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CHAPTER 4

Characteristics of Basic Foreign Trade Data

Nature and Testing of Customs Data

THE raw materials for this study, as for almost all investigations into international commodity trade, are the official monthly, quarterly, and annual reports on foreign commerce published first by the Treasury Department and in later years by the Commerce Department.[1] These reports show the value of exports and imports under several hundred (thousands in recent years) commodity titles. For some of them, quantities (and therefore, by implication, unit values) are also given.

The need for quarterly series, particularly for business cycle analysis, led to our use of imperfectly matching concepts of imports and exports. Exports of domestic (rather than domestic and foreign) merchandise were used because they seemed more logically related to the development of the domestic economy and because the inclusion of re-exports would have necessitated an extensive additional compilation of data. However, the corresponding import concept, imports for consumption, could not be used because quarterly data were available only for general imports.[2]

The principal type of import valuation required by the customs regulations is foreign selling price (the actual transaction price or wholesale price) plus expenses necessary before shipment to the U.S. Exports are valued at American selling price plus freight and other expenses between the source and the border of the United States. For some import items other value concepts are used, such as the price of comparable merchandise produced in the United States ("American valuation") or foreign cost of production. It is clear that, despite the regulations, many exporters and importers make up their own valuation rules.[3]

These customs data, compiled from declarations filed by exporters and importers or their agents, have not generally received very high marks for

[1] A detailed list of these reports is given in Appendix C.

[2] General imports are those coming directly through customs from foreign countries plus those entering customs warehouses. They exclude imports withdrawn from customs warehouses for domestic use. Imports for consumption include the same directly imported goods, but exclude those going from foreign countries into customs warehouses, and include withdrawals from warehouses for domestic consumption. For more extended discussions see R. G. D. Allen and J. Edward Ely, *International Trade Statistics*, New York, 1953, pp. 44–50, and Lawrence F. Schmeckebier, *The Statistical Work of the National Government*, Baltimore, 1925, pp. 327–329.

[3] For an extensive discussion of import valuation, see R. Elberton Smith, *Customs Valuation in the United States*, Chicago, 1948.

accuracy from scholars who have examined them closely. They are often prepared carelessly, especially for duty-free goods. Where tariff questions do arise, there is often incentive for undervaluation or incorrect description of merchandise. Furthermore, requirements for valuation change from time to time, are often ambiguous, and in some cases differ among classes of commodities.

In the period covered by the NBER indexes, the effects of respondents' errors were compounded by the procedures of the collecting agencies. When these agencies fell behind on the processing of reports, shipments were sometimes entered in the data for the months in which they were processed rather than the month of entry into the country.[4]

The only study which examined in any detail the accuracy of traders' reports to the customs authorities was one published by the Department of Commerce in 1939.[5] Values on more than 12,000 invoices, a sample of imports of nine commodities between 1913 and 1937, were compared with those of corresponding customs reports. In terms of numbers the results were discouraging; 60 per cent of the entries were incorrect (by balance of payments standards, but not necessarily according to customs regulations) and another 20 per cent lacked data necessary for the comparison. The most frequent discrepancies involved transportation costs: the failure to include the cost of transport to the customs border of the exporting country or the incorrect inclusion of the cost of ocean freight to the U.S. Other differences involved the inclusion, in whiskey import values, of taxes payable by British consumers but not paid by American importers.[6]

There is, however, a brighter side to the results of this study. The discrepancies, although frequent, were not usually very important in value terms. This was partly because positive and negative errors cancelled each other out to some extent. The net discrepancy was very important only in the case of whiskey (47.5 per cent); in all the other commodities it was below 5 per cent. It should be noted, however, that in all of the transactions in petroleum and most of those in bananas (both of which involved

[4] Questions of the accuracy of the data are discussed in more detail in the following sources: Schmeckebier, *Statistical Work*, pp. 335–339, 355; Dudley J. Cowden, *Measures of Exports of the United States*, New York, 1931, pp. 18–21; Eliot G. Mears, "The Foreign Trade Statistics of the United States," *Journal of the American Statistical Association*, pp. 501–516; Frank R. Rutter, "Statistics of Imports and Exports," *Publications of the American Statistical Association*, March 1916, pp. 16–34; and Smith, *Customs Valuation*.

[5] U.S. Bureau of Foreign and Domestic Commerce, *Merchandise Import Statistics in the Balance of International Payments* (Report on Office Project No. 365–97–3.20 conducted under the auspices of the W.P.A.), mimeo, 1939.

[6] This was correct according to customs regulations but did not, of course, represent purchase prices.

intracompany rather than real commercial transactions), as well as roughly a quarter of those in rubber, sugar, and whiskey, the information needed for assessing the reports was not available.

Although we are aware of the frequency of these errors, we are unable to measure their direction and importance and therefore cannot correct for them. We are, however, able to test the data indirectly by methods described later in this chapter.

The sources of error listed thus far are probably of secondary importance, since they are likely to be random in relation to price changes. The fundamental difficulty, even if all the declarations and compilations were made correctly, is that we are attempting to construct a price index without price data. The unit values used instead apply to commodities defined in terms of the requirements of tariff legislation. They usually lack the precise specification typical of price quotations.

Most of the commodity titles in the export and import classifications are broad enough to include items of widely varying unit value. Where this is true, we cannot be sure whether a change in the unit value represents a change in price or merely a shift in importance among the items included.[7]

It cannot be assumed that differences between the movements of unit values and those of prices are scattered randomly over the commodity universe. The downward bias caused by a shift to a lower grade of product (see footnote 7), probably occurs more frequently among crude products than among manufactured goods. It seems likely that an upward bias would be more frequent among manufactured goods, as consumers, with secularly rising incomes, shift toward higher-quality goods within, as well as between, commodity categories.[8]

The problem posed by heterogeneity within commodity titles is not

[7] Crude petroleum exports illustrate this problem. Unit values fell by about 25 per cent between 1902 and 1923, while the export unit value of illuminating oil, the BLS price for "refined petroleum for export," and the BLS price for Pennsylvania crude petroleum all rose by 40 per cent or more. The divergent behavior of the crude oil unit value was due to a shift from high-grade, high-priced Pennsylvania crude to cheaper grades from other fields.

[8] Several examples of striking changes in quality, perhaps associated more with fashion than with rising incomes, can be found among the commodities listed in imports for consumption. For example, in the narrowly defined category "ladies' or children's gloves, lamb or sheep, glacé finish, unlined," the unit value increased by 29 per cent from 1899 to 1913. But the increase was not a change in price. It was caused principally by a shift from short gloves (under 14 inches in length), whose unit value rose by 8 per cent, to much more expensive long gloves (over 17 inches in length), whose unit value fell by 16 per cent. The shift was even larger between 1899 and 1907, when total unit value rose by 77 per cent, while that for gloves 14 inches or shorter rose by only 12 per cent and that for gloves over 17 inches fell by 11 per cent.

solved by avoiding the word "price" and replacing it by "unit value" as the Department of Commerce does. Prices are unit values, and unit values are of interest only to the extent that they do represent prices.[9] Nor is the problem avoided by computing a quantity index instead of a price index. If nonhomogeneity makes the unit values economically meaningless, the quantities are made equally so.

Our solution was to compare each series with price and unit value data from sources other than customs reports.[10] In many cases we examined the components of a commodity aggregate to see if their behavior cast doubt on the total. Each export series was compared with related domestic price series. Where agreement was close, the unit value series was accepted for the index; where discrepancies in movement were large, the series was rejected. Doubtful cases were resolved by examining unit values for commodities disaggregated by country of destination or customs district of shipment; or comparisons were made with foreign prices and unit values. Import unit values were compared with data from the more detailed commodity list shown annually for imports for consumption and with prices and export unit values in the country of origin and other countries. They were also broken down by country of origin and customs district of entry. In addition, unit values of closely related commodities were compared with each other. None of the series was subjected to the full battery of tests listed, but none was accepted without passing at least one of them.

For many articles, particularly finished manufactures, no quantity data and therefore no unit values were available. Those for which no corresponding domestic or foreign price series was obtainable were put into the uncovered category. Where a price series was available, it was necessary to choose between two assumptions: (1) that the export or import price movements of that commodity were parallel to those of the outside price series, or (2) that the price movements were parallel to the average of those of the other commodities in the same group. Generally, the first assumption was chosen since it was usually confirmed when both sets of data were obtained.

Some of the outside price or unit value series used were available only on an annual basis. Since quarterly data were needed to combine these commodities or groups with others, they were estimated by freehand interpolation of unit values, following, where possible, the quarterly

[9] It would be difficult to imagine much use (except perhaps in connection with shipping problems) for a series showing the total value of exports divided by the total tonnage.

[10] These, along with imports-for-consumption series, are referred to here as "outside data."

movements of related price or unit value series. Groups in which such interpolations played an important part have been indicated in the appendixes. They cannot, of course, be used for quarterly analysis.

Comparison of Customs Data with Price Series

Throughout this study two types of data have been used as equivalents: foreign trade unit values for broadly defined commodities and domestic prices for narrowly defined commodities. Both have appeared in previous studies of export and import prices,[11] but there has been little discussion of their relationship or of the consequences of using one instead of the other.

We have made some crude tests of these data to answer two questions: (1) How well do price and unit-value data agree in the prices they report?, and (2) when they do agree on price levels, how close is their agreement on the dating of transactions? The second question is of interest partly because timing discrepancies between value and price data might produce spurious quantity movements and partly because a knowledge of possible leads and lags might aid in interpreting cyclical behavior. The answer to the first question provides information on the accuracy of the foreign trade indexes. Although neither type of data is wholly satisfactory (the customs data are not prices and the prices are not foreign trade data), we have assumed that where two such different kinds of information agree closely, the truth cannot be far away.

Fluctuations in Prices and Unit Values

The question of agreement between price and unit value records, aside from timing, is a complicated one. Our confidence in the usefulness of the unit values rests mainly on the general agreement of hundreds of pairs of price and unit value series charted against each other. On the other hand there were many instances of violent disagreement. Because the degree of agreement was the main criterion for accepting or rejecting the unit

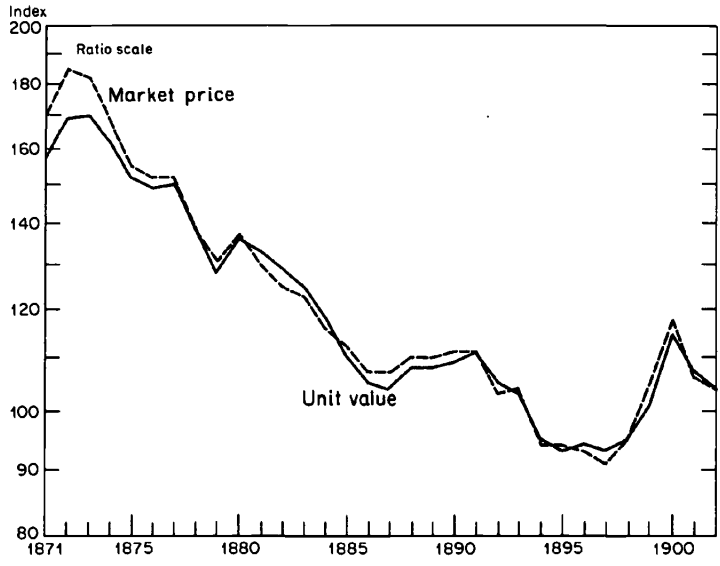
[11] Kreps used import unit values to represent import prices and U.S. wholesale prices to represent export prices (Theodore J. Kreps, "Import and Export Prices in the United States and the Terms of International Trade, 1880–1914," *Quarterly Journal of Economics*, August 1962). The currently published indexes of the U.S. Department of Commerce rely completely on customs data, as do most of the indexes for European countries used by Kindleberger in *The Terms of Trade*, pp. 322–333. Silverman's index numbers for the U.K. were based almost entirely on domestic market prices (A. G. Silverman, "Monthly Index Numbers of British Export and Import Prices, 1880–1913," *Review of Economic Statistics*, August 1930), as were some indexes mentioned by Kindleberger.

values, formal comparisons are made here only for commodities whose unit values were not discarded.

There have been no comprehensive comparisons of the two types of data. Mitchell[12] did make one test in which he compared two indexes of British prices for the years 1871-1902. The indexes were arithmetic means of equally weighted price relatives, one set made up of export and import unit values and the other of Sauerbeck's market prices. He found that the unit values "pursue a more even course than market-price series" and, in particular, that the market price series fell more steeply during the price decline from 1871-72 to the trough in 1897.

CHART 23

Market Price and Unit Value Indexes for 25 Commodities, Great Britain, 1871-1902 (1890-99 = 100)



Source: Wesley C. Mitchell, *Index Numbers of Wholesale Prices in the United States and Foreign Countries*, BLS Bulletin No. 284, Washington, D.C., 1921, p. 30.

[12] Wesley C. Mitchell, *Index Numbers of Wholesale Prices in the United States and Foreign Countries*, B.L.S. Bulletin No. 284, Washington D.C., 1921.

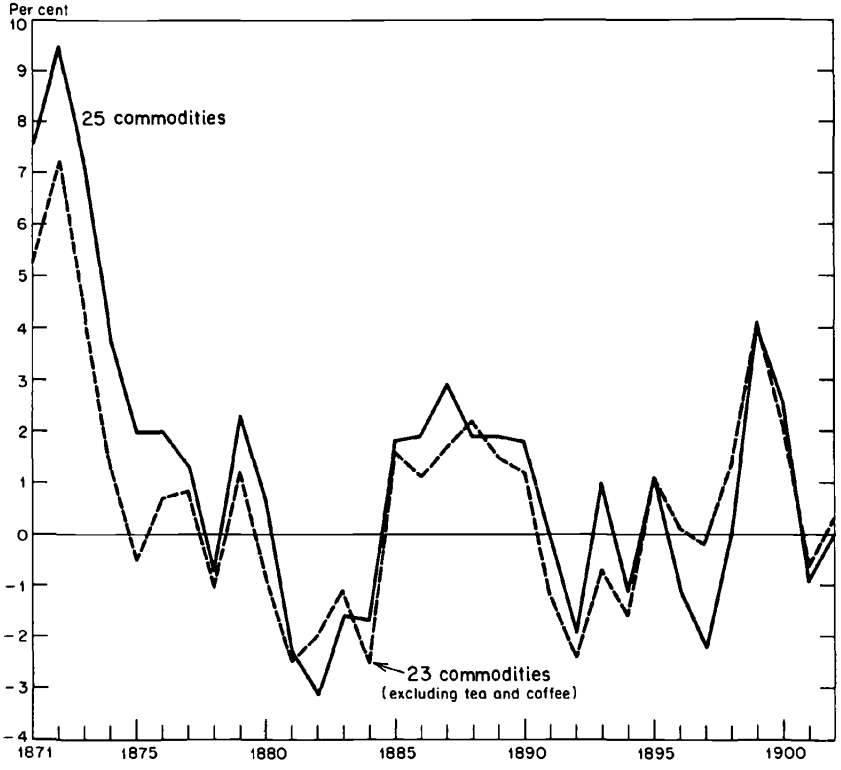
It is clear in Chart 23 that the two indexes agree quite closely, except in 1871-74, despite the fact that the set includes some pairs of prices and unit values (particularly coffee, tea, and bacon) so poorly matched that by our standards the unit values would have been discarded. There is very little indication that the market price index is more volatile than the unit value index except during the first few years.

The differences between the two indexes, taken as percentages of the

CHART 24

Difference Between Market Price and Unit Value Indexes, Great Britain, 1871-1902 (1890-99 = 100)

Differences are taken as a percentage of the unit value index.



Source: Mitchell, *Index Numbers*; United Kingdom Board of Trade, *Report on Wholesale and Retail Prices in the United Kingdom in 1902 with Comparative Tables for a Series of Years*, London, 1903; A. Sauerbeck, 'Movement of Wholesale Prices in Great Britain,' *Monthly Summary of Commerce and Finance of the United States*, Bureau of Statistics, U.S. Department of Commerce and Labor, June 1904, pp. 4686-4692; and *Journal of the (Royal) Statistical Society*, Vol. XLIX, 1886, pp. 642-647.

unit value index, are shown in Chart 24. It is clear again that they fall within a narrow range, except in 1871-74, particularly when the tea and coffee series are removed. No downward trend of the market price index relative to the unit value index is visible after the first three years.

A comparison by Kindleberger[13] of postwar Swedish unit value and price indexes indicates some very wide discrepancies. The largest of these occurred in 1951, when the export price index was 27 per cent higher than the unit value index, even though "the indexes for Sweden based on price are weighted by the value of the commodities going into exports and imports. . . ." But this evidence is not as good as it appears: the price series is a Laspeyres index on a 1935 base, while the unit value series are Fisher "ideal" indexes on a 1948 base.[14] It is not clear therefore, what is responsible for the differences between the two indexes; the type of data used, as Kindleberger implies, or divergent weights and index number formulas.

There are several possible measures of the degree of similarity between prices and unit values. The correlation coefficient and the associated standard error would, in their conventional form, give too favorable a picture of the degree of similarity. This is because the usual correlation equation includes both a slope and a y-intercept. The two types of data would be perfect substitutes only if the ratio between them were constant; that is, if the correlation equation passed through the origin.

One could compare the ratios of the two series with the base-year ratio (as the index number formally does). In other words, one could measure the scatter around a line passing through the origin with slope equal to the base-year ratio. We have not used this measure because it gives no weight to intraperiod comparisons. For example, a price and a unit value series might be considered poorly matched even though they were identical in every year except the base.

Our method of examining the price/unit value relation was to fit to the two sets of data a line passing through the origin; that is, to study the scatter around a "best" estimate of the ratio between unit value and price. These lines were fitted to prices and unit values for eleven of the most important export commodities in the 1913-23 period.[15]

[13] *Terms of Trade*, p. 318.

[14] The Swedish indexes are described in United Nations, *Supplement to the Monthly Bulletin of Statistics*, 1954, pp. 114 and 140.

[15] The unit values were: wheat grain; wheat flour; hams and shoulders, cured; lard; leaf tobacco; unmanufactured cotton; bituminous coal; gasoline, 1913–21, extrapolated to 1923 by gasoline, naptha, and other light products; illuminating oil; and refined copper in ingots, bars, rods, or other forms. (For sources see Appendix C.)

The BLS price series were—wheat: Cash, No. 2, red winter, Chicago; wheat flour:

In nine of the eleven cases the relationship was close, the "explained variance," or r^2, being over 92 per cent. For two commodities, bituminous coal and leaf tobacco, it was only 71 per cent and 21 per cent respectively. When 1920 was dropped from the coal series and 1920 and 1921 from the tobacco series, the figures rose to 88 and 62 per cent.

More relevant for our purposes than the proportion of variance explained, is the relative error involved in estimating unit values from prices. This is measured by comparing "unexplained variation" in unit values with the unit values themselves.

For eight of the eleven commodities the ratio of the standard error of estimate[16] to the mean of the unit values was less than 8 per cent. The ratio for lubricating oil was 10.4 per cent; for bituminous coal, 24.8 per cent; and for leaf tobacco, 45.7 per cent. When 1920 was removed from the coal comparison and 1920 and 1921 from that for leaf tobacco, the figures became 12.9 per cent and 28.4 per cent.

The leaf tobacco unit value and price series were the only badly matched pair in the group, and even these two series were consistent before 1913. Because of the wide range of wartime price changes, both the level of r^2 and the unexplained variation in the 1919-23 period were probably greater than would have been obtained in earlier years. In a more tranquil period, an unchanging price might serve as an excellent approximation to a slightly fluctuating unit value even though the r^2 were 0.

The distribution of the deviations around average unit value/price ratios is of interest because it reveals the frequency with which these ratios differed substantially from their mean in this sample of commodities. Most of the large discrepancies were concentrated in bituminous coal and leaf tobacco (Table 11). Half the deviations in these commodities were greater than 15 per cent, as compared with one out of ninety-eight in other commodities.

Chart 25 shows the similarity in time pattern of the wide deviations in leaf tobacco and bituminous coal. These follow, in general, the movements of the unit value series themselves. This is particularly true around the peaks of the two series and is a reflection not only of differences in timing

standard patents, Minneapolis; hams: smoked, Chicago; Lard: prime contract, New York; tobacco: leaf, average warehouse sales, Kentucky; cotton: Middling upland, New York; bituminous coal: Pocahontas, f.o.b. Norfolk, Va.; gasoline: motor, New York; petroleum: refined, standard white, 110° fire test, New York; lubricating oil: paraffin, 903 gravity, New York; Copper: ingot, electrolytic, refinery. These were all taken from U.S. Department of Labor, *Wholesale Prices, 1890 to 1923*, BLS Bulletin No. 367, 1925, and earlier issues.

[16] Allowing for the loss of only one degree of freedom in the fitting of the line because only one constant was used.

CHART 25

Percentage Variation in Ratios of Unit Values to Prices:
11 Commodities, 1913-23
(average ratio for 1913-23 = 100)

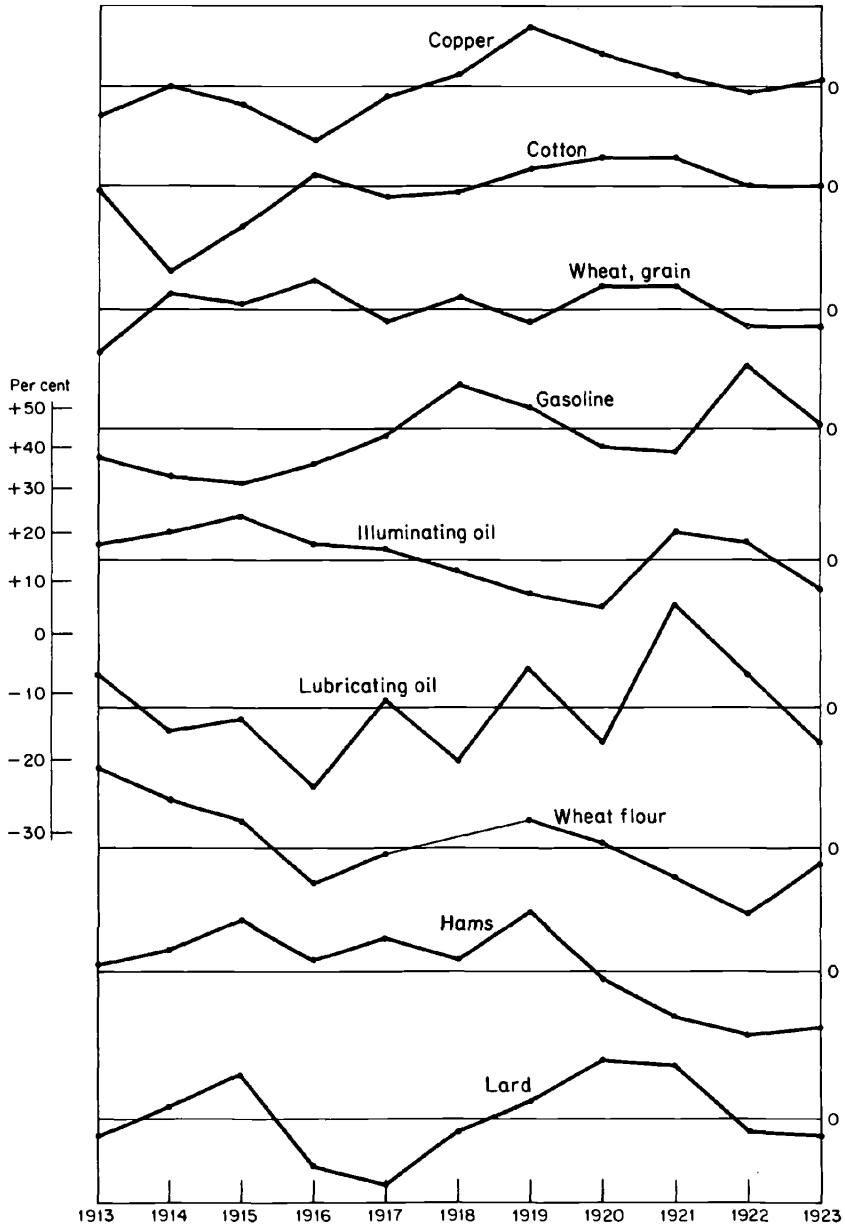
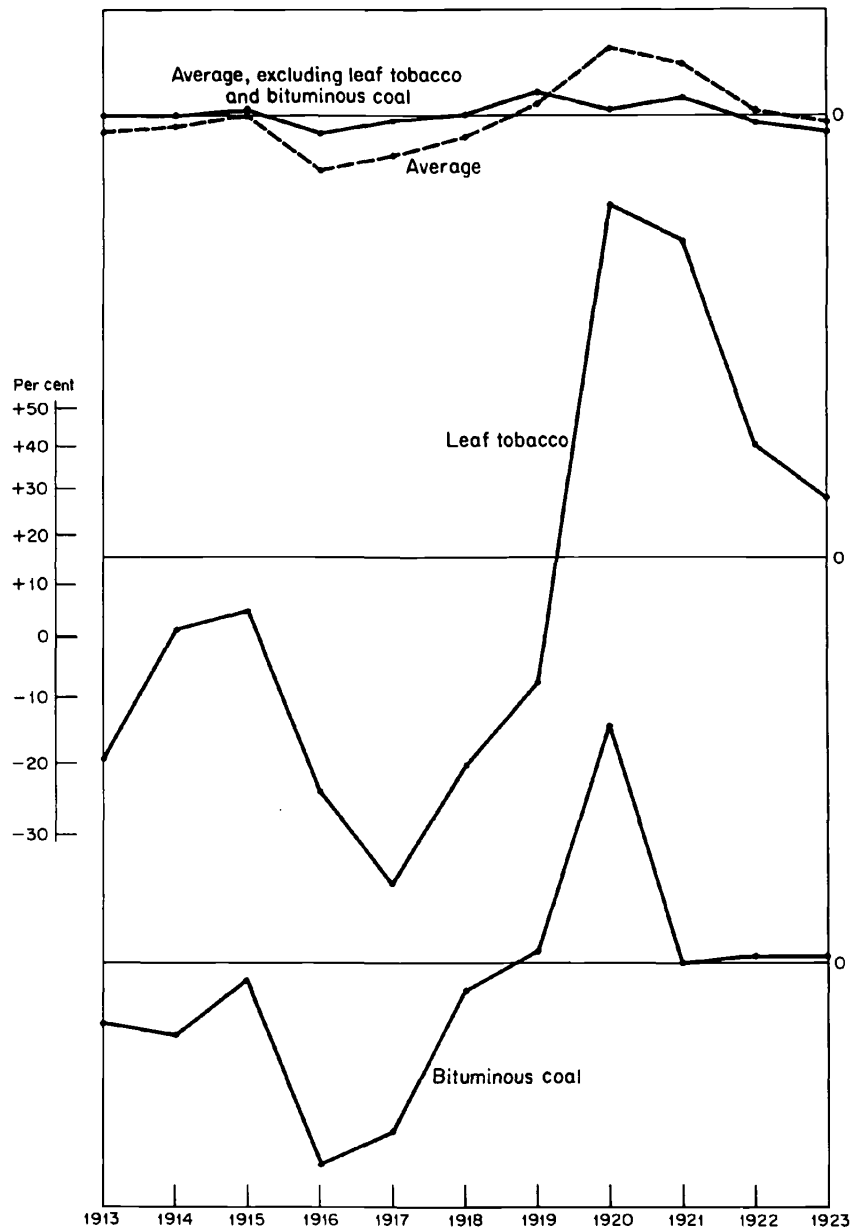


CHART 25 *(Concluded)*



Source: See Chapter 4, footnote 15.

TABLE 11
RATIOS OF UNIT VALUES TO PRICES: DEVIATIONS FROM COMMODITY MEANS, 1913–23

Percentage Deviation From Mean Ratio	All Commodities	Bituminous Coal & Leaf Tobacco	Others
1 or less	18	3	15
2–3	31	2	29
4–5	18	1	17
6–10	28	2	26
11–15	13	3	10
16–20	2	1	1
Over 20	10	10	0
Total	120	22	98

SOURCE: See Table 12.

between prices and unit values but also of the fact that the unit values, contrary to expectations, fluctuate more violently and over a wider range than the prices. The average of all commodities other than bituminous coal and leaf tobacco, moving in a narrow range between 3 per cent below and 4 per cent above the mean, shows a time pattern quite similar to that of coal and tobacco. This is certainly not conclusive evidence, but it does suggest that, in these commodities too, unit values tend to be more volatile than prices.

Timing Differences between Prices and Unit Values

It has been suggested[17] that unit values from customs reports might be expected to lag behind wholesale prices because of the lag between transactions and shipments. In order to judge whether this lag existed and, if so, how large it was, we made a number of tests on American data for the 1913-23 period, which contained several violent price fluctuations. Since timing was the question here rather than the quality of the data, we chose commodities for which the two sets of data were comparable—where the annual prices and unit values traced out similar paths. In each test we compared the dates of turning points for corresponding fluctuations in pairs of monthly price and unit value series. No minimum length or amplitude of fluctuation was imposed—only the condition that there should be matching turns in both series.

One test, based on seven export unit value series and their corresponding BLS wholesale prices, indicated that wholesale prices do tend to lead unit values (Table 12). Fifty-three of the matching turns were coincident; however, wholesale prices led in fifty of the remaining fifty-nine cases. Most

[17] For example, by Kindleberger, *Terms of Trade*, pp. 317–318.

TABLE 12
TIMING RELATION OF EXPORT UNIT VALUES[a] AND WHOLESALE PRICES[b]
(monthly data)

	Cotton	Copper	Illuminating Oil	Corn	Oats	Rye	Wheat	Total
No. of corresponding turns	23	20	7	13	16	17	16	112
Wholesale price leading	14	7	2	6	8	5	8	50
Coincident	9	12	4	4	5	11	8	53
Unit value leading	0	1	1	3	3	1	0	9
Average lead of wholesale price (months)								
All turns	1.04	.45	—.29	.15	.38	.29	.81	.51
Turns with wholesale price leading	1.71	1.29	1.00	1.17	1.38	1.20	1.62	1.46

SOURCE: For BLS data, *Wholesale Prices, 1890 to 1923* and earlier issues. For NBER data, see sources in Appendix C.

[a] Cotton, unmanufactured; refined copper in ingots, bars, rods, and other forms; illuminating oil (kerosene); corn, grain; oats, grain; rye, grain; and wheat, grain.

[b] BLS series for cotton, middling, upland, New York; copper, ingot, electrolytic; refined petroleum, for export; corn, cash, contract grades; oats, cash; rye, No. 2, cash; wheat, cash, Chicago, No. 2, red winter.

TABLE 13
TIMING RELATION OF IMPORT UNIT VALUES[a] AND WHOLESALE PRICES[b]
(monthly data)

	Tin	Cocoa	Sugar	Coffee	Silk	Rubber	Total
No. of corresponding turns	11	10	23	18	19	12	93
Wholesale price leading	9	5	14	13	15	9	65
Coincident	1	4	8	3	2	1	19
Unit value leading	1	1	1	2	2	2	9
Average lead of wholesale prices (months)							
All turns	2.09	.50	.65	.78	1.11	1.33	1.01
Turns with wholesale price leading	2.67	1.80	1.14	1.31	1.53	2.56	1.78

SOURCE: See Table 12.

[a] Tin in bars, blocks, pigs, etc.; cocoa or cacao beans; cane sugar; coffee; rubber, crude; and raw silk.

[b] BLS series for tin, pig; cocoa beans, Arriba; sugar, 96° centrifugal; coffee, Rio, No. 7; raw silk: Japanese—filatures, special, and extra extra; rubber, Para island, fine, N.Y.

of these leads were quite short: forty-six of the fifty were one or two months; the average lead for all turns was half a month. For those cases in which wholesale prices led, the average was a month and a half.[18]

The results of a similar test, comparing U.S. wholesale prices with import unit values, are given in Table 13. Unit values lag more consistently than for exports (sixty-five of ninety-three turns) and by a longer interval—a month on the average. The average lead of wholesale prices, for those turns in which they do lead, is 1.78 months. Wholesale prices lead in a majority of turns for every commodity in the list except one. Furthermore, these leads are not only more frequent than in exports, they are longer on the average; there are thirteen leads of more than two months as compared to only four among exports.

On the assumption that monthly data reveal the true leads of wholesale prices, an experiment was conducted to determine the extent to which our consolidation of the data into quarters hides or exaggerates these leads. Imports were used rather than exports because they showed longer, and therefore more troublesome, leads. The results, in Table 14, indicate that one effect of the consolidation, as might be expected, is to convert many of the leads into coincident turns. There are thirty-six in the quarterly data as compared with nineteen in the monthly data, despite the fact that there are fewer matching turns in the former. Those leads which still remain have increased in length because of the increase in the minimum size of lead; the average lead is now 1.20 months as compared with 1.01 in the monthly data. All but one of the leads in the quarterly data are one quarter; the average is 3.06 months.

Leads and coincidences are almost equally represented in the quarterly data, but the leads are more frequent in four of the six commodities. Except for silk and rubber, where three of four price lags were eliminated, the lags were not erased by the shift to quarterly data.

The turning points that appear in Table 13 differ from those in Table 14. Some were eliminated by averaging in the shift from monthly to quarterly data; almost all of these were coincidences or one-month price leads. Other turns appearing in the quarterly series had not been identifiable in the more volatile monthly data. The effect of shifting from monthly to quarterly data on an identical set of turns is shown in Table 15 for sixty-eight matched turning points.

[18] It would have been desirable to extend this analysis to manufactured goods, but because many of their prices are constant for several months at a time, the selection of a monthly turning point is arbitrary and small leads and lags disappear. In addition manufactured-goods prices exhibit fewer and much milder fluctuations than prices of crude and semimanufactured products.

TABLE 14

TIMING RELATION OF IMPORT UNIT VALUES AND WHOLESALE PRICES
(quarterly data)

	Tin	Cocoa	Sugar	Coffee	Silk	Rubber	Total
No. of corresponding turns	12	13	15	15	17	9	82
Wholesale price leading	5	7	5	8	9	6	40
Coincident	6	6	9	5	8	2	36
Unit value leading	1	1	1	2	0	1	6
Average lead of wholesale price (quarters)							
All turns	0.33	0.43	0.27	0.40	0.53	0.44	0.40
Turns with wholesale price leading	1.00	1.00	1.00	1.00	1.00	1.17	1.02
Average lead of wholesale price (months)							
All turns	1.00	1.29	.81	1.20	1.59	1.32	1.20
Turns with wholesale price leading	3.00	3.00	3.00	3.00	3.00	3.51	3.06

SOURCE: See notes to Table 13.

TABLE 15

EFFECT OF SHIFTING FROM MONTHLY TO QUARTERLY DATA ON LEAD OF WHOLESALE PRICES

	Lead in Monthly Data (Months)	Average Lead in Quarterly Data (Months)	Number of Cases
	5	3.0	1
	4	2.4	5
	3	2.14	7
	2	1.71	14
	1	1.50	22
	0	.27	11
	-1	.50	6
	-2	-3.0	1
	-6	-9.0	1
Total	82	81	68
Average	1.20	1.19	68

SOURCE: See notes to Table 13.

The longer leads of wholesale prices were reduced, on the average, by the conversion. One-month leads were stretched slightly, and coincidences and one-month lags were turned into short leads. The longer lags, however, were extended. The conversion to quarterly data thus altered the distribution of leads and lags, but it had no effect on the average length.

The Combination of Price and Unit Value Data as a Source of Error

"Outside" prices may behave differently from unit values for a number of reasons: the domestic commodity might be very different from the export commodity, even though they travel under the same name; when the commodities are the same, market conditions might be such that domestic and export prices move differently; even if the price movements are similar, the domestic price might lead or lag behind the export price. Any of these phenomena could lead to misconceptions not only about prices but about the behavior of quantities as well, since quantities are not estimated indepently of prices.

Table 16 and Chart 26 illustrate the effect of using an estimated price which is identical to the true one except that it leads the true price by one period.[19] The distortion of the quantity series is marked, although the timing is not altered. The amplitude is doubled and artificial accelerations are introduced into both the expansion and the contraction.

The estimation and interpretation of price-quantity relations may also

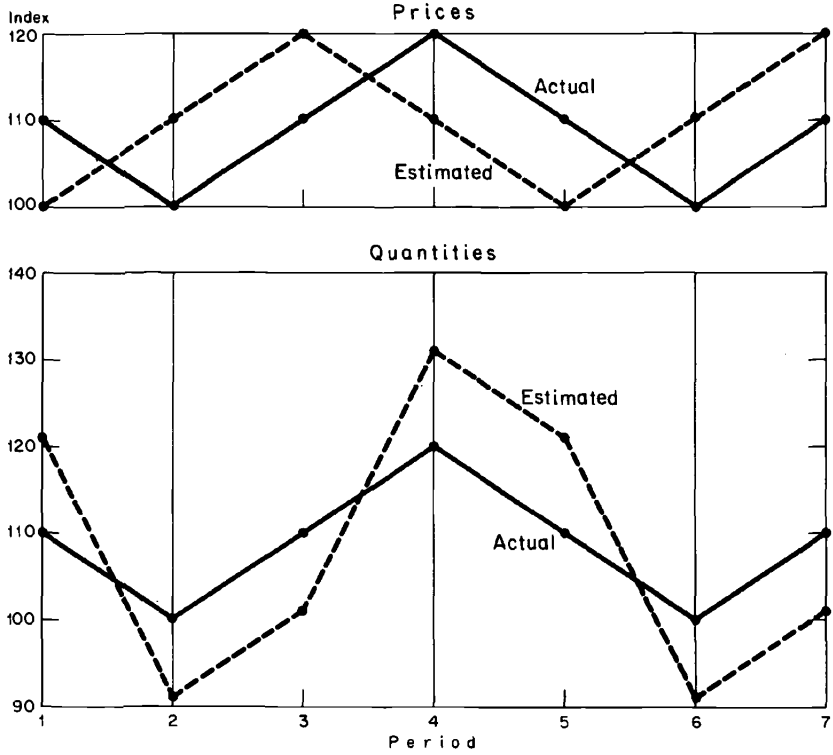
[19] Periods two through six in Table 11 may be viewed as a business cycle divided into five stages.

be affected by such errors. If, for example, a series of arbitrary numbers called "value" is divided by another arbitrary series called "price" to get "quantity," the price-quantity relation will not be random. Since prices and values are independent, high prices will tend to be associated with low quantities, and vice versa. The price elasticity will tend toward one, and the level of the correlation between price and quantity will depend on the relation between the variance in value and the variance in price. The larger the latter compared to the former the higher the price-quantity correlation will be.

In terms of the indexes calculated here, there is some possibility that a spurious negative price-quantity relation has been introduced or that a positive relation has been obscured by such errors. At least the direction of bias, if not the extent, is clear.

CHART 26

Effect on Estimated Quantities of Using Estimated Prices Leading Actual Prices by One Period



Source: Table 16.

TABLE 16

EFFECT ON ESTIMATED QUANTITIES OF USING ESTIMATED PRICES LEADING ACTUAL PRICES BY ONE PERIOD.

	Period						
	1	2	3	4	5	6	7
Actual							
Price	110	100	110	120	110	100	110
Quantity	110	100	110	120	110	100	110
Value	121	100	121	144	121	100	121
Estimated from leading price series							
Price	100	110	120	110	100	110	120
Quantity	121	91	101	131	121	91	101
Value	121	100	121	144	121	100	121

These difficulties, most evident where quantities are derived directly from values and prices, exist wherever there is a lack of independence between the estimation of price and that of quantity. For example, an output series that includes a coverage adjustment in which parallelism in the price movements of covered and uncovered items is assumed,[20] introduces an element of interdependence in price and quantity estimation. The same applies even to those of our series which are based on unit values. If a shift in quality has been mistaken for a change in the price of a commodity, a spurious quantity change in the opposite direction has been introduced.[21]

Conclusion

Despite the defects of customs unit values, we selected, through a number of tests, many which could properly be used as prices. In addition, price data from other sources were combined with customs data to improve coverage. The resulting series, therefore, are referred to as price, rather than unit value, indexes.

There is strong evidence for some lag of unit values behind prices. It is rarely more than a few months in monthly data; and in quarterly data, seldom more than one quarter. Although these lags are negligible for long-

[20] See, for example, Solomon Fabricant, *The Output of Manufacturing Industries: 1899–1937*, New York, NBER, 1940, especially pp. 362–372.

[21] In the example of the gloves mentioned earlier, acceptance of the change in unit value indicated in the totals for 1899 to 1907, +77 per cent, would have meant an estimated change in quantity of about +40 per cent. When the data are broken down by length of glove, the highest possible estimate of the increase in average unit value is about + 10 per cent, and the lowest increase in quantity, more than 100 per cent.

term analysis, they may affect short-term comparisons of foreign trade prices with quantities or domestic prices.

Earlier studies indicating much greater sluggishness in unit values than in prices were examined and found to rest on weak foundations. A comparison of the two types of data in our period indicated little difference in most series. The differences that were observed pointed to the contrary finding : unit values may have been more volatile than prices.