a point in time or the diversity of movements of prices over time. The Bureau reports that the price of an oil storage tank of 55,000 barrel capacity was $37,026.75 in February of 1967, when the index stood at 111.4 (January 1961 = 100). In fact, the practice of basing prices upon one, two, or three reporters, and almost *900* wholesale prices are so based,[1] must represent a pledge to

[1] The distribution of company reporters at an unspecified date in the late 1950's was:

1 reporter	243
2 reporters	216
3 reporters	432
4 reporters	216
5 or more reporters	243
	1,350

Source: *Frequency of Change in Wholesale Prices,* BLS Report No. 142 (1958). In January of 1965 prices of 1,152 commodities were based only upon company reports, and they had an average of 3.6 reporters per commodity; see *BLS Handbook of Methods,* Bulletin No. 1458 (1966), pp. 94–95.

the same doctrine of Unique Price, for these are hardly reassuring sample sizes.

Of course, prices are known to vary with quality of commodity and size of order, so these characteristics are specified more or less precisely by the BLS, and most prices vary with location of seller or buyer, so origin or destination is also usually specified. These qualifications of the Unique Price merely redirect our questions: are the price differentials for variation in quality, lot size, and location stable over time—and stable in absolute or in relative terms? Yet surely these three dimensions do not describe the full complexity of the pricing process. Transactions differ, to cite a few varieties of influences, with

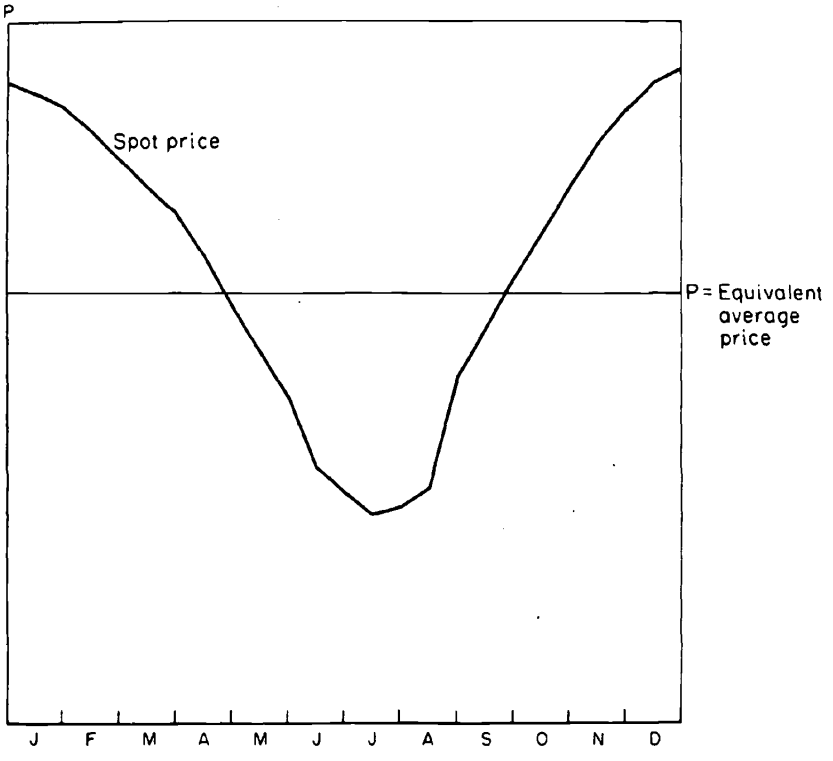
–credit-worthiness of the buyer
–engineering services supplied to the user of the product
–"trade relations", the euphemism for reciprocity in dealings
–tie-in sales, the purchase of related goods
–introductory offers, which compensate the buyer for the additional costs of changing sources or techniques
–speed of delivery
–guarantees of supplies in times of "shortage" (rationing).

These factors may be common to many customers, or they may be quantitatively of small importance, but neither of these reasons for believing in the Unique Price has been demonstrated empirically for ordinary industrial goods.

The *duration* of a price is a variable which deserves special comment. Suppose that the price for individual orders (that is, the "spot" price) has a systematic seasonal pattern (which we illustrate in Figure 4-1). A contract for deliveries over a year will usually be based upon an annual price equivalent to the average of the expected spot prices, minus a saving because of the reduction in costs of negotiation, testing of quality, devising of methods to settle controversies, etc., which is permitted by repetitive dealings. Even if the spot price fluctuates irregularly, a corresponding equivalent annual price will often be contracted (as in Figure 4-2). In this latter case, the contract price will be revised if prices move substantially outside the expected range: many contracts, we found, could be reopened or cancelled by either party with appropriate notice. Thus the contract will be reopened in the situation illustrated in Figure 4-2 and a price of R agreed upon. About half of the

Figure 4-1

Uniform Seasonal Pattern in Price



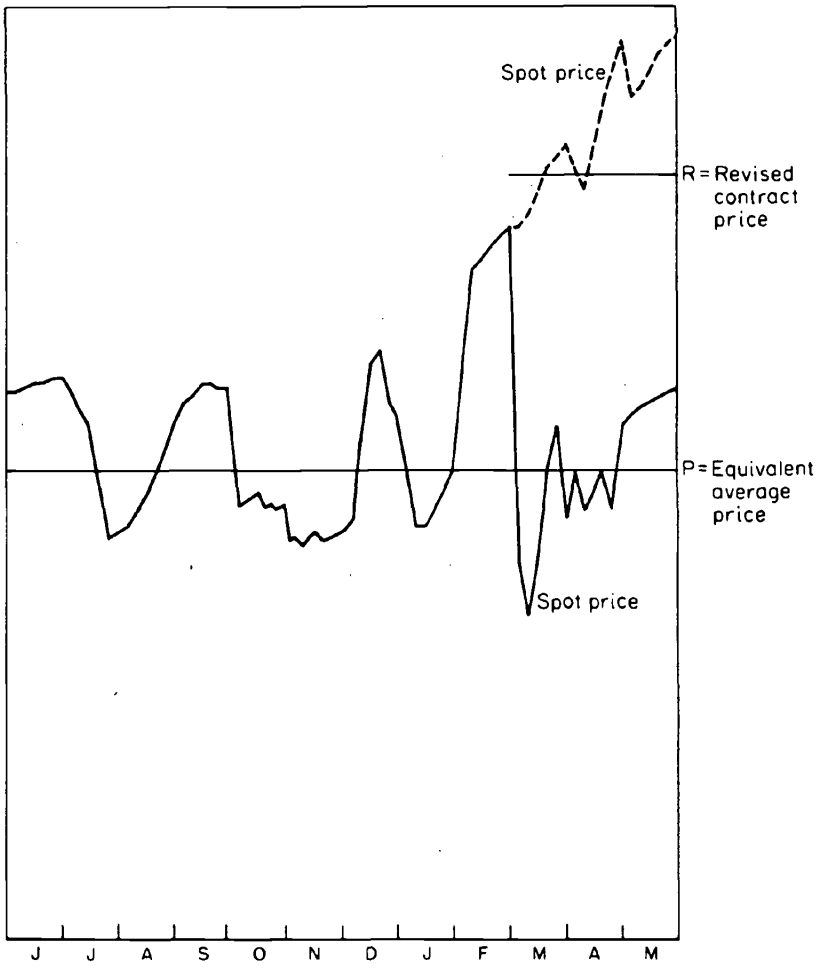
commodities in our sample for both industrial firms and governmental bodies are purchased on the basis of explicit contracts, and approximately half of these contracts are occasionally renegotiated within the contract year. Therefore a price index based upon a number of contract prices will fluctuate frequently only if the contracts are numerous and the contract periods vary among contracts.

Buyers' Prices

When prices are collected from buyers there is less temptation to adhere to the Unique Price. The greater dispersion of price one encounters is, to be sure, partly due to differences in transportation costs and particular technical specifications of goods. Even here, however,

we should note that buyers' prices have some advantages. If one wishes to measure costs of production, buyers' delivered prices are the correct ones: it is what steel (of the types actually purchased) costs the automobile manufacturer that influences his costs, not what the steel mill receives for the steel. Moreover the distinction between delivered prices and prices f.o.b. the production center is becoming progressively more ambiguous (or irrelevant) when much shipping is done in carriers be-

Figure 4-2
Irregular Fluctuations in Price



longing to buyers or sellers; and we frequently encountered the comment that sellers shaded prices by negotiating on freight.

A second source of differences in movements of buyers' prices and sellers' prices is the fact that each buyer is not permanently assigned to a given seller. From time to time a buyer will shift to a new supplier, presumably in response to a better price or other advantages which we would hope to represent by a price difference. Then the index of buyers' prices could decline while every seller's price remained constant. Of course an index of sellers' prices with current weights would reflect the shift of buyers, but no price index is constructed with current weights.

A third source of difference in buyers' and sellers' prices is the different ways in which commodities are chosen. Each seller's price will be that for a particular commodity—e.g., "hot-rolled carbon steel sheets, 10 ga. x 48″ wide x 120″ long, sheared edge, cut length, base chemistry, commercial quality, base packaging, base quantity, mill to user, f.o.b. mill" (so the BLS)—and this price will be collected whether or not any steel of this precise description is sold. Each buyer, on the other hand, will be asked to report the price of that type of hot-rolled carbon steel sheet which he has purchased continuously for some period of time, and it is not only possible but highly probable that no two of a small number of buyers will purchase to precisely the same specifications. Hence a sellers' price index is based upon a more or less precisely defined commodity, which it is hoped reflects the movements of similar commodities, and the buyers' price index is based upon a broader range of commodities.[2]

No matter how precisely the conditions of a transaction are specified,

[2] The range of products included in one of our commodity classes may be illustrated by cold-rolled carbon steel sheet and strip. The physical dimensions include:
.062″ x 36″ x 96″
20 gauge x 36″ x 120″ (USS drawing, oiled)
.125″ x 22″ x 96″
.032″(±.0025) x 7.50″ (AISI 1010, hard temper, RB-90 min.)
AISI, C1213, ½″ diameter
.036″ x 72″ x 142″ (drawing quality AISI 1010, manganese .60 max.)
.030″ x 1⅜″ x coil (SAE 1010, 6,000 lb. skids, No. 4 temper)
.0225″ x 36″ x coil
16 gauge x 36″ x 96″ (C.Q. oiled)
.040″ x 7½″ x 48″
.020″ x 36″ x 48″

the buyers' prices display a dispersion of level and variation in time of change which represent fundamentally the incompleteness of the buyer's, and possibly seller's, information. One must resist the common practice of immediately labeling this incompleteness an "imperfection" of the market; it is a rational adjustment to the costliness of collecting information on prices. If there are numerous sellers, a buyer will find it prohibitively expensive to canvass each seller, or be canvassed by the seller's representative, each day or hour. In a world of change there will not be a Unique Price. We pursue this matter in Chapter 7.

Of course every price paid by some buyer in a given time interval is received by some seller, so in principle the same information can be obtained from a seller. The seller's price *quotations,* however, will not display the multiplicity of prices and the frequency of revision that the transaction prices actually display. Quite aside from legal questions of price discrimination, it would be too costly to revise price quotations continuously.

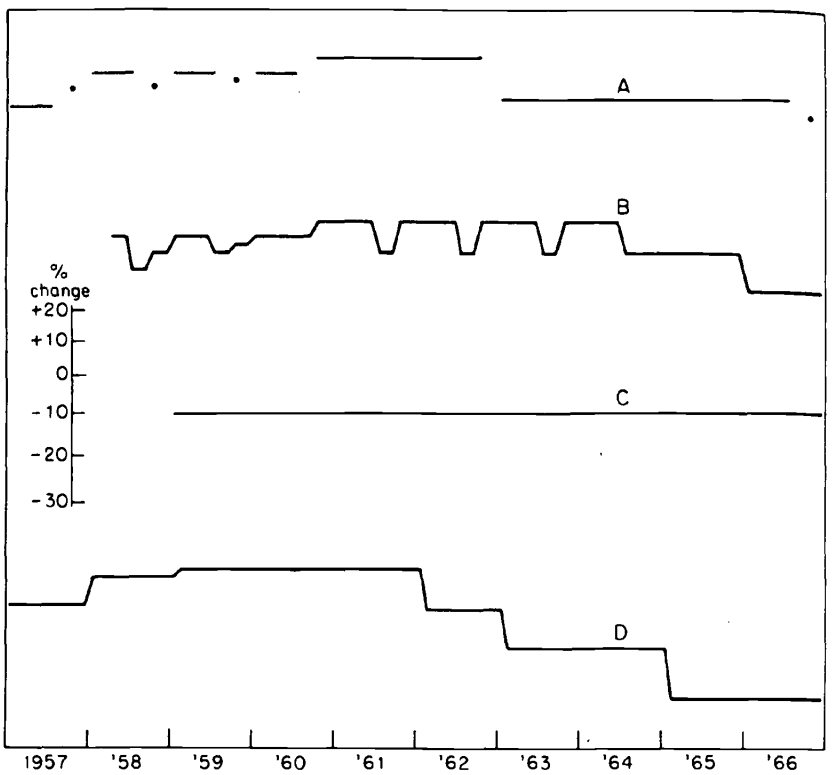
THE DESCRIPTION OF PRICE MOVEMENTS

A collection of prices collected from buyers will display dispersion in level and timing of changes. Our interest is in the timing and size of price changes and, in any event, differences in level of prices due to lot size and delivery point are uninteresting as sources of dispersion, so we adjust all price series to the same level. Sample price series for ammonia are shown in Figure 4-3. They were chosen to display the varieties of price data reported: unchanging prices, irregularly changing prices, broken price series, and frequently changing prices.

From these and other prices we calculate an equally weighted index, which is presented in Figure 4-4 along with the BLS index for ammonia. The comparison of our price index with that of the BLS is made later, here the main interest is the method of presentation of price indexes.

An index of prices has more to report than *the* price, once the myth of the Unique Price is abandoned. Some measure of the statistical reliability of the index is essential. Unfortunately in the absence of random sampling it is impossible to assign an unambiguous statistical measure of reliability to an index. Nevertheless two descriptive statistics are helpful in appraising an index: (1) The number of reporters on which the index is based. (2) The standard deviation of the movements of individ-

Figure 4-3
Ammonia: Selected Individual Price Series



ual prices about the movement of the index (= mean of individual price movements). The latter measure is also included in Figure 4-4 as an annual average.[3] The average number of reporters during each year is reported with the basic tables.[4]

[3] The formula for the annual average standard deviation is as follows:

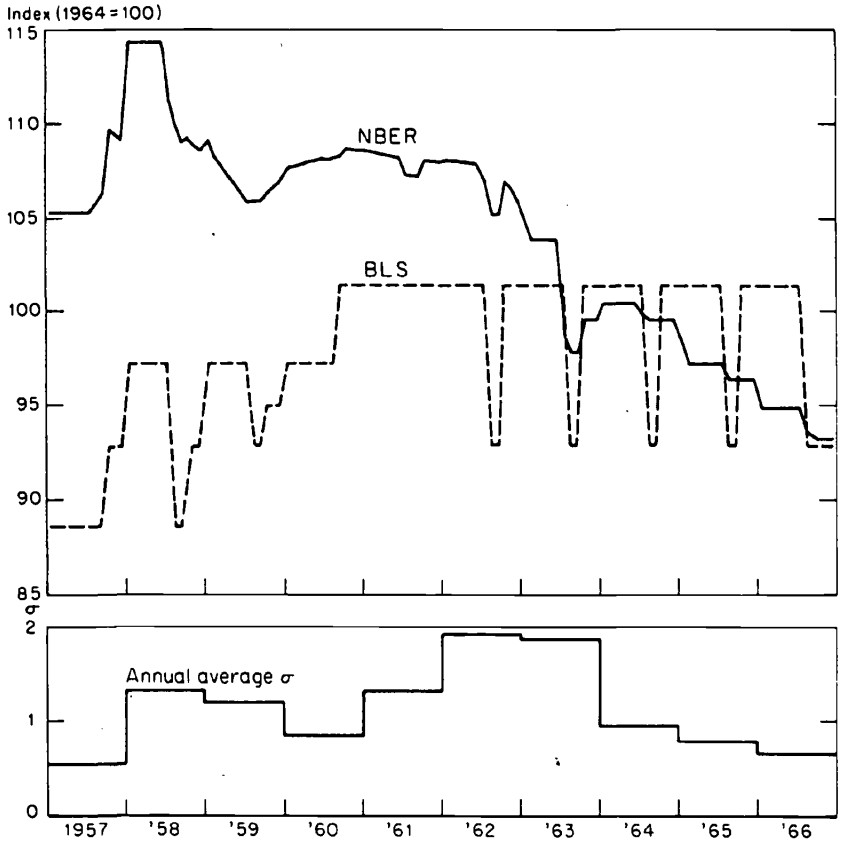
$$\frac{1}{T}\sum_{i=1}^{T}\sqrt{\sum_{j=1}^{N_i}\frac{(P_{i,j}/P_{i-1,j}-I_i/I_{i-1})^2}{N_i-1}}$$

where $P_{i,j}$ is price j in month i, I_i is the index number in month i, N_i is the number of series reporting both in month i and $i-1$ and T is the number of months for which $N_i \geqq 2$.

[4] More precisely, the count of series is based upon number of series entering the monthly rates of change of prices, and the number for a year is the average of the monthly numbers.

Figure 4-4

Ammonia: Comparison of BLS and NBER Price Indexes and Annual Average Standard Deviation of NBER Index



METHODS OF COMPARISON OF PRICE INDEXES

We shall compare the BLS and NB indexes in the next chapter; subsequently in this chapter we shall compare the movements of price indexes of different classes of buyers. What comparisons shall we make? Two price indexes, each covering 120 months, permit a vast number of comparisons—and all within one minute by a computer! Our selection of criteria of concordance is governed by the leading uses of indexes of industrial prices.

Trend

The simplest test of the concordance of movement of two price indexes is a comparison of their secular trends. The average annual percentage change of price is of course a widely used number; it is requisite to the measurement of secular inflation and essential to the deflation of dollar product in the calculation of labor productivity. A constant percentage change equation, $\log_e P = a + bt$, is fitted to each price index.[5] The monthly relative change in price is

$$\frac{P_{t+1} - P_t}{P_t} = e^a \frac{(e^{b(t+1)} - e^{bt})}{e^a e^{bt}} = e^b - .1,$$

which is approximately equal to b, and we use b as the measure of price change. For small changes it is also satisfactory to take $(12 \times b)$ as the annual relative change in price. In order to form some estimate of the goodness of the fit of the trend line to the indexes, graphs of the indexes have been examined and the correlation coefficients of the indexes with time computed. The constant-percentage-growth trend fits tolerably well in the great majority of series but there are a small number for which this is not true. In these exceptional cases there is usually a reversal of trend within the period. The exceptional cases are given special treatment in the trend analyses.[6] In addition trends have been calculated for the first and second five-year periods.

The indexes for the price of ammonia will illustrate the comparison of trends. The regression coefficients of the logarithms of the monthly indexes on time (b in the above notation) are, in percentage terms:

BLS:	.068
NB:	−.134

Hence the BLS index rose an average of $12 \times .068 = .82$ per cent a year and the NB index fell by $12 \times .134 = 1.61$ per cent a year.

Cyclical Behavior

The good fortune of the American economy not to have experienced large short-run fluctuations in the level of economic activity in our

[5] In which $(dP/dt)(1/P) = b$.

[6] These series are identified in Appendix C.

TABLE 4-1

Reference Cycles and Selected General Measures of Economic Activity

Date	Phase of Cycle	BLS WPI [a]	Rate of Unemployment (per cent)	Production Index of FRB [a]	GNP ($ billions) [b]
July 1957	Peak	100.8	4.3	96.2	447.8
April 1958	Trough	101.9	7.5	89.8	434.5
May 1960	Peak	100.8	4.9	109.9	505.0
Feb. 1961	Trough	101.1	8.1	103.7	501.4
Nov. 1964	Trough [c]	100.7	4.5	135.9	634.6
Nov. 1966	Peak [c]	105.9	3.4	160.2	762.1

[a] 1957–59 = 100.

[b] Closest quarter, seasonally adjusted at annual rates.

[c] The period November 1964 to November 1966 is treated as an expansion for reasons discussed in the text. The date of the peak, November 1966, is arbitrarily chosen.

period means that there were no cyclical pressures upon prices comparable to those experienced before 1941. Therefore we are not able to judge the amount of price cutting that would emerge if general business entered a severe depression. The National Bureau reference cycles within our period are listed in Table 4-1, together with a few select numbers to indicate the modest extent of general business declines in this decade. We shall employ as one measure of cyclical price behavior the average monthly rates of price change in the two reference cycle contractions and in the first reference cycle expansion (1958–60), together with the expansion in the last two years (November 1964 to November 1966) because this sharp expansion strongly resembles a reference expansion even though it was not preceded by a contraction. The long reference cycle expansion which began in 1961 is omitted. Its duration was such that large expansions of capacity were possible. Therefore the growth of demand was not likely to have a substantial impact upon prices of the type associated with short-run demand fluctuations.

The illustrative measures for the monthly rate of change of the price of ammonia are as follows:

	BLS	NB
Trough to Peak	−.1806%	−.2504%
April 1958–May 1960	0	−.2270
Nov. 1964–Nov. 1966	−.3687	−.2747
Peak to Trough	.7545	.4742
July 1957–April 1958	1.0287	.8996
May 1960–Feb. 1961	.4802	.0489

The price of ammonia thus moved opposite to the movements of general business: the National Bureau Index rose less in business contractions but fell more in the combined business expansions than the Bureau of Labor Statistics Index. We conclude that for ammonia the NB Index conformed less well in expansions and better in contractions than the BLS Index.

When there are strong trends in the price indexes, the cyclical responsiveness of price may be swamped or exaggerated by the trend component. The constant percentage trends just described then allow us to subtract out the trend changes to get a better measure of cyclical responsiveness. Since a single type of trend line is fitted to all seventy commodity price indexes, trend corrections are only rough, and the trend-corrected price changes are clearly better only when the trend is strong.[7]

In addition, specific cycles (rather different from those usually employed in National Bureau studies) were analyzed for the commodities for which data are available. A specific cycle is determined by the movements in the physical volume of the specific commodity, and the responsiveness of prices to movements of industry output is determined. This relatively unsuccessful investigation is reported in Chapter 5 and Appendix D.

[7] In the case of ammonia, where the trend is *not* strong (the NB Index, which has the larger trend, fell 1.6 per cent a year), cyclical changes become:

	BLS	NB
Trough to Peak	−.2730%	−.1243%
April 1958–May 1960	−.2309	−.2203
Nov. 1964–Nov. 1966	−.3168	−.0243
Peak to Trough	.5236	.4809
July 1957–April 1958	.7978	.9063
May 1960–Feb. 1961	.2493	.0556

Now the NB Index conforms better in expansions, but the two indexes are similar in contractions.

Short-Run Fluctuations

The final set of comparisons involve movements independent of trend and shorter than periods of general business expansion or contraction. We shall employ three measures to this end.

The first measure of short-run movements pertains to the amplitude of fluctuations. For this purpose we calculate the first differences in the natural logarithms of the indexes to be compared; so, say,

$$x_t = \log_e I_t - \log_e I_{t-1}$$

and calculate

$$\sigma^2 = \frac{\Sigma(x_t - \bar{x})^2}{119}.$$

This variance is .00077772 for the BLS index for ammonia, for example, and the standard deviation is $\sqrt{.00077772} = .0279$, so if the monthly percentage changes in the BLS were normally distributed, two-thirds would fall within 2.79 per cent of the mean (which is virtually zero).[8] The corresponding variance for the NB price index for ammonia is .00007992 and the standard deviation is .008940, or .89 per cent. Hence the BLS index is much more volatile than the NB index.

Our second set of measures describes the degree of simultaneity of movements in the monthly price indexes. Simultaneous monthly movements of the two price indexes are compared by the correlation between the first differences of the logarithms of the two indexes; the coefficient is .4310 for ammonia.

Because the monthly price series are often volatile, the comparison of monthly changes is supplemented by comparisons for longer periods. The correlation coefficients of first differences of the logarithms of the price indexes of ammonia will again illustrate our results:

Time Interval	Correlation Coefficient
Quarterly	.6347
Semiannual	.5476
Annual	.5016

In this instance the correlations of monthly changes are very similar to those for longer periods, but often the correlations rise greatly or fall slowly with the lengthening of the time interval.

[8] Actually the distribution of BLS monthly percentage changes is far from normal: 101 of the monthly percentage changes for ammonia are zero. The NBER percentage changes are much closer to a normal distribution (see pp. 66, 67).

Leads or lags in the movement of one price index relative to the other are examined by the corresponding correlations: illustrative calculations for ammonia are given in Table 4-2. Where a nonsimultaneous correlation is largest, the corresponding time difference is taken as the measure of lead or lag.

Some attention has been devoted also to the large price changes in each series. A "large" change is arbitrarily defined as one of 5 per cent or more in any quarter. The large changes in the price of ammonia are listed in Table 4-3. We encounter here a seasonal pattern in the BLS quotations, with absolutely identical reductions of price in August and September in the last five years of the period. Our series has no such seasonal pattern, presumably because of our dependence upon annual contract prices. These "large" change comparisons could, in principle, serve either of two purposes: to measure responsiveness in the indexes to large changes in market conditions; or to identify erratic and implausible movements of either index.

TABLE 4-2

Correlation Coefficients of Monthly Relative Changes, NB and BLS Price Indexes for Ammonia
(measured by first differences in logarithms)

Lead or Lag		Correlation Coefficient
NB	BLS	
Jan.–Feb., Year 2	July–Aug., Year 2	.0226
	June–July, Year 2	−.0002
	May–June, Year 2	.0084
	April–May, Year 2	−.1906
	March–April, Year 2	−.1079
	Feb.–March, Year 2	.2751
	Jan.–Feb., Year 2	.4071
	Dec., Year 1–Jan., Year 2	.0113
	Nov.–Dec., Year 1	−.1399
	Oct.–Nov., Year 1	.0176
	Sept.–Oct., Year 1	−.0521
	Aug.–Sept., Year 1	.0577
	July–Aug., Year 1	.0174

TABLE 4-3

"Large" Quarterly Changes[a] in the Price of Ammonia
(per cent)

Period	BLS	NB	Period	BLS	NB
1958			1964		
2nd–3rd Qtr.	−5.8953		2nd–3rd Qtr.	−5.6459	
1962			3rd–4th Qtr.	5.9838	
2nd–3rd Qtr.	−5.6459		1965		
3rd–4th Qtr.	5.9838		2nd–3rd Qtr.	−5.6459	
1963			3rd–4th Qtr.	5.9838	
2nd–3rd Qtr.	−5.6459	−5.4919	1966		
3rd–4th Qtr.	5.9838		2nd–3rd Qtr.	−5.6459	

[a] A "large" change is defined as one of 5 per cent or more in any quarter.

Choosing between these interpretations requires having outside information on whether market conditions have actually changed. We have not been able to collect sufficient data on output, inventories, and orders to make an effective investigation of this subject, but a few scraps of analysis are presented in Chapter 5 and Appendix D.

PRICE MOVEMENTS BY TYPE OF BUYER

In the process of developing new price indexes, we collected information which allows the construction of indexes for classes of buyers. These class-of-buyer prices are not only interesting in their own right but also add to the understanding of general price movements. Two classifications of buyers are examined: governmental vs. nongovernmental buyers; and (related to size of purchase) weighted vs. unweighted indexes.

Governmental vs. Private Buyers

We requested from buyers the prices of commodities which they bought frequently and in substantial quantities. The buyers' responses led to a sort of self-selection of commodities; governmental units seldom bought most chemicals or semifabricated metals, industrial concerns did not buy drugs. In fact only eight commodities were reported by a suffi-

ciently large number of both public and private buyers to permit the construction of useful indexes. These commodities are:

Commodity	Maximum Number of Price Series	
	Public	Private
Book and magazine paper	9	19
Chlorine, in bulk	5	21
Paper boxes and shipping containers	9	25
Passenger automobile tires	17	15
Portland cement	8	26
Regular gasoline	38	22
Residual fuel oil	24	34
Truck tires	15	15

These commodities are heavily clustered (two each of paper, petroleum, and rubber products) so our comparison will have small claims to generality. We follow the basic scheme of comparison which has just been described.

Trend. The monthly percentage change in prices over the ten year period is given for each series in Table 4-4. The trends of only two commodities differed substantially (chlorine and boxes)—in both cases

TABLE 4-4

Monthly Percentage Trends of Prices of Public and Private Buyers, 1957–66

Commodity	Monthly Percentage Change		
	Public	Private	Public Minus Private
Book and magazine paper	.084	.034	.050
Chlorine, in bulk	−.323	−.098	−.225
Paper boxes and shipping containers [a]	−.116	.006	−.122
Passenger automobile tires	−.098	−.146	.048
Portland cement	.036	.082	−.046
Regular gasoline	−.090	−.064	−.026
Residual fuel oil	−.172	−.144	−.028
Truck tires	−.108	−.119	.011

[a] July 1960 to July 1966.

TABLE 4-5

Variances of First Differences of Logarithms of Price Indexes of Public and Private Buyers, 1957–66

Commodity	Private Buyers	Public Buyers
Book and magazine paper	.15	1.62
Chlorine, in bulk	.12	.99
Paper boxes and shipping containers [a]	.15	1.28
Passenger automobile tires	.72	.35
Portland cement	.15	.16
Regular gasoline	.36	.21
Residual fuel oil	1.17	1.44
Truck tires	.44	.70

[a] July 1960 to July 1966.

public prices fell more rapidly—and the difference was statistically significant only in the case of chlorine. We have no reason to expect the trends to differ for the two sets of prices, and the trends are in fact similar.

Cyclical Analysis. One may correctly say that there was no difference on average and hardly any in detail in the degree of conformity of price movements for public and private buyers during the reference cycles (not presented here). It would be disingenuous, however, not to add that the prices of most of these commodities were insensitive to general business fluctuations, so their agreement was to disagree with general business movements.

Short-Run Movements. The amplitude of short-run fluctuations of the price indexes, as measured by the variance of the first difference of logarithms, is the same for public and private buyers of five of the commodities (Table 4-5). The exceptions all run in one direction: the public price movements are much larger and jerkier in the two paper products and chlorine.

There is little correspondence between the short-run movements in prices of public and private buyers; only the annual price indexes show high correlations (Table 4-6). If one permits leads or lags of one period, most of the quarterly correlation coefficients (not reproduced here) are at least .3.

The buying practices of public bodies may be the source of these low correlations. Both public and private buyers usually use contracts in purchasing the commodities in our sample. The governmental contracts, however, do not have the provision for renegotiation of price within the year which is often found in private contracts—indeed, if

TABLE 4-6

Correlation Coefficients of First Differences of Logarithms of Price Indexes of Public and Private Buyers

Commodity	Time Unit of Price Change	Correlation Coefficient
Book and magazine paper	Monthly	.01
	Quarterly	.13
	Annually	.51
Chlorine, in bulk	Monthly	.20
	Quarterly	.10
	Annually	.27
Paper boxes and shipping containers [a]	Monthly	−.23
	Quarterly	−.25
	Annually	−.94
Passenger automobile tires	Monthly	.03
	Quarterly	.21
	Annually	.26
Portland cement	Monthly	.45
	Quarterly	.48
	Annually	.22
Regular gasoline	Monthly	.13
	Quarterly	.46
	Annually	.84
Residual fuel oil	Monthly	−.13
	Quarterly	−.13
	Annually	.84
Truck tires	Monthly	.03
	Quarterly	−.01
	Annually	.44

[a] July 1960 to July 1966.

public contracts were renegotiable in a month or two, competitive bidding would be purposeless. Hence public prices will be revised less often and by larger amounts.

Conclusion. Our sample is much too small to allow a confident conclusion, but tentatively we may say: public and private buyers pay prices with similar trends and sustained movements but their short-run movements are often different in magnitude and usually in timing.

Weighted vs. Unweighted Price Indexes

Although the BLS price indexes are unweighted averages of prices reported by individual sellers, there can be no doubt that indexes using quantity weights would be preferable. Whether one wishes to use the price index to adjust sales of sellers to stable prices or to adjust costs of buyers to stable prices, there simply exists no valid reason for using unweighted indexes. This is not to say that the difference between weighted and unweighted indexes will be large; that is an empirical question we investigate here. Primary attention is devoted to unweighted indexes in this study to maintain comparability with the BLS indexes.

The data on annual rates of purchase in, or near, 1961 were sought from every company reporting prices to us, but often no quantity information could be obtained. For seventeen commodities there are a sufficiently large number of reporters who gave adequate quantity information to allow us to compile satisfactory weighted price indexes, and our comparisons are based upon these seventeen commodities. The unweighted indexes will pertain only to those reporters who reported quantities, but in general, the unweighted indexes of quantity reporters were similar to those of all reporters. The seventeen commodities are listed in Table 4-7.

Trend. For eleven of the seventeen commodities the trend of the weighted index was downward relative to that of the corresponding unweighted index.[9] The eleven relative declines of the weighted indexes were in general larger in absolute value than the six relative increases: the mean difference in trends was $-.045$ per month or about $-.5$ per

[9] For only one commodity, electric motors, did the trend of the unweighted index differ substantially between all price reporters and the reporters also giving quantities: the respective slopes were $-.262$ and $-.048$. Our comparisons are nevertheless between weighted and unweighted indexes for identical reporters.

TABLE 4-7

Monthly Percentage Rates of Change of Weighted and Unweighted Price Indexes, 1957–66

Commodity	Percentage Change		Difference in Percentage Change
	Weighted Index	Unweighted Index	
Aluminum sheet	−.246	−.199	−.047
Copper magnet wire	−.100	+.033	−.133
Zinc	+.242	+.225	+.017
Regular gasoline	−.095	−.082	−.013
Residual fuel oil	−.073	−.118	+.045
Passenger car tires	−.309	−.181	−.128
Paper, book and magazine	−.008	+.057	−.065
Paper boxes and shipping containers	−.153	−.034	−.119
Sulfuric acid	+.030	+.022	+.008
Caustic soda	−.170	−.121	−.049
Chlorine	−.109	−.100	−.009
Ammonia	−.066	−.091	+.025
Benzene	−.323	−.316	−.017
Phthalic anhydride	−.759	−.797	+.037
Polyvinyl chloride	−.559	−.532	−.027
Tetracycline	−.983	−.651	−.332
Electric motors	−.008	−.048	+.040

year; the corresponding figures are −.027 per month or about −.3 per year if the large difference for tetracycline is omitted.

This comparison deals with trends of prices, not their absolute levels, so the downward tendency of prices to large-quantity buyers has no direct connection with quantity discounts. We suspect that the same forces which, we shall see, lead to a secular fall of NB prices relative to BLS prices in general are operative here. Indeed, since our study is based upon large buyers generally, and BLS prices are probably those quoted to small buyers, the same issue arises in BLS-NB and weighted-unweighted index comparisons (see Chapter 5, p. 56).

Cyclical Behavior. The differences in cyclical behavior of the weighted and unweighted indexes of prices are of trifling magnitude during reference cycle expansions and contractions. Almost never (four times in sixty-five opportunities) is there a difference in direction of price movement, and the differences in magnitude are usually quite small. The conformity to business contractions is unaffected by the use of trend-corrected indexes, but conformity to expansions is measurably improved with trend-corrected prices—and generally conformity is excellent in both directions.

Short-Run Fluctuations. The amplitude of short-run movements in the weighted price indexes is on average quite substantially larger than in the corresponding unweighted price indexes (Table 4-8). In eleven of seventeen commodities the former variance is greater, and

TABLE 4-8

Variances of First Differences in Logarithms of Weighted and Unweighted Price Indexes, 1957–66

Commodity	Weighted Index	Unweighted Index
Aluminum sheet	1.63	1.98
Copper magnet wire	5.15	2.17
Zinc	7.78	6.29
Regular gasoline	1.64	0.32
Residual fuel oil	3.88	0.99
Passenger car tires	4.08	5.60
Paper, book and magazine	0.26	0.21
Paper boxes and shipping containers	1.13	0.28
Sulfuric acid	0.16	0.22
Caustic soda	0.73	0.36
Chlorine	0.19	0.13
Ammonia	4.31	1.23
Benzene	3.73	4.38
Phthalic anhydride	7.24	9.51
Polyvinyl chloride	5.26	3.43
Tetracycline	2.95	4.87
Electric motors	0.29	0.46

TABLE 4-9

Correlation Coefficients of Weighted and Unweighted Price Indexes

Correlation Coefficient	Monthly Data	Quarterly Data
Price Indexes		
.95 or more	9	9
.90 to .95	3	3
.85 to .90	1	1
.80 to .85	1	1
.75 to .80	0	1
.70 to .75	1	0
.65 to .70	0	0
.60 to .65	1	1
Less than .60	1	1
Total	17	17
First Differences of Logarithms of Price Indexes		
.95 or more	1	2
.90 to .95	2	4
.85 to .90	5	3
.80 to .85	2	2
.75 to .80	1	3
.70 to .75	1	0
.65 to .70	0	1
.60 to .65	2	1
Less than .60	3	1
Total	17	17

often much greater, than the latter variance. The weighted indexes are dominated by a few large buyers, as a rule, so a part of the larger variance of weighted indexes is presumably due to smaller *effective* sample size.[10] Each of the underlying price series usually has many zero price changes between adjacent time periods, but the average index for a group of series tends to have fewer zero changes and to move more

[10] The number of buyers necessary to account for at least 80 per cent of total quantity weights, varied as follows:

Buyers	Commodities
1–3	8
4–6	5
7 or more	4

smoothly; hence in the small sample range the variance of first differences of logarithms of the indexes diminishes as sample size rises. Nevertheless the agreement between the weighted and unweighted indexes is fairly good. Not only do the indexes lie close together, but also their movements are well correlated: the mean correlation of the first differences of the logs of the monthly series is .77 (Table 4-9).

Conclusion. Subject to the limitation of a fairly small sample of commodities, we may conclude that the unweighted indexes agree well with the weighted indexes in their short-run and cyclical movements, but the weighted indexes fall relative to the unweighted indexes over the ten-year period. This latter finding anticipates and reinforces a major finding in our comparison of NB and BLS indexes, to which we now turn.