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PRICE RELATIONS BETWEEN MAY AND NEW-CROP WHEAT FUTURES AT CHICAGO SINCE 1885

PREVIOUS investigations of price relations between July and September wheat futures at Chicago are here continued in a study of relations between the May and July futures, supplemented by extensions of the previous study and a broad consideration of price relations among the May, July, and September futures. The conclusions are of special practical interest to hedgers in the Chicago market and to speculators concerned with inter-option price spreads. The influences bearing on price spreads between old- and new-crop futures, however, are frequently the dominating factors in determining price movements of the May future. Conclusions regarding them are therefore of considerable interest to all concerned with wheat price movements from either a practical or an academic standpoint.

Interpretations of the domestic wheat supply position are the chief influences affecting price spreads between old-crop and new-crop futures, and often the chief influences in the price movements of May wheat itself. Corners and squeezes, and perhaps other peculiarly speculative developments, have affected or largely set aside these interpretations more often and to a greater degree than has previously been demonstrated. The traditional ideas of the character of corners and squeezes are inadequate and on occasion misleading.

The common impression that wheat prices tend to suffer a decline in March, followed by a recovery in April, is in large part justified, but contains an important error. The common downward trend in March seems to reflect a real general tendency; but the April rise has rarely occurred except after failure of the March decline and has usually followed such failure. Several other seasonal tendencies in price and in the May–July spread provide useful bases for forecasting changes in price and in the May–July spread.

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Wheat prices reflect the influence of a great variety of factors, with the result that their movements are of complex character, very poorly understood by most casual observers, and only imperfectly understood by the closest students of wheat prices. In these circumstances there is special advantage in making studies of wheat prices in the form of analyses of the *differences* in behavior of different wheat price series — that is, analyses of wheat price spreads. In the differences between two wheat price series, appropriately chosen, one may see clearly the influence of forces whose effects on price itself are obscurely merged with effects of other forces. To illustrate by a very obvious and familiar case: it is commonly difficult to detect the effect of even a large change in ocean freight rates on prices in exporting and importing markets; but the effect of such a change on the price spread between, say, No. 3 Manitoba at Vancouver and the same wheat at Liverpool is entirely clear.

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The differences between the price behavior of old-crop futures and the price behavior of new-crop futures are a most important subject for study. These differences in behavior reflect chiefly the influences of factors that bear particularly on the price of the old-crop future but are partially effective on the new-crop future also; under certain conditions these influences are restricted solely to effects on the old-crop future. A beginning on the analysis of these differences was made last year in our study of relations between the Chicago July and September wheat futures (WHEAT STUDIES, March 1933, IX, 187–238). It was shown there that the differences in behavior between these two futures are such as are to be expected between an old-crop and a new-crop delivery, despite the fact that both futures are commonly (and, for some purposes, correctly) regarded as new-crop futures.

The present study represents a continuation of this general line of investigation, with chief emphasis on price relations between Chicago May and July wheat. Broadly the same general outline is followed as in the earlier study, with (*a*) some changes in order of treatment, (*b*) the omission of detailed analysis of individual corners, squeezes, and similar developments in particular years, and (*c*) the addition of a section on relations between the May–July spread and the July–September spread. The subject of relations between spread changes and price changes is treated more concisely, depending on reference to the earlier study for fuller explanation of methods used; the findings of that study are accepted as sufficient evidence that the May–July spread is more particularly related to total domestic wheat supplies as measured in total year-end carryover than to supplies in special positions or at other times; and relations between the spread and total year-end carryover are examined much more thoroughly than in the previous study.

This further consideration of relations between old-crop and new-crop futures supports and extends the general conclusions previously reached regarding the importance of appraisals of domestic wheat supplies in determining spreads between such futures. In most respects the spread between May and July wheat is found to respond to the same influences that affect the spread between July and September wheat, and in very similar fashion. In consequence these two spreads are very closely related under most circum-

stances. Moreover, influences that tend to widen or narrow the price spread between May and July wheat tend under most circumstances to cause the prices of both futures to move in the same rather than in opposite directions, though with the price of May necessarily moving farther than that of July.

Additional light is thrown on the subject of such technical phenomena as corners and squeezes. Most important is evidence that corners or squeezes occurred in a large number of post-war and later pre-war years; and that squeezes are at least occasionally so handled that their financial success does not depend on effecting a price increase. Because the character of corners and squeezes is not generally well understood, such cases of abnormal market influence have sometimes, perhaps often, gone unrecognized or been regarded more lightly than they deserved by people not well versed in interpretation of the market.[1]

The indications are that successful corners or squeezes in wheat may sometimes have been "hedged." For example, purchases of May wheat made as part of a plan for squeezing the market may be accompanied or shortly followed by sales of later deliveries, perhaps July. These sales of the later futures would not only provide an assured means of disposing of such deliveries on May contracts as may have to be accepted, but leave the "squeezer" indifferent to the development of bearish price influences which may wholly offset the bullish effects of his operations in May wheat. With a corner or squeeze thus hedged, he need be in nowise concerned with the actual changes in price of May wheat, since his profits depend merely on his ability to force a widening of the spread between May and July wheat of which he can take advantage. Indeed he may welcome a tendency toward general wheat price decline as an aid in obscuring the effects of his operations.[2] The subject of corners and squeezes

[1] For example, a sharp squeeze seems to have been run in 1926 May wheat (apparently more severe in Minneapolis than in Chicago), which on the price record appears even in Chicago to have been one of the most severe during the last fifty years. Yet in the course of fairly extensive reading of the trade press and of comments elsewhere on the wheat market, we have seen no statement we can recall that indicated recognition of even the existence of a corner or squeeze in 1926 May wheat. From trade sources, however, we heard at the time severe criticism of the Grain Futures Administration for having failed to check the operations of those responsible for the squeeze. Presumably the conditions were such as to make it difficult to demonstrate existence of a corner or squeeze, especially in terms of traditional concepts of the character of such manipulations.

We have previously stated (WHEAT STUDIES, IX, 214) that "we find no good evidence of even a so-called 'natural' corner developing in 1928." The facts assembled in the course of the present investigation point clearly to the conclusion that a squeeze was in progress in April 1928, involving both Chicago May and July wheat, and that the squeeze was broken by the shipment of some 3 million bushels of No. 1 Northern Spring wheat to Chicago. No occasion has been found for altering our interpretation of other episodes discussed in the same section of our study of price relations between July and September wheat.

In using the terms "corner" and "squeeze" we make no attempt to go beyond the distinction involved in the popular concept of a squeeze as a manipulation of the same character as a corner but less severe; indeed we occasionally use the term "squeeze" to cover both corners and squeezes. We make no attempt to follow a distinction sometimes made between deliberate manipulations and the supposed "natural squeeze." These distinctions and others would be very useful if they could be applied with any degree of accuracy. But one of the inferences arising from our investigations of price behavior is that ideas generally current regarding the character and severity of individual market manipulations are partly erroneous. The information necessary for correct appraisal of most such operations is not publicly available. A striking illustration of the errors in common beliefs on the subject is furnished by the general failure to recognize existence of abnormal market conditions in the case of the severe squeeze in 1926 May wheat, in contrast with the almost universal current acceptance of the belief that there was a real corner in wheat in 1909 (the so-called Patten corner). Price relations in 1909 exhibited a more stable and orderly behavior, and showed less evidence of manipulation, than in any other year of even remotely comparable shortness of wheat supplies in half a century.

[2] The suggestion that corners or squeezes have been handled as here indicated arises wholly from inference, based partly on facts which it has been impossible to present in the present study without unduly extending its scope, but chiefly on facts discussed below. Undoubtedly the foregoing description of operations in a "hedged" squeeze or corner is in some respects incomplete and inaccurate. A certain and full statement could be made only on the basis of detailed knowledge of actual operations of traders in individual cases, which we do not possess. We believe, however, that the description is substantially correct in its main outlines. Discussion of evidence bearing on interpretation of corners and squeezes appears on pp. 186–88, 189–90, 191–92, 196–99, and 211–13.

and other peculiarly speculative influences in their relation to the May–July spread is found too large for more than incidental treatment in the present study. Here we go little farther in this direction than to present some of the evidence that prices and spreads were affected by such influences in a number of years.

To an important degree the behavior of price spreads may be regarded as an independent subject well worthy of study quite apart from its bearing on price behavior. Mill and elevator operators who practice strict hedging may be interested solely in price spreads—interested directly in spreads between cash and futures, but indirectly concerned quite as much with inter-option spreads because it is their behavior that determines in which future a hedge may best be placed and when hedges should be shifted from one future to another. Speculators dealing in spreads may also be interested solely in the difference between prices of two futures. A considerable part of the present study is concerned simply with the spreads between May and July wheat and between July and September wheat at Chicago.

Influences found to bear on price spreads may have their effect solely on one or the other of the two prices involved; or they may affect both prices, either in opposite directions or unequally in the same direction. To determine the price significance of spread factors, it is necessary further to investigate the relations of the spreads or spread factors to prices themselves. This is the main subject of Section III below and is a subject repeatedly referred to in Section IV.

In Section IV are considered not only seasonal characteristics of the May–July spread and related seasonal characteristics of the price of May wheat, but also all other observed seasonal tendencies in the price of Chicago May wheat. In the final section of the study the results of chief significance for forecasting spread changes are brought together and appraised from the standpoint of their use in forming judgments of probable spread changes.

The spreads and prices which are the chief subject of investigation in this study are shown in full detail in Charts 15*A* and 15*B* and Charts 16*A* and 16*B* (pp. 220–23). These charts will be found useful for frequent reference, although in the subsequent analysis reliance will more often be placed on various averages of the detailed data computed to serve the particular requirements of the case.

I. PRICE SPREADS AND YEAR-END CARRYOVER

Both the level and movement of the price spread between May and July wheat at Chicago are intimately related to the abundance or scarcity of domestic wheat supplies in the United States, conveniently measurable in terms of the total year-end carryover of wheat in all positions. The relation between size of the May–July spread and volume of the July 1 carryover is perhaps at no time during the season quite so close as the relation between size of the July–September spread in June and volume of the July 1 carryover, but this fact is attributable chiefly to effects on the spread from influences not directly related to quantity and location of supplies of wheat. These other influences change in character during the course of a season, but the basic facts of the domestic supply position remain broadly the same from month to month. Statistics of total United States stocks of wheat at the end of the crop year provide an excellent index of the domestic wheat supply situation as it affects the May–July spread in all months.

Broadly speaking, when wheat supplies are heavy, the price of July wheat tends to rule higher than May, the difference representing a market-determined price for the economic service of carrying surplus wheat over the period May–July. When domestic supplies of wheat are very short, July wheat goes to a large discount under May, the difference representing an expected degree of relief from scarcity prices in consequence of supplies of new wheat becoming available during July. The amount of the discount depends on the

degree of shortage and also on the level of wheat prices. Given the same shortage of domestic wheat supplies in two different years, July wheat will tend to stand at about the same *percentage* discount under May in each of the two years rather than at the same *absolute* discount.

Even in September or October, when trading in Chicago July wheat frequently starts, the prospective carryover at the end of the crop year can be appraised with some degree of confidence, although usually not within very narrow limits. As the season progresses, the prospective carryover can be appraised more precisely: better estimates of the size of the harvest may become available, and in any event the rates of disappearance of wheat into consumption and export become more clearly defined. The price spread between May and July wheat naturally tends to change during the course of the season as alterations occur in evidence bearing on prospective carryover.

The spread between prices of May and July wheat is determined directly by the balance of buying and selling of traders in the futures markets—probably chiefly by the trading of professional spreaders and, more particularly, by the trading of hedgers. Decisions to place hedges in one future rather than another, or to transfer them from one delivery month to another, have the same type of market influence as decisions of speculators to enter or close spreading trades. In some part—perhaps in large part—such trading is governed by interpretations of certain evident current conditions rather than by interpretation of estimates of probable carryover. These conditions, like the evidence on prospective carryovers, change as the season advances.

For these and other reasons, the nature of which will be made clearer in subsequent sections, substantial changes in the May–July price spread are to be expected during the course of any season — greater changes in some seasons than in others. The actual supply situation, represented by the balance between the total amount of wheat available for the season and the demands to be met from it, however imperfectly it may be known or understood at any time, remains nevertheless a basic, relatively constant factor determining the general level of the range within which the May–July spread may fluctuate during any particular season. The relations, month by month, between the size of the May–July spread and this basic supply situation, conveniently measurable in terms of the actual year-end carryover, are therefore matters of fundamental interest in a consideration of factors affecting this wheat price spread. These relations are conveniently studied from the data presented in Chart 1.

In this chart the relations between the May–July spread and the year-end carryover are shown for successive months from October to May in terms of percentage spreads averaged for the second, third, and fourth Fridays of each month. The position of each dot represents the spread (measured vertically) and carryover (measured horizontally) in one year. Points for pre-war years are shown as solid dots and points for post-war years as hollow dots, in order to indicate the striking change in character of relationships between the two periods. For economy of space in charting, the horizontal intervals representing each difference of 20 million bushels between 240 and 400 millions have been reduced to one-tenth of the intervals representing 20 million bushels in the remainder of each section of the chart.

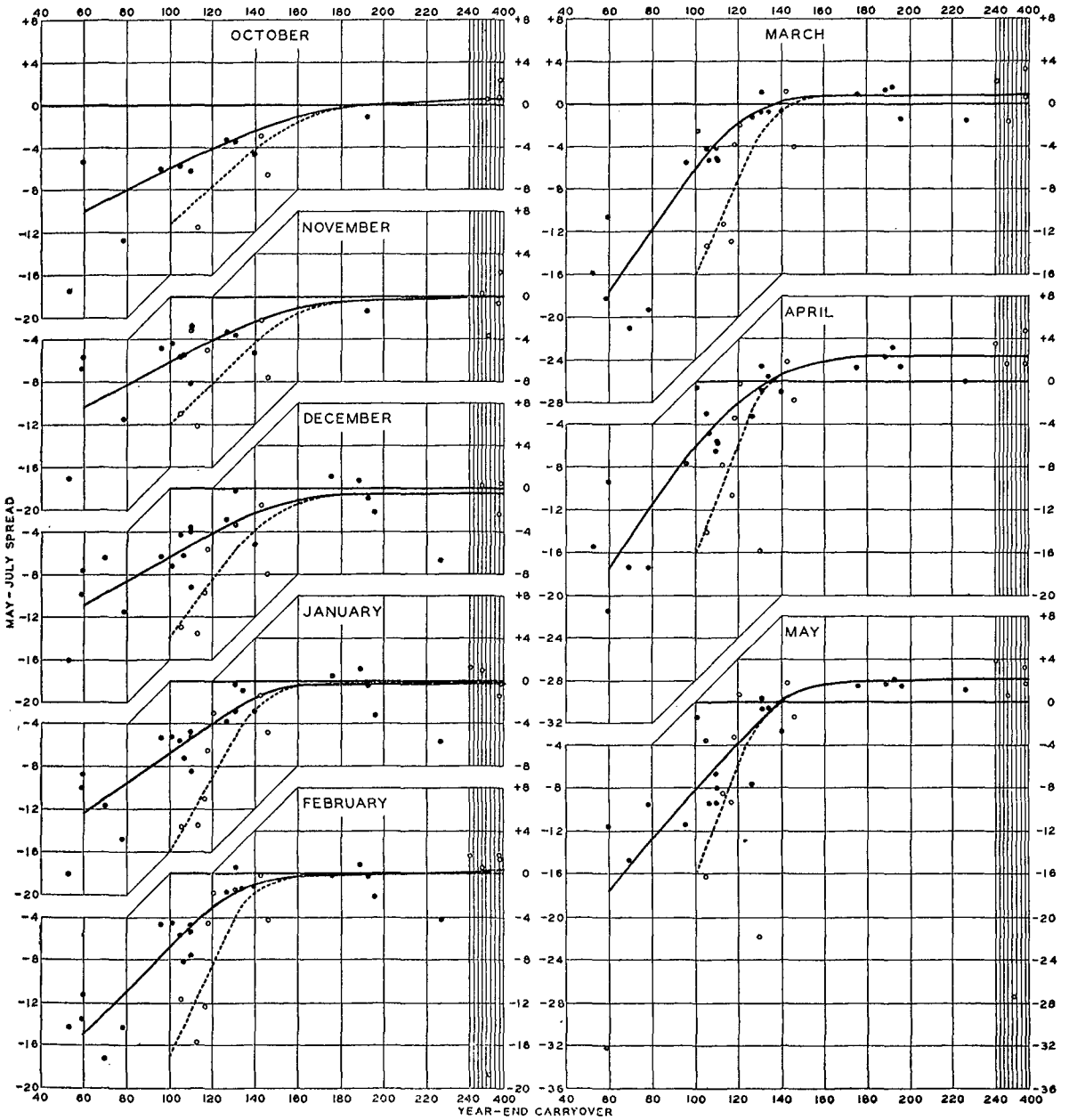
The smooth curves drawn through the distributions of dots show calculated average relationships. Where differences appeared, the relations in pre-war years are indicated by solid lines, the relations in post-war years by broken lines. A few points on the chart were considered to represent notably abnormal relations and were left out of account in fitting the smoothed curves. All data for 1930–31 were thus omitted except for October, because from November to May of that year the spread represented merely a difference between a May future substantially controlled by the Grain Stabilization Corporation and an uncontrolled July future: points for 1930–31 are indeed out of the range of the chart sections except in October, November, February, and May. The only other points similarly omitted were those for 1920–21 (there are

data for only April and May in this year) and for December and January of 1915–16. In all

outside the field of ordinary market factors: the conditions influencing the May–July

CHART 1.—RELATIONS BETWEEN DOMESTIC YEAR-END CARRYOVER AND PRICE SPREAD BETWEEN CHICAGO MAY AND JULY WHEAT, BY MONTHS, OCTOBER–MAY, 1895–96 TO 1916–17 AND 1920–21 TO 1932–33*

(Million bushels; percentages of price of May wheat)



* Data from Tables I and IX. The position of each dot indicates the size of the July 1 carryover of all wheat in the United States and the amount and direction of the May–July spread in one year. Hollow dots represent data for post-war years. The smooth curves drawn through the distributions of dots represent calculated average relations of carry-over to price spread, relations in post-war years differing from those in pre-war years being indicated by broken lines. The changes in relations between the post-war and pre-war periods are attributed to economic changes facilitating development of corners or squeezes in Chicago May wheat.

of these cases the May–July spread was conspicuously affected by influences distinctly

spread were abnormal in a sense distinctly different from that in cases of corners or

squeezes as they developed in other years. To the extent that extreme spreads arising out of corners, squeezes, and other technical market situations may be regarded as abnormal, these curves of relationship do not represent "normal" relations between spread and carryover, except as the "normal" may happen to coincide with the simple average relation which they specifically attempt to show.[1]

Four features of the relationships shown in Chart 1 deserve particular notice.

1. Among years with carryover under about 160 million bushels, there are notable differences between the relations observed for the pre-war period and those observed for the post-war period, indicated respectively by the solid lines fitted to the distributions of solid dots and by the broken lines fitted to the distributions of hollow dots. The relative disparity between pre-war and post-war average relationships increases progressively from October to January and then decreases to May, when it is least.

2. The relation between the May–July spread and July 1 carryover is in general closest and most uniform in February or March,[2] this highest degree of relationship being reached as the culmination of a gradual improvement from the rather poor relationship observed in the autumn. In April and May the relationship becomes more irregular (the scatter of the points around the related lines of average relation greater) than in any earlier months.

3. In the autumn months the average May–July spread for years of very small carryover does not differ greatly from the average spread for years of moderate carryover: the lines of average relationship slope gently down to the left. In later months these differences increase progressively: the slopes of the lines of average relationship become increasingly steep.

4. In addition to the increasing steepness of slope of the lines of average relationship during the winter months, there are other changes, more clearly evident in Chart 3 (p. 191) than in Chart 1.

Certainty and Accuracy of Supply Indications

From the standpoint of interpretation, it is advantageous to consider the above-mentioned features of Chart 1 in somewhat different order. The tendency for the May–July spread to come progressively closer to an average relationship with the carryover in successive months from November to February or March, as noted under (2) above, and the tendency over the same interval for the lines of average relationship to become steeper, noted under (3), undoubtedly reflect the same general influence. In October and November the probable year-end carryover cannot be judged as closely as it can in later months. Moreover in October and November the current market evidences of ease or tightness in the domestic supply situation for the season—which are probably more directly influential in determining the spread than are estimates of carryover out—are less clear and reliable than they become later. Such uncertainty has two natural consequences: (*a*) Conditions pointing toward extreme abundance or extreme shortage are partially discounted early in the season, and the spread is established nearer a general average level than would be warranted if the extreme char-

[1] As an aid in judging the existence and severity of corners, squeezes, and extreme speculative price movements, a knowledge of the relationships to be expected between spread and carryover in the absence of such influences would be very helpful; but we consider the information at present available inadequate for an attempt to indicate relations "normal" in this sense.

In the main the fitted curves in each section of the chart have been run through points corresponding to averages for groups of years, but some slight departures of the curves from group averages have been permitted in recognition of the requisite of consistency among the curves. The curves were fitted as cross-sections of the regression surfaces shown in Chart 3 (p. 191), thus making the position of segments of each curve dependent upon more data than if each had been fitted separately.

[2] There are notable differences among groups of years as to the time when the highest degree of relationship is reached. For years with carryover in excess of 150 million bushels, the relation between spread and carryover is closest in May. For years with carryover of 90–150 million bushels, the closest relation is observed in March for pre-war years, but in January for post-war years. For years with carryover of less than 90 million bushels (all of which are pre-war years), the closest relation is observed in February.

acter of the situation were more certain. This discounting of indications results in relative flatness of the curves of average relationship when the prospects are most uncertain, and progressive steepening of the curves as the indications are accepted with greater confidence and discounted less. (*b*) Evidences early in the season regarding the domestic supply situation not only tend to be somewhat obscure, but also may be distinctly misleading. As the season progresses, errors in appraisal of the situation are likely to be less. The diminution of errors in appraisal of the domestic supply situation naturally results in a tendency toward relatively smaller deviations of spreads from their average relation to carryover.[1]

These considerations naturally lead to the expectation of continued increase in the closeness of relation between spread and carryover to an optimum in April or May. The changing degree of scatter of the dots about corresponding curves in Chart 1 shows that such continued improvement does occur among years of distinctly large carryover; but among years in which the carryover was under 160 million bushels the discrepancies increase again after March instead of decreasing.

Evidence of Speculative Influences

The increase in average discrepancy between carryover and spread after about March, not accompanied by a return to the relative flatness of the curves for October and November, must be attributed to entry of new disturbing factors into the situation. For reasons that will appear more adequately at later points in this study, we attribute this increase in average discrepancy largely to a tendency toward development in April and May of corners, squeezes, and other distinctly speculative market situations.

The striking change in carryover-spread relation between pre-war and post-war years, noted under (1) above, reflects chiefly an increase in level of supplies necessary to prevent development of corners or squeezes in the post-war period. Since the war, domestic supplies adequate for carryovers of 100–120 million bushels have been accompanied by tightness in May wheat (as measured by the May–July spread) comparable with the tightness which before the war was an accompaniment only of supplies so short as to allow no more than 60–80 million bushels for carryover, roughly 35 per cent less wheat. It is noteworthy in this connection that there have been two years since the war (1926–27 and 1927–28) in which the carryover was only 120 million bushels or less, and yet the May–July spread was generally in line with the pre-war average relationship to carryover, as indicated by hollow dots close to the solid lines in Chart 1. It is chiefly the extreme discounts of July wheat under May in 1921–22, 1924–25, and 1925–26 that pull down the lines of average relationship for the post-war period.

Except as insurance against tightness in May wheat, there seems to have been no need for larger year-end carryovers in the post-war period. The substantial shift of the center of flour-milling activity from the spring-wheat Northwest toward the winter-wheat Southwest and developments contributing toward quicker marketing of the new wheat crop have favored decrease in the amount of wheat needed for July 1 carryover in post-war as compared with pre-war years. A small increase in monthly wheat consumption has tended toward slight increase in requirements for July 1 carryover, but probably the major influence in that direction has been an increase in importance attached to wheat of special qualities, particularly high-protein wheat, which may on occasion lead millers to carry such wheat over in considerable quantity for special purposes.

In previous investigation of the July–September price spread at Chicago we found evidence that the amount of carryover necessary to avoid tightness in July wheat was lower after about 1903 or 1904 than in earlier years, in consequence of admission of hard winter wheat to the deliverable grades at Chicago and of associated changes in the wheat situ-

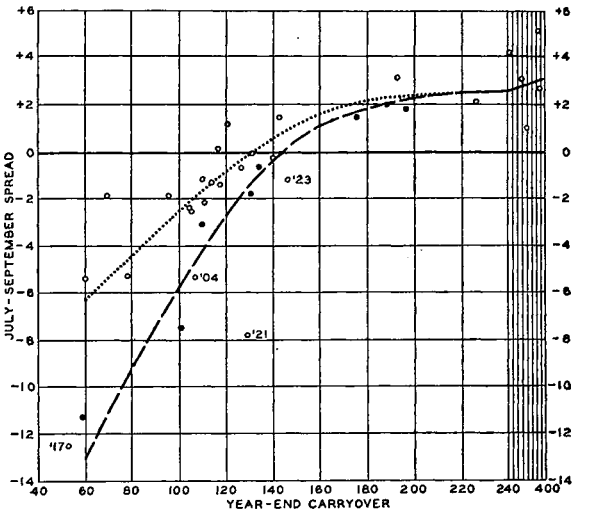
[1] The average size of deviation should be considered relative to the total amount of variation among spreads for the month in all pre-war or in all post-war years.

ation.[1] But we found evidence of only negligible increase in carryover requirements over the war period. The statistical data bearing on these points appear in Chart 2, which is directly comparable with the several sections of Chart 1 except that here the hollow dots represent data for all years from 1904 rather than for post-war years only. The curve of dashes is fitted to the data for 1896–1903, inclusive, represented by the solid dots; the dotted curve is fitted to the data for years since 1903, but neglecting points for 1904, 1917, and 1921. In this chart the line of relationship for later years lies above the line for earlier years, not below, as it does in the several sections of Chart 1. There is, moreover, no evidence of measurable difference between post-war years and other years after 1903. The four extreme negative deviations of hollow circles from the dotted curve include two cases of pre-war years (1904 and 1917) and two of post-war years (1921 and 1923).[2]

Even though the altered relation since the war between carryover and May–July spread be attributable to greater ease in the execution of squeezes in Chicago May wheat, it does not necessarily follow either that the Chicago Board of Trade has become lax in the erection and enforcement of safeguards against squeezes and corners or that the character of speculative trading has altered materially. It may be that the increased susceptibility of the market to squeezes in May wheat rests chiefly or entirely on developments that have reduced the supply of wheat normally in Chicago and available for delivery on futures contracts. Changes in routing of wheat movement have tended to make it uneconomic, in years of relative shortage of domestic supplies since the war, to carry large stocks of contract wheat at Chicago for protection against squeezes. Probably a more potent factor has been the post-war emphasis on protein content in wheat, which in most years has rendered a considerable proportion of the wheat supply at any time too valuable for normal use in delivery on futures contracts.

CHART 2.—RELATION BETWEEN DOMESTIC YEAR-END CARRYOVER AND JULY–SEPTEMBER PRICE SPREAD IN JUNE, 1896–1917 AND 1921–33*

(Million bushels; percentages of price of July wheat)



* Data from Table IX. The position of each dot indicates the size of the July 1 carryover and the amount and direction of the spread between prices of Chicago July and September wheat in June for one year. Hollow dots represent data for years from 1904. The smooth curves drawn through the distribution of dots represent calculated average relations of carryover to spread, the dotted curve indicating the relation in years from 1904 where it differed from the earlier relation. The change in relation about 1904 is attributed chiefly to addition of hard winter wheat to the grades deliverable on futures contracts at Chicago.

[1] WHEAT STUDIES, March 1933, IX, 205–07 and 225–26. The change in relationship referred to was taken account of in that study by recognizing a shift in level of "normal" July 1 carryover such that, with carryover measured in terms of deviations from normal, a single line of relationship between carryover and spread served for all years. In dealing with the May–July spread we found it preferable to measure carryover in absolute terms and to represent the change in relation by separate lines of average relationship. For purposes of comparison we here show the relation between the July–September spread and carryover (in Chart 2) also in terms of absolute carryover, with two different lines of relationship.

The adequacy, from a technical statistical standpoint, of use of a horizontal trend for carryover and differing lines of relationship, in place of a trend of changing level and a single line of relationship, has been carefully verified.

[2] Considering only the evidence of the chart, 1904 would be counted an example of close conformity to the relation of earlier years, but on other grounds we regard it as an example of extreme departure from the relation of later years, which we think would probably have been observed in 1904 also except for existence of a corner in red winter wheat at St. Louis. See further comments on pp. 198–99 below.

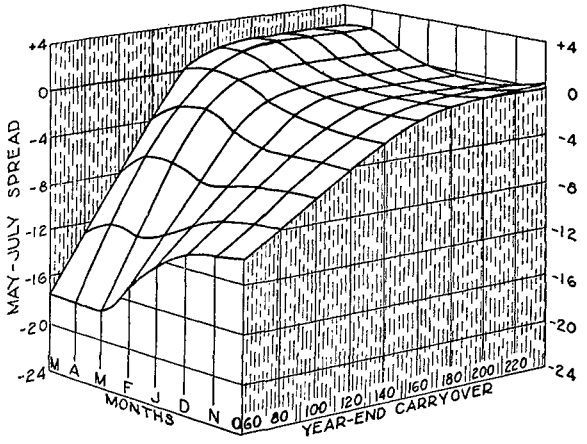
Relations in Successive Months

The general character of the changes from month to month in average relation between spread and carryover can be seen more accurately when the curves of Chart 1 are brought closer together. The clearest effect is obtained by showing them, as in Chart 3,

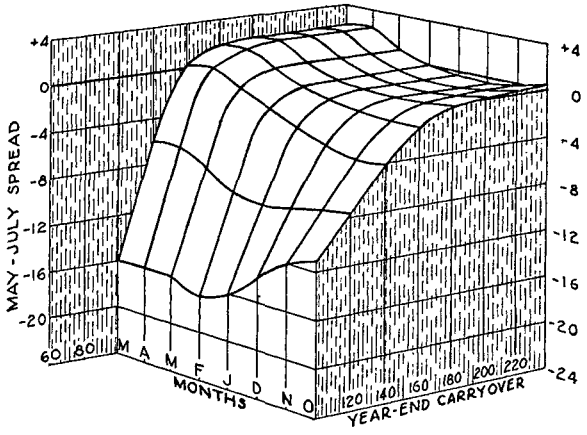
Chart 3.—Average Relations between Year-End Carryover and May–July Price Spread, October–May*

(Million bushels; percentages of price of May wheat)

A. Pre-war Relations



B. Post-war Relations



* The curves of average relationship appearing in separate sections of Chart 1 are here shown in three-dimensional diagrams to indicate more clearly the progressive changes in relationship from October to May.

in close succession in three-dimensional diagrams, one for the pre-war relations and another for the post-war relations. The two sets of curves differ greatly in steepness over the ranges from 100 to 140 million bushels of carryover, but otherwise the only noteworthy difference is that for post-war years approximate maximum steepness was reached about February, whereas for pre-war years it was not reached until March. These diagrams show more clearly than Chart 1 the general tendency for the spread to decline slightly to December, whatever the carryover, and to rise considerably from February to April in years of fairly large carryover.

The changes in relation between carryover and spread are evidences of existence of certain average seasonal tendencies, which are considered in detail in Section IV below.

Relations before 1896

Despite absence of statistics of carryover for years prior to 1896 adequate for inclusion with later years in the foregoing consideration of relations, there is evidence that a notable change in relations between carryover and May–July spread may have occurred shortly before 1896. This conclusion is suggested by consideration of peculiarities in behavior of the May–July spread in the spring of 1887 and of less conspicuous peculiarities in the spring of 1893.

As may conveniently be noted from the curve for 1887 in Chart 15A (p. 220), July wheat was quoted through most of February 1887 at about 3 cents over May. Then began a steep decline in the spread associated with a partially successful attempt to run a corner in May wheat, subsequently shifted to a disastrous attempt to corner the June delivery. Visible supplies of wheat were so large when the manipulation started that the venture was clearly a rash gamble from the outset, yet it is difficult to believe that the most venturesome traders would have attempted a corner if supplies of wheat in 1886–87 had been as large as would have been indicated in years since 1896 by a price of July wheat 3 cents over May in February.

In 1887 the ownership and operation of storage elevators in Chicago was still an enterprise largely independent of the business of accumulating and merchandising grain. The storing of grain owned by others was still a very important part of the business of pub-

lic elevators. Storage charges were one-half cent per bushel after the first ten days' storage (for which the charge was ¾ cent), and apparently a large or major portion of the grain in store in Chicago was held in public storage subject to payment of these charges. Under these circumstances, July wheat probably tended to fall below a 3-cent carrying charge over May only in the event of prospective real shortage of supplies. As the storage and merchandising of grain came to be more largely combined, the modern situation developed under which substantial quantities of grain will be stored for a small or moderate carrying charge in the futures, and a full carrying charge develops only when supplies are very heavy.[1]

The way in which a situation of extreme tightness in the May future in 1893 turned into one suggestive of superabundance of wheat supplies (see Chart 15*A*, p. 220) suggests that even in 1893 there may have been still a rather narrow margin between a supply situation reflecting real scarcity and one that would support a full carrying charge in the July future.

II. RELATIONS AMONG MAY, JULY, AND SEPTEMBER FUTURES

Except under artificial price control there is always a high degree of correspondence among price movements of the May, July, and September wheat futures at Chicago. When prices of the more distant futures are above those of the nearer futures, or not far below, the correspondence of movement tends to be very close. When the more distant futures stand at large discounts under the nearer futures, changes in inter-option spreads are sometimes so large that the price movements for different futures are not closely similar; on occasion, two of the three futures may move in opposite directions.

These rather obvious interrelations among prices of the three futures require only brief consideration here.[2] The chief subject of the present section is a less obvious but in many respects more important feature of the interrelationships among the three futures. This feature of the interrelationships may be indicated by the general and somewhat rough rule: if July wheat is above May in price, September tends to be about equally far above July; but if July is under May, September tends to be only about half as far under July. The present section is devoted chiefly to determining more accurately the interrelations reflected in this rule and to considering the causes and significance of deviation from average relations among the three futures concerned. The degree of simple correspondence of price movement between the May and July futures is nevertheless worthy of brief notice first.

Correspondence of Price Movements

In considering the degree of correspondence among movements of wheat futures prices at Chicago under different circumstances it is convenient to employ a quantitative measure of correspondence. Visual examination of charts is helpful in gaining impressions, but these are reliable only if

[1] For present purposes we have made no effort to trace this interesting development in detail. Its main features are indicated by the following statements of the Federal Trade Commission: "Soon after 1885 there were certain changes of ownership among the warehousemen and the new proprietors began to combine public warehousing and grain buying . . . . From 1895 on, the question of permitting public warehousemen to be at the same time dealers in grain stored in these public warehouses became more acute, and the old complaints were continually revived." (*Report on the Grain Trade*, II, 96, 98, September 1920.)

[2] These interrelationships are reflected in certain relations between changes in prices and changes in spreads, and in this aspect are the sole subject of consideration in the next section of the present study. There is, in fact, a direct mathematical connection between measures of relations between two price series and measures of relations between one of the two price series and the spread between the two. The correlation coefficients in Table III were computed very simply from sums required for analysis of the relations discussed in the next section. Had they been obtainable only by separate computation from the original data, the labor required would have been considered far greater than the usefulness of the results warranted. The formula used in the computation is:

$$r_{12} = \frac{\Sigma x_1^2 + \Sigma x_1 x_3}{\sqrt{\Sigma x_1^2 (\Sigma x_1^2 + 2\Sigma x_1 x_3 + \Sigma x_3^2)}},$$

where x_1 = change in price of May wheat,
x_2 = change in price of July wheat,
x_3 = change in May–July spread.

based on painstaking study; and it is never possible to make close comparisons from such examination. Correspondence of the wheat price movements under consideration may conveniently be measured in terms of Pearsonian coefficients of correlation between week-to-week changes in prices of two futures. These coefficients express perfect correspondence (represented either by identical price changes in the two futures or by changes in one future always greater than changes in the other by some constant percentage) by a coefficient of +1.0, and complete lack of correspondence by a coefficient of zero.

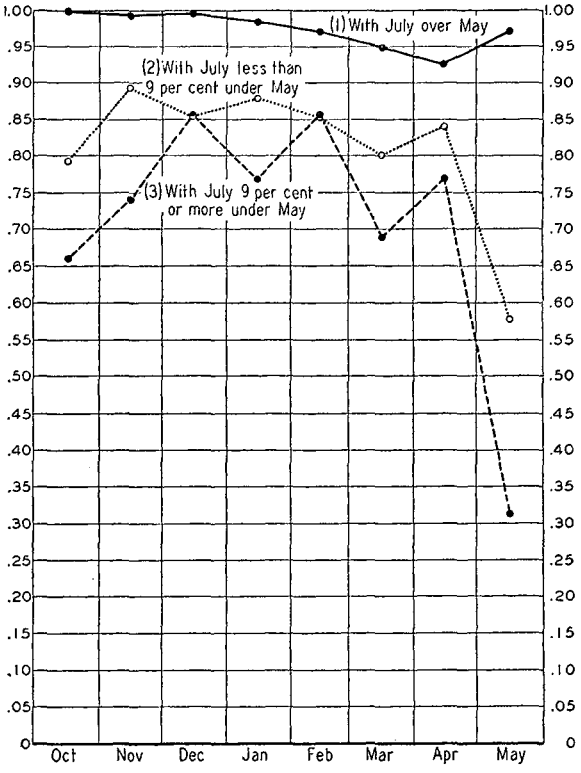
The Pearsonian coefficients of correlation between weekly changes in price of Chicago May wheat and weekly changes in price of Chicago July wheat are given in Table III by months, separately for each of three classes of conditions: (1) when July wheat is above May in price; (2) when July is 0–9 per cent below May; and (3) when July wheat is 9 per cent or more below May. In Chart 4 are shown graphically the squares of these coefficients of correlation. The relative significance of two differing coefficients of correlation is, for most purposes, more nearly proportional to the size of the squares of the coefficients than to the size of the coefficients themselves.

The data in Chart 4 indicate that when the price of July wheat has been above that of May during the months October–December the prices of the two futures moved together almost perfectly, the squared coefficient of correlation being nearly $r^2 = 1.0$. After December the correspondence in movement of the two futures becomes progressively somewhat poorer, but even at the worst in April is measured by the relatively high squared coefficient $r^2 = .925$.

When the price of July wheat has been below that of May the correspondence between weekly price movements of the two futures has been much poorer, yet still fairly close on the whole. Taking in each month all cases in which July was 0–9 per cent under May, the degree of relationship in the four months November to February ranged between $r^2 = .85$ and $r^2 = .90$, and in October, March, and April fell only slightly lower. A marked decrease in the closeness of relationship occurred, however, in May, the coefficient falling below $r^2 = .60$.

CHART 4.—AVERAGE DEGREE OF RELATIONSHIP BETWEEN CHANGES IN PRICE OF MAY AND JULY WHEAT, BY SPREAD CLASSES AND BY MONTHS*

(Coefficients of correlation squared)



* Data from Table III. When domestic wheat supplies are believed to be large, as indicated by a price of July wheat above May, the weekly price changes in these two futures are very similar—during October–December virtually identical. As July wheat goes to increasing discounts under May, the correspondence between weekly price changes of the two futures decreases, and becomes especially low during May when the two futures may move almost independently.

With the price of July wheat 9 per cent or more under that of May the correspondence between weekly price movements of the two futures has been still poorer. In May, under these conditions, the correspondence fell to the low level measured by the coefficient $r^2 = .306$.

RELATIONS BETWEEN SPREADS

Disparity among movements of prices is the reflection of change in inter-option spreads, and even in such disparity of move-

ment among the May, July, and September futures there tends to be preserved a certain uniformity of relative position, summarized roughly in the second paragraph of this section. Stated in slightly different form but just as roughly the normal relation is somewhat as follows: with the price of September wheat below May, July tends to stand about two-thirds of the way down from May toward September; but with September over May, July tends to stand about halfway between. On closer examination of the average relations among these three futures, as regards relative position, it is found that they tend to change progressively from month to month; that they have been somewhat different from 1910 to date than in earlier years; and, perhaps most significant, that the frequency and extent of departures from average relationship have been greater in April and May of most seasons than in earlier months.

The relations under discussion are most conveniently treated as relations between the May–July price spread and the July–September price spread. Chart 5 shows these relations separately for each month from January to May in terms of monthly averages of the two spreads, represented by the location of solid or hollow dots, and lines of average relationship. Both spreads are expressed as percentages of the price of May wheat. Data for the years 1885–1909 are represented by solid dots; data for later years by hollow dots. Where the average relation for the later years appears to differ from that for years prior to 1910, it is represented by a broken line.[1]

It appears from Chart 5 that even as regards average relations there are some notable departures from the rough rule previously stated, that when the price of July wheat is above that of May the price of September tends to be about equally far above July. This rule represents the facts well for March, April, and May, except that, when the

[1] Study of the relations prior to January is unprofitable because data on the July–September spread prior to January are available for very few years; trading in September wheat has only rarely started before the first of January. The monthly averages are based on closing prices for the second, third, and fourth Fridays of the month (rarely for Thursdays or Saturdays instead) or on prices for as many of these days as provide quotations on all three futures. It is not so important that spreads be expressed in percentages for the study of these relations as for the study of relations between spread and carryover, but considerable advantage is gained by the use of percentages.

The lines of average relation for these charts were determined by a method which meets fairly well three different and somewhat inconsistent requirements. For some purposes it is desirable to have lines of average relation that indicate what July–September spreads have on the average accompanied certain May–July spreads. Alternatively, it may be desired that they indicate what May–July spreads have on the average accompanied certain July–September spreads. The same line could satisfy these two requirements precisely only if the dots representing actual relations in individual years all fell exactly on some particular smooth curve. Thirdly, lines may be desired which represent "normal" relations—that is, relations to be expected in the absence of more or less unusual disturbing influences such as corners and squeezes. Such lines may differ considerably from lines of average relation in consequence of a tendency of the disturbing influences to distort the relationship more often in one direction than in the other.

To determine the "normal" relations, information of various sorts was assembled to indicate in which years and months "abnormal" influences (such as corners and squeezes) were in operation; data for these cases were discarded; and lines were fitted to the dots representing the remaining data, judged to reflect approximately "normal" relations. The results were found in this case to correspond closely with lines fitted as a compromise between the two logical lines of mere average relation. Since many of the judgments involved in discarding certain data in the process of determining normal relations were based on inadequate information, it appeared that the compromise lines of average relation provided also as good a basis as was immediately available for judging "normal" relations.

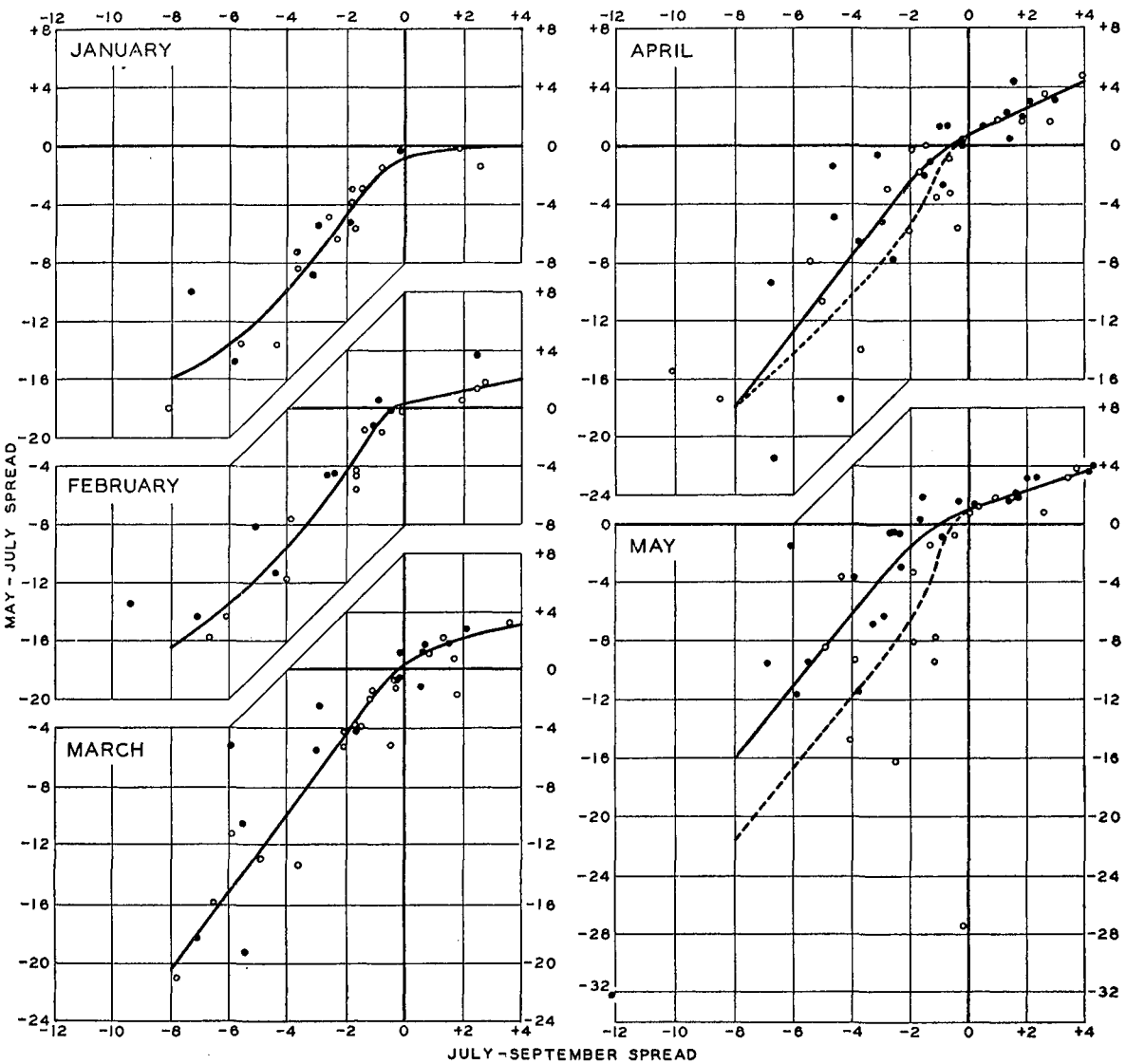
As a means of determining the compromise lines of average relation, paired averages of the two spreads were calculated for groups of years selected not on the basis of size of either of the two spreads, but on the basis of a variable highly correlated with size of both spreads, namely, size of the year-end carryover. The lines of average relation were then run close to, or usually through, the points corresponding to these paired averages, but with consideration of the grouping of individual dots on the charts and also of indicated relations in adjacent months (the problem was viewed as one of fitting the regression surface shown in Chart 6, p. 198, rather than one of fitting separate regression lines). In effect, the method was one designed not to minimize the sum of squares of either vertical or of horizontal deviations of observations from the fitted lines, but to minimize the sum of squares of deviations measured about perpendicularly to the fitted surface.

As implied by the foregoing remarks, these compromise lines of average relation provide also what appears to be about as good a representation as can be given at present of the "normal" relations between the two spreads.

price of July has been less than one cent over May wheat in the month of May, September wheat has rarely been above July by an equal amount, and not infrequently has been below July. In January and February the premiums of September wheat over July have commonly been at least double the premiums of July over May.

CHART 5.—RELATIONS BETWEEN MAY–JULY AND JULY–SEPTEMBER PRICE SPREADS, BY MONTHS, JANUARY–MAY, 1885–1917 AND 1921–33*

(Percentages of price of May wheat)



* Data from Table I, except that in cases where the average July–September spread has been based on quotations for less than three Fridays (because trading started late in the month) the average May–July spread here used is for the same days for which the July–September spread was available.

The position of each dot indicates both the average May–July and the average July–September price spread in the appropriate month in one year. Hollow dots indicate data for years from 1910. The smooth curves drawn through the distributions of dots represent calculated average relations between the two spreads, relations in years from 1910 being shown as broken lines where they differ from earlier relations. The change in character of the relationships in April and May, occurring about 1910, is regarded as chiefly a delayed consequence of the admission of hard winter wheat to the list of deliverable grades at Chicago.

The rough rule that when July is under May wheat September tends to be about half

as far under July is subject to rather less exception in terms of general averages; but in March the proportion between large negative spreads is nearer five to two for the May–July and July–September spreads, respectively, than to the two-to-one ratio of the rule; in April and May the tendency in earlier years was for discounts of two cents or less on July wheat relative to May to be accompanied by about equal discounts of September under July, rather than by discounts only half as great; and for the later years the tendency in April and May has been for discounts of over two cents on July relative to May to be accompanied by distinctly less than half as large discounts of September under May.

Departures from Average Relations

The most important conclusions to be drawn from the facts presented graphically in Chart 5 are indicated not by the character of the lines of average relationship between the two spreads, but by the size and frequency of departures from these average relations.

The fact that both the May–July and the July–September price spreads have been shown to be rather closely related to the domestic wheat supply situation, as measured by year-end carryover, gives reason for expecting the two spreads to be fairly closely related to each other. The five scatter diagrams in Chart 5, however, all show closer relationships between the two spreads than can be explained on the ground of mutual relation to year-end carryover of wheat.[1]

The close grouping of the dots about the lines of average relation for January and February in Chart 5 shows a closeness of relationship between the two price spreads that can be explained only on the assumption of practically identical factors bearing similarly on both spreads. In the previous section it was shown that the actual domestic wheat supply situation as reflected in year-end carryover is a primary determinant of both spreads, but that the actual supply situation becomes effective through market operations based on interpretations, frequently more or less erroneous, of the supply situation; and that in April and May the development of special market situations, frequently related to corners or squeezes, becomes an important factor bearing on the May–July spread. The closeness of the relationship between the May–July and the July–September price spreads in January and February indicates that in these months most of the factors bearing on these two spreads operate similarly on both. The two spreads must be so closely related not only because both depend on the *facts* of the domestic supply situation, but because they depend more particularly on substantially the same interpretations or misinterpretations of the domestic supply situation. Moreover, it appears that it is rarely possible in January or February to perceive the approach of corners and squeezes or the existence of other factors which bear on one of the spreads but not on the other, or possibly may bear oppositely on the two spreads.

In March the relation between the two spreads is on the whole about as close as in earlier months, but there appear a few notably wide deviations of individual dots from the line of average relation. The most conspicuous deviations correspond to spread relations in 1897 and 1904, for which the corresponding dots are above the line of average relation, and 1905, 1914, 1926, and 1930, for which they are below. These cases represent

[1] The basis for this and several subsequent statements can be clearly apparent only to close students of the mathematical theory of correlation. The basis may be roughly indicated, however, by two statements of fact. It may be shown that two statistical series (such as data for the May–July and July–September price spreads) may each show a correlation of $r = +.70$ with a third series (such as the year-end carryover of wheat), and yet the two series show no relation whatever between themselves. Such a situation would indicate existence of another factor that influenced both spreads, but in opposite directions. Such a condition would in fact exist if the price difference between May and September wheat were determined closely by the domestic supply of wheat, and the price of July wheat varied widely between limits set by the prices of the other two futures, the relative position of the price of July wheat depending on whether the winter-wheat harvest promised to be early or late. The relationships observed prove that this is not the actual condition.

Again, it may be shown mathematically that if two series are so closely related to a third that each shows a correlation of $r = +.90$ with the third series (the relationships being linear) the correlation between the two series themselves will be only $r = +.81$, unless there be some additional cause of relationship.

the recognition in March of situations that appeared to have different significance for the two different spreads.

For April and May there is observed a very general tendency for relations between the two spreads in individual years to differ appreciably from the average relationship: the dots are scattered fairly evenly through a considerable range on each side of the lines of average relation. When the spreads are positive, however, the relation between the two remains fairly close in April and becomes particularly close in May. The increased scatter in April and May of the dots representing negative spreads is evidence of market opinion that some special conditions existed bearing differently on one of the two spreads than on the other. Expectation of a corner or squeeze in one future but not in another would exert such an influence. The significance of unusual relations, represented by substantial deviations of dots in Chart 5 from their corresponding lines of average relationship, may well be illustrated by consideration of a few individual cases.

Illustrations of Unusual Relations

Changes in relations between the May–July and the July–September spread preceding the culmination of the Leiter corner in 1898 are indicative of noteworthy changes in market interpretation of the prospects in that year. Trading in September wheat opened in January, and for the month the July–September spread averaged some three cents wider than might have been expected from the size of the May–July spread, a relation represented by the conspicuously divergent solid dot at the left of the first section of Chart 5. This relation, suggesting expectation of a corner in July wheat, was maintained through most of February.[1] During March, however, a reversal of the relative positions of the two spreads indicated a shift to the view that the May future rather than the July would be cornered. From the end of March to near the end of April the May–July spread was some six cents wider than might have been expected from the size of the July–September spread. During May there occurred some wide fluctuations in relations between the two spreads, but for the month as a whole their relation was not far from normal, indicating expectation of about as severe tightness in the July future as had actually developed in the May.

In 1904 the July–September spread was even in January slightly wider than might have been expected from the May–July spread. The discrepancy became more marked in February and conspicuous in March and April. The unusual relations in this year seem to be explained by the corner in No. 2 Red Winter at St. Louis, which drained the West of its supplies of that wheat. The Chicago May future was little affected except near the end of May because of fair supplies of No. 1 Northern in store there; but the general exhaustion of supplies of No. 2 Red Winter wheat considerably limited the volume of new-crop supplies which could be expected to arrive during July, and so widened the July–September spread. There may also have been an actual squeeze in July wheat, although the evidence from price behavior gives little reason for supposing so.[2]

In late February 1930 another unusual relationship appeared which present information permits attributing definitely to artificial market factors. The heavy buying of the Chicago May future by the Grain Stabilization Corporation at that time raised fears of a government-sponsored corner in May wheat and produced an extremely abnormal May–July spread during March. Fears of such a corner were largely dispelled about the end of March, and more nearly normal relations between the two spreads were restored. Nevertheless the May – July spread remained throughout April and May distinctly smaller than might have been expected from the width of the July–September spread.

Confident generalization on the cause of

[1] For several years prior to addition of hard winter wheat to the deliverable grades at Chicago in 1903, July was apparently regarded as an easier future to corner than May. Readers wishing to follow the graphic representation of the divergent relation described in the text may readily identify the corresponding dots in Chart 5 by reference to values of the spreads as recorded in Table I.

[2] This corner in No. 2 Red Winter wheat is described more fully in Wheat Studies, March 1933, IX, 210–11.

unusual relations between the May–July and the July–September spreads cannot be justified until critical detailed analysis has been made of all the more conspicuous cases of such disparity. It is pertinent to observe, however, that our first attempts at accounting for unusual spreads between old- and new-crop futures were directed toward finding explanations in prospects for late or early harvest and movement of the new crop; or explanations in the balance between immediate supply and demand for cash wheat, as affected by changes in market receipts and in rate of exportation. These attempts proved almost wholly fruitless. On the other hand, such information as we have since obtained on technical situations of the general nature of corners and squeezes—and trustworthy information of the sort is very difficult to come at—has uniformly proved highly pertinent in accounting for peculiar spread relationships that defied explanation otherwise. There arises, in consequence, a substantial presumption that notably abnormal spread relationships have rested usually if not always on interference, or at least anticipated interference, with the normal operation of the futures markets.

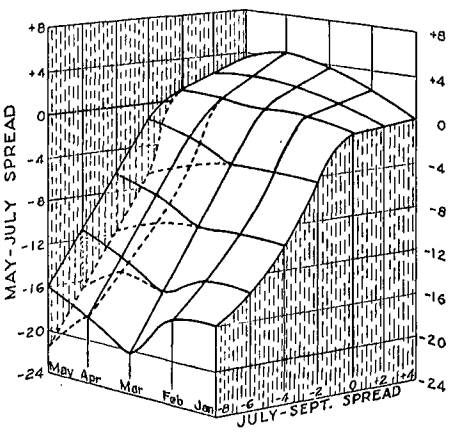
Changes in Average Relations

The lines of average relation between the May–July and July–September wheat price spreads in different months, considered separately near the beginning of this section, deserve further attention from the standpoint of changes in their position and slope from month to month. These changes may be seen most effectively when the curves are brought close together in a three-dimensional diagram, as in Chart 6. The curves shown as broken lines in this diagram, as in Chart 5, represent relations in later years (from 1910) that differed from relations in earlier years.

The increase after February in steepness of the curves of average relationship for large negative spreads is largely an expression of changes in relation between the two spreads from February to March in two years: 1898 and 1905. In both years the change reflected a shift in early March toward the view that tightness in the May future would be more severe than tightness in the July. In 1926, another year affecting this portion of the curves, a similar shift in opinion was registered by the market about mid-February.

Chart 6.—Average Relations between May–July and July–September Price Spreads, January–May*

(Percentages of price of May wheat)



* The curves of average relationship shown in separate sections of Chart 5 are here brought together in a three-dimensional diagram to indicate more clearly the progressive changes in relationship from January to May. The portion of the surface outlined in broken lines represents average relationships from 1910 differing from earlier relationships.

The steepening and general rise from January to April of the portion of the curves covering positive July–September spreads is a reflection of certain differing seasonal tendencies in the two spreads. Changes from March to April in form and level of the portions of the curves covering negative July–September spreads are likewise reflections of differing reactions of the two spreads to influences best treated under the head of seasonal tendencies. These are discussed in Section IV below.

The change about 1910 in average relation between the two spreads during April and May, represented by the differences between the solid and broken curves, we regard as chiefly a consequence of the admission of hard winter wheat to the list of deliverable grades at Chicago. Hard winter wheat was first made deliverable only at a 5-cent discount and on futures contracts made after June 2, 1903. After this date, however, trading in July wheat involved chiefly liquidation of contracts previously made on the old basis,

so that admission of hard winter wheat could have little practical bearing on price relations between old- and new-crop futures until 1904. On February 15, 1904, however, the discount on Nos. 1 and 2 Hard Winter wheat was reduced to two cents, effective on contracts made after that date for July and later delivery. In consequence the admission of hard winter wheats to the deliverable grades first became practically effective on the July–September price spread in 1904.

The addition of hard winter wheat to the deliverable grades at Chicago had at first no apparent effect on the relation between the May–July spread and total July 1 carryover of wheat, though it immediately altered the relation between July 1 carryover and the July–September spread in June, as noted in the previous section. To the extent that addition of hard winter wheat to the deliverable grades altered also relations between July 1 carryover and the July–September spread prior to June, it necessarily altered also relations between the July–September and the May–July spreads.

From the fact that a change in relations between the two spreads did not become noticeable until 1910, and then only as regards relations in April and May, two very significant inferences may be drawn. First, it appears that although the change in deliverable grades was promptly effective on the July–September spread in June it was not until about 1910 that it became clearly effective in influencing the July–September spread in April and May. Second, it appears that despite these effects of the change in deliverable grades on the July–September spread during the months from April through June (presumably through July also) no notable effect has been reflected in the July–September spread during earlier months.

III. RELATIONS OF SPREAD CHANGES TO PRICE CHANGES

A change in the May–July price spread is necessarily accompanied by a change in price of either May or July wheat, and may be accompanied by changes in price of both, either in the same or in opposite directions. Factors bearing on the May–July price spread are necessarily factors bearing on prices of May or July wheat, or on both. The present section is concerned first with the question, what are the price effects of those factors that bear on the May–July spread? and second with the question, how large are the price effects of spread factors in relation to the effects of other price influences?

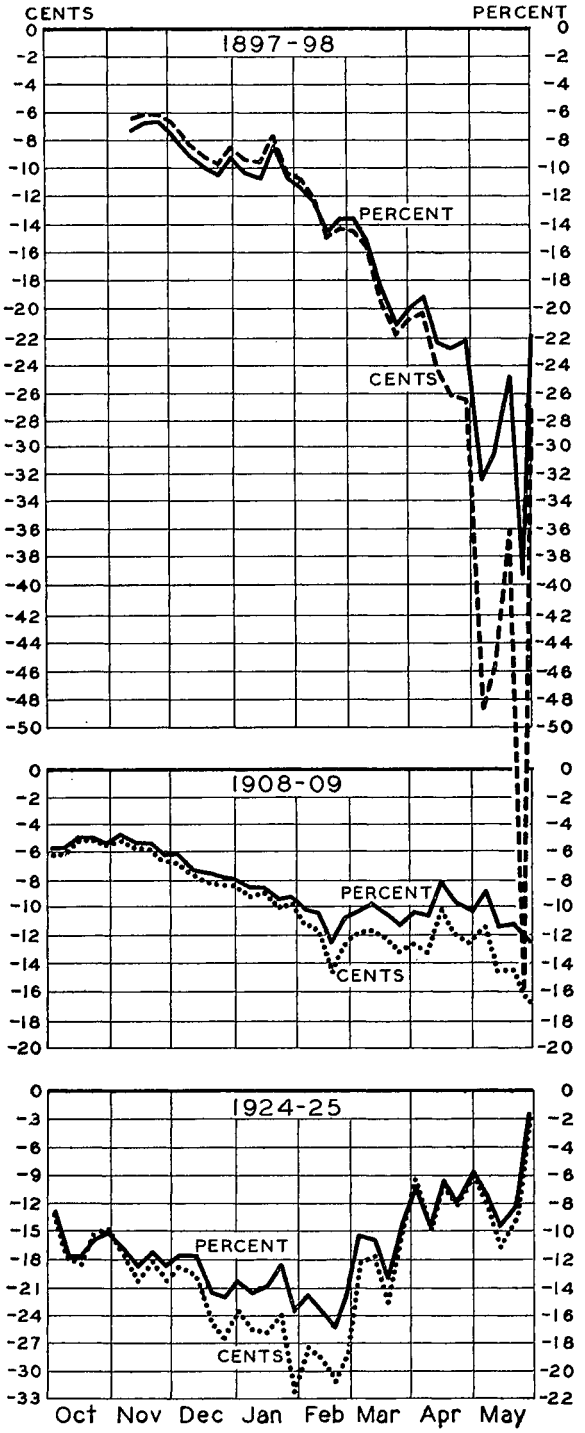
Ratios of Spread to Price

In the discussion above of the relation of the May–July price spread to July 1 carryover of wheat it was noted that the width of negative spreads depended both upon the supply of wheat and upon the level of wheat prices, and that the relation of price to spread might be taken into account by expressing the spread as a percentage of the price. The question naturally arises, is this relation between price and spread an important factor in the spread changes which occur during any one year? In other words, are changes in the May–July spread during individual years largely the result of maintenance of a roughly constant percentage spread while the price of May wheat changes? A little comparison of corresponding spread and price curves in Charts 15*A*, 15*B*, 16*A*, and 16*B* (pp. 220–23) suffices to show that spread changes cannot be thus accounted for either in years in which the spread has been rather narrow for most of the season or in years in which price changes were moderate but spread changes relatively large. Such examination of these charts does not so satisfactorily answer the question as regards years of both wide negative spread and large price changes.

To provide a basis for more definite conclusions, the weekly spread between prices of May and July wheat has been charted both in terms of cents and in terms of percentages of the price of May wheat throughout thirteen seasons in which there seemed best reason for supposing that the spread changes might have resulted in considerable part from large price fluctuations coupled with a relatively constant percentage spread. Three of these pairs of spread curves have been reproduced in

CHART 7.—PRICE SPREADS BETWEEN CHICAGO MAY AND JULY WHEAT, WEEKLY, IN THREE EXTREME YEARS*

(Cents per bushel and percentages of price of May wheat)



* Based on closing prices for one day each week, usually Friday, compiled chiefly from the Chicago *Daily Trade Bulletin*. Spread changes in cents and in percentages correspond closely during a season, even in extreme cases.

Chart 7 to illustrate the facts thus brought out. Even in the cases of greatest price movement and closest correspondence between spread changes and price changes, as in 1897–98 and 1924–25, the changes in spread appear nearly the same whether expressed in cents or in percentages of the price of May wheat. In many years for which the charts are not here reproduced the two curves are practically indistinguishable from each other. Clearly the tendency for the May–July spread to vary in proportion to price has little bearing on the spread changes within a season, even in years of the most extreme price changes.

AVERAGE EFFECT OF SPREAD CHANGE ON PRICE

To determine the average relation between changes in the May–July spread and changes in the prices of May and July wheat, calculations have been made of the weekly changes in price of May and July wheat which have on the average accompanied changes of one cent in the May–July spread under various conditions. The method of calculation was substantially equivalent to that of picking out all the cases (under comparable circumstances) in which the May–July spread rose one cent within a week; noting that in some of these cases the price of May wheat rose considerably during the week, while in others it declined several cents; and calculating a simple average showing that for all of these cases the average change in price of May wheat was a decline (for example) of 1.3 cents.[1]

[1] With one exception the method is the same as that used in our earlier study of price relations between July and September wheat futures, where a detailed discussion will be found (see WHEAT STUDIES, March 1933, IX, 196–203). The difference lies in the basis for the preliminary classification: in the earlier study the data for a season were classified as a group by the direction and absolute size of the spread in April; here the data for each week separately are classified by the direction and size of the percentage spread at the end of the week in question. The data have been subjected to the same sort of analysis described in the previous study, but only the final conclusions and principal supporting data are here discussed. The basic data are shown in full detail in Table V, and important supplementary data are given in the next footnote for the convenience of those who wish to check the conclusions.

Analysis of the averages thus obtained leads to the following conclusions:

1. (*a*) When the price of July wheat is above the price of May, changes in the May–July spread tend to be accompanied by equal changes in the price of May wheat and no change in the price of July wheat.

(*b*) The same tendency is found in May, and substantially the same tendency during the autumn and early winter, even when the price of July wheat is far below the price of May.

2. Beginning with December if the price of July wheat is 9 per cent or more under May, or with January if the price of July is less than 9 per cent under May, a change of one cent in the May–July spread tends to be accompanied by a change of about 1½ cents in the price of May wheat and a change of ½ cent in the price of July wheat. This relation changes slowly until, in March and April (with July wheat under May), a change of one cent in the spread tends to be accompanied by changes of only 1⅓ cents in the price of May wheat and ⅓ cent in the price of July.

These conclusions are expressed in somewhat different and more specific terms in the following statements, each to be regarded as a description of an average observed tendency. They are worded in terms of change in spread in only one direction, but it is to be understood that spread changes in the direction opposite to that stated are accompanied by price changes in the direction opposite to that stated.

When the price of July wheat is above May, whatever the month, a widening of the May–July spread is accomplished by equal decline in the price of May wheat with no change in the price of July.

In October, November, or May, when the price of July wheat is below May, a narrowing of the May–July spread is accomplished also by an equal decline in the price of May wheat with no change in the price of July. This is true likewise in December if July is less than 9 per cent below May.

When the price of July wheat is below May, a narrowing of the May–July spread during January–April (December–April if the price of July is more than 9 per cent below May) is accompanied by a decline in the price of both futures, but a decline in the price of May wheat 1½–1⅓ times as great as the change in spread, and a decline in the price of July only ½–⅓ as great as the change in spread.[1]

[1] These conclusions are based on an analysis of the regression coefficients (averages of change in price accompanying a 1-cent change in spread) and their standard errors for separate spread classes and months, supplemented by regression coefficients and accompanying standard errors obtained by pooling all data which appeared to reflect a common relation. In determining the months and spread classes for which data might properly be pooled, the first consideration was reasonableness of the assumption that they should reflect a common relation between spread changes and price changes. The regression coefficients, interpreted in conjunction with their standard errors, were considered initially as indications of groupings the logical basis of which deserved consideration; and finally for evidence they might give that the data contradicted assumptions which had been considered reasonable. It was found helpful in the analysis to employ graphic representations of the regression coefficients and their standard errors, but these charts have been omitted here because they would tend to mislead readers examining them casually or without adequate understanding of the use of standard errors in the interpretation of statistics.

To facilitate study of the data by critical readers, the regression coefficients and standard errors given in Table V may be supplemented by the following tabulations of regression coefficients and their standard errors obtained by different systems of pooling. For brevity in designation, spread classes are indicated below simply by number, and months by letters *a–h*, representing successively the months October–May.

The grouping of data finally accepted as most reasonable in the light of both economic considerations and the evidence of the statistics yielded the following coefficients of regression of change in price of May wheat per 1-cent change in May–July spread:

Pool designation	Spread groups and months included	Regression coefficient and standard error
A	(1) a, b, c, d, e, f, g	−1.153 ± .307
B	(2) a, b, c; (3) a, b	−1.154 ± .116
C	(2) d; (3) c, d	−1.578 ± .104
D	(2) e, f, g; (3) e, f, g	−1.378 ± .085
E	(1) h; (2) h; (3) h	− .935 ± .060

Differences between the foregoing regression coefficients which are important, together with their standard errors, are:

Between A and C, .425 ± .324
Between B and C, .424 ± .156
Between C and D, .200 ± .135
Between D and E, .443 ± .104

It will be seen that the statistical data demonstrate rather conclusively the differences between pooled Groups B and C and between D and E, but leave room for some doubt whether the other two differences are significant. The difference between C and D, however,

In any particular week, of course, the change in price of May wheat may stand in a very different relation to the change in May–July spread than described above. The price of May wheat is subject to many influences other than those bearing on the May–July spread, and these other price influences are in general responsible for the larger price changes, as will be shown later in this section. The significance of the foregoing averages lies not in great usefulness for predicting price changes from expectation of certain spread changes, but in contribution to understanding of price behavior through showing in what direction and to what extent the spread influences bear on prices.

Classes of Spread Influences

Specific consideration of the character of different spread influences suggests that different spread factors may have somewhat different influences on price. Such an episode as that of March 1898 in which the May–July spread widened while the July–September spread narrowed, in consequence of shift to the view that it was May wheat rather than July that would probably be cornered, seems likely to show a widening of the May–July spread accomplished solely by decline in July wheat rather than by rise in the price of May. Such episodes are of course relatively rare, and the price and spread relationships in them have affected the averages very little. We incline to the view that corners and squeezes, when generally recognized as such, may tend to have rather less price influence than actual shortages of wheat supplies that would naturally produce similar May–July spreads. In the case of the corner or squeeze in May wheat, there is likely to be a presumption that when the corner or squeeze has run its course in May the market may be left with somewhat excessive supplies of cash wheat to be disposed of. The tendency in a recognized corner or squeeze may therefore be to widen the May–July spread through simultaneous elevation of the price of May wheat and depression of July, rather than through differential elevation of both. Such a special relation in certain instances of corners or squeezes, coupled with the fact that prospects of corners or squeezes usually receive little attention before March or April, may account for a peculiarity of the average relations noted above—the fact that in January and February, with July wheat below May, changes in the price of May wheat average about 1½ times as large as the related changes in May–July spread, while in March–April they average only about 1⅓ times as large.

If the foregoing judgments are correct, they warrant a further generalization on the price effect of the most general and fundamental cause of changes in the May–July spread, namely, changes in interpretation of the domestic supply situation. When the price of July wheat is below May, it would seem that after May wheat becomes the dominant future, or at least by December or January, and before the beginning of May, changes in expectations of shortage in domestic wheat supplies that cause a 1-cent widening of the May–July spread are accompanied also by changes of about ½-cent in the July – September spread, with roughly the following increases in price of the various futures:

May	+1.7 cents
July	+ .7 cent
September	+ .2 cent

Such a system of relations among price changes, which would apply equally to price decreases accompanying narrowing of the spread, is consistent not only with observed relations between changes in the May–July spread and changes in the price of May wheat, but also with observed relations between the May–July and the July–September spread and observed relations between changes in the July–September spread and changes in the price of July wheat.

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is an inadequate reflection of a trend which we judge would appear rather clearly significant if subjected to a more critical test than that of a difference between average values of ordinates of two sections of the appropriate curve (which is essentially the test here applied).

Other pooled values computed were as follows:

Pool designation	Spread groups and months included	Regression coefficient and standard error
I	.... (1) a, b; (2) a, b, c; (3) a, b	−1.144 ± .124
II	.... (1) c, d; (2) d; (3) c, d	−1.592 ± .103
III	.... (1) e, f, g; (2) e, f, g	−1.271 ± .120
IV	.... (3) e, f, g	−1.395 ± .141

The relations above described we suppose to apply only when shortage of supplies is anticipated, as indicated by a price of July wheat under May. If July is over May, there is no question of adequacy of supplies, but merely a question of how large a "carrying charge" can be obtained for storing the surplus. Under these conditions a 1-cent narrowing of the May–July spread[1] during January–April seems to be accompanied on the average by price changes in the various futures about as follows:

May	+1 cent
July	0
September	−1 cent

The transition from the system of relations among price changes under conditions of shortage of domestic supplies to this notably different system is presumably not sharp. Probably under conditions of neither clear shortage nor notable surplus (reflected by small discounts of July under May) there appear intermediate systems of relation among price changes.

During the autumn months there have never been quotations on Chicago September wheat to indicate what system of relations might exist among changes in the May, July, and September futures. During May the May–July and July–September spreads so often move independently that average relations among movements of the three futures have relatively little meaning and not much can be added to our original statement—that in May, as an average of all classes of conditions, changes in the May–July spread tend to be accomplished through equal changes in the price of May wheat.

Variability in Price and Spread

The foregoing consideration of the amount and direction of price changes accompanying specific changes in the May–July price spread attains greater meaning when supplemented by data on the importance of these price changes as compared with price changes not directly related to changes in the May–July spread. Indications of the relative importance of general price influences as compared with the spread-determining price influences were given in discussion in the previous section of the degree of relationship between weekly changes in price of the May and the July futures (pp. 192–93 above). The same facts may be indicated somewhat more concretely by comparison of the relative variability of the price of May wheat and of the May–July spread.

Variability of price and of spread may be measured conveniently in terms of average weekly change in each. Computations of average weekly changes separately by months and by three classes of condition with respect to the size and direction of the May–July spread yield the results shown graphically in Chart 8 (p. 204).[2] These data show that when the price of July wheat has been over that of May average weekly changes in the May–July spread have been small. With July wheat less than 9 per cent under May, reflecting moderate shortage of domestic wheat supplies, average weekly changes in the May–July spread have been notably larger than with July over May, and have been especially large during April and May. Average weekly price changes have in general been no larger under these conditions of moderate shortage of domestic supplies than under conditions of surplus, represented by a price of July over May. With more extreme apparent shortage of domestic supplies, as reflected in large discounts of July under May, both average weekly changes in the May–July spread and average weekly changes in the price of May wheat have been much larger than under other conditions, and especially large in April and May.

Direct comparison of averages of weekly changes in the May–July spread with weekly changes in the price of May wheat tends to give a somewhat exaggerated impression of

[1] Narrowing of a positive spread is the equivalent of widening of a negative spread.

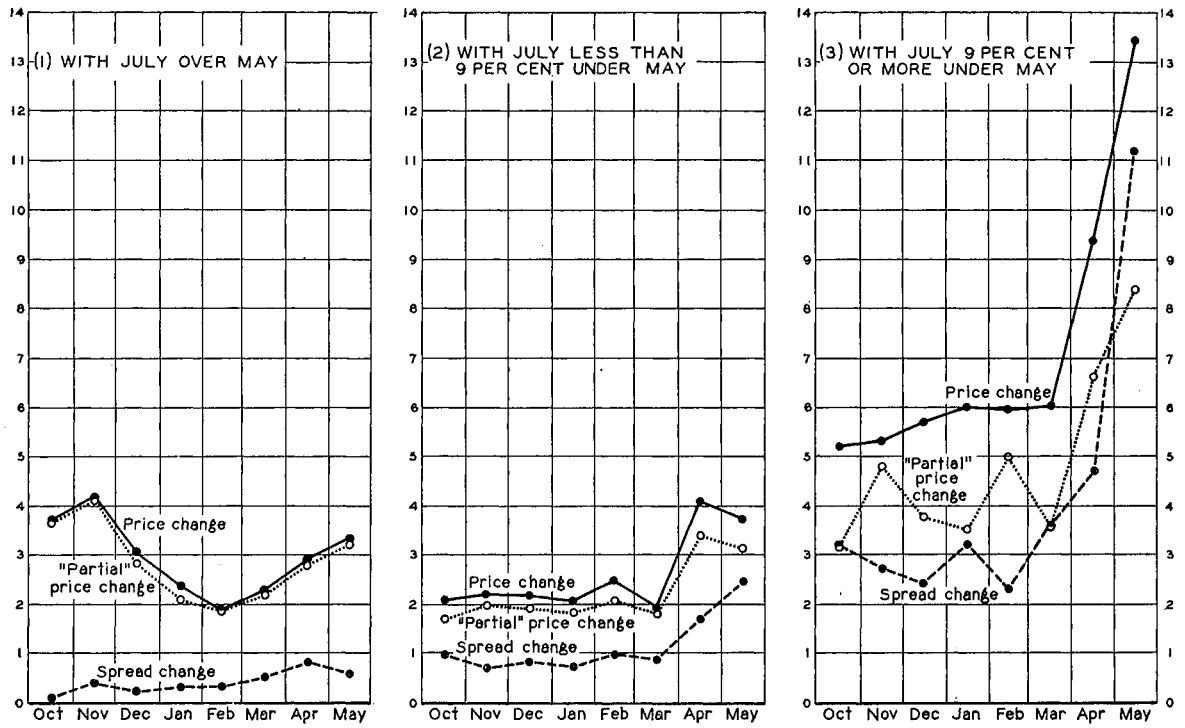
[2] The averages used are not simple arithmetic means, but standard deviations of weekly change, which are averages that have marked advantages over ordinary arithmetic means in some statistical uses. The special character of the averages may be neglected unless it is desired to compare them with other averages which are simple arithmetic means. For such comparison the averages here shown may be reduced by one-fifth to obtain figures corresponding very closely to simple arithmetic means of weekly changes.

the extent to which changes in the price of May wheat result from influences directly related to the spread. A less distorted impression is given by comparison of the average spread changes with averages of the portions of the price changes which are not directly related to the changes in spread. These averages of price changes not directly related to spread changes, designated in Chart 8 as "partial" price changes, are readily made statistically, and may be regarded as representing roughly the average magnitude of the price changes that would have occurred if the May–July spread had remained unchanged.[1]

Having in mind that changes in the May–July spread have in most months been accompanied on the average by equal or larger directly related changes in the price of May wheat, it might be supposed that the average total price change should equal or exceed the average "partial" price change plus the average spread change. The reasoning behind such a supposition is entirely correct as regards individual price changes: each individual price change is composed of a "partial" price change not directly related to the simultaneous spread change plus (or minus) a further change directly related to the simultaneous spread change, and ranging under

CHART 8.—AVERAGES OF WEEKLY CHANGES IN MAY–JULY PRICE SPREAD AND IN TOTAL AND "PARTIAL" CHANGES IN PRICE OF MAY WHEAT, BY SPREAD CLASSES AND BY MONTHS*

(*Cents per bushel*)



* Data from Table VI. The "partial" changes in the price of Chicago May wheat represent portions of the total change which are not directly related to the change in price spread between May and July wheat. Comparison of these averages of "partial" price changes with the averages of changes in May–July spread gives an indication of the relative importance of price influences related to the spread (chiefly interpretations of adequacy of domestic supplies, and factors related to corners and squeezes) as compared with other price influences. In this comparison allowance should be made for the fact that during January–April when July wheat is under May the influence of spread factors on the price of May wheat is usually 30–50 per cent greater than their influence on the May–July spread.

[1] The averages of "partial" price changes are given by the formula

$$\sigma_{1.2} = \sigma_1\sqrt{1 - r^2}$$

in which $\sigma_{1.2}$ is the average "partial" price change, σ_1 the average total price change, and r the coefficient of correlation between price change and spread change.

most conditions from about 1 to 1.7 times as large as the associated spread change. The averages represented in Chart 8 fail to show this relationship, not because of any peculiarity of the price and spread changes, but because of an entirely general characteristic of the effects of combination of independent sources of variation. If one set of factors causes price changes which by themselves would average three cents weekly, and another set of factors causes entirely independent price changes which by themselves would average four cents weekly, the average weekly price change resulting from combination of the two sets of factors is not $3 + 4 = 7$, but $\sqrt{3^2 + 4^2} = 5$. If the average effects of the two sets of factors separately are represented respectively by the lengths of two sides of a right triangle, the average effect of the two sets in combination is represented by the length of the hypotenuse of the triangle.

Direct comparison of the averages of "partial" price changes, as shown in Chart 8, with the averages of changes in May–July spread indicates that when July wheat has been 9 per cent or more under May the average change in the May–July spread has generally been nearly equal to the average change in price of May wheat attributable to factors not related to the spread; and that even when July has been less than 9 per cent under May the average change in the May–July spread has been nearly half of the average change in price of May wheat attributable to factors not related to the spread. Making allowance for the fact that under these conditions the changes in price of May wheat directly related to the change in May–July spread have averaged during January–April from 30 to 50 per cent larger than the spread changes, it appears that the changes in price of May wheat directly related to the changes in May–July spread have been relatively more important than this comparison would indicate. It may be estimated roughly that changes in price of May wheat directly related to changes in the May–July spread have averaged fully as large as all other changes when July has been 9 per cent or more under the price of May, and rather more than half as large as the other changes when July has been less than 9 per cent under May.

IV. SEASONAL CHARACTERISTICS OF SPREAD AND PRICE

The changes from month to month in the relation between the May–July spread and the domestic supply situation, studied in Section I, are themselves indicative of seasonal tendencies in the spread. Specific study of the spread and of the prices for seasonal characteristics results in throwing more light on these tendencies and revealing others.

One of the tendencies in price and, with some qualification, one of the tendencies in spread are of the simple character ordinarily implied by seasonal price tendency; that is to say, they are short-time trends apparently produced by influences that develop regularly at about the same time each year. These we designate as *general* seasonal tendencies. Most of the seasonal tendencies observed are of a different sort, here described as *conditioned* tendencies. A general seasonal tendency implies existence of a relationship between the reaction and some influences lying behind it, but is ordinarily not studied as a relationship. If the influences responsible for a general seasonal tendency are reasonably regular in timing and in strength, it is sufficient to consider merely the typical consequences of the influences as expressed in an average seasonal trend.[1] Satisfactory study of conditioned seasonal tendencies, however, is impossible without consideration of relationships with factors which more or less specifically measure the underlying influences.

Certain seasonal tendencies of Chicago wheat prices and of the May–July spread in their relation to domestic wheat supplies are well shown by weekly averages for years fall-

[1] Probably the common assumption of regularity is frequently not justified. We have shown that the seasonal tendencies of cash wheat prices in the United States arise from influences that are relatively uniform in timing, but vary greatly in strength from year to year (see "The Post-Harvest Depression of Wheat Prices," WHEAT STUDIES, November 1929, VI, 1–30; and "Cycles in Wheat Prices," WHEAT STUDIES, November 1931, VIII, 4–9).

ing into four classes with respect to size of the year-end carryover. A further subdivision separating pre-war and post-war years is necessary in the class comprising years of small carryover. There results from this classification a segregation of years into five groups designated and defined as follows:[1]

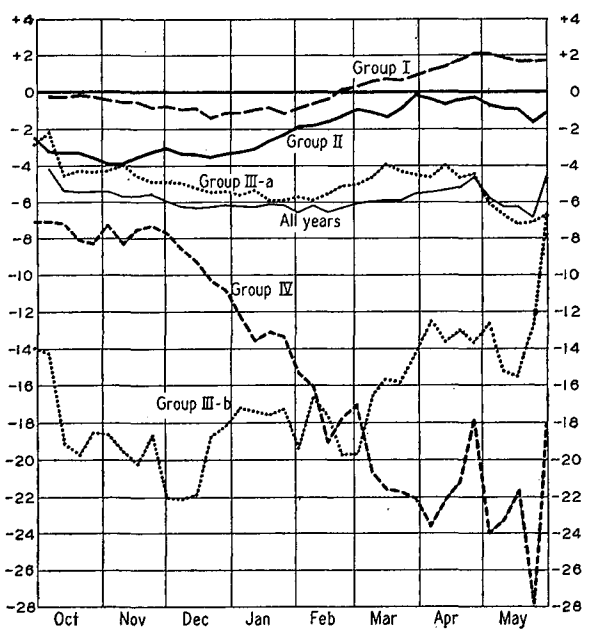
Group

I. Large carryover (over 160 million bushels)
II. Liberal carryover (120–160 million)
III*a*. Small carryover, pre-war (90–120 million)
III*b*. Small carryover, post-war (90–120 million)
IV. Very small carryover (under 90 million)

Weekly averages of the May–July spread and of the price of May wheat for years in each of these five groups are given in Tables VII and VIII and shown graphically in Charts 9 and 10, together with weekly averages for the five groups combined.[2]

CHART 9.—AVERAGES, BY WEEKS, OF PRICE SPREAD BETWEEN CHICAGO MAY AND JULY WHEAT, BY GROUPS ON STOCKS CLASSIFICATION*

(*Cents per bushel*)



* Data from Table VII. Classification of years as described above. These averages reflect, on a weekly basis, the seasonal tendencies observable in Chart 3 (p. 191). See also footnote 3 on this page.

The tendencies indicated by these averages are interesting chiefly for comparison with Chart 3 (p. 191) and with averages obtained from another classification of years to be discussed next.[3] It suffices at this point to make the following observations based on study of the spread and price curves for the individual years in each group. The trends of the May–July spread from October through most of December are relatively uniform

[1] The five groups and subgroups include the following years:

I	II	III*a*	III*b*	IV
1895–96	1900–01	1896–97	1921–22	1897–98
1898–99	1901–02	1902–03	1924–25	1904–05
1899–1900	1905–06	1903–04	1925–26	1908–09
1906–07	1910–11	1907–08	1926–27	1914–15
1915–16	1912–13	1909–10		
1928–29	1922–23	1911–12		
1931–32	1923–24	1913–14		
1932–33	1927–28			

Years prior to 1895–96 are omitted from this classification owing to absence of adequate statistics of year-end carryover. Four other years are omitted because of extraordinary conditions and consequent abnormal behavior of prices and spread that would render the averages less representative if they were included. The four years omitted on these grounds, with numbers of the groups (in parentheses) in which they would otherwise have fallen, are: 1916–17 (IV), 1920–21 (II), 1929–30 (I), and 1930–31 (I). The only notably abnormal feature of 1929–30 appeared in the behavior of the May–July spread from late February through March 1930, when the Grain Stabilization Corporation was conducting its early operations. Spread data for the remainder of the season and price data for the whole of this season might appropriately have been included in the averages, but the inconveniences in both calculation and exposition that would have attended such partial inclusion of 1929–30 outweighed possible advantages.

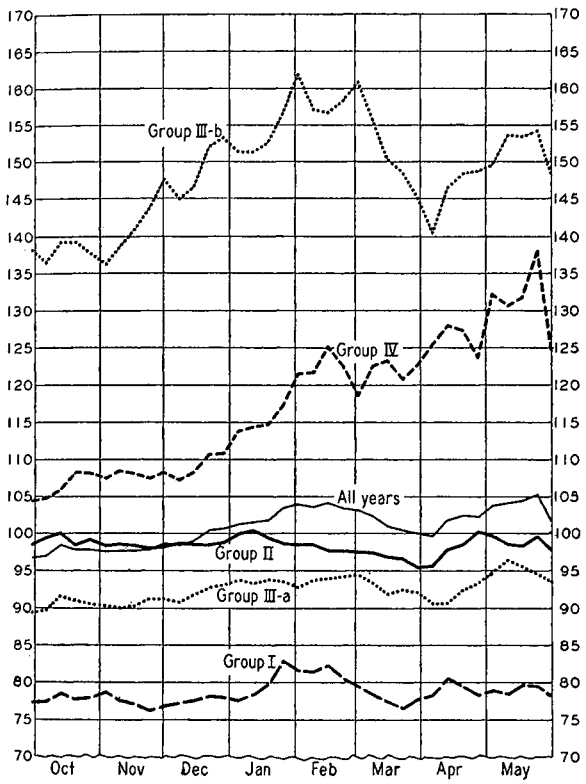
[2] In the computation of these averages, a complication arose from the fact that in many years trading in July wheat did not begin until considerably after the first of October, with the result that the May–July spread was available for only a part of the period from October to May. In one year included in the averages (1900), trading in May wheat did not begin until October 12. These cases were dealt with in the group averages by taking simple arithmetic means of the prices or spreads for weeks in which there were data for all years, but for earlier weeks obtaining averages by applying successively arithmetic means of week-to-week changes in the available prices or spreads. The group averages were combined into general averages by weighting the group averages by the number of years in each group.

[3] In comparisons with Chart 3 it should be borne in mind that that chart is based on averages of percentage spreads, these averages on spreads in cents. A simple average of percentage spreads is equivalent to a weighted average of spreads in cents; the weighting is theoretically desirable but was considered an unnecessary refinement in dealing with the weekly data where its application would have required much additional labor.

among the individual years within each group. The trends from January through May are also very uniform within Groups I and II (years of liberal and large carryover out),

CHART 10.—AVERAGES, BY WEEKS, OF PRICE OF CHICAGO MAY WHEAT, BY GROUPS ON STOCKS CLASSIFICATION*

(Cents per bushel)



* Data from Table VIII. Classification of years as described on p. 206.

and fairly uniform among the years of Group III*a* (pre-war years of small carryover). Among years of Groups III*b* and IV (post-war years of small carryover and all years of very small carryover—which happen to be all pre-war years) there is wide variation in the course of the May–July spread during January–May of different years, and the movements of the averages are not closely representative. The important characteristic of the spread in years in these groups (III*b* and IV) is a tendency to wide fluctuations, not predictable from the supply situation alone.

BEHAVIOR CLASSIFICATION

A more illuminating classification of years is obtained by using as bases for segregation the December level and the December, or December–January, movement of the May–July spread. The relations between the May–July spread and the year-end carryover, as shown in Section I above, are such that the May–July spread may be regarded as reflecting a market appraisal of the domestic supply situation. A classification of years on the basis of level and movement of the May–July spread is therefore a classification based upon market appraisal of the domestic supply situation and upon changes in that appraisal.[1] It should be expected to give results broadly similar to those from classification on the basis of year-end stocks. Its merits, from an analytical standpoint, probably arise from the fact that the market appraisal reflects pertinent facts that do not appear in the bare statistics of year-end carryover. Among these are prospects for a corner or squeeze. From the standpoint of use in forecasting, this basis of classification has certain additional advantages that appear in the next section.

The main outlines of the classification of years according to behavior of the May–July spread arise very simply from facts developed in Section I. It was there shown that even very early in the season the level of the May–July spread has reflected fairly well the prospects for year-end carryover, but with a general tendency to fail fully to discount prospects for either extreme surplus or ex-

[1] Pertinent objection to a statement similar to this in our study of "Price Relations between July and September Wheat Futures at Chicago since 1885" (WHEAT STUDIES, March 1933, IX, 224) has been raised in correspondence by a close student of wheat prices. He feels that the statement implies an essentially mechanical connection between stocks and spread, and excludes from consideration factors not directly connected with supplies. We find it necessary to continue to refer to both the May–July and the July–September spreads as reflecting primarily market appraisals of the domestic supply situation, but would emphasize, first, that appraisal of the supply situation is not identical with estimation of year-end carryover, and, second, that the statement refers to the outstanding characteristic of the spreads without implication that the spreads, or more particularly their changes, are unaffected by important factors not directly associated with physical supplies of wheat.

treme shortage; and that by March the May–July spread has usually come close to an average relation between spread and stocks. On further investigation it appeared that not until December or sometimes January did the amount and direction of movement of the spread reliably forecast its subsequent movement into March. The December or December–January movement of the spread has been found indicative, however, of conditions that influence the movement of the May–July spread not only into March but beyond, and indicative also of conditions that influence the course of the price of May wheat as well as its relation to the price of July wheat.

For analytical purposes a sufficiently fine classification of years on the basis of behavior of the May–July spread is obtained by segregation into four groups. These may be defined in general terms as follows:[1]

1. Years in which the average price of July wheat in December was above the price of May wheat or not more than 2 per cent below (Group A).[2]

2. Years in which the average price of July wheat in December was more than 2 per cent under the price of May wheat and—

declined little relative to May wheat during December, to a low recorded not later than the first week of January (Group B);[3]

declined sharply relative to May wheat during December, but recovered fully by the first week of February (Group C);

declined slowly and persistently relative to May wheat during December and January, or rapidly and without full recovery by the first week of February (Group D).

The years falling into each group on the basis of these definitions are given below, followed for the sake of comparison by numbers in parentheses showing the groups into which they fell in the previous classification on the basis of year-end carryover. Square brackets designate years classified but omitted from group averages. The year 1920–21 could not be classified, for reasons indicated in footnote 3 below. The year 1930–31 was left out of consideration on the ground that after early November of that year both the price of May wheat and the May–July spread were dominated by Grain Stabilization Corporation control rather than by normal market forces.

Group A	Group B	Group C
1884–85	1890–91	1892–93
1885–86	1891–92	1907–08 (III*a*)
[1886–87]	1896–97 (III*a*)	1910–11 (II)
1887–88	1898–99 (I)	[1916–17 (IV)]
1889–90	1902–03 (III*a*)	1925–26 (III*b*)
1893–94	1903–04 (III*a*)	
1894–95	1905–06 (II)	Group D
1895–96 (I)	1909–10 (III*a*)	1888–89
1899–1900 (I)	1912–13 (II)	1897–98 (IV)
1900–01 (II)	1915–16 (I)	1904–05 (IV)
1901–02 (II)	1922–23 (II)	1908–09 (IV)
1906–07 (I)	1926–27 (III*b*)	1911–12 (III*a*)
1923–24 (II)	1927–28 (II)	1913–14 (III*a*)
1928–29 (I)	1931–32 (I)	1914–15 (IV)
[1929–30 (I)]		1921–22 (III*b*)
1932–33 (I)		1924–25 (III*b*)

Weekly averages of the May–July spread for each of these four groups of years, and for the four groups combined, are shown graphically in Chart 11 (p. 210), and weekly averages of the May and July futures in Chart 13 (p. 214).[4]

[1] More specific description of the basis of classification is given in the next section and an alteration in definition of Group C is suggested.

[2] For the purpose of classification of several years in which July wheat was not quoted until after December, percentages of 99 in January, 100 in February, or 101 in March were taken as equivalent to 98 per cent in December.

[3] For the purpose of classification of 1891–92 and 1927–28, Group B was defined alternatively as comprising years in which the price of July wheat in January was 96–99 per cent of the price of May wheat. These years were the only ones apart from 1920–21 not falling in Group A and yet lacking quotations on July wheat from a date early enough to show a clear December or December–January trend in the May–July spread to provide basis for classification. In 1920–21 trading in July wheat did not start until April and opened at a level about 20 cents below May wheat, with the result that inclusion of that year was impossible under any reasonable extension of the behavior classification.

[4] The averages of prices of July wheat are shown in Chart 13 to provide, by comparison with the prices of May, an alternative representation of the course of the May–July spread that is particularly useful in comparing movements of price and spread. The averages for prices of July wheat are obtained by adding the averages of May–July spread to corresponding averages of the prices of May wheat, rather than by computing separate averages. These two possible methods would give identical results if quotations on July wheat were always available with quotations on

The averages of weekly spreads and prices shown graphically in these charts suffer from the general weakness of averages in that they tend to cover up significant facts that would appear from a full study of the data, and fail entirely to indicate the degree of uniformity with which indicated tendencies manifest themselves. To facilitate study of these tendencies as they have appeared in individual years, the curves of prices and spreads have been brought together by groups in Charts 12 and 14 (pp. 211 and 215). The condensation necessary for convenient comparison precludes inclusion of scale values to indicate the absolute levels of prices and spreads in the various years. Reference may readily be made to Charts 15*A*, 15*B*, 16*A*, 16*B* (pp. 220–23) when attention to absolute values is necessary; in the main it will be found sufficient merely to compare the courses taken by the curves for the individual years, which appear clearly in Charts 12 and 14. The charts include data for 1886–87, 1916–17, and 1929–30, although they were omitted from the averages. While exceptional cases may justifiably be omitted from averages designed to be broadly representative, it is important that the existence of such exceptional cases and their character should receive consideration.[1]

Seasonal Spread Characteristics

Averages of the May–July spread for all classes of years combined, as shown by the light solid line in Chart 11, suggest the existence of only relatively weak general seasonal trends, represented by a tendency for the spread to decline about two cents from early October to late December, to recover this loss between late February and the end of April, and to decline again about two cents in May. When these very moderate changes in the general averages are compared with the large contrary changes that sometimes occur in individual years, the indicated "average tendencies" appear quite insignificant.

On appropriate analysis, however, it is found that in the main the general averages present merely a blurred composite of the results of several different and important *conditioned* seasonal tendencies. A group of these which, taken together, may be described as a *seasonal characteristic* has just been discussed as providing the main basis for the behavior classification (used for segregating the years into the four classes for which the group averages are shown in Chart 11). The several important conditioned tendencies are most conveniently discussed by groups of years as thus classified. The different conditioned seasonal tendencies are on the whole well represented by the courses of the respective group averages, but for interpretation of the uniformity and significance of the tendencies it will be necessary to refer frequently to the curves for individual years, as shown by groups in Chart 12.

Spreads in Group A.—The courses of the May–July spread in the years falling in Group A are marked by extraordinary regularity and uniformity, as may be seen from Chart 12. In the main this reflects the fact that a price of July wheat above May wheat or less than 2 per cent below in December is indicative of domestic wheat supplies clearly so liberal as to leave little opportunity for changes in appraisal of the supply position sufficient to produce marked effects on the spread. The fluctuations of the spread in 1929–30 were of course a result of abnormal influences from fear of a squeeze in May wheat by the Grain Stabilization Corporation —such a squeeze as no private individual or syndicate could have attempted. The wide fluctuations of the spread in 1887 probably have chief present significance as an indication that the relation between wheat supplies and the May–July spread prior to the early

May wheat, but under actual circumstances they give slightly differing results. This method of obtaining consistency between the price averages and the spread averages appears somewhat preferable to that of computing averages of prices of May wheat using data only for weeks for which prices of July wheat were available—the plan which in principle was followed in our study of July and September wheat futures (Wheat Studies, March 1933, IX, 219–20).

[1] Data for two years are omitted even from these charts: for 1920–21 because there existed no basis for placing it in the classification; and for 1930–31 because movements of both May price and May–July spread in that year were largely dominated by government-sponsored control of the May future rather than by market forces. Data for these years, however, appear graphically in Charts 15*B* and 16*B*.

or middle 'nineties may have differed from the relation in subsequent years.[1]

In no year in this group, apart from 1886–87, was there a decline in the May–July spread from December to April. A few years showed practically no change in the spread over this interval and a few years showed increases of 4–6 cents, but more commonly there occurred an increase of about 2 cents. Usually this rise culminated at the end of April, or shortly before, but in 1895 and 1901 the peak was reached about the first of April. In all but 3 years (1890, 1924, and 1933) the spread tended downward during May, primarily as a reflection of the tendency of a positive carrying charge between cash wheat and more distant futures to diminish during a delivery month. (When the price of July wheat is substantially above that of May, the price of May wheat during the month of May becomes substantially equivalent to a price on cash wheat.)

Spreads in Group B.—The years falling in Group B are distinguished from those in Group A not only by lower prices of July wheat relative to May in December, but in general by lower prices of July relative to May in earlier months and a downward drift of the May–July spread into or through December. In several years this midwinter bottom was reached as early as the second week of December; in 1898–99, 1926–27, and 1927–28 it was not reached until the first week of January; in 1891–92 the late opening of trading in July wheat made registration of a bottom before mid-January impossible.

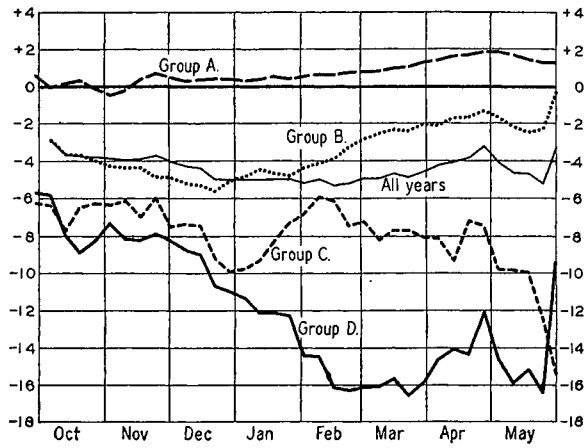
This midwinter bottom marked the extreme discount of July wheat under May in 11 years out of the 14 in the group. In 1898–99 a lower and final bottom was recorded in the last week of January. In 1902–03 and 1903–04, however, the May–July spread made a new and much lower bottom in late January and for most of the remainder of the season was under the December low.

With the single exception of 1902–03, every year in this group showed a strong rise in the May–July spread from December or early January to March or April. Most commonly (in 10 years) the peak was reached at or near the end of April. In 1891–92 it was reached about the end of March, in 1905–06 shortly before the middle of March, and in 1927–28 not until the end of May.

[1] See discussion of this point on pp. 191–92.

CHART 11.—AVERAGES, BY WEEKS, OF PRICE SPREAD BETWEEN CHICAGO MAY AND JULY WHEAT, BY GROUPS ON BEHAVIOR CLASSIFICATION*

(Cents per bushel)



* Data from Table VII. Classification of years as described on p. 208.

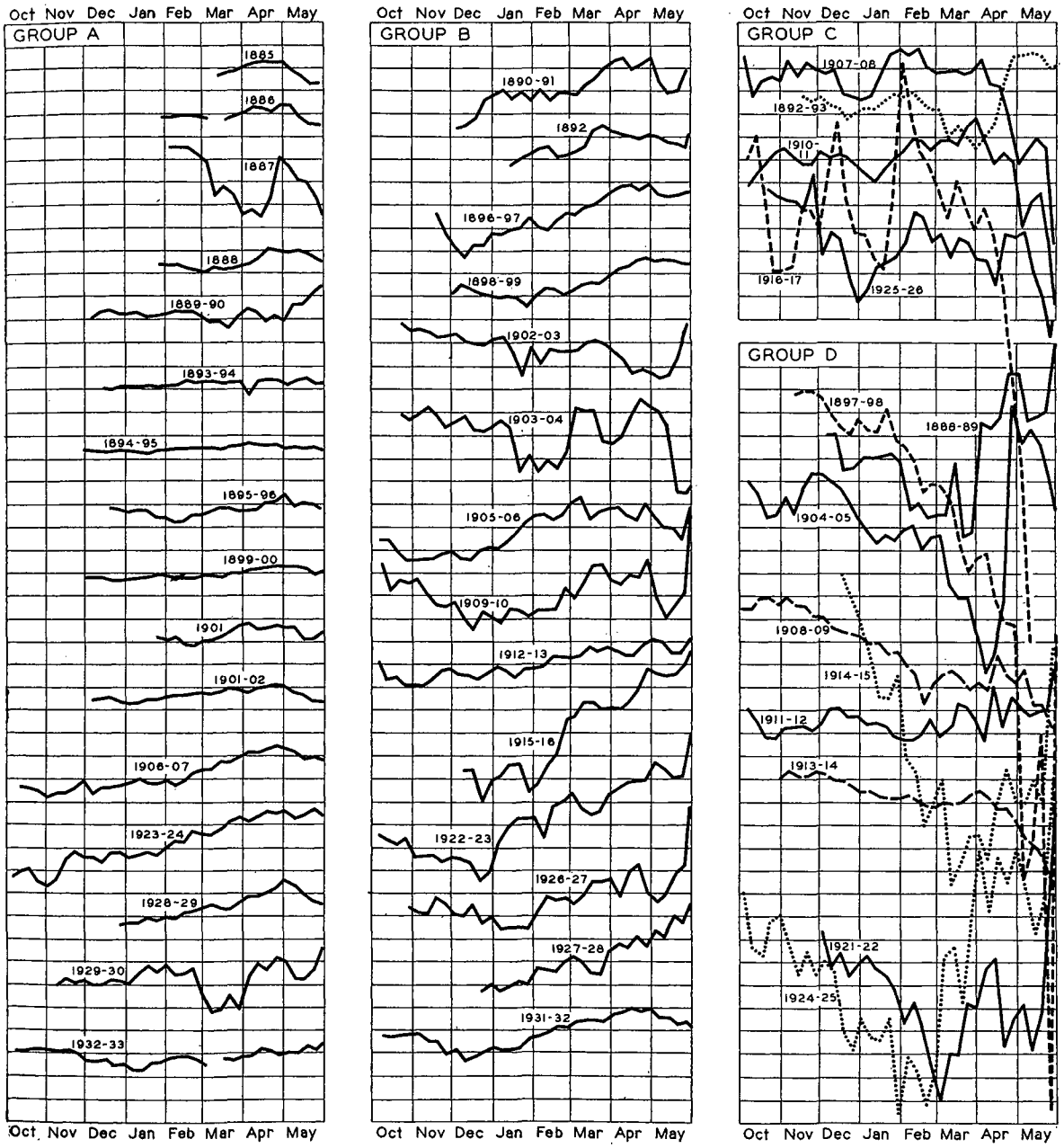
The only seasonal trend in the May–July spread common to all the groups of years shown is the decline during May, and even this reflects at least two different tendencies; for the influences behind the movement in most years of Group A are different from those in most other years. Several other significant tendencies are here reflected, each dependent on certain attendant conditions common to most or all of the years in a single group.

During the first two or three weeks of May, July wheat declined relative to May in all but 2 years of this group, the exceptions being in 1926–27 and 1927–28. This decline reflects generally not a narrowing of discounts on cash wheat relative to the July future, as in the years of Group A, but a widening of premiums on cash wheat relative to July.

Spreads in Groups C and D.—The sharp decline of the May–July spread in December of years in Group C and the subsequent equal or greater rise by the end of the first week of February provide the basis of classification. The course of the May–July spread after early February, which played no part in determining the classification of the years, is also fairly uniform. In each year except 1911 pronounced downward movement of the spread began in February; in 1911 the beginning of substantially continuous downward movement was postponed until the first

CHART 12.—WEEKLY MAY–JULY SPREAD CURVES, BY YEARS IN BEHAVIOR CLASSIFICATION, 1885 TO 1932–33*

(Cents per bushel)[a]



* Spreads at the close on one day each week, usually Friday, computed from data compiled chiefly from the Chicago *Daily Trade Bulletin.*

[a] The horizontal rulings are at 2-cent intervals. Scale values cannot be shown because rulings crossing more than one curve represent different values for the separate curves. All the curves shown appear also in Charts 15*A* and 15*B* (pp. 220 and 222) with scale values indicated.

of April. The downward movement continued broadly through May in each year except 1893. The evidence is fairly clear that the behavior of the May–July spread in each of these years was associated with the development of a squeeze or corner in May wheat, carried through the delivery month in each year except 1893, but in that year abandoned

in early April. The suggestion naturally occurs that perhaps only financial difficulties associated with onset of the panic of 1893 prevented the May–July spread from continuing in that year to decline much as in the other 4 years of the group. There is some reason, however, to think abandonment of the squeeze may have been occasioned merely by realization that supplies of wheat were too heavy to permit carrying the squeeze to a successful conclusion.

In computing the spread and price averages for this group of years, data for 1917 were omitted, not because the movement of the spread in that year was abnormal in character or even in amount, expressed as a percentage of the price of May wheat, but partly because the spread changes measured in cents were abnormally large and chiefly because the price changes were abnormal in both character and amount.

Group D comprises 9 years of fairly uniform spread movement up to the end of January and very diverse movement thereafter. In two of the years (1908–09 and 1911–12) changes in the spread after the end of January were distinctly moderate. In a third year (1913–14) changes in the spread after January were very similar to those of one year (1910–11) included in Group C. Five of the remaining 6 years show extreme declines of July wheat relative to May after the end of January, followed in all but one case (1897–98) by sharp recovery. In the sixth year of wide changes in spread after January (1924–25) the further decline was brief and small, and was followed by an extraordinary upturn.

Moderate uniformity in behavior of the May–July spread in years of Group D ends with late February. After the end of February the most conspicuous tendency among years of this class is the tendency for movements of the May–July spread to be extreme and erratic—about as often in one direction as in another over any particular portion of the remainder of the season. The suggestion of the averages (Chart 11) that there is a tendency in this group of years for the spread to rise in April and decline again through most of May is of very questionable significance.

Broadly speaking, we regard Group D as comprising years of rather severe shortage of domestic supplies, with the shortage generally underestimated early in the season and even through December, and generally overestimated in the late winter or early spring. The wide movements of the May–July spread appear attributable largely to speculative activities of unorganized groups of futures traders rather than to intentional squeezes or corners such as are largely represented in years of Group C. This is a provisional judgment, for verification of which more critical study of the events of a number of the years involved is clearly necessary. It is at once apparent that the year 1897–98 must be counted at least a partial exception, for the existence of the Leiter corner in that year is well known. This fact supports rather than weakens our tentative theory, however, since the theory rests on the supposition that with an organized squeeze or corner July wheat will usually (but not invariably) tend to go to progressively greater discounts under May until the end, or near the end, of May; and on the basis of this behavior characteristic alone 1897–98 would be classed as a corner year. On this basis 1913–14 would also be classed as a year of a corner or squeeze.

If it is true that the years of Group C are years of organized corners or squeezes and those of Group D generally not, there arises naturally the question, why should a strong rise of July wheat relative to May in January (the basis of distinction between these two groups) furnish such a relatively trustworthy basis for anticipating a corner or squeeze? Our present judgment is that the pertinent circumstances in years of Group C may be typically somewhat as follows (1925–26 would constitute a conspicuous exception in certain respects): despite a prospect for small carryover on July 1, resulting in a substantial and widening discount of July wheat under May in December, immediate supplies are abundant and cash wheat is at a discount under May that represents approximately a full carrying charge. Continuation of the ease in the cash situation during January leads to a tendency to raise estimates of the prospective carryover, with resulting rise of

July wheat relative to May (or decline of May relative to July). Large speculative traders and cash-grain dealers who correctly appraise the prospective carryover are thus given an unusual incentive to buy May wheat against sales of July (a transaction taking the form for an elevator operator of transfer of hedges from the May to the July future). The subsequent natural decline of July wheat relative to May as the actual shortage of supplies becomes apparent is then accentuated through development of a squeeze in consequence of large holders of May contracts or of cash wheat refusing to sell except at abnormal premiums over the price of July wheat.

Relations of Spread Behavior to Wheat Supplies

Although the classification of years by characteristics of behavior of the May–July spread has been found most useful for revealing the chief conditioned seasonal tendencies of the May–July spread, inferences have been drawn at numerous points suggesting more fundamental conditioning factors lying behind the behavior classification itself; and in each such case the domestic wheat supply position has been viewed as a prominent or dominant element in the situation. Even so, one or two pertinent connections between wheat supplies and behavior tendencies of the May–July spread remain to be indicated.

Study of the tabulation of years included in the four behavior classes, as given on page 208, reveals that, in so far as year-end carryovers are known, Groups A and B of the behavior classification are composed entirely of crop years ending with liberal or large carryovers (Groups I and II), plus all but one year of moderately small carryover (Group III) prior to 1910–11 and plus one year of small carryovers since 1910–11. Groups C and D are composed of all the years of very small carryover (Group IV), and all but one of the years of moderately small carryover since 1910–11, plus one year (1910–11 itself) of liberal carryover. The behavior characteristics of the May–July spread in the years of Behavior Groups A and B may therefore be regarded as conditioned mainly by relative abundance of domestic wheat supplies. The physical quantity of wheat constituting the requisite abundance, however, has been greater since about 1910 than in earlier years.[1]

Physical quantity of wheat supplies is apparently not very pertinent to the important distinction between Behavior Groups C and D. As has been suggested above, however, we believe relative abundance of immediately available supplies about midwinter may have a bearing on this distinction. Direct information on the presence or absence of an organized attempt to corner or squeeze the market might be more pertinent than either knowledge of the domestic wheat supply situation or any characteristics of market behavior up to early February, such as are used for the behavior classification. Continuation of January price decline to the middle of February or later seems to be also an important characteristic, as noted below and at the end of Section V.

Seasonal Price Characteristics

Five distinct seasonal characteristics of the price of May wheat have been noted, largely as a result of study of price behavior in connection with behavior of the May–July spread.[2] One of these—a tendency toward

[1] A change in seasonal tendencies of the May–July spread of course implies some change in the system of relations between the spread, month by month, and year-end carryover. It will be recalled, however, that no such change was noted in Section I, where this subject was under consideration. A marked change was noted, however, between the pre-war and the post-war periods. The seasons 1910–11 to 1913–14 were years in which domestic supplies were near the margin between shortage and fair abundance. They were therefore years in which the seasonal behavior characteristics of the May–July spread could be altered to the extent observed by only a slight change in controlling circumstances. It is unquestionable that at the same time a corresponding change occurred in the system of relations between spread and carryover; but the alteration in this system of relations did not become great enough to be discernible in Chart 1 until it was greatly augmented by a new set of influences that developed between the pre-war and post-war periods.

[2] In the main these characteristics appear very similarly in the prices of July and September wheat; evidence of some of them was discussed in our earlier study of price relations between July and September futures (Wheat Studies, March 1933, IX, 218–27).

price decline in March—is a simple seasonal trend, or "general seasonal tendency" in the more usual sense. The other four seasonal price characteristics take the form of tendencies for certain price trends to develop under particular special circumstances—that is, they are conditioned tendencies. Designating all five characteristics simply by the timing and direction of price movement that has accompanied the pertinent related circumstances, they may be listed as follows: (1) March price decline (general); (2) October–May price decline (conditioned); (3) January–February price decline (conditioned); (4) December–February price rise (conditioned); (5) April price rise (conditioned).

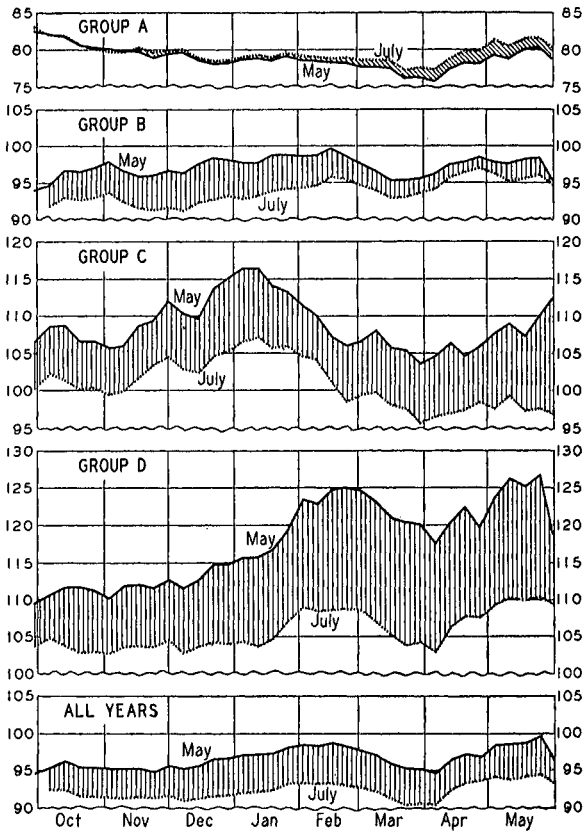
The following conclusions regarding these seasonal price characteristics rest in part on the price averages shown in Chart 13, but are drawn in the main from detailed study of price movements in individual years, as shown in Chart 14. At best the averages taken by themselves give only inadequate evidence of the characteristics involved, and no indication of the uniformity of the tendencies indicated. With regard to some of the characteristics in question the averages give misleading impressions. The averages are nevertheless convenient and useful for study in connection with the price curves for individual years. In stating the conclusions drawn, some general indication of their basis is always given, but in the main Chart 14 is relied upon to give the details of the evidence on which they rest.

Discussion of the seasonal price characteristics proceeds most simply under topical arrangement by tendencies, as listed above, rather than by groups of years. At convenient points notice will be taken of movements of the averages not accepted as reflecting true tendencies.

The March price decline.—The tendency for the price of May wheat to decline during the month of March, or from the latter part of February to late March, is the only one of the seasonal price characteristics here considered which may reasonably be regarded as a general seasonal tendency. It appears with nearly equal strength in each of the four classes into which the years are divided for present purposes. Very few years show notable price increases in March, the rise in March of 1928 being one of the largest; and definite price decline occurred during March or February–March of 26 of the 44 years for which price curves are shown in Chart 14.[1]

CHART 13.—AVERAGES, BY WEEKS, OF PRICES OF CHICAGO MAY AND JULY WHEAT, BY GROUPS ON BEHAVIOR CLASSIFICATION*

(Cents per bushel)



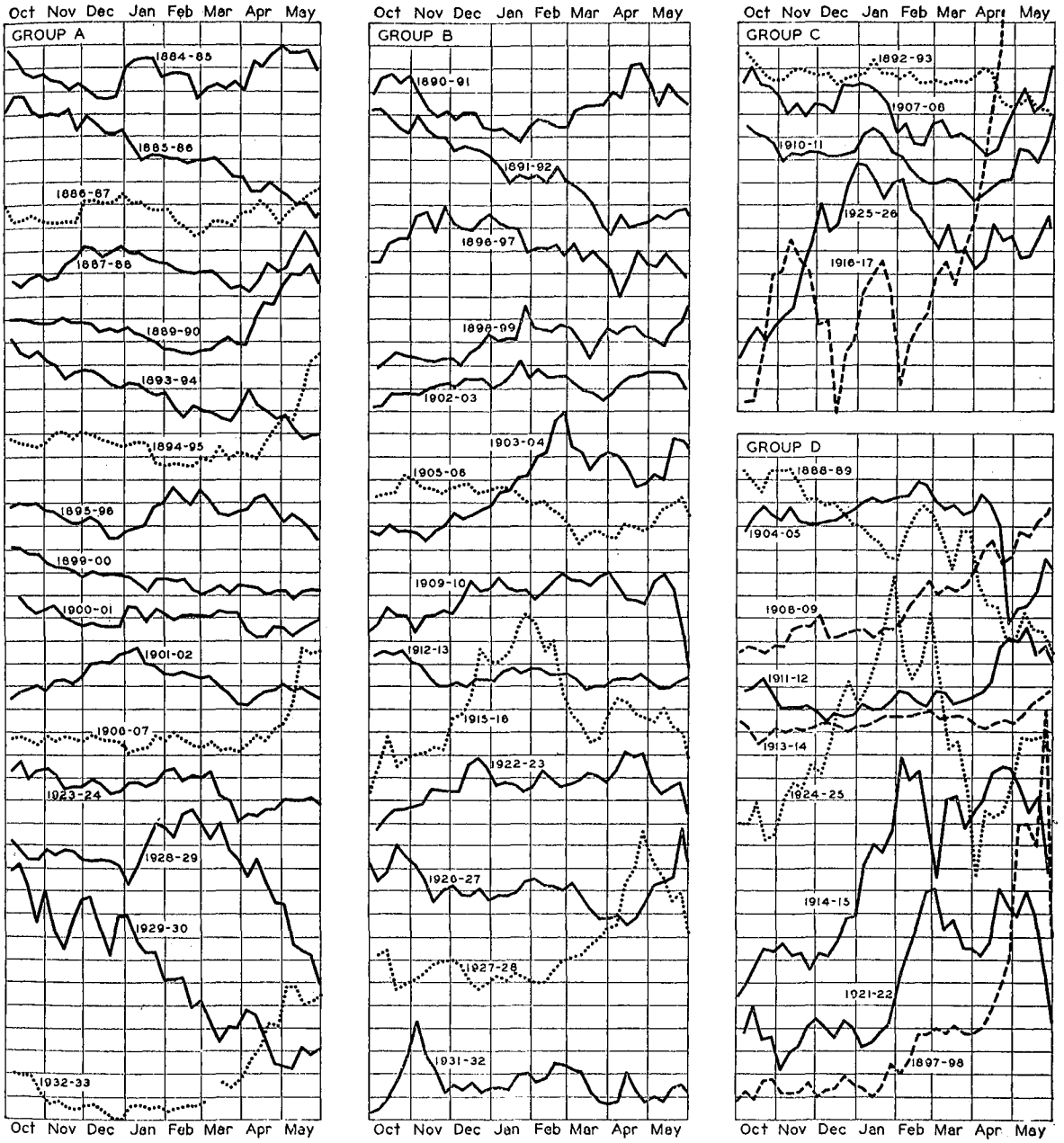
* Data for May wheat from Table VIII; for July wheat, obtained by combining data in Tables VII and VIII. Classification of years as described on p. 208.

These price averages reflect the influence of a *general* seasonal tendency toward price decline in March, common to all groups, and four *conditioned* seasonal tendencies—a different one in each group. The vertical distances between averages for May and July wheat represent averages of the May–July spread and are shaded for emphasis.

[1] This statement is based on a conservative interpretation. In 1899 and again in 1910 the price of May wheat declined through about the first half of March, but recovered its loss by the end of March. Both these years are classed as cases in which the March price decline failed to develop.

CHART 14.—WEEKLY PRICE CURVES FOR MAY WHEAT, BY YEARS IN BEHAVIOR CLASSIFICATION, 1884–85 TO 1932–33*

(*Cents per bushel*)[a]



* Closing prices on one day each week, usually Friday, compiled chiefly from the Chicago *Daily Trade Bulletin*.

[a] The horizontal rulings are at 5-cent intervals. Scale values cannot be shown because rulings crossing more than one curve represent different values for the separate curves. All the curves shown appear also in Charts 16*A* and 16*B* (pp. 221 and 223) with scale values indicated.

Sharp price decline occurred also in March of 1921, not included in the chart. Price stability or rise in March has generally been associated with conditions that resulted later in a strong price increase, as will be noted in the discussion below of the tendency toward April price increase.

Further study may reveal the tendency toward price decline in March as a conditioned tendency, manifested only under certain

rather common circumstances, but for the present it appears properly regarded as a true general seasonal tendency which has been offset in about four years out of ten by contrary influences, but has almost invariably prevented bullish influences from developing a strong price rise during March.[1]

The October–May price decline.—The price record by years suggests a general tendency for the price of May wheat to decline persistently from October through May in years of large domestic supply and expected heavy carryover. These are the years included in Group A of Charts 13 and 14. This tendency we regard as not strictly a seasonal price characteristic, but the prominence with which it appears in the downward course of the price averages for Group A from October to early April necessitates its consideration here. It is chiefly a tendency associated with the downward phase of the "long cycle" in wheat prices.

Although the averages for Group A show a reversal of trend in early April, a strong downward tendency appearing earlier in the season more often than not continues through May and into the next crop year. The upward turn in the averages is aided by the fact that the fundamental tendency toward price declines responsible for the earlier downward trend occasionally terminates or is reversed about the first of April. The averages are more largely influenced, however, by the fact that in April another and temporarily stronger price tendency, discussed below under the head of "The April Price Rise," not infrequently offsets for the time being a fundamental and persisting downward tendency.

The January–February price decline.—The price averages for Group C in Chart 13 show a strong rise through November and December, followed by a still larger decline to the end of March. The November–December rise is without real significance since it results almost wholly from a very large price increase in a single one of the four years entering into the averages;[2] and the price decline during March appears to be no more than a manifestation of the same general tendency observed in the other classes of years. The January–February decline in the averages, however, is contributed to by price decline during this period in each of the years entering into the averages and represents a price movement found only infrequently among years of the other groups.

Although it is historically a characteristic of relatively rare occurrence—only 5 out of 44 years fall in the group — this tendency toward price decline in years of Group C is worthy of notice. The price trend in January–February of these years undoubtedly has had its chief origin in the same unexpected evidence of ease in the domestic supply position that caused the sharp January rise in the May–July spread which distinguishes years of this group from those of Group D. The two groups are alike in being composed of years in which domestic supplies were short, but differ as regards the trend in January of market-reflected opinion on the degree of shortage. In years of Group C a tendency during December toward increasing emphasis on prospective shortage of supplies—a tendency reflected in rapidly increasing discounts of July wheat under May — is sharply reversed in January. This reversal toward the view that domestic supplies would not prove notably short brought with it in each year a substantial decline in the price of July wheat as well as a decline of May relative to July, and the price decline in both deliveries continued after May wheat again began to show more strength than July.

The December–February price rise. — All but one of the nine years in Group D show a price increase running through at least two of the three months December–February. In the exceptional year, 1888–89, a strong February rise was recorded despite the fact that the winter and spring as a whole were dominated by a general tendency toward decline

[1] Various suggestions have been made in attempted explanation of this tendency toward price weakness in March, but none has impressed us as very convincing. It may be that the tendency rests chiefly on prevalence of the *belief* that wheat prices may be expected to decline during March and that purchases for a rise should be delayed until about the end of March or early April.

[2] Data for 1917, shown with Group C in Chart 14, were omitted from the averages.

from an extraordinary price peak reached about the end of October. In 4 of the 9 years (1897–98, 1914–15, 1921–22, and 1924–25) the two-month price increase exceeded 20 cents at the 1913 price level. Comparable price increases have occurred during the same period in years falling in other groups, but in no other group with any substantial regularity; and among all the 35 years outside of Group D, only 2 (1903–04 and 1915–16, in Group B) show price increases in this period as large as those in 4 of the 9 years in Group D. It seems not inappropriate, therefore, to designate the tendency toward at least two months of price increase during December–February of years of Group D as *the* tendency toward December–February price rise.

This tendency is clearly related chiefly to strengthening anticipation of shortage in domestic wheat supplies, the price increases in May wheat being only mildly reflected in the July future. In the averages an increase between the first week of December and the last week of February of 12.3 cents in the May future was accompanied by an increase of only 4.2 cents in the July future. This relationship is not representative, however, being affected by inclusion in the averages of one year in which May wheat declined and July declined more than May. In those individual years in which the rise in price of the May future was moderate, the accompanying rise in price of July wheat was generally slight or even nil; but in those years in which the price rise in May wheat was large (1897–98, 1914–15, 1921–22, and 1924–25), July wheat rose about two-thirds as much as May.

The April price rise.—Price increases during the month of April have occurred with sufficient frequency and strength to leave their impress on the averages for each of the four groups of years. Nevertheless, we are of the opinion that there is no true *general* tendency for April price rise, comparable with the general tendency toward March decline, but rather two separate *conditioned* tendencies. A general seasonal tendency we define as one which fails to appear in particular years only in consequence of the development of other influences that counteract it; a conditioned seasonal tendency we define as one that appears only in the presence of favorable conditioning circumstances.[1]

The April price increases in years of Group C tend to continue through May and fall in a class by themselves. They seem to be consequences chiefly of development of corners or squeezes in May wheat, as noted in the discussion above of tendencies of the May–July spread in this group of years. It is noteworthy that in years of Group C April price strength has generally been more conspicuous in May wheat than in July wheat, whereas in the other groups of years April price increases tend to be greater in July wheat than in May.

In the other groups of years the indicated tendency toward April price rise is conditioned not primarily by circumstances that determine their classification in the grouping here used, but by development of conditions favorable to a crop-scare price rise. Just what these conditions are is not wholly clear; reports of serious crop damage are a necessary condition, but not the only condition required. A very reliable index of the existence of the requisite conditions is furnished by the price trend during March. Failure of the usual March price decline to develop has usually been followed by conspicuous price rise in April, and all but one of the eight sharp price rises culminating in April or May which we have classed as phases of crop-scare price cycles have followed moderate price increase, or at least stability in price of May or July wheat, during March.[2]

With respect to the relation between the

[1] The differences on which this distinction rests are probably differences of degree rather than of kind, with the consequence that marginal cases could be found in which it would be doubtful whether the tendency should be classed as "general" or "conditioned"; but among the tendencies here under consideration the differences are so great that the distinction is useful.

[2] The reference is to crop-scare price cycles as discussed in "Cycles in Wheat Prices," WHEAT STUDIES, November 1931, VIII, 18–27. The 8 years in which the sharp price increases culminating in April or May occurred were 1895, 1898, 1907, 1912, 1915, 1921, 1928, and 1933. The year 1917 could be included as a ninth example, although it was not considered in the discussion cited. A price rise falling only slightly short of the requirements set for a "sharp" increase occurred in April–May of 1890. In March of each of these years

tendencies to March price decline and to April rise the price averages by themselves are distinctly misleading. They suggest that March price decline tends to be followed by price increase in April, whereas the fact is that substantial price increase in April rarely occurs except following absence of the usual March decline.

V. FORECASTING THE MAY–JULY PRICE SPREAD

A number of the facts developed in previous sections have obvious direct application in the formation of judgments on probable price changes, and, more particularly, of judgments on probable changes in the price spread between Chicago May and July wheat. Their very general usefulness in this special connection warrants recapitulation of the more pertinent facts in such a way as to indicate more clearly their connection and relative importance from this standpoint.

When Supplies Are Large

On the record of past years, it appears that the character of the problem involved in anticipating changes in the May–July spread is notably different when domestic wheat supplies are adequate for a July 1 carryover of over 150 million bushels than when they are substantially smaller. Since 1896, when wheat supplies sufficient for a carryover of over 150 million bushels have been available and government-sponsored measures for support of May wheat have not been invoked, the May–July spread has fluctuated very little from week to week; has always come in May to an average representing July wheat between 1½–4 per cent over May (usually close to 2 per cent over); and has always shown a fairly steady upward trend from some time in December–February to about the end of April. These facts provide a basis for fairly confident statement of the course likely to be followed by the May–July spread in any year in which a carryover in excess of 150 million bushels seems clearly in prospect.

It was chiefly on the basis of these facts and anticipation of a carryover of some 240 million bushels on July 1, 1934, that we stated in January, when July wheat was about 1¾ cents under May: "Chicago July wheat is likely to go to a premium over May, perhaps during February and at least by the end of April, and September wheat will probably increase its premium over July . . . . price relationships among these futures similar to those of last year are to be expected."[1] In forming and stating such a judgment, the possibility of development of unusual situations must be recognized. We called attention particularly to the possibility that a severe decline in wheat prices might develop and be met by government-sponsored purchasing that would distort the relations between May and new-crop wheat futures. Perhaps in view of the relatively small stocks of contract wheat in Chicago, the possibility should be recognized that a mild squeeze in May wheat might be attempted despite the size of the total United States supply.

When Supplies Are Smaller

When domestic wheat supplies appear to be much below a level providing a year-end carryover of 150 million bushels, appraisal of the supply situation is first of all important as an indication that prospects for the May–July spread are very uncertain, and that the spread is likely to show wide fluctuations during the course of the season. An estimate of size of the prospective carryover may be

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except 1898, 1907, and 1921 both May and July wheat rose or at least failed to show the usual March decline; in 1898 May wheat failed to decline during March, although July wheat declined rather sharply, and in March 1907 July wheat failed to decline although May declined slightly; in March 1921 the price of May wheat declined sharply and conditions were such as to suggest that July would have declined even more had it been quoted (trading in July wheat did not begin until March 28).

There were 18 years in which May wheat rose or moved horizontally during March or February–March. Of these, 7 included crop-scare price cycles culminating in April or May (1895, 1898, 1912, 1915, 1917, 1928, 1933); 5 included conspicuous price rises running at least to near the end of April (1885, 1890, 1891, 1909, and 1923); 2 showed price rises through only early April (1887 and 1893); and 4 failed to show an April price increase (1899, 1900, 1901, and 1910). See also related statement and footnote on p. 214.

[1] "World Wheat Survey and Outlook, January 1934," Wheat Studies, January 1934, X, 176.

helpful, but can be regarded as indicative of the prospects in only the roughest sense. If the prospects are for a carryover of about 110 million bushels, allowance for a range of error of only 10 million bushels in the advance estimate of carryover would require that a forecast of the spread in May, based on the average post-war relation to year-end stocks, should be stated in the form of a prediction that the price of July wheat would be somewhere between 6 and 16 per cent under May. Allowing for the same moderate range of error, and allowing also for the probability of such departures from the average relation as have actually occurred since the war, it could be predicted only that in May the price of July wheat would probably be somewhere between 1 per cent over May and 16 per cent under.[1]

When the carryover promises to be in the range of 120–150 million bushels, an adequately grounded estimate of carryover may be expected to give a more trustworthy basis for estimating probable width of the May–July spread than when the carryover promises to be smaller. Even within this range, inevitable uncertainties in carryover prospects introduce large uncertainties in "normal" expectations for the May–July spread; and even though the carryover be accurately appraised, the May–July spread may depart far from the level represented by an average relation—that is, the relation in the year in question may prove to be far from "normal."

At the least, however, an appraisal of prospects for carryover gives a basis for judging the degree of uncertainty regarding prospects for the May–July spread. To a hedger this alone may be important, since it gives a basis for reasoned appraisal of the additional risk involved in carrying a hedge in one future, when another would give better protection against price change; the apparent added risk may then be weighed intelligently against an expectation of greater profit from carrying the hedge in the future that gives the less complete price insurance. Moreover, the appraisal of carryover prospects provides something of a check, sometimes a good check, on judgments reached otherwise regarding prospects for the May–July spread.

[1] These conclusions and those of the next paragraph may be reached by anyone merely from study of Chart 1 (p. 187).

Behavior Characteristics as a Forecasting Basis

The historical record suggests that the behavior characteristics used in classifying the years for study of seasonal tendencies might provide an excellent basis for appraising probable changes in the May–July price spread. Most of the tendencies discussed in Section IV have been so regular and persistent over a period of nearly fifty years that sudden change in them appears unlikely.

The conditions that determine classification among the four behavior groups studied in the previous section are stated near the beginning of that section. They may be made somewhat clearer by repetition here in slightly different form, as follows:

Group A.—Average price of July wheat in December 98 per cent or more of price of May wheat.

Group B.—Average price of July wheat in December under 98 per cent of price of May wheat, and showing less than 2 per cent decline relative to May from its high point early in the month to a low marked by two weeks of subsequent stability or rise, the low falling not later than the first week of January.

Group C.—Average price of July wheat in December under 98 per cent of price of May wheat and showing decline of 2 per cent or more relative to May from its high point early in the month, followed by full recovery relative to May wheat by the first week of February or earlier. (See also revision of this definition suggested in final paragraphs below.)

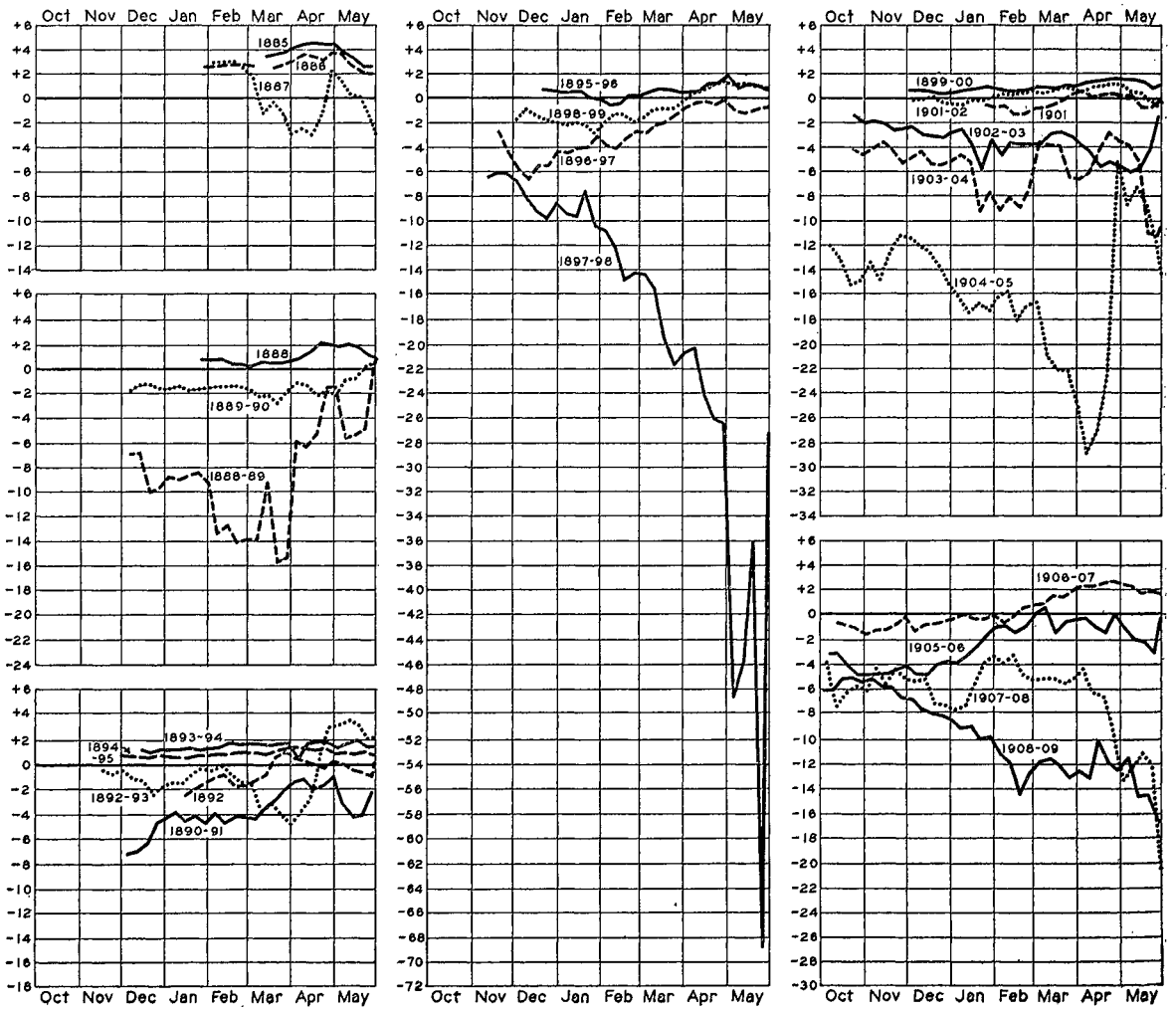
Group D.—Average price of July wheat in December under 98 per cent of price of May wheat and showing decline of 2 per cent or more relative to May, not recovered by first week of February, or a decline of less than 2 per cent continued through the first week of January at least.

The historical record of changes not only in the May–July spread but also in the price

of May wheat, through seasons falling in each of these groups, is shown concisely in Charts 11–14 (pp. 210, 211, 214, and 215) and has been discussed at length in the previous section. Here it is sufficient to remark further that from the standpoint of appraising probable movement in any season the charts showing curves for individual years are particularly important. They suggest the type and range of variations likely to be met in the particular behavior pattern characteristic of years in a given group, as well as the general common tendency. For applications in practical forecasting, we judge an understanding of the degree of variability in manifestations of a common tendency to be nearly as important as knowledge of the tendency itself.

CHART 15 A.—PRICE SPREADS BETWEEN CHICAGO MAY AND JULY WHEAT, WEEKLY, 1885 TO 1908–09*

(Cents per bushel)



* Spreads at the close on one day each week, usually Friday, computed from data compiled chiefly from the Chicago *Daily Trade Bulletin*. Spreads are shown as premiums (+) of July wheat over May, or discounts (—) of July under May.

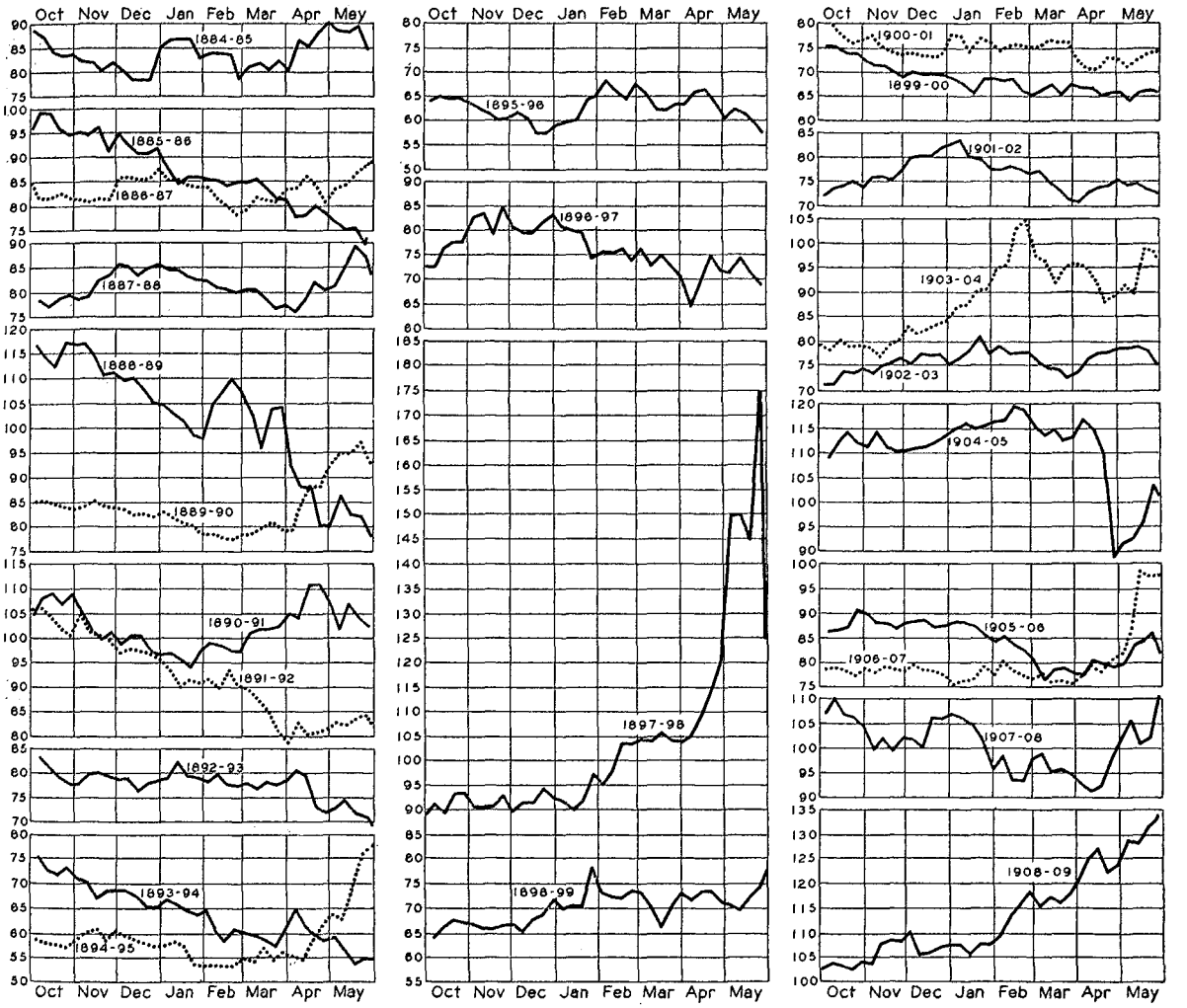
The foregoing definitions of group characteristics have been framed from a study of spreads at the close on one day each week (usually Friday), whereas in applications to forecasting the classification of a season will ordinarily be based on daily quotations; but we see no reason to suppose that the rules of classification should be changed for use in connection with daily quotations. It is true

that under certain circumstances use of daily quotations would result in placing a year in another group than that indicated by quotations for one day each week. But appearance of such a situation is evidence that the conditions are intermediate between those typical of the two groups, with the result that any appraisal of the situation must be uncertain; the significant difficulty is not to be remedied by mere alteration in wording of the rules for classification, or substitution of daily for the less adequate weekly quotations.

Border-line cases, however, require some special consideration. Cases near the border between Groups A and B raise no practical difficulty because of the similarity of spread behavior after midwinter of years in the two groups. Cases near the line separating Groups B and D present a real problem, however, for spread behavior after midwinter in years of Group D is the reverse of that in years of Group B. In any case appearing to lie near the border between Groups B and D, we should be disposed to rely less on the specific wording of the rules of classification given above than on interpretation in the light of the general principle behind the rules: that midwinter trend in the May–July spread

CHART 16 A.—PRICES OF CHICAGO MAY WHEAT, WEEKLY, 1884–85 TO 1908–09*

(Cents per bushel)



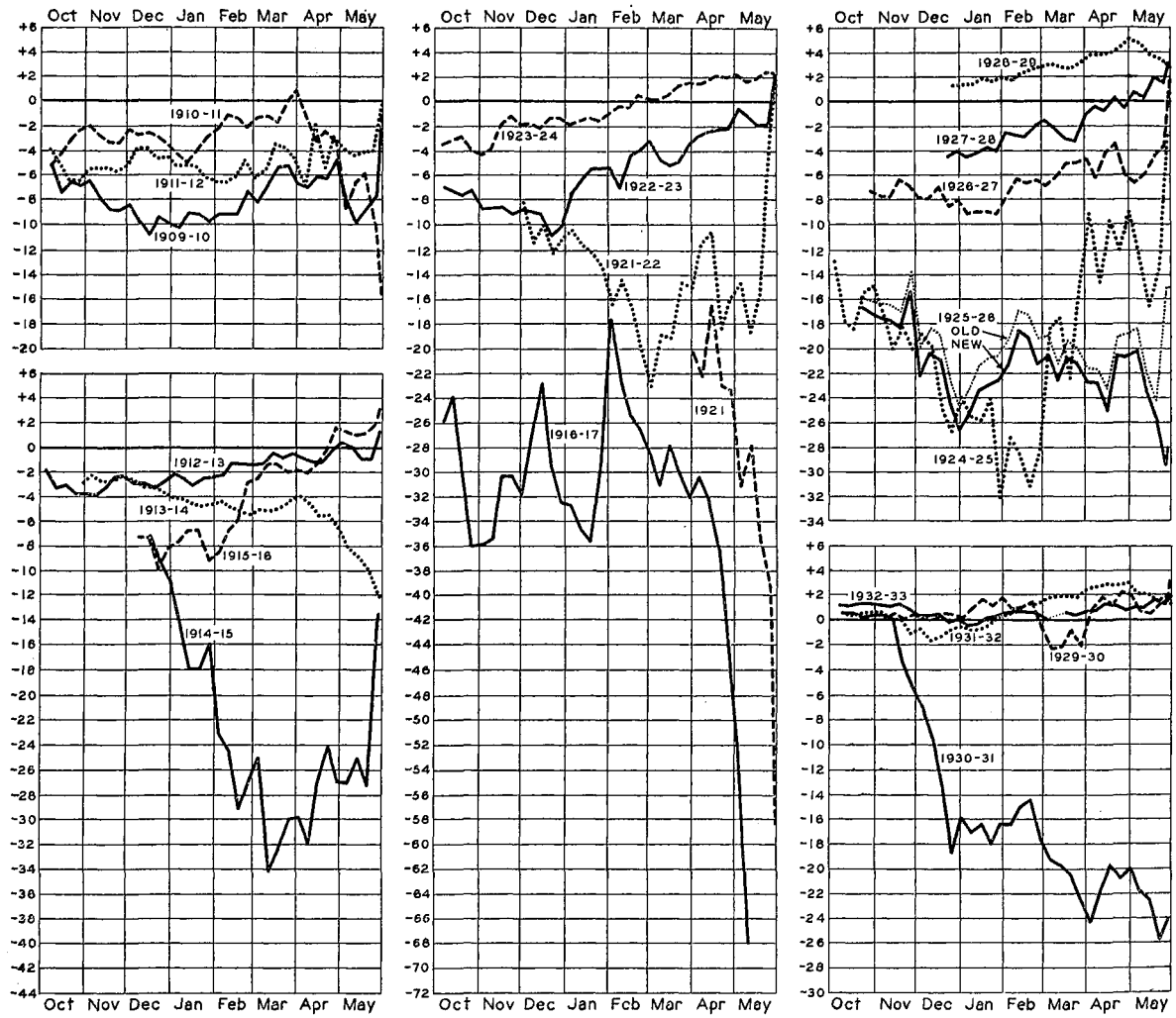
* Closing prices on one day each week, usually Friday, compiled chiefly from the Chicago *Daily Trade Bulletin*.

tends to point the direction of subsequent movement if due allowance be made for a very general tendency toward moderate decline of the spread (decline of July wheat relative to May) in December. Yet even application of this principle must be uncertain in some years.

Under the definitions given above, Group C might logically be regarded as a subclass within Group D. On the basis of fundamental conditions, however, Group C appears rather to comprise a relatively small number of years in which conditions were broadly those represented in Group B, but with certain important qualifications; in other words, it seems more consistent with the main facts to regard Group C as essentially a subclass under Group B. These considerations are important from the standpoint of appraisals of prospects in years that appear possibly to deserve classification in Group C. The distinction in the rules as given above is not based on the general principle that subsequent movement of the May–July spread is

CHART 15 B.—PRICE SPREADS BETWEEN CHICAGO MAY AND JULY WHEAT, WEEKLY, 1909–10 TO 1932–33*

(*Cents per bushel*)

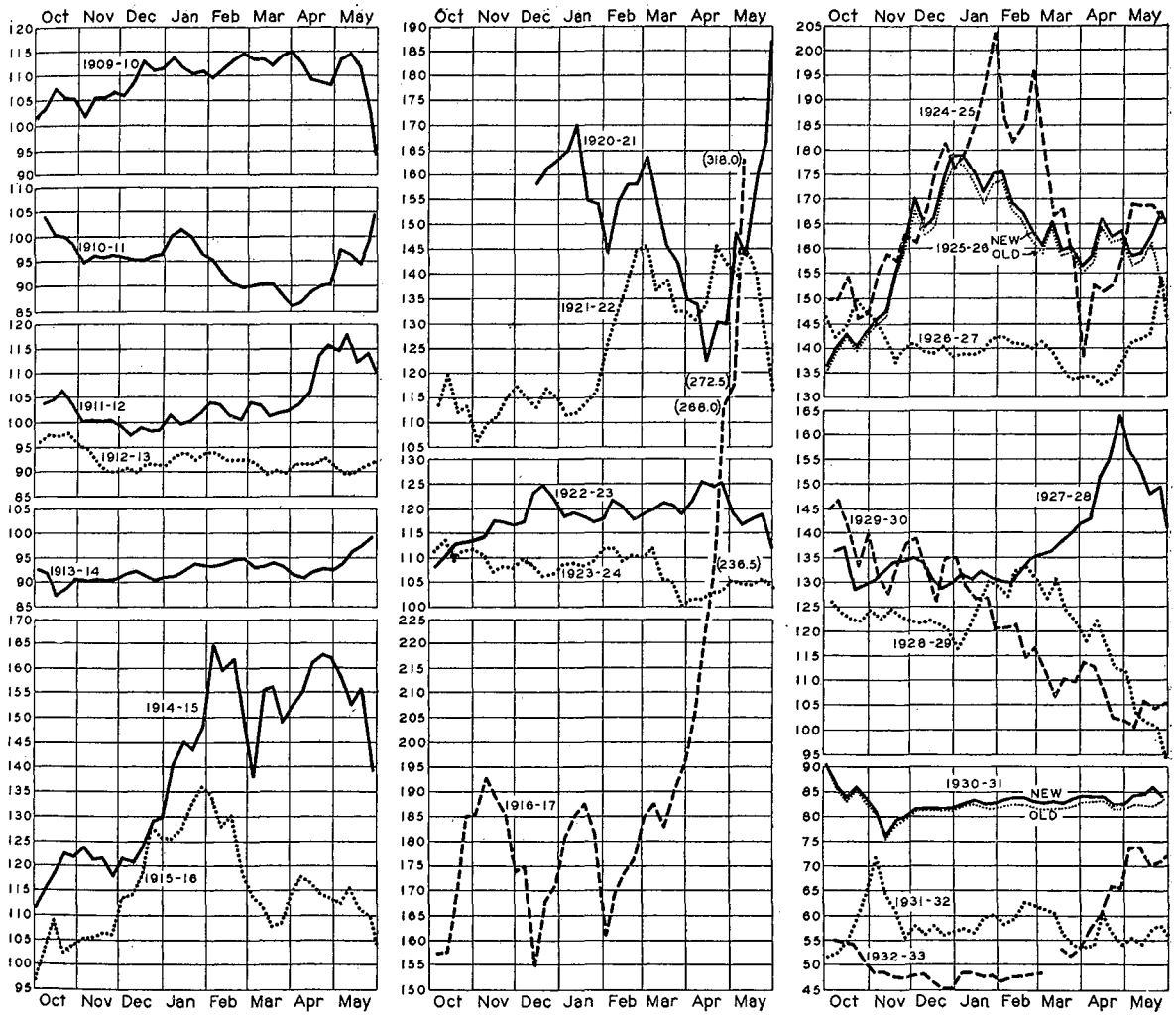


* Data as for Chart 15*A*. For 1925–26 there are shown spreads representing discounts of July wheat (quoted only on the basis of the new delivery provisions) below both "new style" and "old style" May. The wide difference between these two spreads near the end of May is illuminating in connection with the squeeze in 1926 May wheat.

indicated by its midwinter trend, for that trend as a whole is the same in Groups B and C. The distinction is based rather on amount of decline in the May–July spread before an price decline through most of January–February (except in 1916–17, which in other respects also appears not truly on a par with the other years of the group). This character-

CHART 16 B.—PRICES OF CHICAGO MAY WHEAT, WEEKLY, 1909–10 TO 1932–33*

(Cents per bushel)



* Data as for Chart 16A. For 1925–26 prices of both "new style" and "old style" May wheat are shown corresponding to the two spread curves for this year in Chart 15B.

upward trend seems to establish itself. This appears to us a rather arbitrary distinction, appropriate enough for use in analytical work when there was seen no more fundamental basis for a distinction that clearly needed to be made, but a very uncertain distinction for use in actual contemporary appraisal.

Study of the data on the basis of this classification has shown that the conditions peculiar to Group C have been attended by a broad istic price decline probably offers a much more trustworthy basis for identifying the conditions peculiar to years of Group C than does the distinction given in the rules previously stated.

The foregoing considerations suggest that the purposes of forecasting might be served well by assuming that continued upward movement of the May–July spread (that is, classification in Group B) was indicated (*a*)

as soon as a small December or December–January decline (less than 2 per cent) showed a reversal extending through two weeks, or (*b*) as soon as a larger decline was nearly or quite recovered. This should be regarded, however, as a preliminary judgment to be altered if a January price decline should be continued to the middle of February. In other words, during the month of January a year would be classified provisionally in Group B on the basis of established trend in the May–July spread, subject to reclassification in Group C by the middle of February if the price movement so indicated.

This study has been prepared by Holbrook Working

APPENDIX

TABLE I.—PRICE SPREADS BETWEEN CHICAGO MAY AND JULY WHEAT AND BETWEEN JULY AND SEPTEMBER, AS PERCENTAGES OF PRICE OF MAY WHEAT, MONTHLY, 1884–85 TO 1916–17 AND 1920–21 TO 1932–33*

(Percentages)

Season	May-July spreads								July-September spreads				
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jan.	Feb.	Mar.	Apr.	May
1884–85	...	...	...	...	...	+ 4.4	+ 5.1	+ 3.7	...	...	...	...	+ 4.2[a]
1885–86	...	...	...	...	+ 3.3	+ 3.2[a]	+ 4.4	+ 3.1	...	...	...	+ 1.5	+ 2.0
1886–87	...	...	...	...	+ 3.6	— 1.1	— 2.7	— .5	...	+2.4	+ .5	— .9	— 2.7
1887–88	...	...	...	...	+ .6	+ .5	+ 2.3	+ 1.9	...	...	...	...	— 1.6[a]
1888–89	...	...	— 8.2	— 8.7	—12.6	—12.9	— 5.1	— 6.3	...	...	...	— 3.0	— 2.9
1889–90	...	...	— 1.7	— 2.1	— 1.9	— 2.8	— 2.0	— .5	...	...	...	— 1.6	— 2.6
1890–91	...	...	— 6.1	— 4.4	— 4.5	— 2.7	— 1.5	— 3.6	...	...	...	— 4.7	— 3.9
1891–92	...	...	...	— 2.5[a]	— 1.6	+ .3	0	— .8	...	...	...	— .2[a]	— .9
1892–93	...	— .8[a]	— 2.1	— 1.0	— 1.1	— 4.8	+ .4	+ 4.0	...	...	...	+ 1.4	+ 4.3
1893–94	...	...	+ 1.6[a]	+ 1.9	+ 2.7	+ 2.8	+ 3.1	+ 3.2	...	...	+2.1	+ 3.0	+ 2.4
1894–95	...	...	+ 1.2	+ 1.1	+ 1.7	+ 1.8	+ 2.0	+ 1.4	...	...	+1.5[a]	+ 1.8	+ .2
1895–96	...	...	+ 1.1[a]	+ .5	— .2	+ 1.0	+ 1.4	+ 1.6	...	...	...	+ .5	+ 1.4
1896–97	...	— 4.4[a]	— 7.3	— 5.2	— 4.5	— 2.5	— .6	— 1.4	—1.9	—2.4	—2.9	— 3.2	— 6.1
1897–98	...	— 6.8	— 9.8	—10.0	—13.5	—18.2	—21.5	—32.1	—7.3	—9.4	—7.1	— 6.6	—12.2
1898–99	...	...	— 2.1	— 3.2	— 2.1	— 1.3	+ 1.4	+ 1.5	...	...	...	— 1.0	— .3
1899–00	...	...	+ .8	+ 1.1	+ .9	+ 1.2	+ 2.3	+ 1.9	...	...	+ .6	+ 1.3	+ 1.7
1900–01	...	...	...	— .9[b]	— 1.4	— .7	+ .4	— .6	...	...	...	...	— 2.4
1901–02	...	...	— .1	— .3	+ .5	+ 1.1	+ 1.4	+ .3	...	— .9	— .1	— .7	— 1.7
1902–03	...	— 3.2	— 4.0	— 5.2	— 4.8	— 4.1	— 6.6	— 6.8	...	...	—1.7	— 3.8	— 3.3
1903–04	...	— 5.5	— 6.2	— 7.2	— 8.1	— 5.1	— 4.9	— 9.5	—3.7	—5.1	—5.9	— 4.6	— 5.5
1904–05	—12.7	—11.5	—11.5	—14.8	—14.3	—19.2	—17.5	— 9.6	—5.8	—7.1	—5.4	— 4.4	— 6.9
1905–06	— 4.6	— 5.3	— 5.2	— 2.9	— 1.2	— .6	— 1.0	— 2.8	—1.8	—1.1	— .2	— 1.3	— 2.3
1906–07	— 1.1	— 1.4	— .9	— .3	— .1	+ 1.7	+ 3.1	+ 2.1	— .2[a]	— .5	+ .7	+ 2.1	+ 1.6
1907–08	— 6.0	— 4.8	— 6.3	— 5.4	— 4.7	— 5.5	— 7.8	—11.4	—3.0	—2.7	—3.0	— 2.6	— 3.8
1908–09	— 5.3	— 5.7	— 7.6	— 8.8	—11.3	—10.5	— 9.4	—11.6	—3.2	—4.4	—5.5	— 6.8	— 5.9
1909–10	— 6.1	— 8.1	— 9.1	— 8.4	— 7.6	— 5.2	— 5.9	— 8.0	—3.7	—3.9	—2.1	— 2.1	— 1.9
1910–11	— 3.3	— 3.3	— 2.9	— 3.9	— 1.7	— 1.1	— 3.2	— 7.7	—1.8	— .8	— .3	— .6	— 1.1
1911–12	— 5.7	— 5.6	— 4.2	— 5.6	— 5.7	— 4.2	— 3.0	— 3.6	—1.7	—1.7	—2.1	— 2.8	— 4.4
1912–13	— 3.5	— 3.6	— 3.3	— 2.9	— 1.5	— .7	— .9	— .7	—1.5	—1.4	— .4	— .7	— .5
1913–14	...	— 2.9	— 3.6	— 4.8	— 5.4	— 5.1	— 5.7	— 9.4	...	...	— .5	— .4	— 1.2
1914–15	...	...	— 6.5[a]	—11.7	—17.1	—21.0	—17.4	—14.8	...	...	—7.8	— 8.5	— 4.1
1915–16	...	...	— 6.8	— 5.7	— 4.1	— 1.5	0	+ 1.2	...	...	—1.1[a]	— 1.5	+ .3
1916–17	—17.5	—17.0	—16.0	—18.0	—14.3	—15.9	—15.5	...	—8.1	—6.1	—6.5	—10.1	...
1920–21	...	...	...	...	...	...	—15.9	—21.9	...	...	...	...	...
1921–22	...	...	— 9.8	—11.0	—12.4	—12.9	—10.7	— 9.3	...	...	—4.9	— 5.0	— 3.9
1922–23	— 6.6	— 7.6	— 8.0	— 4.9	— 4.3	— 4.0	— 1.8	— 1.4	—2.6	—1.7	—1.5	— 1.7	— 1.3
1923–24	— 3.0	— 2.2	— 1.6	— 1.4	— .2	+ 1.1	+ 1.9	+ 1.9	— .8	— .1	+ .8	+ 1.0	+ .9
1924–25	—11.5	—12.1	—13.6	—13.5	—15.7	—11.2	— 7.9	— 8.5	—5.6	—6.7	—5.9	— 5.4	— 4.9
1925–26	...	—11.0	—13.0	—13.6	—11.7	—13.3	—14.0	—16.2	—4.3	—4.0	—3.6	— 3.7	— 2.5
1926–27	...	— 5.0	— 5.6	— 6.4	— 4.6	— 3.9	— 3.5	— 3.2	—2.3	—1.7	—1.7	— 1.1	— 1.9
1927–28	...	...	...	— 3.0	— 1.9	— 2.0	— .3	+ .8	...	...	—1.2	— 2.0	0
1928–29	...	...	...	+ 1.3	+ 1.6	+ 2.2	+ 3.5	+ 3.9	...	...	+1.3	+ 2.6	+ 3.7
1929–30	...	+ .2	+ .2	+ 1.0	+ .5	— 1.6	+ 1.7	+ .8	...	+1.9	+1.8	+ 2.8	+ 2.6
1930–31	+ .5	— 3.7	—17.0	—20.6	—18.8	—25.1	—24.8	—27.4	...	+ .3	0	— .9	— .2
1931–32	+ .8	— .6	— 2.3	— 1.3	+ 1.8	+ 3.3	+ 4.8	+ 3.2	+2.5	+2.7	+3.6	+ 3.9	+ 3.4
1932–33	+ 2.3	+ 2.2	+ .4	— .1	+ 1.3	+ .8[a]	+ 1.7	+ 1.8	+1.8	+2.4	+1.7[a]	+ 1.8	+ 1.5

* Computed, except as otherwise noted, by averaging for each month the price spread at the close on the second, third, and fourth Friday of each month (occasionally Thursday or Saturday) and dividing by corresponding averages of the closing price of May wheat. Original data compiled chiefly from the Chicago *Daily Trade Bulletin*. Dots (...) indicate absence of quotations in the later of the two futures paired except in May 1917, when trading in May wheat was discontinued May 11.

[a] Average for third and fourth Fridays only.

[b] Data for fourth Friday only.

TABLE II. — NUMBER OF TABULATED WEEKLY CHANGES IN MAY–JULY SPREAD AND PERCENTAGES OF POSSIBLE NUMBER, BY SPREAD CLASSES AND BY MONTHS*

Month	Number of weekly changes			Percentages of possible number		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
Oct.	8	47	15	3.6	20.9	6.7
Nov.	8	66	16	4.4	36.7	8.9
Dec.	18	86	29	10.0	47.8	16.1
Jan.	34	123	39	15.1	54.7	17.3
Feb.	52	84	36	28.9	46.7	20.0
Mar.	55	80	36	30.6	45.5	20.0
Apr.	70	75	35	38.9	41.7	19.4
May	94	78	50	41.8	34.7	22.2

* This table is provided to indicate the number of observations used in computing the statistics given under the same rubrics in Tables III–VI below. All data which could be found on weekly changes (generally Friday–Friday) in the price spread between May and July wheat, 1884–85 to 1932–33, were used except those for March 1930 and October–May 1930–31. Changes from the previous Friday to the last business day of May were counted as the last weekly change in each season. For convenience in assigning to months, changes were numbered in reverse order and assigned by number, four to each month except October, January, and May, which received five. Classification as described in note to Table III.

For most months the percentages add up to less than 100 per cent because in one year or more either May or July wheat was not quoted throughout the month.

TABLE III. — COEFFICIENTS OF CORRELATION BETWEEN WEEKLY CHANGES IN PRICES OF CHICAGO MAY AND JULY WHEAT FUTURES, BY SPREAD CLASSES AND BY MONTHS*

Month	Coefficients			Coefficients squared		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
Oct.	+1.000	+.889	+.812	.999	.791	.659
Nov.	+ .996	+.944	+.860	.992	.892	.740
Dec.	+ .998	+.924	+.925	.995	.854	.855
Jan.	+ .992	+.938	+.876	.984	.879	.768
Feb.	+ .985	+.923	+.925	.969	.852	.856
Mar.	+ .974	+.895	+.830	.948	.801	.688
Apr.	+ .962	+.917	+.877	.925	.840	.769
May	+ .985	+.760	+.559	.970	.578	.313

* Computed from the price data providing the basis for the May–July spreads and changes described in note to Table II. Assignment to spread classes was on the basis of relative position of the two prices at the end of each weekly change, as follows: Class 1, price of July wheat over that of May; Class 2, price of July wheat same as that of May or not more than 9 per cent below; Class 3, price of July wheat 9 per cent or more below that of May. The condition for Class 1 reflects expectation of a large surplus of wheat for carryover on July 1; for Classes 2 and 3, expectation of moderate and small carryover respectively, frequently indications of a corner or squeeze in May wheat.

TABLE IV. — COEFFICIENTS OF CORRELATION BETWEEN WEEKLY CHANGES IN MAY–JULY SPREAD AND CHANGES IN PRICES OF CHICAGO WHEAT FUTURES, BY SPREAD CLASSES AND BY MONTHS*

Month	With May future			With July future		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
Oct.	+.199	−.594	−.796	+.224	−.160	−.293
Nov.	+.154	−.426	−.441	+.242	−.104	+.078
Dec.	−.374	−.456	−.751	−.311	−.081	−.443
Jan.	−.440	−.502	−.812	−.322	−.170	−.431
Feb.	−.112	−.552	−.551	+.063	−.189	−.194
Mar.	−.276	−.390	−.807	−.050	+.062	−.340
Apr.	−.287	−.570	−.705	−.013	−.194	−.277
May	−.267	−.547	−.781	−.095	+.128	+.081

* Data and classification as described in notes to Tables II and III. These Pearsonian coefficients of correlation measure a different aspect of the relation between changes in May–July spread and changes in price than that reflected by the averages (regression coefficients) in Table V. Each coefficient indicates the proportion of the average total price change (by spread class and by month) that appears to be actually associated with changes in the May–July spread, and by inference suggests the relative importance of spread factors in determining price movements.

TABLE V.—AVERAGE CHANGES IN PRICE OF CHICAGO MAY WHEAT FOR EACH 1-CENT CHANGE IN MAY–JULY SPREAD, AND STANDARD ERRORS OF AVERAGES, BY SPREAD CLASSES AND BY MONTHS*

(Cents per bushel)

Month	Class 1	Class 2	Class 3
Oct.	+7.667±15.356	−1.282±.259	−1.303±.275
Nov.	+1.670± 4.383	−1.287±.342	− .862±.469
Dec.	−5.267± 3.270	−1.189±.253	−1.770±.300
Jan.	−3.260± 1.176	−1.423±.223	−1.522±.180
Feb.	− .638± .803	−1.410±.235	−1.425±.370
Mar.	−1.215± .579	− .871±.233	−1.359±.171
Apr.	−1.047± .423	−1.400±.234	−1.408±.247
May	−1.528± .575	− .835±.146	− .939±.108

* These averages are Pearsonian regression coefficients computed from the weekly changes in May–July spread and corresponding price changes described in notes to Tables II and III. Each average is preceded by a minus sign if a positive change in the spread (rise of July wheat *relative* to May) was accompanied on the average by an actual decline of the price of May wheat, as is most common; plus signs indicate the reverse relation. Plus-or-minus signs (±) separate averages from their standard errors.

Corresponding averages of changes in the price of July wheat may be obtained by adding 1.000 to each of the averages given above (for example, $-1.408 + 1.000 = -.408$, and $-.939 + 1.000 = +.061$).

TABLE VI.—STANDARD DEVIATIONS OF WEEKLY CHANGES IN MAY–JULY SPREAD AND IN PRICES OF MAY AND JULY WHEAT, BY SPREAD CLASSES AND BY MONTHS*

(*Cents per bushel*)

Month	May-July spread			May wheat price						July wheat price		
				Total			Partial					
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
Oct.	.097	.965	3.181	3.723	2.083	5.208	3.648	1.676	3.152	3.743	1.699	3.298
Nov.	.384	.722	2.729	4.172	2.180	5.337	4.122	1.972	4.790	4.248	1.984	4.806
Dec.	.216	.826	2.425	3.046	2.153	5.714	2.825	1.916	3.773	2.971	1.922	4.209
Jan.	.317	.736	3.212	2.348	2.084	6.021	2.108	1.802	3.514	2.227	1.829	3.893
Feb.	.327	.975	2.308	1.868	2.490	5.973	1.856	2.076	4.984	1.860	2.114	5.081
Mar.	.515	.870	3.583	2.260	1.946	6.037	2.172	1.792	3.566	2.174	1.796	3.793
Apr.	.794	1.672	4.692	2.893	4.103	9.372	2.771	3.371	6.647	2.770	3.435	6.916
May	.581	2.445	11.179	3.322	3.730	13.440	3.201	3.122	8.393	3.215	3.149	8.414

* Computed from data and with classification described in notes to Tables II and III (prices taken only for dates on which both May and July wheat were quoted). "Partial" price change as defined on p. 204. These standard deviations are averages of weekly change discussed in the text in Section III.

TABLE VII.—AVERAGES, BY WEEKS, OF SPREAD BETWEEN CHICAGO MAY AND JULY WHEAT FUTURES, OCTOBER–MAY, BY CLASSES OF YEARS*

Date	Classification by carryover						Classification by spread behavior				
	I	II	III a	III b	IV	All years[a]	A	B	C	D	All years[b]
Sept. 29	....	−2.46	−2.80	−13.95	− 7.09	....	+ .64	....	− 6.23	− 5.62	....
Oct. 6	− .22	−3.26	−2.20	−14.25	− 7.09	−4.15	− .06	−2.81	− 6.38	− 5.77	−2.87
13	− .27	−3.32	−4.57	−19.15	− 7.19	−5.36	+ .19	−3.67	− 7.63	− 7.87	−3.66
20	− .20	−3.30	−4.27	−19.75	− 8.14	−5.47	+ .29	−3.69	− 6.48	− 8.82	−3.73
27	− .23	−3.56	−4.39	−18.55	− 8.29	−5.43	− .11	−3.99	− 6.25	− 8.20	−3.81
Nov. 3	− .43	−3.88	−4.23	−18.65	− 7.29	−5.41	− .44	−4.23	− 6.35	− 7.32	−3.82
10	− .56	−3.92	−3.95	−19.58	− 8.34	−5.65	− .21	−4.39	− 6.08	− 8.12	−3.95
17	− .53	−3.54	−4.52	−20.21	− 7.51	−5.65	+ .42	−4.35	− 6.95	− 8.19	−3.82
24	− .86	−3.26	−4.89	−18.71	− 7.34	−5.53	+ .69	−4.82	− 5.97	− 7.86	−3.72
Dec. 1	− .76	−3.02	−4.89	−22.01	− 7.67	−5.91	+ .52	−4.88	− 7.49	− 8.19	−4.02
8	− .98	−3.38	−4.98	−22.06	− 8.60	−6.21	+ .30	−5.17	− 7.39	− 8.72	−4.30
15	− .91	−3.46	−5.25	−21.86	− 9.27	−6.33	+ .39	−5.26	− 7.47	− 8.96	−4.36
22	−1.41	−3.54	−5.49	−18.81	−10.29	−6.27	+ .44	−5.53	− 9.17	−10.67	−4.98
29	−1.14	−3.41	−5.45	−18.19	−10.81	−6.15	+ .41	−5.01	− 9.87	−10.99	−4.95
Jan. 5	−1.16	−3.27	−5.61	−17.24	−12.31	−6.22	+ .30	−4.82	− 9.72	−11.30	−4.97
12	− .95	−3.06	−5.37	−17.44	−13.51	−6.24	+ .40	−4.47	− 9.32	−12.14	−4.96
19	− .83	−2.60	−5.93	−17.56	−13.11	−6.18	+ .52	−4.73	− 8.30	−12.12	−4.91
26	−1.19	−2.34	−5.89	−17.34	−13.36	−6.20	+ .47	−4.77	− 7.35	−12.25	−4.88
Feb. 2	− .90	−1.90	−5.73	−19.44	−15.36	−6.51	+ .57	−4.35	− 6.83	−14.46	−5.13
9	− .68	−1.84	−5.84	−16.69	−16.06	−6.19	+ .62	−4.11	− 5.91	−14.47	−4.94
16	− .39	−1.59	−5.55	−17.74	−19.14	−6.52	+ .64	−3.87	− 6.11	−16.15	−5.24
23	+ .06	−1.34	−5.16	−19.76	−17.74	−6.33	+ .79	−3.25	− 7.41	−16.25	−5.13
Mar. 2	+ .26	− .96	−5.02	−19.71	−17.02	−6.05	+ .81	−2.83	− 7.19	−16.07	−4.92
9	+ .57	−1.10	−4.61	−16.56	−20.64	−5.98	+ .83	−2.57	− 8.19	−16.04	−4.91
16	+ .73	−1.36	−3.98	−15.68	−21.56	−5.87	+ .98	−2.33	− 7.67	−15.64	−4.64
23	+ .62	− .92	−4.31	−15.83	−21.76	−5.90	+1.07	−2.40	− 7.67	−16.50	−4.82
30	+ .91	− .22	−4.50	−14.38	−22.08	−5.54	+1.31	−2.05	− 8.02	−15.86	−4.52
Apr. 6	+1.20	− .42	−4.60	−12.50	−23.53	−5.49	+1.45	−2.03	− 8.07	−14.62	−4.19
13	+1.41	− .70	−4.00	−13.62	−22.13	−5.33	+1.63	−1.69	− 9.32	−14.05	−4.01
20	+1.72	− .44	−4.70	−13.04	−21.21	−5.15	+1.74	−1.58	− 7.17	−14.36	−3.80
27	+2.06	− .29	−4.46	−13.66	−17.83	−4.61	+1.85	−1.32	− 7.45	−12.13	−3.21
May 4	+2.05	− .73	−6.12	−12.66	−23.98	−5.77	+1.84	−1.63	− 9.77	−14.64	−4.10
11	+1.83	− .89	−6.71	−15.28	−23.23	−6.24	+1.67	−2.17	− 9.75	−15.84	−4.60
18	+1.68	− .93	−7.24	−15.58	−21.63	−6.24	+1.47	−2.49	− 9.97	−15.20	−4.66
25	+1.64	−1.62	−7.10	−12.68	−27.85	−6.83	+1.31	−2.30	−12.35	−16.42	−5.15
31	+1.68	−1.12	−6.69	− 6.80	−18.00	−4.57	+1.32	− .26	−15.45	− 9.39	−3.21

* Based on closing prices on Fridays (occasionally Thursdays or Saturdays) nearest dates indicated, compiled chiefly from the Chicago *Daily Trade Bulletin*. Classifications as described on pp. 206 and 208.

[a] Averages for years from 1895–96 only; means of group averages weighted by number of years in group.

[b] Averages for years from 1884–85; means of group averages weighted by number of years in group.

TABLE VIII.—AVERAGES, BY WEEKS, OF PRICE OF CHICAGO MAY WHEAT, OCTOBER–MAY, BY CLASSES OF YEARS*

Date	Classification by carryover						Classification by spread behavior				
	I	II	III a	III b	IV	All years[a]	A	B	C	D	All years[b]
Sept. 29	77.1	98.6	89.4	138.2	104.3	96.8	82.4	94.0	106.4	109.4	94.6
Oct. 6	77.3	99.4	89.8	136.5	104.8	97.0	82.1	94.7	108.7	110.7	95.3
13	78.5	100.0	91.7	139.2	106.0	98.4	81.8	96.7	108.9	111.7	96.1
20	77.8	98.4	91.0	139.2	108.2	97.9	80.6	96.5	106.6	111.8	95.4
27	78.0	99.1	90.6	137.6	108.1	97.9	80.3	97.0	106.6	111.2	95.4
Nov. 3	78.8	98.4	90.3	136.2	107.5	97.6	80.1	97.8	105.8	110.1	95.2
10	77.5	98.7	90.0	138.7	108.5	97.7	79.9	96.7	106.0	111.9	95.2
17	77.1	98.4	90.3	140.9	108.1	97.8	79.7	95.9	108.8	112.0	95.2
24	76.1	98.0	91.1	143.7	107.5	97.9	78.9	96.0	109.4	111.6	94.9
Dec. 1	76.9	98.2	91.2	147.7	108.2	98.8	79.4	96.6	112.0	112.7	95.7
8	77.1	98.8	90.9	145.0	107.3	98.5	79.7	96.3	110.3	111.6	95.3
15	77.6	98.7	91.9	146.5	108.2	99.1	78.6	97.5	109.7	112.8	95.6
22	78.1	98.5	92.8	152.0	110.7	100.4	78.0	98.3	113.8	114.9	96.5
29	78.0	98.9	93.1	153.3	110.9	100.8	78.1	98.1	115.1	114.9	96.6
Jan. 5	77.6	100.0	93.8	151.3	113.9	101.2	78.7	97.7	116.4	115.6	97.0
12	78.4	100.4	93.3	151.4	114.3	101.5	78.9	97.7	116.4	115.8	97.1
19	79.8	99.4	93.8	152.6	114.6	101.9	78.4	98.6	114.0	116.9	97.2
26	82.9	98.6	93.6	156.8	117.3	103.4	79.1	98.9	113.3	119.3	98.0
Feb. 2	81.6	98.5	92.9	161.9	121.5	104.0	78.5	98.6	111.4	123.4	98.4
9	81.4	98.5	93.8	157.1	121.8	103.6	78.4	98.7	110.0	122.9	98.2
16	82.2	97.8	94.0	156.8	125.1	104.1	78.2	99.7	107.2	124.7	98.6
23	80.5	97.7	94.2	158.4	122.5	103.5	78.1	98.6	106.0	125.0	98.1
Mar. 2	79.6	97.5	94.4	160.9	118.5	103.1	77.7	97.7	106.6	124.6	97.6
9	78.4	97.4	93.3	155.6	122.5	102.3	77.7	96.5	108.0	123.0	97.0
16	77.4	96.9	91.9	150.3	123.2	101.0	77.5	95.3	105.8	121.0	95.9
23	76.6	96.6	92.5	148.7	120.8	100.4	76.1	95.4	105.4	120.4	95.3
30	77.8	95.4	92.1	145.1	122.6	100.0	76.2	95.6	103.8	120.1	95.2
Apr. 6	78.3	95.7	90.6	140.5	125.5	99.7	75.8	96.1	104.6	117.6	94.7
13	80.5	97.9	90.8	146.3	128.0	101.9	77.3	97.4	106.3	120.4	96.4
20	79.6	98.6	92.5	148.4	127.3	102.5	78.1	97.9	104.6	122.2	97.1
27	78.4	100.2	93.3	148.8	123.7	102.3	78.0	98.3	105.9	119.8	96.8
May 4	79.0	99.7	94.8	149.6	132.2	103.9	79.3	97.9	107.6	123.8	98.2
11	78.6	98.7	96.4	153.7	130.8	104.2	78.8	97.5	109.0	126.1	98.5
18	79.8	98.3	95.6	153.5	131.9	104.4	80.0	98.2	107.3	125.2	98.8
25	79.6	99.7	94.6	154.2	138.0	105.3	80.3	98.4	110.0	126.8	99.6
31	78.2	97.9	93.6	148.5	124.8	101.8	78.9	95.2	112.3	118.8	96.5

* See corresponding note to Table VII.

[a] Averages as described in corresponding note to Table VII.

[b] See corresponding note to Table VII.

TABLE IX.—TOTAL WHEAT CARRYOVER IN THE UNITED STATES, JULY 1, AND PERCENTAGE SPREAD BETWEEN CHICAGO JULY AND SEPTEMBER WHEAT IN JUNE, 1896–1917 AND 1921–33*

(Million bushels; percentages of price of July wheat)

Year	Carry-over	July-Sept. spread	Year	Carry-over	July-Sept. spread	Year	Carry-over	July-Sept. spread	Year	Carry-over	July-Sept. spread
1896	175.2	+ 1.5	1905	78.1	—5.3	1914	109.5	— 1.2	1925	113.8	—1.3
1897	100.4	— 7.5	1906	139.7	— .2	1915	69.7	— 1.9	1926	105.0	—2.5
1898	58.7	—11.3	1907	192.4	+3.2	1916	226.3	+ 2.1	1927	117.9	—1.4
1899	195.8	+ 1.8	1908	95.5	—1.9	1917	52.8	—12.5	1928	120.3	+1.2
1900	188.2	+ 2.0	1909	59.8	—5.4				1929	241.8	+4.2
1901	134.2	— .6	1910	110.1	—2.1	1921	129.4	— 7.8	1930	302.9	+3.1
1902	130.4	— 1.8	1911	126.0	— .6	1922	116.6	+ .2	1931	324.0	+1.0
1903	109.7	— 3.1	1912	104.6	—2.4	1923	145.7	— 1.2	1932	382.1	+5.2
1904	106.3	— 5.3	1913	130.5	0	1924	142.5	+ 1.5	1933	385.9	+2.7

* Average July–September spreads computed as for Table I except that percentages are in terms of price of July wheat instead of price of May. Data for July 1 carryover, 1896–1921, from WHEAT STUDIES, IV, 180; for 1922–33, from WHEAT STUDIES, X, 135.

ANALYTICAL INDEX*

TEXT

* The character of this study, together with space limitations, has necessitated treatment of some important topics only in the form of scattered incidental comments. An index is accordingly included with this issue, in order to facilitate effective use of discussions that have been thus scattered. The index will be repeated in the customary general index to be issued after Volume X is complete.

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