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immediate object of the present investigation is not the study of price-making forces which affect individual commodities, but the derivation of a set of measures relating to the characteristics of specific commodity prices and capable of comparison and combination with similar measures relating to other commodities. The emphasis throughout has been on such comparisons. Of the measures discussed above in surveying relations between prices and quantities, three are abstract coefficients which would appear to be suitable for this purpose. These are the coefficients of correlation, determination and flexibility.

The use of these coefficients in making comparisons and in forming combinations introduces difficulties which were not encountered in using the measures described in earlier sections. Each of the earlier measures—of variability, trend, cyclical behavior—described a characteristic of a given price series, considered by itself. But the values of the coefficients of correlation, determination and flexibility depend upon the relations between given price series and quantity series. If the coefficients relating to different commodities are to be compared we must be sure not only that the price series used are comparable, but that the quantity series employed are also comparable, and that the technical methods, by which the original price and quantity series have been adjusted and combined, permit valid comparison of the results. The conditions which would insure perfect comparability are difficult to secure and, accordingly, comparisons of coefficients of flexibility of price and elasticity of demand (and of the related measures discussed above) must always be made with great caution.[1]

VI Relations Among Commodity Price Characteristics

In the preceding sections there have been presented a number of measures descriptive of the behavior of individual commodity prices. It is of interest to determine whether the characteristics

[1]E. J. Working after analyzing the conditions which affect the significance of a statistical demand or supply curve, suggests four points upon which information must be had before such a curve may be properly interpreted. These points concern (1) the relative variability of supply or demand curves in a given instance (Working means, by the variability of a supply or demand curve, tendency to shift back and forth from time to time), (2) the market to which the price and quantity data refer, (3) the extent to which "other things are held equal," and (4) the presence or absence of correlation between the shifting of supply and demand curves. Although the statistical significance of all these points has not been fully determined, Working's general discussion, and his emphasis upon a knowledge of all relevant details in interpreting results secured in this field, bear immediately upon the subject of price flexibility, which is the object of our present concern. (See "What do Statistical 'Demand Curves' Show?", E. J. Working, *Quarterly Journal of Economics*, February, 1927, pp. 212-235.)

described by these several measures are related to each other in any consistent fashion. Such relations have been tested in a few cases, in connection with the preceding discussion. The following tables have been drawn up for the purpose of summarizing these and certain other relations.

TABLE 52

CORRELATION COEFFICIENTS MEASURING THE RELATIONS BETWEEN YEAR-TO-YEAR VARIABILITY AND OTHER CHARACTERISTICS OF INDIVIDUAL COMMODITY PRICES

(1) Series correlated with measure of year-to-year variability[1]	(2) No. of observations	(3) Coefficient of correlation
Measure of monthly variability	206	+.70
Measure of frequency of change (monthly)	206	+.58
Average annual rate of increase	206	+.27
Index of cyclical variability	149	+.79

[1]The measures correlated in the first three cases here listed were derived from prices for the period 1890-1913 (1896-1913 for the measures of rates of increase). The fourth entry was computed from measures relating to the period 1890-1924, for year-to-year variability, and 1890-1925, for cyclical variability.

The relations between the measures of year-to-year variability and the measures of monthly variability and frequency of change have already been noted. A fairly high positive correlation between the year-to-year variability and the cyclical variability is to be expected. The coefficient of correlation has a value of +.79.[1]

The relation between the year-to-year variability and the average annual rate of increase is significant for, although the coefficient is low, it is equal to more than four times its standard error. The phenomena are not independent. During the pre-war years to which these measures relate, the commodities which had the steepest price trends tended to be more variable in price than those with less pronounced trends. (This furnishes no proof, of course, of a causal connection between these factors.[2])

[1]The coefficient +.79 is based, it should be noted, upon data relating to 149 commodities. It was deemed advisable to limit the comparison to this group, which included all those commodities (except 26 which were markedly irregular in their cyclical movements) which passed through five or more complete cycles between 1890 and 1925, in order that the measure of cyclical variability might be significant in all cases. All the correlations into which measures of cyclical behavior enter are based upon this restricted group.

[2]In measuring year-to-year variability an attempt has been made (by measuring deviations from the means of annual link relatives) to eliminate the effects of those changes in price which represent direct trend movements. It is probable, however, that these effects have not been entirely removed, a fact for which allowance must be made in interpreting the above coefficient.

In the following table the relations between monthly variability and certain other characteristics are summarized.

TABLE 53

CORRELATION COEFFICIENTS MEASURING THE RELATIONS BETWEEN MONTHLY VARIABILITY AND OTHER CHARACTERISTICS OF INDIVIDUAL COMMODITY PRICES

(1) Series correlated with measure of monthly variability[1]	(2) No. of observations	(3) Coefficient of correlation
Measure of year-to-year variability	206	+.70
Measure of frequency of change (monthly)	206	+.73
Average annual rate of increase	205	+.30[2]
Index of cyclical variability	149	+.90
Average time of revival	149	—.51
Average time of recession	149	—.45
Average duration of rise (i. e. average interval between date of low and date of high)	149	+.05
Average percentage of rise	149	+.85

[1]The measures correlated in the first three cases here listed were derived from prices for the period 1890-1913 (1896-1913 for the measures of rates of increase). The remaining entries were computed from measures relating to the period 1890-1925.

[2]In deriving this coefficient, measures relating to one highly variable commodity, onions, were omitted.

All these coefficients, with the exception of that which has a value of .05, are significant of real relationships.[1] There is a high correlation between the monthly variability and the cyclical variability, as there is, also, between the monthly variability and the average percentage of price rise during periods of revival and prosperity. The commodities which are most variable from month to month are subject to wider cyclical swings than are those which are fairly stable in price from month to month.[2] The coefficients measuring the relations between monthly variability and average dates of low and high indicate that the commodities which are more variable in price tend to rise earlier in revival and to fall earlier in recession than those which are more stable in price. (In interpreting the above coefficients of —.51 and —.45 it must be remembered that the time measure of a price movement prior to the reference date has a negative sign.) It is significant that there is no apparent connection between the variability of commodity prices and the duration of the period of rise.

[1]With respect to the third item in this table allowance must be made for the influence of trend factors upon the measures of monthly variability. See p. 41.

[2]It should be noted that in measuring cyclical variability in the present study no attempt was made to isolate cyclical fluctuations. Accordingly, the index of cyclical variability is not free from the influence of seasonal and accidental movements, both of which affect the values of the monthly variability measures.

The following table gives the results secured when measures of frequency of price change are paired with measures of various other characteristics of commodity prices.[1]

TABLE 54

CORRELATION COEFFICIENTS MEASURING THE RELATIONS BETWEEN THE FREQUENCY OF MONTHLY PRICE CHANGE AND OTHER CHARACTERISTICS OF INDIVIDUAL COMMODITY PRICES.

(1) Series correlated with measure of frequency of monthly price change*	(2) No. of observations	(3) Coefficient of correlation
Measure of year-to-year variability	206	+.58
Measure of monthly variability	206	+.73
Average annual rate of increase	206	+.36
Index of cyclical variability	149	+.72

*The measures correlated in the first three cases here listed were derived from prices for the period 1890-1913 (1896-1913 for the measures of rates of increase). The fourth entry was computed from measures relating to the period 1890-1925.

In addition to the relations previously commented upon, it may be noted that there are significant positive relationships between the frequency of price change and the average annual rate of increase, and between the frequency of price change and the index of cyclical variability.

In a final table measures of the relations between pre-war price trends and other price characteristics are presented.

TABLE 55

CORRELATION COEFFICIENTS MEASURING THE RELATIONS BETWEEN THE AVERAGE ANNUAL RATES OF INCREASE AND OTHER CHARACTERISTICS OF INDIVIDUAL COMMODITY PRICES

(1) Series correlated with average annual rate of increase*	(2) No. of observations	(3) Coefficient of correlation
Measure of year-to-year variability	206	+.27
Measure of monthly variability	205	+.30†
Measure of frequency of price change	206	+.36
Measure of cyclical variability	147	+.17
Average time of revival	149	—.16
Average time of recession	149	+.02

*All rate of increase measures entering into these calculations are based upon prices for the years 1896-1913. The measures of year-to-year variability, monthly variability and frequency of change are derived from prices for the years 1890-1913. The measures of cyclical variability, time of revival and time of recession relate to cycles occurring between 1897 and 1913.

†In deriving this coefficient, measures relating to one highly variable commodity, onions, were omitted.

[1]Coefficients measuring the correlation between indexes of frequency of price change and other variables must be discounted somewhat, since the frequency distributions of the measures of frequency of change depart materially from the normal type. U-shaped distributions are secured when these measures are combined. A detailed account of these and other distributions of measures of price behavior is given in Chapter IV.

In discussing the first three of these measures in preceding sections it has been pointed out that, although the coefficients are low, there is evidence of a significant relationship between the degree of variability of commodity prices and the pre-war trends of these prices. The first of the measures listed above is equal to 4.3 times its standard error, the second to 4.7 times that measure, while the third is 6.1 times its standard error.[1]

In computing the last three measures in Table 55 averages relating to cyclical behavior during the five cycles which occurred between 1897 and 1913 have been paired with the measures of rates of increase between 1896 and 1913. During this period there was no apparent relation between the average time of recession and the rate of increase. There is some indication that commodities with the sharpest rates of increase tended to rise in price early, during revival, but the coefficient (—.16) is equal only to 2.01 times its standard error, and does not furnish conclusive evidence on this point. Similarly, there is a suggestion that commodities with the steepest trends were subject to price cycles of wider amplitude than those which rose at lower rates, but again the evidence is not conclusive. The coefficient (+.17) is equal to 2.12 times its standard error.

VII Summary

As a first step in the study of price behavior a number of measures describing characteristics of the prices of individual commodities have been computed. In addition to price relatives of the customary type there have been discussed in this chapter measures of variability and trend, measures relating to the behavior of individual commodity prices during cycles in general business, and measures descriptive of the relations between the prices and quantities of specific commodities. These measures furnish raw materials for the study of prices in combination and for the analysis of the price system. For this reason, and because of their probable

[1]There is reason to suspect that these positive correlations are wholly or in part due to the influence of farm products, which as a group are highly variable in price, and which, during the several decades prior to the war, were increasing in price at rates well above the average. When farm products are excluded there remain 182 articles. For these commodities the correlation between the average annual rate of price increase and the year-to-year variability of prices is +.23. This coefficient is smaller than the measure for all commodities, but must still be adjudged significant of a real relationship, since it is more than three times as great as its standard error. An identical figure is secured when the average annual rate of increase is correlated with the measure of monthly variability.