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constant level. The attendant circumstances, considered in connection with the evidence of the dispersion index, may suggest the nature and direction of the change which the restoration of internal equilibrium will involve.

V Price Displacement

It was suggested at an earlier point that our present problem is essentially that of measuring price instability, and a distinction was made between instability of the price level and internal instability. Internal instability was defined, provisionally, as the condition which develops when a set of established price relations is disturbed. One measure of such instability, the index of dispersion, has already been discussed. We advance in the present section to a further consideration of the problem of measuring those internal disturbances in price relations which are of such profound importance in the everyday processes of buying and selling.

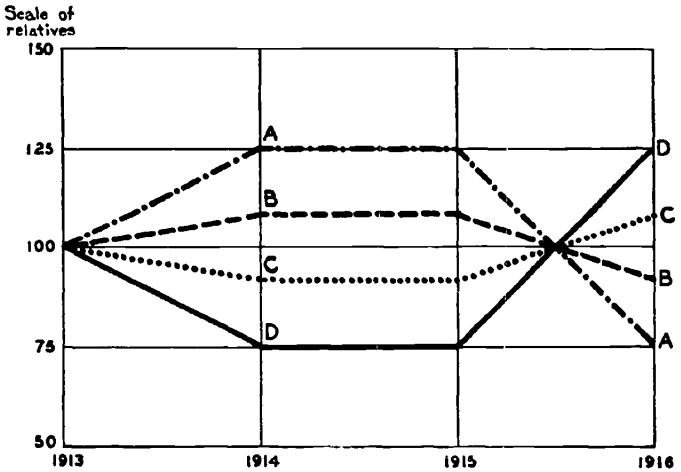
A measure of dispersion, by itself, is inadequate to describe all the alterations in price relations which take place between given dates. This is apparent from a study of Figures 25 and 26, which show the movements of the relative prices of ten commodities from 1913 to 1926. It is clear that the degree of dispersion varies, year by year, and that this dispersion changes the relations between the prices of the individual commodities here presented. But it is also clear that there are other changes in relationship which elude measurement by the index of dispersion. The lines representing fixed base relatives (Figure 25) are constantly crossing and recrossing. The dispersion of relative prices in two years may be approximately the same (a condition exemplified by unweighted relatives, on the 1913 base, in 1919 and 1924), but the commodities may stand in quite a different order. This shifting of relative position may affect buying and selling relationships just as much as would a change in the degree of dispersion.

The nature of this internal shifting, which is here called *price displacement*, may be made clearer by a hypothetical example. There are sketched in Figure 36 the movements of the relative prices of four commodities, represented by the letters A, B, C and D, from 1913 to 1916. Prices in 1913 furnish the bases of the relatives. If the movements in the prices of these four commodities are to be followed by means of the average alone, no change will be noted between the four years covered. The average is 100 throughout.

FIGURE 36

AN ILLUSTRATION OF PRICE DISPLACEMENT.

Changes in the Relative Prices of Four Commodities from 1913 to 1916.



Moreover, the dispersion of prices with reference to the base year, 1913, is the same in 1914, 1915 and 1916. Yet between 1915 and 1916 a change of obvious economic importance has taken place. This is the complete reversal in the price relations of the four commodities. Article A which was in 1915 highest, relatively, is lowest in 1916, and the positions of the other articles have been correspondingly changed. A measure of such internal displacement is needed, as a supplement to the usual index of prices and the measure of dispersion, if price changes are to be accurately portrayed.

1. THE MEASUREMENT OF PRICE DISPLACEMENT

In seeking a measure of the shifting or internal displacement of prices from year to year (or month to month) trials were made with several different devices. Because of the dominant influence of one or two exceptional cases, the coefficient of correlation based upon the actual price relatives did not seem to be appropriate to the present purpose. This difficulty could be overcome, in part, by measuring the correlation between logarithms of price relatives. This was done in certain experiments. The most satisfactory results, however, were secured from the coefficient of rank correlation,

based upon the squares of the differences in rank. The formula for its computation is

$$\rho = \frac{1 - 6\Sigma d^2}{N(N^2-1)}$$

where d represents a difference in rank. It is computed quite readily by arranging the relative prices in order of rank in the two years to be compared, determining the differences in the rankings of individual commodities in these years, and applying the above formula. Pearson has shown that if the original data upon which the rankings are based are distributed normally, r, computed directly from the data, will differ slightly from ρ, computed from the ranks. In the present case, however, we are not using ρ as an approximation to r, but as a measure significant in itself. The absolute value of ρ at a given time has no particular significance for us; our interest lies in a comparison of values at different times. For this purpose the coefficient of rank correlation seems to be an adequate and reliable measure of shifting price relations.

The maximum value of the coefficient of rank correlation is $+1$, its minimum value -1. The data shown graphically in Figure 36 will serve as an illustration.

Commodity	Rank, 1914	Rank, 1915	Rank, 1916
A	1	1	4
B	2	2	3
C	3	3	2
D	4	4	1

Under these conditions the correlation between the rankings in 1914 and 1915 is $+1$, while the correlation between the rankings in 1915 and 1916 is -1. For any degree of shifting less revolutionary than a complete reversal the coefficient would be greater (algebraically) than -1 and, unless the rankings were identical in the two years compared, less than $+1$.

The coefficient of rank correlation may be looked upon as a measure of price disturbance, since its value depends upon the amount of displacement taking place within a given time interval. Used in conjunction with a measure of changes in the general price level and a measure of dispersion, it serves to give a fairly complete account of general changes in prices and in price relations between given dates.

For practical use as a measure of price disturbance it is de-

sirable to present this measure of correlation in a slightly modified form. The values of ρ, as a measure of price displacement, are found to fall, in general, between $+1$ and 0. As the value falls toward zero it indicates increasing price disturbance. This may be a bit confusing, as in index numbers of the usual type rising values represent increasing change. Accordingly, this measure is used in the form $1-\rho$. A value of zero for this index will mean no price disturbance, and rising values will mean increasing displacement. The maximum value, which would represent an exact reversal of all price relations, is $1-(-1)$, or 2.

Several special problems arise in connection with the index of price displacement. Its value depends, of course, upon the base of the price relative used, as well as upon the particular years or months compared. When fixed base relatives are employed the year-to-year shifting of price relatives tends to decrease as the base period becomes more remote, because of the increase in dispersion which is so marked during the several years immediately following the base year. Yet link relatives cannot be employed, for it is shifts of position with reference to a *common base* which we seek to measure. We may, as an alternative, employ a moving base period, each year serving as a base for the relatives of the first and second years succeeding. Thus we would correlate 1914 and 1915 relatives on the 1913 base, 1915 and 1916 relatives on the 1914 base, and so on. By this means we may avoid the bias due to increasing dispersion and secure the desired measure of displacement from year to year (or month to month) with reference to a common base. Index numbers of displacement have been computed from both fixed base and moving base relatives.

2. The Displacement of Fixed Base Relatives with Reference to a Constant Criterion

The three sets of fixed base relatives described in earlier sections (covering the periods 1891 to 1902, on the 1891 base, 1902 to 1913, on the 1902 base, and 1913 to 1926, on the 1913 base) have been utilized in the measurement of price shifting. The relatives for the first and second periods have been extended to 1903 and 1914, respectively, for the purposes of the present study. In the first analysis a constant criterion has been employed in each period, this criterion being the ranking of relatives in the first year after the base year. That is, the relative positions of the various commodities in each year of the first period have been compared with

their relative positions in 1892. For the second period the ranking in 1903 has served as criterion, and for the third period the ranking in 1914 has been used. No particular significance attaches to the choice of these years. The immediate requirement is that a constant yard-stick shall be used in measuring the shifts from year to year. The bearing of the criterion upon the interpretation of the results is discussed at a later point.

The indexes of displacement are given in the following table, and are plotted in Figure 37. They are based upon the prices of 216 commodities throughout, except for the years 1925 and 1926, for which 213 and 212 series were used, respectively.

TABLE 104

MEASURES OF PRICE DISPLACEMENT, 1893-1926

Displacement of Fixed Base Relatives, by Periods, with Reference to a Constant Criterion in each Period.

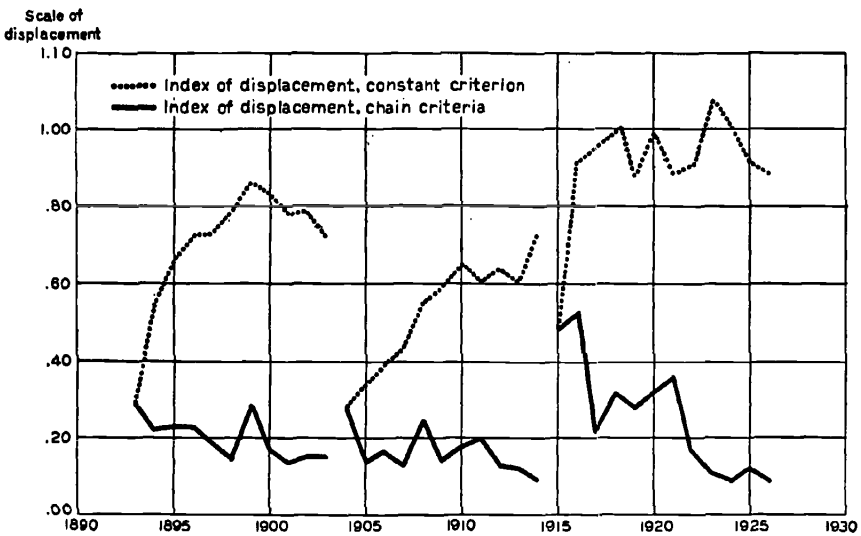
(1) Years compared	(2) Base of relatives	(3) Index of displacement
1893–1892	1891	.28
1894–1892	1891	.55
1895–1892	1891	.67
1896–1892	1891	.73
1897–1892	1891	.73
1898–1892	1891	.80
1899–1892	1891	.86
1900–1892	1891	.83
1901–1892	1891	.78
1902–1892	1891	.79
1903–1892	1891	.73
1904–1903	1902	.28
1905–1903	1902	.34
1906–1903	1902	.40
1907–1903	1902	.43
1908–1903	1902	.56
1909–1903	1902	.59
1910–1903	1902	.65
1911–1903	1902	.61
1912–1903	1902	.64
1913–1903	1902	.61
1914–1903	1902	.74
1915–1914	1913	.48
1916–1914	1913	.92
1917–1914	1913	.95
1918–1914	1913	1.00
1919–1914	1913	.87
1920–1914	1913	.99
1921–1914	1913	.89
1922–1914	1913	.91
1923–1914	1913	1.07
1924–1914	1913	1.01
1925–1914	1913	.92
1926–1914	1913	.89

In studying these values the precise significance of each figure must be borne in mind. We may take the first entry in the table as an example. This measures the degree of price shifting between 1892 and 1893. In 1892 the relatives, on the 1891 base, stood in a certain position, when arranged in order of magnitude. At the top of the list was jute, for which the relative was 129.7. At the bottom were potatoes, with a relative of 58.9. If in 1893 the ranking of the relatives on the 1891 base had been the same throughout as in 1892 the index of displacement would have a value of zero. But there had been some changes. Mess pork was now at the top, with a relative of 162.3, and rye was lowest in the list, with a relative of 58.8. The index of displacement takes account, of course, not only of the shift in the top and bottom values, but of all the changes in position of the relative prices of the 216 articles included. The value of .28 indicates a material degree of shifting between 1892 and 1893.

FIGURE 37

INDEXES OF PRICE DISPLACEMENT, 1893-1926.

Measures of the Degree of Shifting of Fixed Base Relatives, by Periods, with Reference to a Constant Criterion and to Chain Criteria in Each Period.



The degree of departure from the 1892 relations increased, with a pause between 1896 and 1897, to 1899, for which year the displacement is measured by an index of .86. The degree of dis-

placement declined slightly thereafter, the index having a value of .73 when the period ended in 1903.[1]

In the second period, for which relatives on the 1902 base have been employed, the degree of departure from the 1903 situation increases to 1914, with slight downward movements in 1911 and 1913. The measure of the degree of displacement during the 11 year period from 1903 to 1914 has a value of .74, as compared with .73 for the 11 year period from 1892 to 1903. Approximately the same degree of change was experienced over each of these periods, judging from the terminal values of the index, although more radical changes occurred within the first period.

The developments from 1915 to 1926 stand in rather sharp contrast to those of the periods just described. The degree of shifting in position of 1913 base relatives between 1914 and 1915 is measured by an index of .48. The displacement during the one year period from 1914 to 1915 was greater than that which occurred over the four year period from 1903 to 1907. By 1916 the departure from 1914 relationships, measured by an index of .92, was greater than that which took place over the entire 11 year period from 1892 to 1903, or over the period from 1903 to 1914. From 1916 to 1926 the index oscillates in the neighborhood of this value. It reaches noticeably higher values (.99 or above) in 1918, 1920, 1923 and 1924, but by far the sharpest break took place in the two years from 1914 to 1916. The high value of 1918 was followed, in 1919, by something of a swing back to 1914 relationships, and the years 1921, 1925 and 1926 were marked by similar changes. Future tendencies in this direction will be followed with interest. In 1926 the index of displacement had a value of .89, slightly below that recorded for 1916 and equal to that for 1921.

In interpreting these figures it will be recalled that a value of 1.00 for the index of displacement represents a complete destruction of the set of price relations prevailing at the date represented by the criterion, while a value of 2.00 would indicate an exact reversal of the rankings throughout, the building up a new set of price relations representing the precise opposite of those prevailing at the

[1]In another computation the degree of displacement between 1892 and 1914 has been measured, employing relatives on the 1891 base. It is of interest to note that in 1914 the relatives on the 1891 base showed approximately the same degree of departure from the 1892 situation as they did in 1903. The value of the index of displacement was .74. (This figure is not to be confused with the similar value, measuring the relation between 1914 and 1903, derived from relatives on the 1902 base.) There had, of course, been considerable shifting between 1903 and 1914, but in relation to the 1892 situation the two years represented about the same degree of change.

earlier date. By "a set of price relations," as that phrase is used in the discussion of price displacement, is meant the particular system defined by the ranking of a given group of price relatives at a given date. Thus the ranking in 1914 of relatives on the 1913 base defines one set of price relations, while the ranking in 1914 of relatives on the 1902 base would define a quite different set of relations. These different sets of relations vary widely in significance and, accordingly, the index of displacement is always to be interpreted in terms of the particular criteria and the particular displacements to which it relates. When it is said that "a set of price relations has been destroyed," this does not mean that all ties between elements in the price system have been severed, but merely that the set of relations defined by a particular ranking of price relatives has been destroyed. The significance of such a "destruction" depends, obviously, on the significance of the relations defined by the ranking in question.

The measures of displacement relating to the last period show that by 1916 the set of price relations prevailing in 1914 (as measured by relatives on the 1913 base) had been almost completely destroyed (the index had a value of .92), and that by 1918 no vestige of these relations survived (the value of the index was 1.00 in 1918). Between 1918 and 1923 there were minor swings, culminating in a maximum degree of displacement in 1923. Since 1923 there has been a slight tendency to return to the 1914 relations, but the degree of departure from pre-war relations, as defined by the present criterion, remains considerable. There is but a remote connection between the ranking of 1913 relatives in 1914 and the ranking of these relatives in 1926.

This is perhaps to be expected. As was pointed out at an earlier point, no particular significance may be attached to the ranking of 1913 base relatives in 1914. As a constant yard-stick, with which rankings at various other dates may be compared, it is useful, but it cannot be accepted as representing a very significant set of pre-war price relations. Changes in individual prices from one year to the next must reflect, in large part, the play of accidental and temporary forces, and only to a small extent the operation of those relatively permanent forces which are of chief importance in forming a "system" of price relations. If the index of displacement is to be used to register shifts in a well-established set of price relations, the ranking of relatives which is to serve as the basis of comparison (the criterion) should be that prevailing at a period further removed from the base period.

For the purpose of measuring such shifts use has been made of relatives on the 1891 base, which have been carried forward through 1926. The commodities represented are 195 in number (except for the years 1918 and 1925, for which there were 194, and 1926, for which there were 193 quotations).[1] The ranking of these relatives in 1914 has been used as the standard of comparison throughout. By 1914 the relatives on the 1891 base may be assumed to have reached fairly stable positions in relation to each other. The differences between them would reflect to some extent temporary dislocations due to current cyclical and accidental movements, but the chief cause for differences between relatives on a base 23 years distant would be variations in underlying trends. Long-time changes in costs of production, enduring shifts in consumer demand, changes in styles and habits—all these would be reflected in the ranking of relatives on a base so many years removed. Partly because of the deep-seated character of these changes and the stability of the resulting set of price relations, partly because of the wide dispersion of the relatives after the lapse of 23 years, less radical shifts are to be expected than under the conditions previously studied, and greater significance is to be attached to given measures of displacement. These measures are shown in the following table. They are plotted in Figure 38.

TABLE 105

MEASURES OF PRICE DISPLACEMENT, 1915-1926

Displacement of Relatives on the 1891 Base, with Reference to the Ranking of these Relatives in 1914.

Years compared	Index of displacement	Years compared	Index of displacement
1915–1914	.17	1921–1914	.43
1916–1914	.28	1922–1914	.41
1917–1914	.40	1923–1914	.48
1918–1914	.36	1924–1914	.42
1919–1914	.27	1925–1914	.33
1920–1914	.44	1926–1914	.33

It is first to be noted that these indexes of displacement are distinctly lower in value than the series in Table 104 measuring the shifts in relationship after 1914. The highest value is .48, for 1923, as compared with 1.07, the figure for 1923 when relatives on the

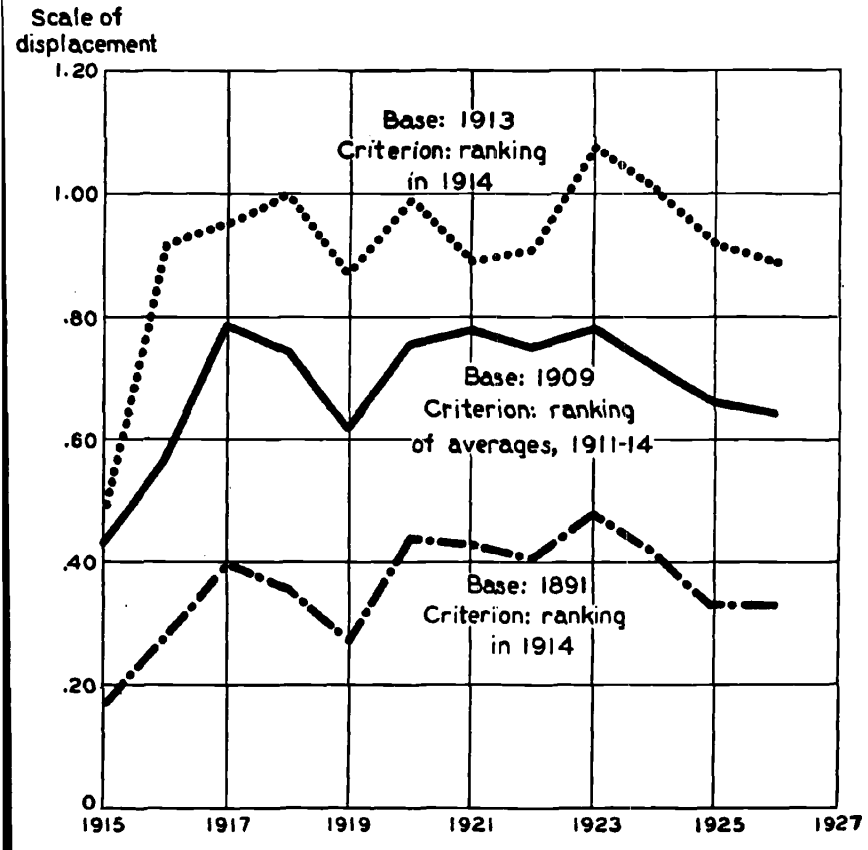
[1]These are the commodities employed in computing the various measures of price level changes and price dispersion for the years from 1891 to 1902. See Appendix Table I.

1913 base were employed. If we think of the 1914 ranking of 1913 relatives as representing an established system of pre-war price relationships, we would say that this system was completely destroyed during the price revolution which began in 1915. If we accept the 1914 ranking of relatives on the 1891 base as representing pre-war price relationships, the figures in Table 105 would indicate that although these relationships were materially altered by war and post-war changes, they were by no means destroyed. The latter is undoubtedly a more valid statement than the former, since the second set of relationships is more significant than the first.

FIGURE 38

INDEXES OF PRICE DISPLACEMENT, 1915-1926.

Measures of the Degree of Shifting of Three Series of Fixed Base Relatives with Reference to a Constant Criterion for Each Series.



The changes in the index of displacement recorded in Table 105 are of considerable interest. The transition to a war economy brought a definite swing away from the 1914 ranking. This movement reached a first peak in 1917. In 1918 there was a minor movement back toward the 1914 relationships, a movement which was much more pronounced in 1919. The first effect of the end of the war was to initiate a return to pre-war price relations. (The same tendency is apparent in the measures given in Table 104. It is possible that this movement is in part a reflection of federal price regulation from 1917 to 1919.) Between 1920 and 1923 there was another clear swing away from the relationships of pre-war days. The indexes in Tables 104 and 105 agree in showing 1923 to be farthest removed from 1914 in respect to commodity price relations. Between 1924 and 1926 there was a swing back toward 1914 price relations, a swing which is reflected in the movements of both index numbers.

A third set of measures of the displacement of prices during the war and post-war years is presented in Table 106. The significance of any such measures depends, as has been pointed out, on the adequacy of the criterion which is assumed to define a system of established price relations. Neither of the criteria previously employed as representative of pre-war relations is altogether satisfactory. That based upon the ranking of relatives one year after the base year gives too much weight to accidental factors of no permanent significance. On the other hand, 1891 is perhaps too far removed from the year serving as criterion. For by 1914 the dispersion of relatives on the 1891 base was so great that any change in ranking required a considerable movement of prices. In computing the present measures of displacement, relatives on the 1909 base have been employed, and in arranging the ranking to serve as criterion the values of these relatives in the years 1911 to 1914 have been averaged. The ranking of averages of relatives for a period of four years should give a set of price relationships less affected by temporary shifts than would the ranking in any one year and, by the use of a base two to five years removed from the years entering into the criterion, time is given for the development of a fairly significant "system." The present criterion is probably a better representative of pre-war price relations than is either of those previously employed. This index is plotted, with the two previously discussed, in Figure 38.

TABLE 106

MEASURES OF PRICE DISPLACEMENT, 1915-1926

Displacement of Relatives on the 1909 Base, with Reference to the Ranking of Averages of these Relatives during the Years 1911-1914

Year compared with pre-war criterion	Index of displacement[1]
1915	.43
1916	.57
1917	.79
1918	.75
1919	.62
1920	.76
1921	.78
1922	.75
1923	.78
1924	.72
1925	.66
1926	.64

[1]This index is computed from 216 price series, except for the years 1925 and 1926. In these years 213 and 212 series, respectively, were used.

Although these indexes differ materially in value there is a significant correspondence between them in respect to the general course of their movements during the years from 1915 to 1926. The agreement in the direction and degree of the annual movements of the indexes based upon 1891 and upon 1909 relatives is particularly marked. The index derived from 1909 relatives differs from the others in that it shows a degree of displacement in 1917 slightly greater than in 1923. The other two reach their highest values in 1923.

The differences between the absolute values of the three indexes are of considerable interest, for these absolute values indicate the degree to which the set of pre-war relationships defined by each of the three criteria survived the disturbances of the war and post-war years. As compared with maximum values of 1.07 (in 1923) for the index derived from 1913 relatives, and .48 (also in 1923) for the index based upon 1891 relatives, the index secured from the 1909 relatives reaches maximum values of .79 in 1917 and .78 in 1923. The value of .48 represents, as has been pointed out, a substantial modification in the given set of price relations, .79 represents a more profound alteration, while 1.07 indicates the complete disappearance of the set of relations which serves as criterion. It is to be expected that the index secured from 1909 relatives should

fall between the two other indexes. The set of relations defined by the ranking of pre-war averages of relatives on the 1909 base did not have roots as deep as did the set derived from 1891 relatives but was much more firmly established than the system defined by the 1914 ranking of relatives on the 1913 base. The varying changes which the price revolution wrought in these three sets of relations correspond to these differences, the most deeply rooted system experiencing the smallest degree of disturbance.

The 1926 situation is summarily described by the three final values of these indexes, .89 in respect to the system of price relations which was the resultant of changes from 1913 to 1914, .64 in respect to the system which developed between 1909 and 1914, and .33 in respect to the system which developed between 1891 and 1914. Only a vestige of the first set of relations remained, the second was fundamentally modified, while the third, although altered materially endured in its main features.

The general correspondence between the year-to-year movements of these three indexes of displacement, and the consistent and logical differences between their respective annual values give added significance to the story they tell.

3. The Displacement of Fixed Base Relatives with Reference to the Preceding Year as Criterion

The indexes discussed above have measured the degree of shifting of price relatives with reference to a fixed standard in each period. Interest attaches also to the year-to-year shifts in price relations. These shifts may be measured by comparing the rankings of fixed base relatives in successive years. Measures of displacement derived from these rankings are given in the following table and are plotted, with certain of the measures considered above, in Figure 37.

In interpreting these results we face a difficulty because of the relation of dispersion to displacement, when the displacement measure is computed by the method employed above. As the individual relatives on a fixed base become more widely dispersed, change in ranking is brought about only by relatively greater change in prices. When the criterion is a constant one, as in the first set of displacement measures presented, this factor of increasing dispersion tends to bring about a fairly stable value of the displacement index. When the criterion in each case is the ranking of fixed bas

TABLE 107

MEASURES OF PRICE DISPLACEMENT, 1893-1926

Displacement of Fixed Base Relatives from Year to Year

(1) Years compared	(2) Base of relatives	(3) Index of displacement
1893–1892	1891	.28
1894–1893	1891	.22
1895–1894	1891	.23
1896–1895	1891	.23
1897–1896	1891	.19
1898–1897	1891	.15
1899–1898	1891	.28
1900–1899	1891	.17
1901–1900	1891	.14
1902–1901	1891	.15
1903–1902	1891	.15
1904–1903	1902	.28
1905–1904	1902	.14
1906–1905	1902	.16
1907–1906	1902	.13
1908–1907	1902	.25
1909–1908	1902	.14
1910–1909	1902	.18
1911–1910	1902	.20
1912–1911	1902	.13
1913–1912	1902	.12
1914–1913	1902	.09
1915–1914	1913	.48
1916–1915	1913	.52
1917–1916	1913	.22
1918–1917	1913	.32
1919–1918	1913	.28
1920–1919	1913	.32
1921–1920	1913	.36
1922–1921	1913	.17
1923–1922	1913	.11
1924–1923	1913	.09
1925–1924	1913	.13
1926–1925	1913	.09

relatives in the preceding year, the factor of increasing dispersion tends constantly to lower the index of displacement. Thus, so long as there is an upward secular tendency in the dispersion of fixed base relatives, there will be a downward trend in a measure of displacement involving the year-to-year comparison of fixed base relatives. Such a movement is apparent in each of the three periods covered by the index of displacement at present under discussion. This tendency must be recognized, but it does not invalidate all comparison of these measures.

During the first period the index of displacement declined regularly, as would be expected because of the increase in dispersion, but there was a single marked break in this decline in 1899. The index of displacement between 1898 and 1899 had a value of .28. If we except the first years of the two periods, this indicates a greater degree of shifting than took place in any twelve-month interval between 1893 and 1914. This substantiates other evidence that 1899 was a year of marked internal price disturbance. In 1908 the index, with a value of .25, stood next highest (again excepting the first year in each of the first two periods; because of the smallness of the dispersion of fixed base relatives during the first two years after the base year, a relatively high index of displacement is to be expected in these years).

The 12 years from 1915 to 1926 may be broken into three fairly distinct divisions. The first, which includes the years 1915 and 1916, covers the period of sharp and violent transition to a war-time economy. During these years the present index of displacement attained the highest value recorded during the 34 years of this history. The index had a value of .48 in 1915 and .52 in 1916. The tremendous internal revolution in the price structure is perhaps more clearly indicated by these figures for 1915 and 1916 than by any other price measure we have employed. The high values of the index are doubly significant because of the very considerable dispersion of the 1913 base relatives in these years.

The second division, extending from 1917 to 1921, covers the last years of the war and the years of transition from war-time organization to a peace-time economy. By 1917 something approaching war-time stability had been attained. The index of displacement fell from .52 in 1916 to .22 in 1917. While this latter figure was relatively high compared with pre-war figures, it was the lowest value recorded between 1915 and 1921. From 1917 to 1921 the index of displacement moved upward, with a slight decline in 1919. This upward movement occurred during a period marked by approximate stability of the index of dispersion (unweighted). The considerable increase in the degree of displacement in 1920 and 1921 reflects the price readjustments accompanying liquidation and the building up of a set of price relationships adapted to peace-time conditions. The severity of this readjustment is attested by the relatively high values of the present index in 1920 and 1921 (values of .32 and .36). These were higher than any values recorded in pre-war years, a fact which is the more significant because the dis-

persion of fixed base relatives during these years was greater than during any period prior to the war.

The third division includes the years from 1922 to 1926. This is a period of stability, during which the index of displacement ranged between .09 and .17. In the one year from 1921 to 1922 the value of the index was reduced by more than one-half, falling from .36 to .17. It was below this latter figure in all the years after 1922. By that year the violent year-to-year shifts in price relations which had characterized the preceding seven years were over.

The nature of this condition of stability which has prevailed during the last several years calls for some consideration. That its establishment involved a considerable break with the preceding years is evidenced by the high values of the index of year-to-year change in 1920 and 1921. Even more complete was the departure from war-time relations. This has been measured by means of a separate index, based upon the ranking of price relatives (on the 1913 base) in 1917 and in 1926. This index of displacement, computed from 212 relatives, has a value of 1.07. This means that by 1926 no vestige remained of the set of price relations (represented by the ranking of relatives on the 1913 base) which prevailed in 1917. In view of the magnitude of the dispersion of 1913 relatives in both the years compared, this value of the index of displacement represents a fundamental change.

It has been pointed out that this recent condition of stability has been marked by a tendency to return to the system of price relations which prevailed before the war, a tendency which is apparent in respect to each of the three criteria of pre-war price relations. This is a significant movement, and it will be a matter of considerable interest to determine whether it continues during the next several years.

4. The Displacement of Two-Year Link Relatives with Reference to the Preceding Year as Criterion

In order to eliminate the effect of the time factor upon the index of displacement, a measure based upon one- and two-year link relatives has been constructed. The values secured are given in the following table, and are plotted in Figure 39.[1]

[1]As in the preceding calculations these measures are based upon the prices of 216 commodities in each year, except 1925, when 213 commodities were used, and 1926, when 212 price series were available.

TABLE 108

MEASURES OF PRICE DISPLACEMENT, 1893-1926

Displacement of Two-Year Link Relatives, with Reference to the Ranking of Link Relatives in the Preceding Year.

(1) Years compared	(2) Base of relatives	(3) Index of displacement
1893–1892	1891	.28
1894–1893	1892	.30
1895–1894	1893	.34
1896–1895	1894	.27
1897–1896	1895	.38
1898–1897	1896	.21
1899–1898	1897	.36
1900–1899	1898	.32
1901–1900	1899	.42
1902–1901	1900	.35
1903–1902	1901	.47
1904–1903	1902	.28
1905–1904	1903	.34
1906–1905	1904	.31
1907–1906	1905	.21
1908–1907	1906	.62
1909–1908	1907	.30
1910–1909	1908	.27
1911–1910	1909	.47
1912–1911	1910	.41
1913–1912	1911	.30
1914–1913	1912	.40
1915–1914	1913	.48
1916–1915	1914	.36
1917–1916	1915	.26
1918–1917	1916	.34
1919–1918	1917	.30
1920–1919	1918	.29
1921–1920	1919	.37
1922–1921	1920	.27
1923–1922	1921	.23
1924–1923	1922	.24
1925–1924	1923	.23
1926–1925	1924	.23

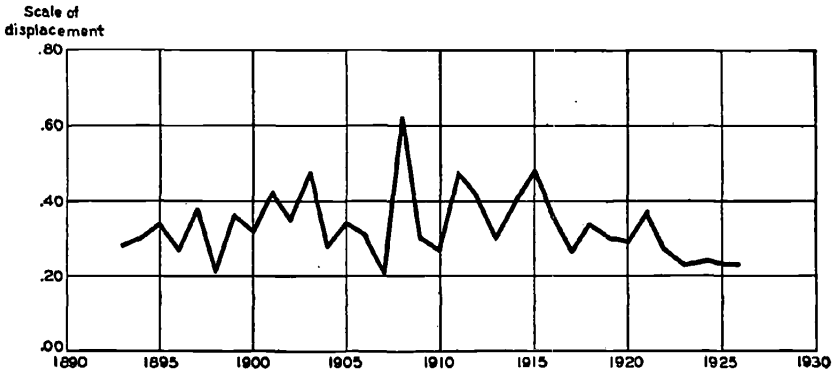
The interpretation of this index is not as simple as in the two cases preceding. The index of displacement for every year, it must be remembered, is affected by prices in three years—the year which is used as the base of the relatives, the year which serves as a criterion in comparing the rankings of relatives, and the year to which the measures specifically relate. (The latter is the *given* year, in index number terminology.) In computing the indexes of displacement given in Tables 104, 105 and 106 the relatives employed were all on the same base, and the criterion was constant for all the comparisons relating to a given period. Changes in the values of the

index from year to year reflected changes in the ranking of relatives in the *given* years. There was only one variable to follow. This procedure was modified somewhat in computing the indexes in Table 107. Here the base of the relatives was the same throughout each period, but both criterion and given year changed from year to year. The interpretation of the values remains fairly simple, however, for the derived measures indicate the violence of the shifts in position between successive years. The index given in Table 108 involves three variables, for the base of the relatives, criterion and given year vary each time. Thus the value of the index in 1908 is affected by the prices of 216 commodities in three different years, 1906, 1907 and 1908, while the value of the index in 1912 is affected by prices in 1910, 1911 and 1912. The values for 1908 and for 1912 have no factor in common. Yet, as a means of measuring the intensity of year-to-year price disturbances, these measures possess significance.[1]

FIGURE 39

INDEX OF PRICE DISPLACEMENT, 1893-1926.

Measures of the Degree of Shifting of Two-Year Link Relatives, with Reference to the Ranking of Link Relatives in the Preceding Year.



The index of displacement based upon one-year and two-year link relatives serves as a measure of the violence of price changes

[1]The differences between this index and those showing violence of year-to-year shifts in fixed base relatives (which are plotted in Figure 37) show how important the choice of a base is. Both indexes measure the displacement of prices between a given year and the year preceding. The differences between the two sets of measures are attributable entirely to differences in the bases of the relatives.

with reference to the immediate past. Perhaps it is most significant to look upon it as a measure of the degree to which tendencies prevailing in a given year represent a continuation of those prevailing during the preceding year. The lower the index of displacement the more uniform is the internal movement between successive years; the higher the index, the greater is the check to the tendencies prevailing in the year preceding.

The general course of the index differs materially from that of the one discussed previously. From 1893 to 1903 there is a general upward movement in the value of the index. There was a major check to this increase in 1898, with minor checks in 1896, 1900 and 1902. The general upward movement may be interpreted to mean that during most of this period there were conflicting tendencies in the movements of prices. The tide of business was not running consistently in one direction. These shifts in price tendencies were most marked between 1896 and 1897, between 1900 and 1901, and between 1902 and 1903. Between 1897 and 1898, if one may judge from this index, the tide was moving uniformly in a single direction, with only minor disturbances.

After 1903 there came a period of four years marked by a relatively unbroken flow in a single direction. Apart from a very slight check in 1905 the index moved downward, reaching a very low value in 1907. During the years of prosperity preceding the crisis of 1907 there were few discordant elements. Between 1906 and 1907 the tide was at its smoothest. This remarkable stability is significant, because of its bearing upon the theory that greater and greater price maladjustments develop during revival and prosperity, these culminating in a crisis which brings about a more stable condition. The present measures of price displacement do not indicate that maladjustments with reference to the immediate past develop during prosperity. (Since the indexes now under discussion relate only to year-to-year shifts, they would throw no light upon possible maladjustments with reference to an earlier situation.)

The tendencies which prevailed between 1906 and 1907 (which represented, apparently, a continuation of those prevailing after 1903) were sharply reversed in 1908. In this year the index of displacement based on link relatives reached a much higher value than in any other year during the period 1893-1926. This is a surprising result, as one would have expected much greater disturbances during the war and post-war years. Presumably it is ex-

plained by the nature of the index, which measures disturbances with reference to an immediate past. The shift in price relations between 1906 and 1907 was very slight, but 1908 brought a sharp, swift break in established relations. During the price changes of the war years and of the period of liquidation after the war pronounced changes in price relations took place, as is evidenced by the other measures of displacement, but there was no such sharp and sudden break with the past as in 1908.[1]

After 1908 the index of displacement remains low for two years, is fairly high in 1911 and 1912, falls in 1913, to rise again in 1914 and 1915. The value for 1915, which is the second highest for the entire period, gives evidence of a sharp dislocation. During the years 1916 and 1917 a decline in the measures of displacement indicates a continuation of those tendencies which prevailed in 1915. The year 1918 brought a somewhat higher value again, but the check to 1917 tendencies was not pronounced. Relatively low values were obtained for 1919 and 1920. There was no sharp break with the immediate past in this period. The year 1921 marks a slight advance, but one which is smaller than might have been expected. The explanation is, perhaps, that the readjustment of price relations which the end of the war necessitated was in process during all the years from 1918 to 1921, though the external manifestations were most marked in the last year. Such gradual changes may keep the index on a fairly high level, but would not give rise to such a high value as that of the year 1908. From 1922 to 1926 the values of the index were relatively low. Only in two earlier years (1898 and 1907) were values recorded lower than those of the years 1923 to 1926. There is a suggestion here that during this period, as in the years from 1904 to 1907, the tide of business was moving steadily in one direction, with no serious checks or dislocations.

Each of the three annual indexes of displacement measures a somewhat different type of price change, and the nature of each must be borne in mind in interpreting it. Taken together they give a comprehensive account of the shifts in price relations which occur over a given period of time.

[1]The fact that average annual prices are employed in these calculations detracts somewhat from the faithfulness of the picture which the index gives. An average for any year may measure the net result of two opposite movements. Thus an average for 1920 represents the net value of the upward movement during the first part of the year and the downward movement in the last part. The years 1920 and 1921 do not, perhaps, stand in as sharp opposition to each other as do 1907 and 1908. In 1907 the break in commodity prices came well toward the end of the year, and the average for the year as a whole represents the forces of prosperity.

5. Monthly Measures of Price Displacement

In following the shifting of prices from month to month, measures corresponding to all those employed in handling annual prices might be utilized. In the present study use has been made only of fixed base relatives, and the analysis has been confined to the period 1920-1926. Changes in the ranking of price relatives (on the 1913 base) from month to month and over a twelve-month period have been measured. The indexes of displacement are based upon the prices of 100 commodities at wholesale.[1]

The measures of month-to-month displacement appear in the following table. They are plotted in Figure 40.

TABLE 109

Monthly Measures of Price Displacement, 1920-1926

Displacement of Fixed Base Relatives, with Reference to Preceding Month as Criterion.

(Base of relatives: 1913)

(1) Months compared	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Index of displacement						
	1920	1921	1922	1923	1924	1925	1926
Jan.–Dec.		.038	.032	.014	.016	.028	.041
Feb.–Jan.	.021	.038	.017	.013	.019	.025	.015
Mar.–Feb.	.022	.022	.021	.011	.018	.034	.042
Apr.–Mar.	.044	.024	.019	.017	.015	.021	.010
May–Apr.	.018	.035	.031	.020	.014	.024	.024
June–May	.018	.015	.019	.009	.021	.033	.015
July–June	.016	.031	.015	.014	.021	.016	.016
Aug.–July	.025	.025	.048	.008	.018	.022	.009
Sept.–Aug.	.045	.034	.028	.025	.026	.021	.018
Oct.–Sept.	.044	.031	.011	.025	.019	.043	.027
Nov.–Oct.	.048	.030	.026	.025	.024	.016	.023
Dec.–Nov.	.038	.007	.027	.014	.018	.063	.020

The course of this index is in many respects like that of the monthly index of dispersion. Though the major movements of the period covered are fairly clear, there is great irregularity in the month-to-month movements. This irregularity is doubtless accounted for in part by the smallness of the sample. There is reason to think, however, that this irregularity represents an inherent characteristic of the data. The various measures of internal change which have been computed on a monthly basis indicate that such al-

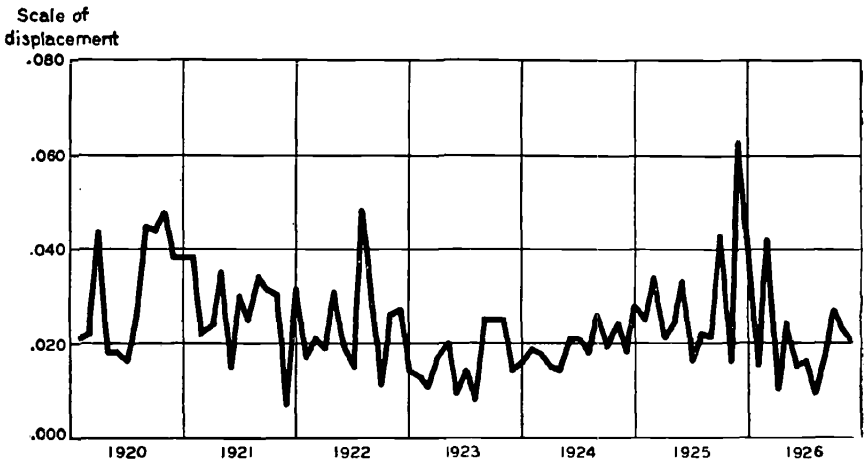
[1]See footnote, p. 271, for a list of these commodities.

terations in price relationships, even those which accompany major price movements, are sporadic and irregular.

FIGURE 40

MONTHLY INDEX OF PRICE DISPLACEMENT, 1920-1926.

Measures of the Degree of Shifting of Fixed Base Relatives with Reference to Preceding Month as Criterion.



Except for a markedly high value in April, 1920, registering the change in position from March to April, the values of the index of displacement were low during the first seven months of 1920. In August there was a rise, and in September a very pronounced increase. For the six month period from September, 1920 to February, 1921 the index remained very high. This was the period of drastic internal change, accompanying the general liquidation in the commodity markets. After February there came an irregular decline, a low point being reached in December, 1921. Thereafter there was a series of erratic movements, following a general downward course until August of 1923. An irregular upward movement then set in, the peak being reached in December, 1925. The index moved unevenly downward during 1926.

Spasmodic and uneven as these movements are, they tell a fairly consistent story. The disturbances which accompanied the recession of 1920 and early 1921 are clearly reflected in the movements of the index. The minor cycle which reached a peak in 1923 left slight impress upon the index, but the relatively high values which lasted from September to November of that year may probably be

attributed to this factor. From 1924 to 1926 the broader movements of the index correspond roughly to the changes in the general price level, although here, as in the earlier years, the minor month-to-month changes in price relations partly conceal the underlying movements.

It was found, in studying changes in the price level and in price dispersion, that measures derived from twelve-month link relatives are free from most of the minor fluctuations which distort month-to-month measures, and that these twelve-month measures reflect clearly the broad movements in prices and in business conditions. An index of displacement measuring the shifts in relative position which have taken place over a twelve-month interval has been computed for the period 1920-1926. Price relatives for 100 commodities, on the 1913 base, have been employed. Values of the index are given in the following table, and are presented graphically in Figure 41. This index should be interpreted in connection with the corresponding measures of changes in the price level and in price dispersion which are plotted in Figure 34.

TABLE 110

MONTHLY MEASURES OF PRICE DISPLACEMENT, 1920-1926

Displacement of Fixed Base Relatives, with Reference to Twelfth Month Preceding as Criterion[1]

(Base of relatives: 1913)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Index of displacement						
Months	1920–1919	1921–1920	1922–1921	1923–1922	1924–1923	1925–1924	1926–1925
Jan.	.35	.59	.23	.22	.11	.25	.21
Feb.	.35	.58	.25	.24	.09	.22	.22
Mar.	.42	.58	.25	.27	.10	.19	.20
Apr.	.43	.58	.21	.26	.12	.17	.19
May	.44	.53	.21	.22	.12	.18	.15
June	.44	.48	.20	.20	.11	.15	.14
July	.47	.46	.23	.17	.12	.12	.12
Aug.	.47	.45	.24	.16	.15	.15	.12
Sept.	.42	.38	.22	.15	.15	.15	.14
Oct.	.51	.31	.24	.15	.15	.21	.18
Nov.	.61	.21	.22	.11	.17	.24	.14
Dec.	.58	.21	.22	.12	.20	.19	.13

[1]The index measures the shifts in relative position between a given month of one year and the same month of the year preceding. The column headings, with the entries in column (1), indicate the months and the years to which each measure relates.

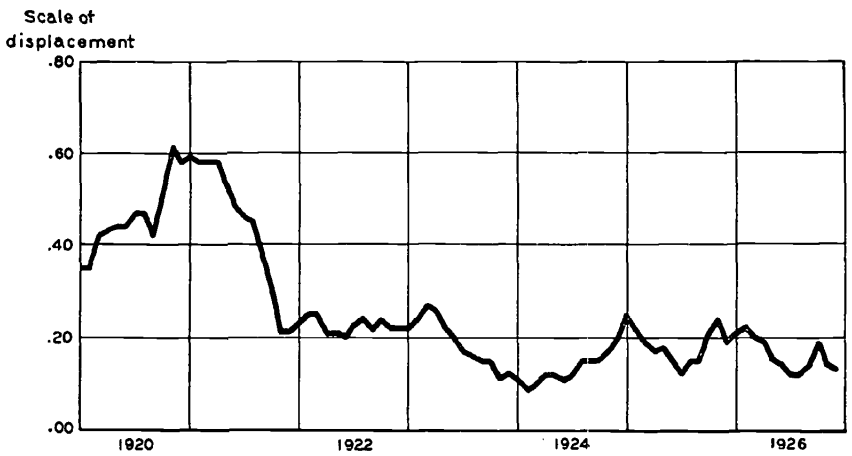
The values in the preceding table are all very much higher, it will be noted, than those in Table 109, relating to month-to-month

shifts. They also exceed materially the values for corresponding years in Table 107, measuring the displacement of fixed base relatives (1913 base) from year to year. Since the relatives employed in working with monthly data are also on the 1913 base, and since the time interval is the same (12 months) for the calculations leading to the results given in Tables 107 and 110, these differences possess some significance. It appears that the shifting in position between months which are separated by a twelve-month interval is consistently greater than the shifting of annual averages for successive years. The process of averaging serves to cancel (or conceal) the effects of numerous price shifts which are revealed when monthly data are used.

FIGURE 41

MONTHLY INDEX OF PRICE DISPLACEMENT, 1920-1926.

Measures of the Degree of Shifting of Fixed Base Relatives with Reference to Twelfth Month Preceding as Criterion.



The major swings of the index of displacement over this seven year period coincide fairly closely with the movements of other indexes of price changes. The most severe disturbances, and they were very severe, judging from the average value of the index, came between November, 1920, and April, 1921. Thereafter there was a rapid and unbroken decline in the degree of displacement until November, 1921. This last date marks the end of the disturbances attendant upon the general liquidation of 1920 and 1921, in so far as they are revealed by this index. There were no appreciable changes

during 1922, but a slight rise brought a minor peak in March, 1923. This was followed by a steady and considerable decline until the lowest value of the seven year period was reached in February, 1924. The degree of displacement increased month by month thereafter until January, 1925, declined until July, rose again until November, 1925, and declined somewhat irregularly throughout 1926.

In all their major swings during this period there is close agreement between the indexes of dispersion and of displacement which relate to changes over twelve-month intervals. Both indexes were relatively high prior to the break in prices in May, 1920. There was a slight decline shortly after the break started, but the continuation of the fall in prices brought sharp rises in both indexes. Thereafter abnormally high values were recorded until the end of the price decline (as recorded by the twelve-month index) in the middle of 1921. Both indexes show that the maximum disturbance in established relations came during the period of most rapid change in the price level.[1]

As a descriptive device, the index of displacement appears to be a useful supplement to measures of changes in the price level and measures of dispersion. It gives a measure of those shifts in relationship which are of such immediate concern in the ordinary processes of buying and selling. As has been indicated, it may be applied in various ways in studying price changes. The index of displacement computed from fixed base relatives, using a constant criterion, measures the degree of shifting in reference to a fixed date in the past. The same relatives may be used in measuring shifts from year to year, but the matter is complicated somewhat in this latter case by the varying degrees of dispersion of fixed base relatives at different dates. Annual data may be used in measuring the degree of displacement in reference to the immediate past, employing one- and two-year link relatives. Finally, the displacement from month to month or over a twelve-month period may be determined from monthly prices, expressed as relatives on a fixed base.

[1]A fairly close relation between the index of dispersion based on twelve-month link relatives and the index of displacement which measures shifts, over a twelve-month interval, in the ranking of fixed base relatives is to be expected, although the methods of measurement are quite different. A considerable dispersion of twelve-month link relatives would ordinarily involve a considerable shift in the ranking of relatives for the two months concerned, when these relatives are computed upon a base some time removed.

For the same reason, some relationship is to be expected between the dispersion of annual link relatives and the displacement from one year to the next of relatives upon a fixed base.

The month-to-month measures are so greatly affected by irregular movements in the prices of individual commodities that their usefulness appears to be limited. Indexes of displacement over twelve-month intervals are free from this defect, and provide the most satisfactory measures of changes in the internal relations among commodity prices.

VI On the Characteristics of the Population of Prices

1. The Description of Populations in Terms of Group Characteristics: Criteria of Curve Type

In describing the behavior of commodity prices in combination in the preceding sections of this chapter we have dealt with two aspects of frequency distributions of price relatives, the central tendency and the dispersion, and have in addition sought to measure shifts in the relative positions of price relatives. We come now to certain other group measures, the explanation of which calls for a brief general account of methods of describing the attributes of populations.

We were concerned, in the first chapter, with the measurement of certain characteristics of individual prices. Our interest now is in the characteristics of *populations* of prices. The difference in viewpoint is a fairly obvious one, yet one which must be stressed. The entity to be described is no longer an individual but a group, and the group has attributes of an order quite different from those of individuals. Measures of group characteristics are of two classes, those which define the type of population to which the group belongs, and those which describe attributes which are unrelated to type. In the second class are two measures which have been previously dealt with, measures of central tendency and dispersion. These describe important characteristics of frequency distributions, but characteristics in respect to which populations may differ materially while still being of the same common type. Thus a group of men might differ materially from a group of women in mean height and in the degree of variation from the mean, yet the populations of which the two groups were samples might both be of the normal (i. e. Gaussian) type in respect to height.

Differences in population type possess a degree of significance not yet fully determined, but certain matters connected with this subject are of immediate interest to the student of prices. In defining such types, when the populations are represented by frequency