Volume Title: The Behavior of Prices

Volume Author/Editor: Frederick C. Mills

Volume Publisher: NBER

Volume ISBN: 0-87014-010-8

Volume URL: http://www.nber.org/books/mill27-1

Publication Date: 1927

Chapter Title: Group Characteristics of Measures of Price Variability and Trend

Chapter Author: Frederick C. Mills

Chapter URL: http://www.nber.org/chapters/c5335

Chapter pages in book: (p. 370 - 386)

CHAPTER IV

MEASURES OF PRICE BEHAVIOR IN COMBINATION

We have attempted in the preceding chapter to secure information about the price structure by studying the characteristics of price relatives in combination. Such relatives describe only one aspect of price behavior. All the other measures of price behavior which were dealt with in the first two chapters may be combined in similar fashion in determining the characteristics of the population of prices. Although the data available do not permit an extension of this type of investigation to all aspects of price behavior, certain of the measures we have may be studied in respect to group attributes.

I Group Characteristics of Measures of Price Variability and Trend

1. MEASURES OF MONTHLY VARIABILITY OF WHOLESALE PRICES, IN COMBINATION

The measures of monthly price variability which were described in Chapter I may be combined by years, or the averages for individual commodities over a term of years may be combined. The distributions secured from the annual values are of a type which does not vary greatly from year to year, except during periods of rather violent price change. In the following table six representative annual distributions are given, together with a distribution secured by classifying averages for individual commodities for the entire period from 1890 to 1925, exclusive of the disturbed years between 1914 and 1921.[1] These distributions are presented graphically, in the form of column diagrams, in Figure 52.

The distributions which relate to the relatively quiet years prior to the war are peaked and J-shaped, sharply skewed in a positive direction. There is a heavy concentration of frequencies at the lower end of the scale, indicating a relatively low degree of monthly variability for the great bulk of commodities. The tails tapering far to the right reveal the presence of a small number of

[1]The averages combined in this distribution are those given in Appendix Table VI for farm products and foods and in Appendix Table IV for all other commodities.

TABLE 119

FREQUENCY TABLES SHOWING DISTRIBUTIONS OF COMMODITY PRICE SERIES
CLASSIFIED ACCORDING TO MONTHLY VARIABILITY

| (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Frequencies			
Class limits Measure of variability	1890	1901	1914	1916	1920	1925	Averages 1890–1925 excluding 1914–1921
.00—1.99	83	76	94	16	19	80	51
2.00– 3.99	40	51	40	27	22	42	57
4.00– 5.99	24	30	23	37	29	35	36
6.00– 7.99	18	18	19	35	30	25	33
8.00– 9.99	14	9	12	43	27	5	16
10.00–11.99	4	5	8	10	14	6	5
12.00–13.99	5	7	6	17	11	8	4
14.00–15.99	4	2	2	7	14	1	0
16.00–17.99	2	2	1	6	10	1	0
18.00–19.99	2	0	5	4	7	0	1
20.00–21.99	2	2	1	3	5	0	0
22.00–23.99	2	1	1	1	8	1	1
24.00–25.99	1	1	1	3	6	2	0
26.00–27.99	0	0	1	2	1	0	1
28.00–29.99	0	0		0	3	1	1
30.00–31.99	1	1		1	2	0	
32.00–33.99	0			0	1	3	
34.00–35.99	1			0	0	1	
36.00–37.99	1			0	2		
38.00–39.99				1	1		
40.00–41.99				0	2		
42.00–43.99				0			
44.00–45.99				0			
46.00–47.99				1			
Totals	204	205	214	214	214	211	206

commodities marked by extremely high variability. This is charac-
teristic, and is found in the distribution for each year of the period
covered.

The distributions for the years 1916 to 1921 possess this tail
extending to the right, but differ from the distributions of or-
dinary years in that the mode falls well above the owest class. The
distributions for 1916 and 1920 which are shown n Figure 52 furnish
two somewhat different examples drawn from this period. They are
positively skewed, but with the movement of the mode to the right
there has come a closer approach to symmetry. The distribution
for 1925 represents a return to the pre-war type.

These several distributions throw considerable light upon the
nature of the population of commodity prices, when classified in
respect to their variability from month to month. In normal times

FIGURE 52

COLUMN DIAGRAMS SHOWING DISTRIBUTIONS OF MEASURES OF MONTHLY
VARIABILITY FOR SELECTED YEARS, WITH A DISTRIBUTION BASED
UPON AVERAGES FOR THE PERIOD 1890-1925.[1]
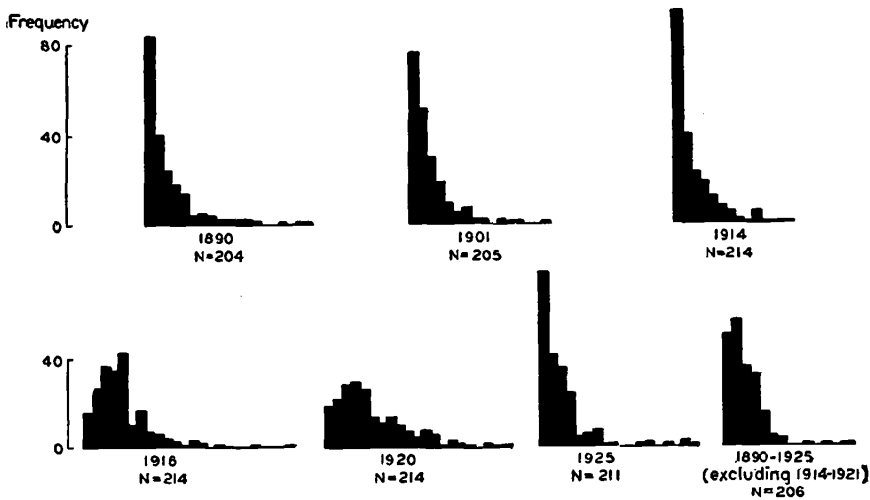
[1]The unit employed on the x-scale and the class frequencies are given in Table 119.

a stable group, fluctuating over a narrow range within the year, is of dominant importance. Proceeding up the scale of variability there is a decrease from the beginning in the frequencies found in successive classes. A few outlying commodities fluctuate widely within the year, but these constitute a very small minority of the total number.

This situation is not changed by the rather considerable advances and declines in the price level which occur during most business cycles. A great price revolution, however, increases the modal variability materially, and we secure distributions which approximate the type found in most collections of quantitative material. There is a decline in frequencies on both sides of the mode, but the relatively small group of widely fluctuating commodities remains, maintaining the pronounced positive skewness of the distributions.

The distribution of averages, for which the class frequencies are given in the last column of Table 119 and which is shown graphically in Figure 52, is sharply skewed in a positive direction, with a concentration of cases near the lower end of the scale. The mode is slightly above the lowest class, however, giving a distribution which

in form tends slightly away from the type which was usual before the war.

Averages and measures of variation relating to the distributions of monthly variability measures for the years from 1890 to 1926 are summarized in the following table. Measures of the monthly

TABLE 120

MONTHLY VARIABILITY OF WHOLESALE PRICES

AVERAGES AND STANDARD DEVIATIONS COMPUTED FROM MEASURES OF PRICE VARIABILITY FOR INDIVIDUAL COMMODITIES, 1890-1926, WITH VARIABILITY MEASURES RELATING TO AN INDEX OF WHOLESALE PRICES.

(1) Year	(2) No. of price series	(3) Mean	(4) Standard deviation	(5) Monthly variability U. S. Bureau of Labor Statistics index
1890	204	4.8	6.2	
1891	204	4.4	5.9	
1892	204	4.5	6.0	
1893	206	4.9	5.8	
1894	206	4.6	4.6	
1895	206	6.3	6.7	
1896	206	4.7	4.7	
1897	206	4.8	5.7	
1898	206	4.1	4.7	
1899	206	6.0	5.6	
1900	206	5.5	5.9	1.34
1901	205	4.3	4.9	1.58
1902	214	4.7	6.3	2.58
1903	214	4.8	5.4	2.03
1904	214	4.1	4.3	1.26
1905	214	4.5	4.8	.77
1906	214	3.5	4.0	1.78
1907	214	4.5	4.8	1.42
1908	214	4.7	4.6	1.20
1909	214	4.6	5.3	2.66
1910	214	4.3	4.9	2.56
1911	214	4.3	5.6	1.79
1912	214	4.6	6.1	1.68
1913	213	3.7	5.1	.55
1914	214	4.4	5.3	1.23
1915	214	5.9	6.5	2.02
1916	214	8.7	6.5	6.89
1917	214	10.6	6.7	5.95
1918	213	7.3	5.5	3.37
1919	212	9.7	7.1	3.96
1920	214	10.8	8.8	6.95
1921	214	8.5	5.7	4.97
1922	213	6.5	6.6	3.86
1923	214	4.9	5.1	1.59
1924	213	5.4	5.5	1.61
1925	211	4.7	6.1	1.12
1926	211	4.2	4.9	1.23

variability of the general index of wholesale prices[1] for the years since 1900 are included for the purpose of comparison. The two sets of measures are shown in Figure 53.

The relative stability of the averages from year to year, prior to the war-time disturbances, is worthy of note. Only twice in the 25 years from 1890 to 1914 does the average rise above 6.0, and only twice does it fall below 4.0. In 20 of the 25 years it is between 4.0 and 5.0. We may judge from this considerable sample that except in times of such extreme price disturbances as were brought by the war, the amplitude of the fluctuations of individual prices, viewed collectively, does not vary greatly from one year to the next. The cyclical swings of the general price level are hardly apparent in these averages, which take account of all price changes. The host of accidental and seasonal price changes, the multitude of minor and major price movements which represent adjustments to shifting relations of supply and demand for individual commodities—all these go on without substantial break. Cyclical changes are, of course, intermingled with these at all times, but the point of importance is that there appear to be no pronounced increases or decreases in the degree of price variability which may be associated with cyclical swings of business or with cyclical swings in the general price level. Between January, 1909, and December, 1909, the price index rose from 93 to 103. The average measure of variability for that year was 4.58. In January, 1905, the price index had a value of 87; in December, 1905, the index had a value of 87. The index for the year fluctuated between 85 and 87. The average of the variability measures for 1905 was 4.55. The year 1909 was marked by considerable change in the price level while 1905 was a year of practically no change, yet the two averages, based upon the movements of individual commodity prices, were substantially the same in the two years.

This rather curious independence of the measures of changes in the general price level and the measures of fluctuations in individual commodity prices is clearly brought out when the annual averages given in column (3) of Table 120 are compared with measures of the monthly variability of the general price index, in column (5). They are graphically compared in Figure 53.

The absolute values of the averages relating to individual commodity prices are, of course, greater. Much of the variability of

[1] The index of the United States Bureau of Labor Statistics. The measures of variability were secured by handling this index as an individual series, just as the prices of individual commodities were treated.

FIGURE 53

MEASURES OF MONTHLY VARIABILITY OF WHOLESALE PRICES.

Comparison of Annual Averages, Computed from Measures of Variability
of Individual Price Series, with Measures Derived from the
Index of Wholesale Prices of the United
States Bureau of Labor Statistics.

individual prices is cancelled by opposite movements of other prices
when an index is constructed.   But the averages of the individual
measures are much more stable from year to year than are the
measures relating to the general index.   Using annual values for
the period 1900-1914, the coefficient of variation of the measures
derived from the price index is 37.3; the corresponding coefficient
for the averages is 10.1.   During this period, at least, changes from
year to year in the degree of variability of the index of wholesale
prices were not paralleled by similar changes in the variability of
individual prices.

The absence of a significant relationship between the averages
of the individual measures of price variability and the measures of
variation in the price index is clearly demonstrated by the coefficient
of correlation.   This coefficient has a value of $+.19$, when measures
for the years from 1900 to 1914 are employed.   (Corresponding items

in columns (3) and (5) of Table 120 have been paired in computing this coefficient.)

The high values of the average measures of variability in 1895 and 1899 appear to be exceptions to the rule that the variability of individual commodity prices is not greatly affected by variations in the price level. The relatively high figure for 1895 is doubtless due to the sharp double reversal in the direction of the general price movement. A cyclical low value was recorded in March of that year, and a high in October. In 1899, the other year of high variability in the pre-war era, there was a considerable rise in the price level during the year.

It was pointed out in the preceding chapter, in discussing the trend of the index of dispersion, that there had been a distinct downward movement during the 24 years prior to the war. This was taken to be an indication of increasing price stability. The averages of the monthly variability measures show a similar tendency. The statistical evidence does not definitely prove the downward trend to be significant (the coefficient measuring the slope of a line fitted to the annual measures from 1890 to 1913 is equal to 1.45 times its standard error) but the tendency toward a decline in the degree of variability is worthy of note.

The two years in which the average measures of variability were lowest were 1906 and 1913, the former a year of unchecked prosperity, the latter a year of prosperity and recession. These exceptionally low values came in the decade preceding the war.

The previous discussion has dealt solely with the period prior to the war. The severe price disturbances of the years 1915 to 1922 increased the variability of individual commodity prices materially. In no one of the seven years from 1916 to 1922 does the average of the variability measures fall as low as the maximum value recorded prior to that time (6.3 in 1895). The tremendous price cycle of this period brought fluctuations in individual commodity prices which have no counterpart in our price history since 1890. Not until 1923 was the variability of individual prices reduced to a level approximating pre-war records. From 1920 to 1926 the annual averages of the variability measures moved steadily downward, except for a slight up-turn in 1924.

These annual averages of price variability indicate the average magnitude of fluctuations in individual commodity prices within a twelve-month interval. In so doing they throw light on a phase of price behavior which no other measure illuminates fully. The ap-

proximate stability of this average during years of rising and falling
prices, during years of prosperity and depression, of revival and
recession, is perhaps the fact of chief importance to be gleaned from this
survey. Only an extreme price revolution changes materially the aver-
age amplitude of fluctuations in the prices of individual commodities.

The standard deviations which are given in column (4) of Table
120 are of interest in showing how extreme are the differences be-
tween individual commodities in the matter of monthly variability.
In all but three of the pre-war years the standard deviations of these
measures exceed their means. This wide range in the matter of varia-
bility was revealed by the individual figures given in Chapter I. The
present set of measures describe this variation in quantitative terms.[1]

2. MEASURES OF YEAR-TO-YEAR VARIABILITY OF WHOLESALE
PRICES, IN COMBINATION

When the measures of year-to-year variability for 216 commodi-
ties are combined, the following distribution is secured. This is
shown graphically in Figure 54.

TABLE 121

FREQUENCY TABLE SHOWING THE DISTRIBUTION OF 216 COMMODITY PRICE SERIES
CLASSIFIED ACCORDING TO YEAR-TO-YEAR VARIABILITY DURING THE PERIOD
1890-1913, WITH STATISTICAL MEASURES DESCRIPTIVE OF
THE DISTRIBUTION

| (1)	(2)	(3)
	Measure of variability	
Class limits	Midpoint	Frequency
.00– 1.99	1	7
2.00– 3.99	3	29
4.00– 5.99	5	34
6.00– 7.99	7	44
8.00– 9.99	9	23
10.00–11.99	11	24
12.00–13.99	13	21
14.00–15.99	15	17
16.00–17.99	17	11
18.00–19.99	19	2
20.00–21.99	21	1
22.00–23.99	23	1
24.00–25.99	25	1
26.00–27.99	27	0
28.00–29.99	29	0
30.00–31.99	31	0
32.00–33.99	33	0
34.00–35.99	35	1
Total		216
Mean	8.80	
Median	7.73	
Standard deviation	4.98	
Coefficient of variation	56.6	

[1]The fact was noted at an earlier point that for J-curves, of the type to which the
present distributions belong, the efficiency of the first and second moments is low. The

The distribution is peaked, and skewed in a positive direction. As with the measures of monthly variability there is a clustering of the great mass of the measures near the lower end of the scale, with a limited number of commodities which are highly variable in price lying far out to the right. The skewness is much less pronounced, however, than it is in the distribution of monthly measures.   The

FIGURE 54

COLUMN DIAGRAM SHOWING THE DISTRIBUTION OF MEASURES OF YEAR-TO-YEAR VARIABILITY

BASED UPON PRICES OF 216 COMMODITIES DURING THE PERIOD 1890-1913.
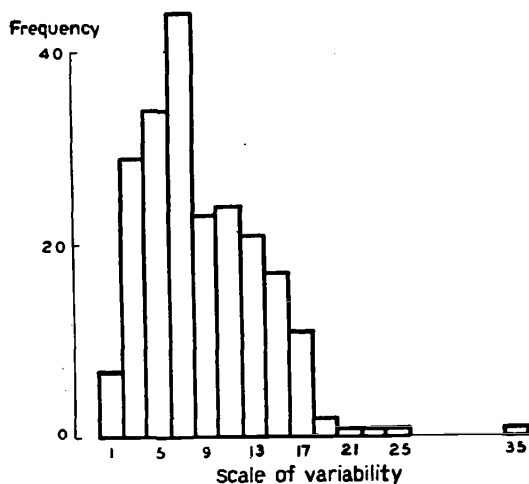
dispersion of the individual measures about the mean is relatively high (coefficient of variation 56.6), but it is not so great as the dispersion of monthly variability measures.   Differences between commodities in respect to monthly variability are greater than in respect to year-to-year variability.

The remaining attributes of the distribution are discussed below, in comparing distributions relating to various measures of price behavior.

means and standard deviations used in describing these distributions have not, therefore, the degree of validity they have in connection with distributions which come closer to the normal type.

3. Measures of Frequency of Price Change, in Combination

The frequency distributions of measures describing the behavior of commodity prices, which have been presented in Chapter III and in the preceding pages of this chapter, cover a wide variety of types, ranging from normal distributions to the most extreme divergent forms. When frequency of change measures are combined something entirely different in the way of frequency distributions is secured. These give a series of U-shaped distributions, a type which is relatively rare in the annals of statistics.

The measure of frequency of change for an individual commodity is secured by dividing the number of months in which a change in price is recorded by the total number of months for which prices are quoted, less one. This gives a quantity which varies between zero and unity, zero indicating no price change during the period covered, unity indicating a change in price every month. Such a measure has been worked out for each commodity for each of five different periods. Combining the measures for the separate periods, and for the entire period excluding the years 1914-1921, six frequency distributions are secured. The class frequencies are given in the following table.

TABLE 122

FREQUENCY TABLES SHOWING DISTRIBUTIONS OF 206 COMMODITIES CLASSIFIED
ACCORDING TO FREQUENCY OF MONTHLY PRICE CHANGES

(1) Class limits Measure of frequency of change[1]	(2)	(3)	(4)	(5)	(6)	(7)
			Frequencies			
	1890–1897	1898–1905	1906–1913	1914–1921	1922–1925	1890–1925 (excl. 1914–1921)
.00– .10	58	49	58	7	35	45
.11– .20	18	22	19	25	31	25
.21– .30	20	20	23	25	14	16
.31– .40	14	13	14	23	14	19
.41– .50	6	12	9	25	8	14
.51– .60	5	12	8	11	5	7
.61– .70	11	11	8	17	10	6
.71– .80	12	8	13	13	7	15
.81– .90	10	13	13	12	18	15
.91–1.00	52	46	41	48	64	44
Totals	206	206	206	206	206	206

[1]The range of the first class in the above table (in actual values .00 to .105. the original measures being recorded to the second decimal place) is slightly greater than the range of any other class, and the range of the last class (in actual values .905 to 1.000) is slightly less than the range of any other class. The error introduced is negligible, however.

Column diagrams representing these distributions are plotted in Figure 55. Measures descriptive of the distributions are given below.

TABLE 123

FREQUENCY OF MONTHLY PRICE CHANGES

AVERAGES AND MEASURES OF VARIATION, BY PERIODS

(1) Period	(2) Mean	(3) Standard deviation	(4) Coefficient of variation
1890–1897	.456	.369	80.8
1898–1905	.467	.352	75.4
1906–1913	.441	.355	80.5
1914–1921	.540	.301	55.7
1922–1925	.534	.367	68.7
1890–1925 (ex- cluding 1914–21)	.463	.350	75.6

The averages show a slight decline in the mean value of the measure of frequency of change during the three periods prior to the war, with approximately the same degree of variation throughout.[1] The three frequency distributions for these periods are of the same general U-shape. There is a rather significant elongation of the left arm of the U in the third period, however, and a corresponding shortening of the right arm. This means that there were, during the period from 1906 to 1913, relatively more commodities in the class for which the frequency of change was very small, and a smaller number of commodities in the class having an extremely high frequency of change, than there were during the two earlier periods. The tendency toward greater price stability which was in evidence during the several decades prior to the war is here apparent.

The war reversed this tendency. The long left arm of the distribution disappears, and the right arm is extended. Although there is a substantial concentration in the four classes next above the lowest, the modal class is that at the upper end of the scale. The average is materially higher than the averages computed from distributions for the three earlier periods.

The last period covered (1922-1925) witnessed a partial return

[1] Arithmetic mean and standard deviation lose much of their significance and validity when used in locating and scaling distributions of the U-type to which these belong. See R. A. Fisher, "On the Mathematical Foundations of Theoretical Statistics" *Phil. Trans. Royal Society of London*, Vol. 222A.

FIGURE 55

COLUMN DIAGRAMS SHOWING DISTRIBUTIONS OF MEASURES OF
FREQUENCY OF PRICE CHANGE, BY PERIODS.[1]

Frequency

[1]The class intervals in which the x-scales are graduated are given in Table 122.

to the clearly defined U-type which prevailed before the war. The left arm, which represents the grouping of commodities which are quite stable in price, is again in evidence, although it is not so pronounced as in the first three distributions. The right arm is even more elongated than during the disturbances of the war period. The average remains high, but slightly below that for the period 1914-1921.

The final distribution, composed of measures of frequency of price change relating to the entire period from 1890 to 1925 (excluding the years 1914-1921), is fairly symmetrical, and of the U-type exemplified in the pre-war distributions.

4. MEASURES OF PRICE TRENDS, IN COMBINATION

In Chapter I there were given measures defining the average annual rates of change in price, between 1896 and 1913, for 223 commodities. Differences between these rates, it was suggested, represent rather fundamental changes in economic relations, and are of considerable importance in a study of economic tendencies. The frequency distribution of these rates, and accompanying measures, are given in the following table. This distribution is shown graphically in Figure 56.

TABLE 124

FREQUENCY TABLE SHOWING THE DISTRIBUTION OF 223 COMMODITIES CLASSIFIED
ACCORDING TO AVERAGE ANNUAL RATE OF CHANGE IN PRICE BETWEEN
1896 AND 1913, WITH STATISTICAL MEASURES DESCRIPTIVE
OF THE DISTRIBUTION

(1) Class limits Rate of change (per cent)	(2) Midpoint	(3) Frequency
—3.50 to — 2.51	— 3	4
—2.50 to — 1.51	— 2	3
—1.50 to — .51	— 1	8
— .50 to + .49	0	31
+ .50 to + 1.49	+ 1	41
+1.50 to + 2.49	+ 2	58
+2.50 to + 3.49	+ 3	39
+3.50 to + 4.49	+ 4	20
+4.50 to + 5.49	+ 5	15
+5.50 to + 6.49	+ 6	2
+6.50 to + 7.49	+ 7	1
+7.50 to + 8.49	+ 8	0
+8.50 to + 9.49	+ 9	0
+9.50 to +10.49	+10	1
Total		223

|		
Mean	+1.94	
Median	+1.93	
Standard deviation	1.83	

The general drift of prices was, of course, upward during this period. The arithmetic mean of the 223 measures is +1.94, representing an average increase in price of 1.94 per cent each year.[1] The standard deviation is 1.83, a figure which indicates rather considerable differences between the rates of increase of the constituent series. These differences have been commented upon at an earlier point.

The distribution is very nearly symmetrical, but departs from the normal type in the matter of peakedness. There is a heavier concentration of observations near the mean and a somewhat greater spread at the two extremities than in the normal distribution.

[1] This differs somewhat from the average annual rate of increase in the all-commodities index of the U. S. Bureau of Labor Statistics during this period, which was 2.35 per cent. The difference is due to three factors—the difference in the number of commodities included, the absence of weighting in securing the average of 1.94 per cent, and purely mathematical differences between the slope of a line fitted to averages of a number of series, and the average of a number of quantities measuring the slopes of lines fitted to individual series.

FIGURE 56

COLUMN DIAGRAM SHOWING THE DISTRIBUTION OF MEASURES DEFINING
THE AVERAGE ANNUAL RATES OF CHANGE IN THE
PRICES OF 223 COMMODITIES, DURING THE PERIOD
1896-1913.
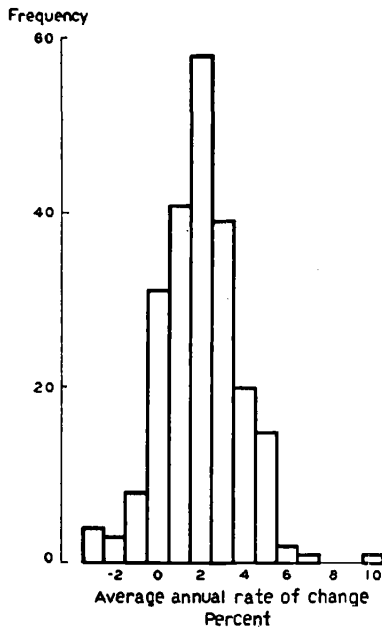
§ Comparison of Distribution Types

In summary, we may compare the various measures which have
been dealt with in the preceding sections of this chapter, the comparison
being restricted to their group characteristics. The statistical mea-
sures descriptive of the different frequency distributions discussed
above are summarized in the following table. Points defined by the
criteria of curve type, β_1 and β_2, for the several distributions are plotted
in Figure 57.

In studying these measures and in interpreting Figure 57 reference
should be made to the several tables and figures in Chapter III de-
scribing the characteristics of distributions of price relatives, and to the
accompanying explanations. The various distributions to which the
measures in this and earlier chapters relate all represent different aspects
of price behavior, and comparison of the results is significant for this
reason.

The distributions of monthly variability measures are all of the J-
type, with tails extending in the direction of positive values. Since the

TABLE 125

STATISTICAL CONSTANTS RELATING TO DISTRIBUTIONS OF MEASURES OF PRICE VARIABILITY AND TREND

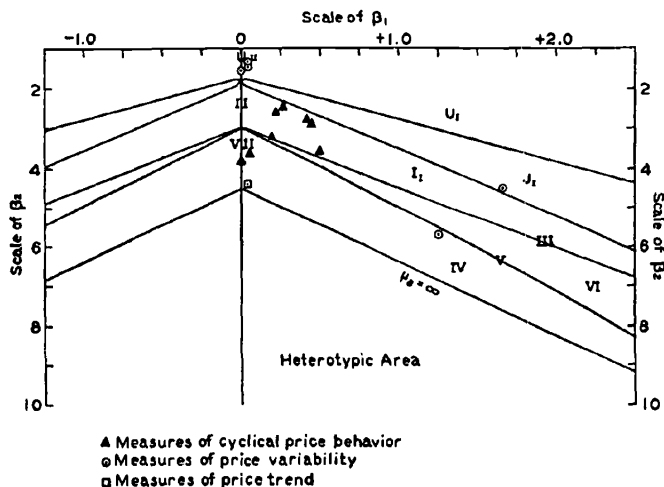| (1) Date or period	(2) Mean	(3) Median	(4) Standard deviation	(5) Coefficient of variation	(6) β_1	(7) β_2	(8) Skewness	(9) Kurtosis	(10) κ_1	(11) κ_2	(12) r	(13) Pearsonian curve type
Measures of Monthly Variability[1]												
1890	5.06	2.95	6.06	119.7	6.5007	10.9129		7.9129	−3.6763	−3.5434	−5.5690	IJ
1901	4.47	3.04	4.74	106.0	5.7748	10.3870		7.3870	−2.5504	−4.1879	−8.4980	IJ
1914	4.55	2.65	5.00	109.8	3.8725	7.0949		4.0949	−3.4277	−1.7171	−3.8902	IJ
1916	8.69	7.54	6.46	74.3	4.7557	10.6737		7.6737	1.0803	7.2384	27.3146	VIJ
1920	10.91	8.52	8.45	77.4	1.6603	4.5365		5.5365	−1.9079	−.9386	−5.9003	IJ
1925	4.94	3.26	5.97	120.9	8.7303	13.1357		10.1357	−5.9195	−3.6429	−3.4517	IJ
1890–1925 excluding 1914–1921	4.79	3.85	4.08	85.1	6.3436	13.1986		10.1986	1.3664	9.0199	25.7099	VIJ
Measures of Year-to-Year Variability												
1890–1913	8.80	7.73	4.98	56.6	1.2618	5.7513	.4034	2.7513	1.7172	.7320	12.1925	IV
Measures of Frequency of Price Change												
1890–1897	.456	.355	.369	80.8	.0474	1.3585	.1904	1.6415	−3.4252	.0124	−.5450	IU
1914–1921	.540	.497	.301	55.7	.0058	1.5899	.1609	1.4101	−2.8376	.0017	−1.2350	IU
1890–1925 excluding 1914–1921	.463	.395	.350	75.6	.0422	1.4393	.2217	1.5607	−3.2480	−.0114	−.7334	IU
Measures of Price Trend												
1896–1913	1.94	1.93	1.83	[2]	.0511	4.4405	.0652	1.4405	2.7277	.0147	7.4551	IV

[1] The means and standard deviations of the first six distributions in this group differ slightly from those given in Table 120. The differences are due to the employment of a different class-interval and different class limits in the two cases. Since all the distributions in this group are of the J-type, measures of skewness have been omitted.

[2] Because of the form in which the average annual rates of change have been expressed, the coefficient of variation would not be a significant measure for this distribution.

FIGURE 57

THE POPULATION OF PRICES.

Diagram Showing the Location of Points Defined by the Values of β_1 and β_2 for Distributions of Measures Describing the Behavior of Commodity Prices.[1]

▲ Measures of cyclical price behavior
⊕ Measures of price variability
□ Measures of price trend

[1] The points representing distributions of measures of monthly variability for the following years fall beyond the limits of the chart:

	β_1	β_2
1890	6.5007	10.9129
1901	5.7748	10.3870
1914	3.8725	7.0949
1916	4.7557	10.6737
1925	8.7303	13.1357
1890-1925, excluding 1914-1921.	6.3436	13.1986

corresponding ideal curves are modeless (being asymptotic to the vertical axis) no measure of skewness which is comparable to the measures relating to modal distributions can be secured.

The measures of year-to-year variability give a positively skewed Type IV distribution. The coefficient of variation is distinctly smaller than it is for the distributions of measures of monthly variability.

Points representing the three distributions relating to frequency of price change fall in a cluster not far from the axis of symmetry, at a point on the scale of β_2 values lower than has been reached by any of the measures for other distributions. These are the U-shaped distributions which have been commented upon above. (For these distributions the measure of skewness is the ratio to the standard deviation of the distance from mean to anti-mode.)

The distribution composed of measures of the average annual rates of change in the prices of individual commodities between 1896 and 1913 is a peaked, Type IV distribution, which is almost symmetrical.

One point calling for comment is the fact that none of these distributions falls in the heterotypic area. This is in sharp contrast to the situation portrayed by Figures 43 and 48, relating to distributions of price relatives. Of 190 distributions of price relatives which were analyzed in detail, 90 (47 per cent of the total) were heterotypic. There is reason to think that heterotypic distributions contain certain elements of instability, that the populations to which such distributions relate do not cohere as closely or are not as homogeneous as are populations from which distributions of more orthodox types are drawn. Judging from this evidence one would conclude that prices are least stable, are most exposed to the influence of unbalanced and disruptive forces, in respect to the degree of change between specific dates. Distributions which are much more stable, when tested in terms of their positive moments, are secured when the population of prices is sampled in regard to general variability, or in respect to the rates at which prices change over a period of years.[1]

II Group Characteristics of Measures of Cyclical Price Movements

A number of measures dealing with the behavior of commodity prices during cycles in general business have been described in the first chapter. These measures may be combined in various ways in a study of the price aspects of the business cycle. The timing, the duration and the magnitude of price changes during these cyclical swings may be studied, the emphasis being upon general tendencies and averages, rather than upon the behavior of individual price series. Each cycle may be studied as a unit and compared with other cycles in this analysis, or the average behavior of commodity prices, in combination, in all cycles, may be investigated. The detailed discussion of individual cycles may be preceded by a general survey of the price movements which have occurred during the cycles covered in the present study.

[1]It is important to note, however, that these latter distributions, which are stable when judged with reference to the probable errors of the descriptive statistics, contain many representatives of the families of U-curves and J-curves. (All the distributions of measures of frequency of price change are of the U-type, and all the distributions of measures of monthly price variability are of the J-type.) Most distributions of this type, it has been contended by R. A. Fisher, lie outside the area within which the method of moments may be efficiently applied in deriving from a sample information concerning a general population. In particular, it is questionable whether the first and second moments (as used in deriving means and standard deviations) furnish valid bases for generalization. Accordingly, although our constants may not be characterized by infinite probable errors when we sample the population of prices in respect to the attributes at present under discussion, other difficulties are encountered when we apply familiar methods to these samples. The outline of an alternative method appears in the memoir by R. A. Fisher which has been previously cited. ("On the Mathematical Foundations of Theoretical Statistics," *Phil. Trans. of the Royal Society*, Vol. 222A)