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WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

VOL. X, NO. 2 (Price $1.00) NOVEMBER 1933

PRICE LEADERSHIP AND INTERACTION AMONG MAJOR WHEAT FUTURES MARKETS

THE real character of price leadership and price interaction among major wheat markets of the world is a phase of price behavior which heretofore has received scarcely any systematic investigation. In the absence of definite information on such matters, it has been necessary to rely largely upon personal impressions and opinions. Here are presented the results of a detailed investigation of price leadership and interaction among Chicago, Winnipeg, and Liverpool for the seven years 1924–31. These results call for revision of many opinions which are widely held.

From an analysis of initial changes and responses, it is found that Chicago and Winnipeg "originate" approximately two-thirds of all price movements, and Liverpool only about one-third. Thus Chicago and Winnipeg are definitely the more active in directing the general course of prices. They tend to be more active and influential price leaders in summer than in winter months. Liverpool tends to be a somewhat more active and influential leader in winter than in summer months. In general, Liverpool is a less volatile and less sensitive market than Chicago or Winnipeg. Its price movements usually correspond more closely with those of Winnipeg than with those of Chicago.

In the data examined there could be found no evidence of a fundamental bearish tendency in Liverpool or of a fundamental bullish tendency in Chicago and Winnipeg, such as is occasionally supposed to exist. Also, it appears that when prices in North American markets are above export parity their movements remain closely related to price movements in other markets. The maintenance of prices at such heights seems to have no significant effect upon the price interaction between markets or on the correspondence of Liverpool and North American price changes over brief intervals.

STANFORD UNIVERSITY, CALIFORNIA

November 1933

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Entered as second-class matter February 11, 1925, at the Post Office at Palo Alto, Stanford University Branch, California, under the Act of August 24, 1912.

Published by Stanford University for the Food Research Institute.

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PRICE LEADERSHIP AND INTERACTION AMONG MAJOR WHEAT FUTURES MARKETS

This study presents results of an investigation of a neglected phase of price behavior. It is concerned primarily with price leadership and interaction in the development of interrelated price movements in the three principal wheat markets of the world—Chicago, Winnipeg, and Liverpool. Its immediate purpose is to set forth the character of price interaction among these markets in the recording of price movements, and to provide a reliable indication of the price independence and leadership of Liverpool as compared with that of the two North American markets. The broader objective is a clarification of the rôles played by these markets in recording price changes, as a basis for a more adequate understanding of the character and significance of broad general price movements.

CONTENTS

Assumptions regarding interaction and leadership are often made in the analysis of price movements. Yet only the most general sort of information on the subject has heretofore been available. On the specific rôles of individual markets in initiating and recording price movements, there has existed little more than a wide range of unsubstantiated and even contradictory opinions.

It is generally recognized, for instance, that, owing to the extensive international commerce in grain, rapid communication, intermarket trading, and speculation, wheat prices in these and other widely scattered markets are closely interrelated. It is equally well known that price changes in any of the principal markets tend promptly to induce price changes directly or indirectly in the others, that among distant markets there is a good deal of price interaction, and that as a result of this interaction a broad similarity of their price movements obtains. But surprisingly little is known of the real origin and development of the movements commonly studied.

The familiar line of reasoning is fundamentally that movements which reflect independent price changes in given markets (assuming no change in shipping costs) must be followed by readjusting responses in other markets if the new prices are to be sustained; otherwise, price corrections or rectifying changes must eventually develop in the market of original movement. Independent movements, consequently, tend to create abnormal price spreads, while readjusting responses in other markets and rectifying changes in the market of original movement tend to restore spreads to normal dimensions and thus bring prices back "into line."

Such reasoning gives no clue, however, as to just where these independent leading movements actually originate. The predominant view is that independent changes originate in many markets and even in several simultaneously. Explicit adherence to the belief that price movements emanate from a single market is not common. Yet those who deny the soundness of this view at one time often support it at another. With respect to the specific rôles of individual markets—and particularly of the three principal markets —in initiating movements and in price-making generally, current opinions are markedly divergent and contradictory.

In the literature one finds broad statements to the effect that Liverpool prices "lead" the world, or that they "dominate," "fix," or "determine" prices elsewhere. Similar ideas are often implied when not explicitly stated. With scarcely more support for the opinion, Chicago and Winnipeg are occasionally given credit for the same important accomplishment. Others have said that these markets record prices which merely reflect prevailing

"world" prices established at Liverpool, with the implication (whether intended or not) that the North American markets passively follow Liverpool movements, but actively originate none, or at most none of importance. In recent years it has been said that Chicago has suffered a loss of former "leadership and buoyancy" which sustained prices in periods of stress and excessively reflected bullish items. Some have gone so far as to hold that bearishness originates in Liverpool and bullishness in Chicago and Winnipeg. A few have supposed that export markets originate most movements, and that import markets serve as arbiters in the character of their response.

This diversity of opinion indicates clearly the need of a systematic investigation of this complex question, especially for the three major wheat markets—Chicago, Winnipeg, and Liverpool. Such an investigation is undertaken in this study through the analysis of changes in representative futures prices in these three markets during the seven-year period from May 1, 1924, to April 30, 1931.

Very few attempts to determine relative leadership among these markets have hitherto been made. There is no study which furnishes entirely reliable conclusions. The field, therefore, remains open for major contributions of substantial importance to price theory and price analysis and of considerable interest to wheat traders. To make some of these contributions is the purpose of the present investigation.

The principal conclusions reached are summarized at the end of each section. There one will find brief discussions of the flexible price relationship among the three markets (pp. 44–45), the way in which major movements develop (pp. 49–50), price leadership as between the North American markets and Liverpool (pp. 61–63), and the degree of relationship between their price movements in different seasons and when North American prices are above export parity (pp. 68–69). Of these, the last two are perhaps of greatest interest, since they present the main conclusions of the study.

I. THE BASIS OF ANALYSIS

Segregation of Related Changes

The problem of determining to what extent the North American markets and Liverpool influence and lead one another is fundamentally one that requires the identification, segregation, and analysis of three types of price changes: (1) independent or initial price changes in each market; (2) the related price responses in the other markets induced by these initial changes; and (3) the rectifying changes which may follow in the market of original movement.

Two major difficulties are ordinarily encountered in the identification of these three types of price changes in a given market or of related changes in different markets. The first arises out of the fact that the three types of price changes usually occur in combination and not separately. The second arises out of the fact that it is difficult to determine precisely what influences are responsible for given price changes which may appear to qualify as of one type or another. Even under the most favorable conditions no more than an approximate classification of changes into these three categories can be made.

Between markets having simultaneous trading sessions and a free and virtually continuous inter-market flow of news, such for instance as Chicago and Winnipeg, there is constant price interaction, and even an approximate classification of price changes is exceedingly difficult. For this reason no analysis of leadership as between Chicago and Winnipeg is attempted here. But as between Chicago and Liverpool or Winnipeg and Liverpool the price interaction is considerably less complicated because the trading sessions in these markets are largely non-simultaneous. The Liverpool session opens several hours earlier than the Chicago and Winnipeg sessions; it closes several hours before they close, and the three sessions overlap only during the first hour of trading in Chicago and Winnipeg. This permits the recording of independent price changes in Liverpool before the North American markets open for trad-

ing, and in the North American markets after Liverpool closes, which cannot be reflected in the closed markets until the opening of a subsequent trading session. Opening prices in Liverpool tend to respond to the previous closing prices in Chicago and Winnipeg and to reflect the initial changes embodied in those prices. Opening prices in the North American markets tend to respond to current prices in Liverpool and to reflect initial changes there. Price changes during the brief interval of simultaneous trading tend to interact in more complex fashion. As between the North American markets on the one hand and Liverpool on the other, then, the changes over these three intervals provide a basis for at least an approximate segregation of initial changes and responses, and consequently a promising basis for investigating leadership and interaction between those markets.

More precisely, the movements within, or the net changes during, that portion of the Liverpool session when North American markets are closed and that portion of the Chicago and Winnipeg sessions when Liverpool is closed may be regarded as mainly, if not entirely, independent or leading movements; that is, changes due to factors not yet discounted in the closed market(s). On the other hand, overnight changes in the North American markets and Liverpool may be taken as representing principally dependent movements, or price responses to the above-mentioned independent or leading movements in the opposite markets, and to some extent initial changes reflecting local developments and overnight news not previously discounted.[1] The changes during the interval of overlapping sessions are more intricately related, and their classification is more difficult because the leadership is obscured by interaction. But the changes are in some cases obviously reactions to opening prices, and upon analysis an appraisal of their relative independence or dependence can usually be made.

It is recognized that the changes over these three intervals do not furnish as refined evidence of initial movements and responses as might be desired. The late-session changes in Chicago and Winnipeg and the early-session changes in Liverpool doubtless often over- or understate the actual independent changes. The overnight changes likewise often over- or understate the actual response to or influence of these "independent" changes, because of delayed reactions or the modifying influence of auxiliary or compensatory factors. The changes during the period of simultaneous trading in all markets are even more complex sums of interrelated changes recorded wholly within the interval and reactions to the opening prices of Chicago and Winnipeg.[2] To these difficulties are added further complications arising out of differences in the amount of movement and volatility of markets, and out of variations in shipping differentials and "normal" inter-

[1] It is this well-known tendency of Liverpool to reflect North American price changes at the opening which is the basis of the common practice of calculating its hypothetical opening or "due" price. This "due" price is calculated on the basis of the net change between 10:30 or 11:30 (Broomhall uses 11:30) and the close at Chicago or Winnipeg. This change is expected to be followed more or less, depending upon local conditions and overnight news in Liverpool.

[2] It will be noted that this investigation is restricted to Chicago, Winnipeg, and Liverpool, while price interaction is not restricted to these three markets. Of course, Chicago and Winnipeg are influenced directly by other markets than Liverpool, and Liverpool is influenced directly by other markets than Chicago and Winnipeg. But there is no doubt that these three markets are influenced principally by one another. The predominant consideration which traders in each of these markets give to prices in the other two supports the view that as a rule the smaller North American markets exert most of their influence on Liverpool indirectly through Chicago and Winnipeg prices, and that the smaller European markets exert much or most of their influence on North American markets indirectly through Liverpool prices. To some extent, then, the direct influence of these markets on one another represents the indirect influence of smaller markets. Moreover, in addition to the direct influence of smaller European and North American markets, each of the major markets is to some degree influenced directly by Buenos Aires, and other Southern Hemisphere markets. In this analysis, however, the direct and indirect interaction with other markets may usually be ignored. In other words, we may consider the apparent interaction and leadership between Chicago and Liverpool, or between Winnipeg and Liverpool, as though it all resulted from the direct influence of these markets on each other without regard to influences from elsewhere. The result will be only a slight overstatement of the total independence of each market and the influence of each market on the others for which allowance can be made.

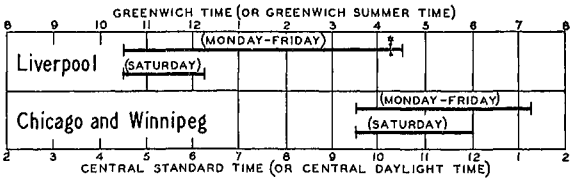
market spreads. In spite of these limitations, however, the price changes in these three intervals offer the most convenient and satisfactory basis yet discovered for investigating the interaction, leadership, and interrelated development of price movements in these markets.[1]

To obtain a more definite idea of the nature of the price changes to be studied, it is advisable to consider briefly the trading hours in the three markets, the exact intervals for which the price changes are to be computed, and the character of the basic data to be used.

Trading Hours

The official hours for trading in futures contracts in Chicago, Winnipeg, and Liverpool are exhibited in Chart 1. In Chicago and Winnipeg, as in most North American markets, the trading sessions run from 9:30 A.M. to 1:15 P.M., Central Standard Time (Chicago time), except on Saturday, when they close at 12: 00 noon. The Liverpool trading is between 10: 30 A.M. and 4: 30 P.M. (changed from 4: 15 P.M. on October 20, 1930), except for the close on Saturday at 12: 15 P.M., Greenwich Time. Chicago time is six hours later than Liverpool (Greenwich) Time. Translated into Chicago time, the Liverpool sessions occur between 4: 30 and 10: 30 A.M., except on Saturday when the close is at 6: 15 A.M. The Chicago and Winnipeg sessions comprise three and three-fourths hours, except on Saturday. The Liverpool session covers a time span of six hours, of which five hours precede the Chicago and Winnipeg sessions and one hour is concurrent with them. (Previous to October 20, 1930, the session covered five and three-quarters hours, and the overlapping period was three-quarters of an hour.)

Chart 1.—Official Hours of Trading in Liverpool, Chicago, and Winnipeg



* Liverpool closed at 4:15 P.M. before October 20, 1930.

During the summer months clocks are moved up one hour in Chicago and Liverpool, and the nominal trading hours remain the same. In Winnipeg, where standard time is retained during the summer, the trading sessions are advanced one hour in the summer to correspond with the trading hours at Chicago. The relationship is, therefore, uniform throughout the year, except occasionally during brief periods in April and September when slight changes are made in Liverpool in case the three markets transfer to or from summer time in different weeks.[2]

In general, as these hours indicate, Liverpool is open from 4: 30 to 9: 30 A.M. Chicago time, before the Chicago and Winnipeg markets open, and from 9: 30 to 10: 30 (10: 15 before October 20, 1930) while the latter are open. The sessions in Chicago and Winnipeg continue, however, from 10: 30 to 1: 15 P.M. while Liverpool is closed. On Saturday Liverpool is open only from 4: 30 to 6: 15 A.M. Chicago time, and Chicago and Winnipeg from 9: 30 to 12: 00 noon, so that there is no period of concurrent trading.[3]

Intervals

For reasons to be discussed later, it is necessary to employ price changes over the

[1] This general method of analyzing price changes differs only in detail from that developed by Dr. Holbrook Working and first employed in Wheat Studies, May 1930, VI, 311–13.

[2] Liverpool occasionally goes on or off summer time one week before or after Chicago; in such an event, trading hours in that market are usually adapted for the week so as to have an overlapping of a half-hour or more with the Chicago session. Winnipeg customarily shifts to and from summer hours with Chicago.

[3] Although Buenos Aires price movements are not investigated in this study, some statement of the trading hours in that market is called for because of the influence of its prices on those of Northern Hemisphere markets. The trading session in Buenos Aires ordinarily occurs in two periods, the exact hours of which have been slightly changed several times in the past nine years. At present, the trading occurs between the hours of 10:00 and 12:00 and 15:00 and 17:00, Buenos Aires time, except on Saturday when there is no afternoon session. Buenos Aires clocks run four hours behind those of Liverpool, and two hours ahead of those in Chicago. Hence, the market is open from 2:00 to 4:00 and 7:00 to 9:00 P.M. Liverpool time and from 8:00 to 10:00 A.M. and 1:00 to 3:00 P.M. Chicago time.

approximate rather than the exact intervals of simultaneous and non-simultaneous trading in Liverpool and the North American markets. For convenience, the three intervals selected will be designated as First, Second, and Third. For the same reason, the net price changes will be designated according to their time of occurrence and character, as primary, secondary, and contemporary.

The First Interval constitutes for Chicago and Winnipeg the approximate period of trading in Chicago and Winnipeg after the Liverpool market closes; for Liverpool it is the period between the closing and opening in that market. The Second Interval constitutes for Liverpool the approximate period of trading in Liverpool before Chicago and Winnipeg open for trading; for Chicago and Winnipeg it is the period between their closing and opening. The Third Interval is roughly the period of simultaneous trading in the latter part of the Liverpool session and the early part of the Chicago and Winnipeg sessions.

The net price changes during the First Interval in Chicago and Winnipeg, being predominantly independent movements, are designated as primary changes, while the related overnight or First-Interval changes in Liverpool, which tend to reflect these movements, are named secondary changes. The Second-Interval changes in Liverpool are the primary changes for that market, while the related overnight or Second-Interval changes in Chicago and Winnipeg, which tend to reflect these earlier movements in Liverpool, are called secondary changes. Thus, primary changes tend to be initial changes while secondary changes are the overnight responses.

The changes designated as contemporary are those recorded in the Third Interval in each market. They are not entirely contemporary movements. They are the price changes recorded in Liverpool during approximately the last two and one-quarter hours of trading and in Chicago and Winnipeg during approximately the first hour and a quarter of trading, only one hour of which is simultaneous with the period in Liverpool. Since these changes are to a considerable extent simultaneous, the fact needs to be indicated. For this reason we have designated them as contemporary changes.

These intervals and changes may be indicated still more definitely in terms of the exact hours of their occurrence. These hours are presented in Table 1 (p. 40). In addition to the qualifying footnotes to Table 1, a few brief explanatory comments are useful.

The First and Third Intervals are slightly different before and after October 20, 1930, because of the change in the Liverpool closing time from 4:15 to 4:30 on that date.

When a holiday occurs during the week, it is necessary to extend the First Interval in Liverpool and the Second Interval in Chicago and Winnipeg from the close on the preceding business day to the opening on the next business day.

The Third Intervals in Chicago and Winnipeg are extended fifteen minutes beyond the Liverpool close to allow for the transmission of the Liverpool closing cable and a response to it. On this account also the First Interval in Chicago and Winnipeg is begun fifteen minutes after the Liverpool close.

The period of trading in Liverpool during which there is no trading in Chicago and Winnipeg ordinarily extends from the opening at 10:30 to 3:30 Liverpool time. The only recorded prices available to us, however, are the 2:15 prices which are cabled to Chicago.[1] For this reason we are obliged to adopt as the Second Interval for Liverpool—the interval of primary change—the period from 10:30 (the opening) to 2:15 on Monday to Friday, and from 10:30 to the close at 12:15 on Saturday. The lack of later prices is only a minor defect, for as a rule there appears to be little movement in the afternoon until the cables of opening prices from Chicago and Winnipeg are received.

Since the Third Interval in Liverpool must be taken as the period from 2:15 to the close

[1] We are indebted to the Chicago office of the Grain Futures Administration for permitting us to compile most of these data from their almost unique record, and to the Chicago Board of Trade for the more recent quotations. During brief periods in the last seven years, the records include 2:30, 3:00, or 3:15 o'clock prices instead of the 2:15. They are invariably prices received before the Chicago and Winnipeg opening, however, and hence adequately serve our purpose.

(on Monday to Friday), it is only partially simultaneous with the shorter Third Interval in Chicago and Winnipeg, which begins an hour and a quarter after the Liverpool interval, is simultaneous with it for three-quarters of an hour or an hour, and extends beyond the Liverpool close by fifteen minutes. It will be noted that on Saturday there is no Third Interval, for on that day the sessions do not overlap.

TABLE 1.—DURATION OF FIRST, SECOND, AND THIRD INTERVALS IN LIVERPOOL, CHICAGO, AND WINNIPEG

Place and date	First Interval	Second Interval	Third Interval
	Greenwich Standard or Greenwich Summer Time		
Liverpool*	*(Secondary change)*	*(Primary change)*	*(Contemporary change)*
Before Oct. 20, 1930...	Close (4:15 on Monday–Friday, 12:15 on Saturday) to open (10:30) on next business day.	Open (10:30) to 2:15 on Monday–Friday, and open (10:30) to close (12:15) on Saturday.	2:15 to close (4:15) on Monday–Friday.
After Oct. 20, 1930....	Close (4:30 on Monday–Friday, 12:15 on Saturday) to open (10:30) on next business day.	Open (10:30) to 2:15 on Monday–Friday, and open (10:30) to close (12:15) on Saturday.	2:15 to close (4:30) on Monday–Friday.
	Central Standard or Central Summer Time		
Chicago and Winnipeg†	*(Primary change)*	*(Secondary change)*	*(Contemporary change)*
Before Oct. 20, 1930...	10:30 to close (1:15) on Monday–Friday, and open (9:30) to close (12:00) on Saturday.	Close (1:15 on Monday–Friday, 12:00 on Saturday) to open (9:30) on next business day.	Open (9:30) to 10:30 on Monday–Friday.
After Oct. 20, 1930....	10:45 to close (1:15) on Monday–Friday and open (9:30) to close (12:00) on Saturday.	Close (1:15 on Monday–Friday, 12:00 on Saturday) to open (9:30) on next business day.	Open (9:30) to 10:45 on Monday–Friday.

* In this statement 2:15 is indicated throughout as the dividing time for the two session intervals. Actually for brief periods, because of a lack of these prices, 2:30, 3:00, or 3:15 prices are employed instead, and the duration of the periods is thereby changed.

† During Summer Time in Chicago, the Winnipeg trading session occurs one hour earlier, hence the intervals in that market during the summer months are one hour earlier than here indicated.

THE DATA

Daily closing prices of wheat futures and net price changes over the First, Second, and Third Intervals just described constitute the basic evidence to be presented and interpreted in this study. These data are shown by twelve-month periods in Plates I to VII, following page 50.

The prices employed are of prominent futures. The year selected is May 1 to April 30. In order to present for each year a homogeneous price series reflecting chiefly the influences of a given crop, we usually employ for Chicago the September future from May to August inclusive and the May future from September to April, and for Winnipeg and Liverpool the October futures from May to September inclusive and the May futures from October to April.[1] These prices, it will be noted, are for contracts which hold the position of dominant futures during a good deal of the period and of prominent futures during the remainder. To have used the

[1] For Chicago, there are exceptions in 1927, when the September future is employed till September 21, and in 1930–31, when the July future is substituted for the May from October 8 to April 30. For Winnipeg and Liverpool, the May futures are used in 1926–27 from September 6, and for Liverpool, the December futures are employed during October 1 to November 13, 1924, and October 1 to 28, 1925, when May futures were not quoted.

dominant futures throughout would have involved frequent switching from one future to another. This would have introduced a needless complication and no material improvement, or indeed any significant change, in the general results.

To provide a clear view of the price movements in these futures and of their development, Plates I to VII are designed to exhibit (*A*) daily closing prices and (*B*) cumulated totals of the price changes in each market during the First, Second, and Third Intervals, respectively. The cumulated price changes in the First Interval include the primary changes in Chicago, the primary changes in Winnipeg, and the related secondary changes in Liverpool; in the Second Interval they include the primary changes in Liverpool and the related secondary changes in Chicago and Winnipeg; in the Third Interval they include the contemporary changes in Chicago, in Winnipeg, and in Liverpool. For convenience primary changes are designated by heavy curves and the related secondary changes by less conspicuous lines.

These interval changes are cumulated to permit a more ready comparison with the daily closing prices. The closing prices may in fact be regarded as cumulated totals of daily changes added to the first price in the series. Comparison of the price curve with the curves of cumulated interval changes, therefore, reveals almost at a glance how and when the general price movements actually developed. All that is necessary for such a view is to compare the movements recorded in the three intervals during the period of a given general movement and the movement itself as recorded in closing prices. If a general movement is recorded largely in one interval, the cumulated changes in that interval will usually resemble closely the price movement as exhibited by closing prices. If it is recorded in two or more intervals, the comparison will show the extent of the contribution in each.

The cumulated totals shown in these plates are calculated by adding algebraically the successive interval changes for each year from May 1 to the following April 30. Hence each point on the cumulated curves represents, for the corresponding day, the net change (algebraic sum of net changes recorded daily) in prices that has occurred in that interval since the beginning of May. Moreover, the algebraic sum of the three cumulated totals for any market on any day is equivalent to the net price change for the selected market between the date taken and the preceding May 1. When a switch from one future to another occurs during the year, the curve of secondary changes shows a break representing the difference between the closing price of the expiring future and the opening price of the new future. Such changes are designated on the charts by X's. Occasionally they produce abrupt breaks in the curve, raising or lowering its level for the remainder of the year. For the interpretation of these charts in conjunction with the analysis of particular movements, the general level of the cumulated curves is of less importance than the movements they exhibit during the period considered. This must be kept in mind in studying them.

With these introductory remarks regarding the basis of analysis and the nature of the price data to be used, we may proceed to our consideration of the data as shown graphically by the charts and quantitatively by the amounts of change summarized in various tabulations below.

II. PRICE RELATIONSHIPS IN THE MAJOR MOVEMENTS

Among the price characteristics of these markets which give some clue to the interrelated price behavior of Chicago, Winnipeg, and Liverpool are certain important intermarket relationships between their daily changes and larger movements.

In considering these and other relationships it is necessary to employ some precise definition of what constitutes a "large price movement" so that the characteristics of market relationships in such movements may be examined quantitatively. For this purpose "large price movements" are defined as fairly continuous price movements occurring simul-

taneously in the three markets and amounting to ten cents or more in at least two of the three markets. Such movements are hereafter designated as major movements, that term being reserved exclusively for use in the specific sense of price movements of the character described. When the direction of major movements is to be indicated, a major upward movement is designated as a major advance and a major downward movement as a major decline.

In most cases the major advances are followed immediately by major declines, and major declines are followed immediately by major advances. Occasionally, however, two major advances or two major declines of markedly different trend occur in succession. Occasionally, too, a major advance or a major decline is followed by relatively stable prices for a period of a few weeks or several months. The price changes in these intervening periods of relative price stability are designated for convenience as minor movements. In most of the subsequent analyses these minor movements may be ignored.

With this terminology in mind, the charts of daily closing prices may be considered for the purpose of studying inter-market price relationships in the major movements.

Similarity of Movements

Considering first the course of daily closing prices in the seven years shown in Section A of Plates I to VII, it appears that all of the large general movements and most of the small movements are reflected in more or less equal degree in all three markets. A careful inspection of the movements in each year reveals differences in the extent of individual movements both large and small, but rarely can a movement be found in one market that is not in some degree reflected in the other two.

This is well illustrated by the movements of 1924–25 shown in Plate I. In this year Winnipeg prices rose from a level about 5 cents below Chicago and 17 cents below Liverpool in May to a level above Chicago by July and above Liverpool by January. They were back to the Chicago level by late March. The most conspicuous differences in the extent of the movements in the three markets appear during July–October and December–March; but throughout the whole period the Winnipeg movements from day to day, from week to week, and from month to month had their counterpart in both Chicago and Liverpool. Similar conditions are to be found in the other years.

This near-parallelism of large and small movements is one of the most striking characteristics of prices in these markets. It is particularly significant in connection with this study because it reflects the close interrelationship, interdependence, and prompt interaction which exists among Chicago, Winnipeg, and Liverpool prices.

Inequality of Movements

The second striking characteristic of these prices is the difference in the amplitude of the major swings in the different markets. The charts show clearly that the major movements are sometimes larger in Winnipeg than in Chicago, sometimes larger in Chicago than in Winnipeg, and frequently larger in these two markets than in Liverpool. These unequal movements indicate differences in the volatility of the markets and some degree of price independence; they imply differences in the rôles of these markets in price-making, particularly as between Chicago and Winnipeg on the one hand and Liverpool on the other.

In this inequality of movements there appears the general characteristic that during major advances Liverpool prices tend to rise less than Chicago and Winnipeg prices, and the spreads to narrow; while during major recessions Liverpool prices tend to fall less, and the spreads to widen. The facts are conveniently summarized in the following tabulation, which exhibits for the seven years 1924–31 the number of cases in which the Chicago–Liverpool and Winnipeg–Liverpool spreads widened or narrowed during major advances, and during major declines. According to these figures, the tendency for spreads to narrow in major advances and to widen in major declines is very pronounced

as between Winnipeg and Liverpool. The same tendency as between Chicago and Liverpool is only slightly less pronounced.

Cases	Chicago–Liverpool		Winnipeg–Liverpool	
	Advances	Declines	Advances	Declines
Total	26	28[a]	26	28
Spreads narrowed	19	3	24	5
Spreads widened	7	24	2	23

[a] In one decline the spread was unchanged.

In some of these cases the changes in spreads were small and not particularly significant; but in a large number of them the spreads narrowed conspicuously during major advances and widened conspicuously during major declines. Classifying changes in spread of four cents or more as conspicuous, and changes of less than four cents as small, the number of cases in which Chicago–Liverpool and Winnipeg – Liverpool spreads widened conspicuously, narrowed conspicuously, or changed little during major advances and major declines is as follows:

Cases	Chicago–Liverpool		Winnipeg–Liverpool	
	Advances	Declines	Advances	Declines
Total	26	28	26	28
Spreads:				
Conspicuously narrowed	12	2	18	0
Conspicuously widened	5	14	1	13
Changed little	9	12	7	15

Thus, approximately half of the Chicago and Winnipeg major movements were conspicuously larger than those of Liverpool. Most of the others were larger by less than 4 cents.

Only two of the 26 major advances and only one of the 28 major declines were actually larger in Liverpool than in both Chicago and Winnipeg. Hence, Liverpool prices quite regularly moved within a narrower range than prices in either Chicago or Winnipeg.

The foregoing evidence of the regularity with which Chicago and Winnipeg prices tend to run beyond Liverpool prices, in both advances and declines, may profitably be supplemented by data on the average magnitude of the movements. The following tabulations show the average size of major advances and major declines in each market (in cents) and the percentage relationship of average major movements in Chicago and Winnipeg, respectively, to movements in Liverpool.

Major movements	Chicago	Winnipeg	Liverpool
	Average size of major movements in cents		
Advances	20.0	21.9	16.1
Declines	21.5	22.4	17.7
	Percentage of Liverpool average movement		
Advances	124	136	100
Declines	122	127	100

From these data it appears that on the average Winnipeg movements were largest, Chicago movements nearly as large, and Liverpool movements considerably smaller. In terms of these averages Winnipeg prices rose 5.8 cents (or 36 per cent) more than Liverpool prices, and declined 4.7 cents (or 27 per cent) more than Liverpool prices declined. Chicago prices advanced 3.9 cents (or 24 per cent) more than Liverpool and fell 3.8 cents (or 22 per cent) more.[1]

The larger Winnipeg movements suggest that Winnipeg and Liverpool prices correspond less closely than Chicago and Liverpool prices, but in fact this is not the case. It was noted above that in a few instances Liverpool recorded larger movements than Chicago and/or Winnipeg. The degree of correspondence and inequality can be more accurately shown, therefore, by the average differences between simultaneous major movements in each pair of markets. These average differences (in cents) are shown below:

[1] The Chicago and Winnipeg advances, it will be noted, exceed those in Liverpool by roughly the same amount that their declines exceed those in Liverpool. A perfect balance is not mathematically necessary because of partial readjustments during the periods of minor movement and the occasional expiration, during a major movement, of futures that are "out of line" with Liverpool, or more often of futures with price spreads notably different from those ruling when the series was introduced.

Major movement	Chicago vs. Liverpool	Winnipeg vs. Liverpool	Chicago vs. Winnipeg
Advances	6.2	6.2	5.4
Declines	5.5	5.4	3.5

They indicate that Winnipeg advances corresponded with those in Liverpool just as closely as the Chicago advances. The correspondence in declines was slightly closer between Winnipeg and Liverpool than between Chicago and Liverpool. The correspondence of Chicago and Winnipeg movements was somewhat better in the advances and markedly better in the declines than the correspondence between Chicago and Liverpool or Winnipeg and Liverpool movements.

The average size of major movements shown above for Chicago and Winnipeg suggests that Winnipeg prices tend to move somewhat more in both major advances and major declines than Chicago prices. The Winnipeg movements average 1.9 cents larger in the advances and .9 cent larger in the declines. There is, however, less regularity in this tendency than in the tendency of Liverpool to record less movement than the North American markets. Chicago recorded larger movements than Winnipeg in 8 of the 26 major advances and in 9 of the 28 major declines. In 7 of these 16 cases Chicago major movements were conspicuously greater than the Winnipeg movements. In 15 cases Winnipeg major movements were conspicuously greater than those of Chicago. In other cases the differences were small. Classing a difference of four cents or more as conspicuous and a difference of less than four cents as small, we may summarize the cases as follows:

Cases	Major advances	Major declines	Total
Total	26	28	54
Chicago—conspicuously greater	4	3	7
Winnipeg—conspicuously greater	10	5	15
Difference small	12	20	32

It is clear from these figures that Winnipeg tended to run conspicuously beyond Chicago in less than one-third of all major movements, that Chicago recorded conspicuously more price change in about one-eighth of the movements, and that in about 60 per cent of the cases there were only small differences in the Chicago and Winnipeg movements. In general Chicago did tend to move less than Winnipeg, but in many cases the differences in movement were small, and in a number of cases Chicago recorded the larger movement.

The Flexible Price Relationship

In the foregoing analyses we have seen that, while both large and small movements tend to be promptly reflected in all three markets, Liverpool is ordinarily a considerably more stable or less volatile market than either Chicago or Winnipeg in terms of major movements; on the same basis Chicago is ordinarily a somewhat more stable market than Winnipeg. These differences in volatility are of distinct importance as indications of the different rôles of the markets in price-making.

The unequal general movements occasionally signify, in part at least, changing basic relationships due to changing shipping costs or to changing quality of deliverable wheat. More frequently they signify the independent elevation of North American prices relative to Liverpool and subsequent recessions toward export parity. This means that price levels and price movements in these markets often exhibit some independence of one another. But at such times their prices continue to reflect to a notable degree the large and small movements in each of the other markets. This broad but imperfect parallelism of general movements gives some clue to the character of price interdependence which exists. Clearly it is not a rigid interdependence which keeps Liverpool prices wholly and at all times dependent on prices in Chicago and/or Winnipeg plus shipping costs, or which keeps prices in the latter markets wholly and at all times dependent on prices in Liverpool minus shipping costs. The adjustment of prices is not so perfect that the export markets and Liverpool are kept constantly in line. Indeed, if the dependence were complete, most of the price movements in these markets would be impossible. The interrelationship and interdependence is more flexible; it permits larger movements in the North American

markets than in Liverpool. But ordinarily it is not so flexible that price movements can be recorded in one market without being promptly reflected in the others.[1]

III. THE DEVELOPMENT OF MAJOR MOVEMENTS

An Approach to the Question of Leadership

The fact that Chicago and Winnipeg tend to record larger advances and declines than Liverpool suggests that the North American markets are usually the predominant leaders in major movements; but this more extreme movement alone is not a conclusive indication of leadership. To formulate definite conclusions as to leadership, it is necessary to know how the individual major movements develop and on which side of the Atlantic they are initiated or first recorded. An investigation of the prices and cumulated interval changes shown in Plates I to VII (following p. 50) will furnish the needed information, for these charts provide a means of determining in considerable detail how the movements of 1924–31 actually developed and the comparative leadership of North American markets and Liverpool in recording them.

Section B of the plates, it will be recalled, shows the related price changes in each interval in terms of cumulated totals. The First-Interval changes represent (*a*) price movements recorded in Chicago and Winnipeg after the Liverpool market closes, and (*b*) the related overnight change in Liverpool recorded the next morning. The Second-Interval changes represent (*a*) early morning movements in Liverpool after the opening and before the North American markets open, and (*b*) the related overnight changes in Chicago and Winnipeg recorded at the opening while the Liverpool market is still in session. The Third-Interval changes are the so-called contemporary movements recorded late in the Liverpool session and early in the Chicago and Winnipeg sessions.

By studying the development of major movements as shown by these changes, it is possible to determine both when and how the movements were recorded. To determine *when* the movements in each market were recorded it is necessary to compare only the movement in daily closing prices and, for the corresponding period and market, the price changes recorded in the First, Second, and Third Intervals. But to determine *how* the movements developed in relation to prices in the other markets—whether they developed mainly as initial movements or as responses and rectifying changes—the interval movements must be compared also with those in the other two markets and the relationships among them considered.

The basic relationships among the interval changes were indicated above (pp. 36–38). These relationships may be observed in the plates by comparing the movements in all three markets during each interval. Such a comparison shows in fairly satisfactory fashion the extent to which the interval changes in each market accompany or respond to those in another. Between these changes one may observe more or less disparity, but in general a marked correspondence. In other words, as originally postulated, the Liverpool secondary (overnight) changes tend to respond to and reflect the earlier First-Interval (primary) changes in Chicago and Winnipeg, but not perfectly because the responses are influenced more or less by other factors (including local conditions, additional overnight

[1] This inequality of movement complicates the tracing of related price changes and influences in the advances and even more in the declines. The larger advances in North American markets are obviously to some extent independent of Liverpool owing to differences in local conditions in these markets. To just what extent larger declines in the North American markets are to be regarded as rectifying changes caused by the failure of Liverpool to advance, and to what extent they are independent reactions due to other factors, it is impossible to determine. Although the relatively low Liverpool prices doubtless contribute to the reactions, considerable importance must be attached to the flexibility of the relationship and to the change in local conditions and sentiment in Chicago and Winnipeg, which stimulates not only the return toward export parity but major declines at the same time. On the whole, it appears that no more than a minor allowance need be made for rectifying changes in the interval movements of Chicago and Winnipeg during these declines.

news, and occasionally price changes in the previous Third Interval in North America); Chicago and Winnipeg secondary (overnight) changes tend to reflect the earlier Second-Interval (primary) changes in Liverpool, but not exactly because of other influences (including local conditions, additional overnight news, and occasionally the Liverpool opening response to North American price changes of the previous day); and the Third-Interval (contemporary) changes, being interrelated, tend to correspond, but more or less discrepancy occurs because of price reactions to the opening prices of Chicago and Winnipeg and to differences in the news and market conditions in the three markets during this short period. As anticipated, the discrepancies in each interval are frequent, but they are not sufficiently large to obscure the fundamental relationships among the changes.

On the basis of these general relationships we may now consider in some detail how the individual major movements developed in each market in relation to the other two and determine on which side of the Atlantic the movements were largely independent and on which side they were largely responses. Such an analysis offers a reliable means of determining the relative leadership of the markets.

In making this examination of the development and origin of particular price movements space does not permit a review of all movements. But there is really no need to review in detail the development of each of the 54 major movements recorded, for while no two such movements are exactly alike, and no two of them developed in exactly the same way, they do show certain broad similarities of movement and development which permit the grouping and consideration of them according to "type" of development. Among different movements originating in the same market or markets there is usually a broad similarity in the relative amount and character of net change in each interval. The movements may be classified according to origin, therefore, on the basis of the relative amount and character of change recorded in each interval. They may be segregated broadly into three classes: (1) those originating chiefly in Chicago and Winnipeg and developing in the form of price responses in Liverpool; (2) those originating chiefly in Liverpool and developing in the form of price responses in Chicago and Winnipeg; and (3) those originating about equally in the North American markets and Liverpool and developing about equally as price responses in each market. For present purposes it is sufficient to describe in detail only a few examples of each type and to list the others exemplifying each type without discussing them in detail. Those interested in particular movements not discussed may easily follow them in Plates I to VII.

Movements Originating Largely in Chicago and Winnipeg

As typical examples of movements originating largely in Chicago and Winnipeg we may examine the advance in June–July 1924 and the subsequent recession in July–August. According to Plate I, the advance which began early in June and culminated after several interruptions late in July was the first major movement of 1924–25. The rise was largest in Winnipeg and smallest in Chicago. The First-Interval changes show that Chicago and Winnipeg prices began to rise in that interval early in June and that Liverpool tended to respond the next morning. Prices continued to rise in this fashion throughout most of June. During this month there was little price movement in the Second Interval and Second-Interval price movement contributed little to the advance of prices. In the Third Interval prices were irregular from day to day, but in Winnipeg they tended to rise, producing a material net advance for the month. Early in July Chicago and Winnipeg prices declined for several days in the First Interval, and Liverpool opening prices followed. Then prices in this interval strengthened, and North American markets recorded advances day after day with only occasional declines. Liverpool secondary changes reflected these movements. In the Second Interval, during July, Winnipeg prices rose independently of Liverpool for about a week, then Liverpool initiated a sharp advance to which Winnipeg responded fully and Chi-

cago responded partially. After this rise Winnipeg and Chicago recorded independent weakness for several days and then tended to respond to Liverpool movements again. The Third - Interval changes show little correspondence of movement. In mid-July Chicago prices responded in the Third Interval to the Liverpool and Winnipeg Second - Interval movements which it had failed to follow at the opening. Late in July Chicago and Winnipeg each recorded some Third - Interval movement independently of Liverpool. Liverpool prices reacted in mid-July to the Second-Interval break in opening prices at Chicago and Winnipeg; otherwise Liverpool was rather inactive in the Third Interval.

The advance as a whole, it appears, developed very largely in the First Interval through initial changes in Winnipeg and Chicago and overnight responses in Liverpool. Less than one-third of the movement developed in the Second Interval, or in other words, through initial changes in Liverpool and responses on this side. Chicago and Winnipeg each recorded some movement in the Third Interval, principally as initial changes, but the Chicago changes were partially responses to previous changes in Liverpool and Winnipeg prices. The major movement as a whole was clearly of North American origin more largely than of Liverpool origin, and it may be so classified.

The next major movement in 1924 was the irregular decline from late July to late August. By the sort of analysis just followed, it appears that this decline was another movement of the same type, being recorded largely in the First Interval through initial changes in Chicago and Winnipeg and responses in Liverpool. The latter market initiated slight Second-Interval strength early in August and then weakness, but this was only partially reflected in North America. Third-Interval changes were irregular in each market. They contributed little to the major decline except in Winnipeg, where prices dropped in this interval late in August as spreads widened. The development of this movement resembles that of the June–July advance in this respect, in that it was initiated very largely in the North American markets and passively reflected in Liverpool. This is shown by the dominant importance of the First - Interval changes.

If other major movements in this and later years are analyzed in this fashion a large proportion of them will be found to have originated, or at least to have been first recorded, in the North American markets. In 1924–25 the October–November decline, the November advance, the January advance, the January–February decline, the March–April decline, the early-April advance and mid-April decline all originated in this general way. A complete list of the major movements in this and later years so originating will be found in Appendix Table I.

It is generally true of the major movements originating chiefly in Chicago and Winnipeg that they develop largely or to a considerable extent in the First Interval. In most cases there is relatively little net Second- or Third-Interval movement, but in a few cases Chicago and Winnipeg recorded some independent Second- and/or Third - Interval change to which Liverpool responded more or less. Such independent movements can usually be identified on the charts.

Movements Originating about Equally in North America and Liverpool

The second class of movements are those originating about equally in the North American markets and Liverpool. Usually these movements have the characteristic of developing about equally either in the First and Second Intervals or in all three intervals in each market. To illustrate this type of development, the August–October advance of 1924, the May advance of 1925, the May decline of 1929, and the August–November decline of 1929 may be examined in some detail.

The advance of August – October 1924 (Plate I) developed in typical fashion, chiefly in the First and Second Intervals. Chicago and Winnipeg initiated irregular changes and some of the net advance in the First Interval. To these changes Liverpool prices usually responded at the opening. Liverpool recorded initial advances in the Second Interval to which Chicago and Winnipeg prices re-

sponded.[1] In the Third Interval there was little movement of importance, but small advances in late September and early October made slight contributions to the general price movement. Since Liverpool and the North American markets each initiated a large part of the movement in their primary changes, and each recorded a large part of it as responses in opening prices, it must be classified as a movement of dual origin, initiated by the North American markets and Liverpool combined.

Other movements of this type in 1924–25 are the December advance, the February advance, the February–March decline, and the mid-March advance. In later years there were many others, listed in Appendix Table I. Not all of these movements developed in as simple fashion as the one just discussed. To show more clearly some of the variations in their development several of them may be examined briefly.

A few of these movements are quasi-typical on account of delayed price responses. This is true of the May advance of 1925 (Plate II). Liverpool originated some of the movement in the Second Interval and Winnipeg responded at the opening. Chicago failed to respond at the opening but did so in the Third Interval. The remainder of the advance was for the most part a First-Interval movement. Chicago prices were conspicuously strong as the Chicago–Liverpool spread narrowed.

In a few cases primary changes are not important contributors to a movement. This is well illustrated by the May decline of 1929, shown in Plate VI. Chicago recorded some First-Interval weakness; to this Liverpool contributed further independent weakness in opening prices. In the Second Interval, Liverpool prices were stable, while Chicago and Winnipeg prices dropped repeatedly in response to the Liverpool opening and with some further independent weakness. More weakness developed in the Third Interval in all markets. The movement was apparently of dual origin, but primary changes in Winnipeg and Liverpool contributed little to the decline.

Occasionally there are movements of notably complicated development. The August–November decline of 1929 is an example (Plate VI). The North American markets initiated some First-Interval weakness, which Liverpool reflected in independently weak opening prices. Liverpool recorded weakness in the Second Interval in August and September and strength in October. The North American opening responses were influenced by this primary movement and by the Liverpool opening combined. There was considerable movement in the Third Interval but little net change for the period. Many of the contemporary changes, especially in Liverpool, were reactions to maladjustments arising in the other two intervals. When the changes are analyzed in this fashion it appears that the movement as a whole was initiated about equally in the North American markets and Liverpool, and was therefore of dual origin.

As we have seen in these examples, delayed responses and price reactions from one interval to the next complicate the tracing of the development of movements, but even this does not obscure their origin. Many of the movements of complicated development may be identified quite definitely as having been initiated about equally on each side of the Atlantic.

Movements Originating Largely in Liverpool

The other type of movement is that initiated largely in Liverpool. This type of movement is characterized by a relatively large proportion of Second-Interval change and occasionally by some independent secondary movement in the First Interval. The First-Interval net changes in Chicago and Winnipeg tend to be relatively small and the Third-Interval movements in all markets limited. The principal examples of this type are the October–December advance, December–March decline, and March–April rise in 1925–26, and the November rise and December–March de-

[1] In comparing the cumulated interval changes the break representing the change from one future to another should be ignored; that is to say, the two segments of each curve should be considered as though they were connected, with the latter segment raised or lowered by the amount of the break. The movements exhibited by the curves should be compared, not the level of the curves.

cline in 1929–30. Only a brief review of these movements is necessary to show the character of their development.

Some of the price movement in the advance of October–December, 1925 (Plate II), was initiated by Chicago and Winnipeg in the First Interval. Liverpool responded to this First-Interval movement and recorded further independent advances. In addition, Liverpool initiated a rise of nearly 30 cents in its Second Interval; Winnipeg responded fully and Chicago partially. In the Third Interval Liverpool was irregular and slightly weak as a result of reactions to the North American opening prices; Chicago and Winnipeg advanced, partially in delayed response to the earlier rises in Liverpool. Considering the entire movement, relatively little of it seems to have originated in Chicago and Winnipeg; most of it was of Liverpool origin.

From the same plate the decline from late December to early March may be studied as another example of the third type of price development. A careful inspection of the interval changes in this decline shows that Chicago and Winnipeg recorded First-Interval strength in January and First-Interval weakness in February, but relatively little net weakness for the movement as a whole. At times Liverpool was independently weak at the opening. In the Second Interval Liverpool initiated a sharp decline in February and early March, which the North American markets tended to follow. During January notable weakness was recorded in the Third Interval chiefly in Chicago and Liverpool. Although Chicago and Winnipeg initiated a considerable portion of the December–March price movement, a decidedly larger portion appears to have originated in Liverpool, and the movement may, therefore, be classified as predominantly of Liverpool origin.

Another example during this year is the March–April rise. This movement originated chiefly in Liverpool as independent First-Interval strength and Second-Interval advances. Chicago and Winnipeg initiated very little movement during the period except the sharp break in prices after mid-March. Liverpool was clearly the more active leader.

In 1929–30 there were two interesting examples of movements developing in this general fashion. These—the sharp advance of November and the December–March decline —appear in Plate VI. During the November advance North American markets initiated little First-Interval change, but Liverpool was independently bullish in its opening response and in its Second-Interval changes. Chicago and Winnipeg responded only moderately at their opening; this induced sharp price reactions during the Third Interval in Liverpool. Most of the rise can be traced to Liverpool.

The decline of December 31 to March 14 developed in roughly the same manner. There was relatively little net First-Interval change in Chicago and Winnipeg; Liverpool secondary responses were independently weak, especially in early February. Most of the movement developed in the Second Interval, so that Liverpool was clearly the dominant leader.

For these movements as for the other two types there are occasionally independent overnight changes, delayed responses, and reactions, but the actual rôle of Liverpool in initiating the larger portion is apparent.

Summary

In brief, the foregoing analysis has shown that a number of the major movements developed chiefly as initial changes in Chicago and Winnipeg and as responses to these changes in Liverpool; that others originated to a considerable extent in both the North American markets and Liverpool and developed in each market partially as initial changes and partially as responses; and that still other movements developed chiefly as initial changes in Liverpool and as responses in Chicago and Winnipeg.

It indicates also that movements recorded principally in the First Interval in each market are ordinarily movements originating largely in North American markets; that those recorded principally in the Second Interval in each market are usually movements originating largely in Liverpool; and that those recorded about equally in the First and Second Intervals, or in all three intervals, in each market, are usually movements originating about equally in North American mar-

kets and Liverpool. But there is some variation in the method of recording initial changes and responses, and hence in the development of movements originating in each market.

Secondary changes are ordinarily responses to primary changes in the same interval, but occasionally the two differ considerably in amount or direction. In such cases the secondary changes usually reflect either price independence or price responses to changes in earlier intervals. Thus, Liverpool occasionally recorded independent First-Interval (overnight) strength or weakness which North American markets reflected in their Second-Interval (overnight) changes, creating discrepancies between these secondary changes and the Liverpool primary changes. The primary changes themselves occasionally represent to some extent price responses to earlier changes in other intervals. Third-Interval changes are difficult to analyze. They often represent reactions to maladjustments in the Second Interval, but to a considerable extent they appear to represent interrelated changes originating principally in the North American markets.

It is because of such variations in the character of interval changes that a detailed analysis must be made for most major movements before their development and origin can be determined. When due consideration is given to the independent secondary and contemporary changes and to price reactions and rectifying changes in each interval, however, as was done in analyzing the movements for the above review,[1] a close approximation of their origin and independent or dependent development may be reached.

IV. EVIDENCE OF LEADERSHIP

The foregoing analysis of the general character of relationships in wheat price movements in the three major wheat futures markets serves to indicate what facts may profitably be examined for evidence of relative activity in the leadership of price movements. It indicates, moreover, that, contrary to common belief, useful evidence of leadership is not to be obtained by observing the frequency of price movements in one market which are followed tardily by another market.

Tardy response by the following market may be characteristic of the price relations between certain leading and following markets, but as among the three major wheat markets, response by one to price movements in another is usually about as prompt as the timing of market sessions permits. To the extent that more than technically inevitable delay in response is observed, the tendency to tardy response may even be regarded as evidence of superior independence of the market showing the delay. The fact that in any particular movement the price changes in one market occur later in time than the changes in another of course gives clear evidence that in that particular movement the leadership is with the market moving first. But given the fact that some movements originate in one market and some in another, the observation that movements originating in market *A* were always followed promptly by market *B*, while movements originating in market *B* were often followed only tardily by market *A*, might, other things equal, be taken as evidence of superior independence of market *A*, the market showing the occasional tardy response. Specifically, several instances were noted in the foregoing section of initial movements in Liverpool in the Second Interval which were not fully followed by Chicago until the Third Interval. Chicago gave the appearance of refusing to follow the Liverpool initial movement until Liverpool had emphasized its initial movement by refusing to react in the Third Interval to Chicago's refusal to follow promptly. Fewer cases were found of similar delay in Liverpool's response to initial Chicago movement.

The possibility that delayed response in

[1] An analysis of the character of interval changes is frequently facilitated by a study of daily market reviews for information on the causes of the changes, and in some cases such information is essential. The original analysis of the changes for this investigation was made with constant consideration of the market reports, but in some cases the supplementary information thus acquired proved to be not wholly necessary. For lack of space a discussion of these basic market influences is omitted here.

PLATE I.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1924–25*

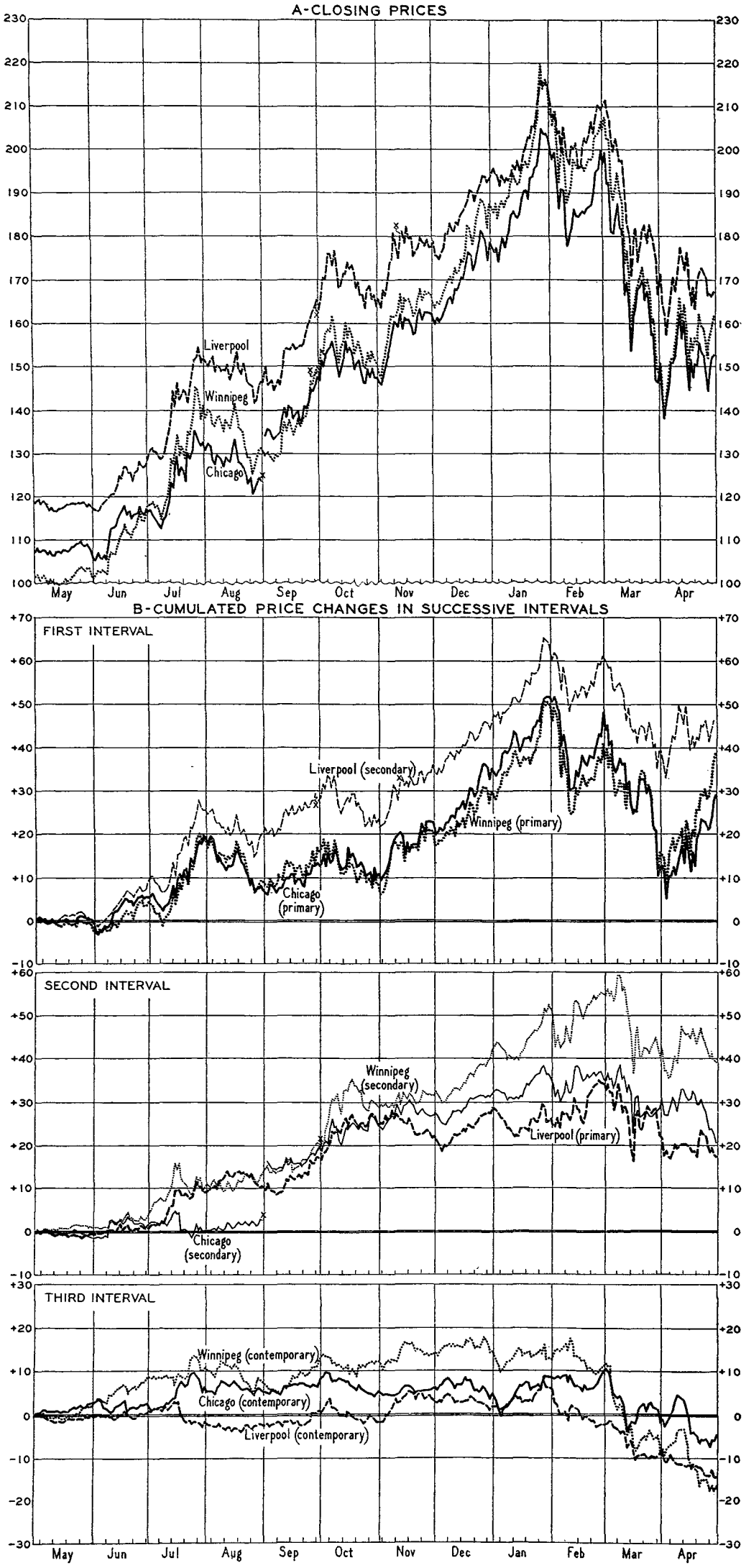


PLATE II.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1925–26*

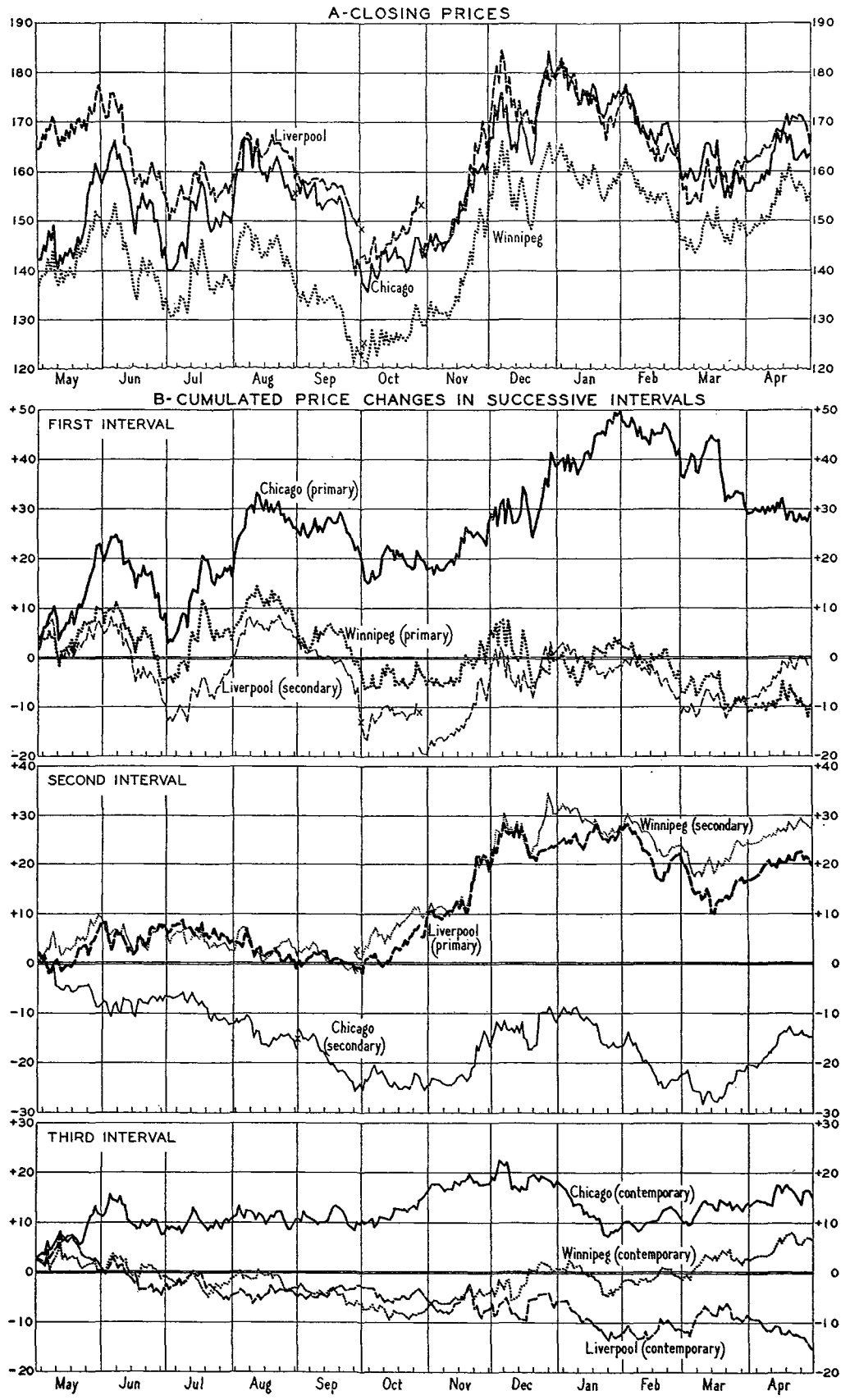
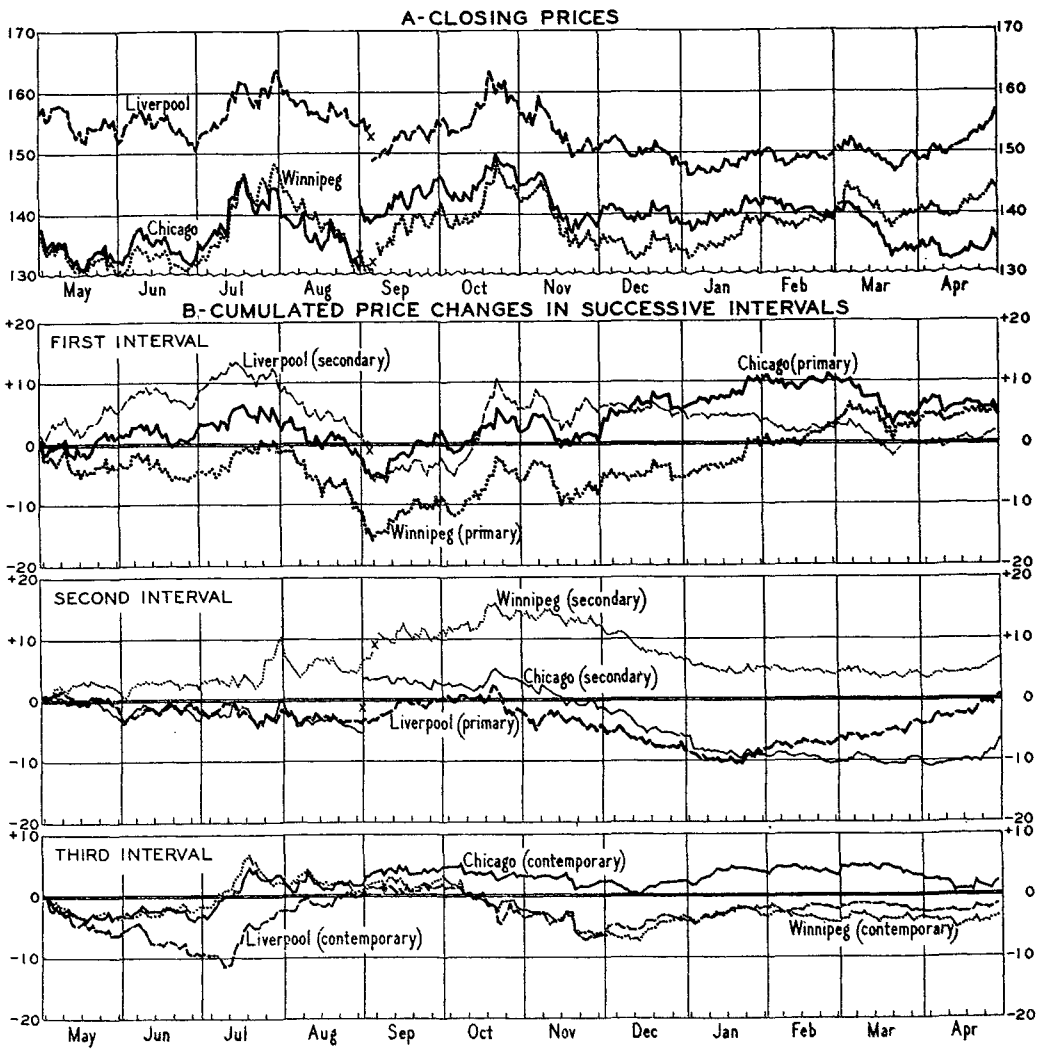


PLATE III.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1926–27*



* Prices and changes in United States cents per bushel. Based for Chicago on the September future May 1–August 31, and on the May future September 1–April 30; for Winnipeg and Liverpool, on the October future May 1–September 30, and on the May futures October 1–April 30, except that in 1926–27 the May futures were used September 6 to April 30, in 1924–25 the Liverpool December future was used October 1–November 13, and in 1925–26 the Liverpool December future was used October 1–October 28.

In each plate, Section A shows the actual price movement in each of three markets, and Section B shows the part of the total price movement contributed by price change during each of three intervals within the day. In general, the First Interval comprises in each day the period when the Liverpool market is closed and Chicago and Winnipeg markets are open; the Second Interval is the period when Liverpool is open but Chicago and Winnipeg closed; the Third Interval is the period when all three markets are open simultaneously.

The First-Interval price changes in Chicago and Winnipeg, occurring during their sessions, are regarded as primary movements; the First-Interval changes in Liverpool, being overnight changes largely in response to Chicago and Winnipeg session changes, are regarded as secondary movements. The Second-Interval price movements in Chicago and Winnipeg are overnight changes, largely in response to Liverpool session changes, and are regarded as secondary; the Second-Interval price changes in Liverpool, occurring during its session, are regarded as primary movements. The Third-Interval price changes, recorded largely when all three markets are open simultaneously, cannot be classed as dominantly either primary or secondary and are designated merely as contemporary.

For the purpose of conveniently studying the contribution to the total price movement of changes occurring in each of the three intervals separately, changes in corresponding intervals on successive days are added together cumulatively to form continuous curves. The relation between individual interval changes and the continuous curves of interval movement is the same as that between daily price changes and the curves of daily closing prices. The curve of daily closing prices is precisely equivalent to a cumulation of daily close-to-close price changes. For any market the actual price change over any number of days is the sum of the changes in the three curves of cumulative interval changes for the same days.

PLATE I.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1924–25*

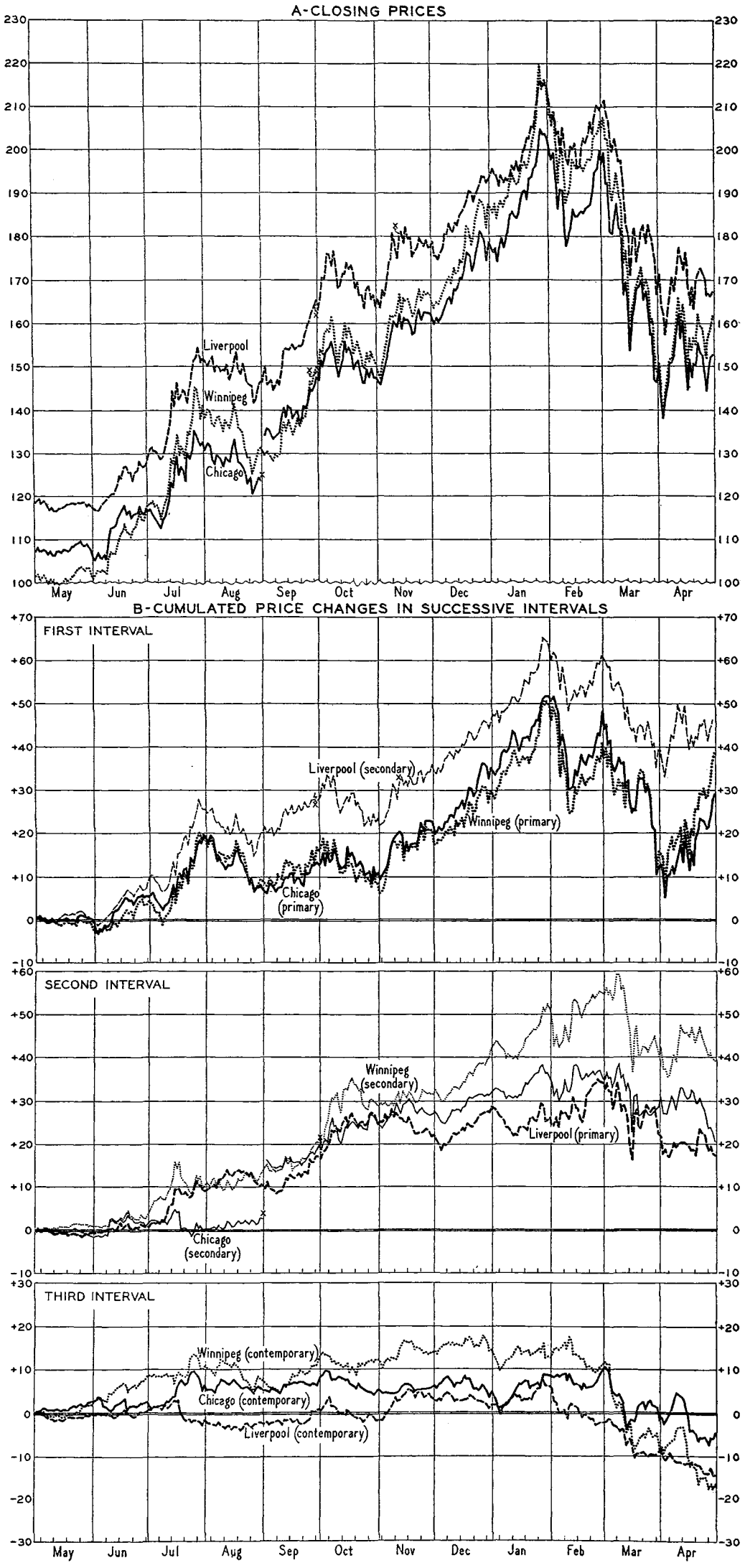


PLATE II.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1925–26*

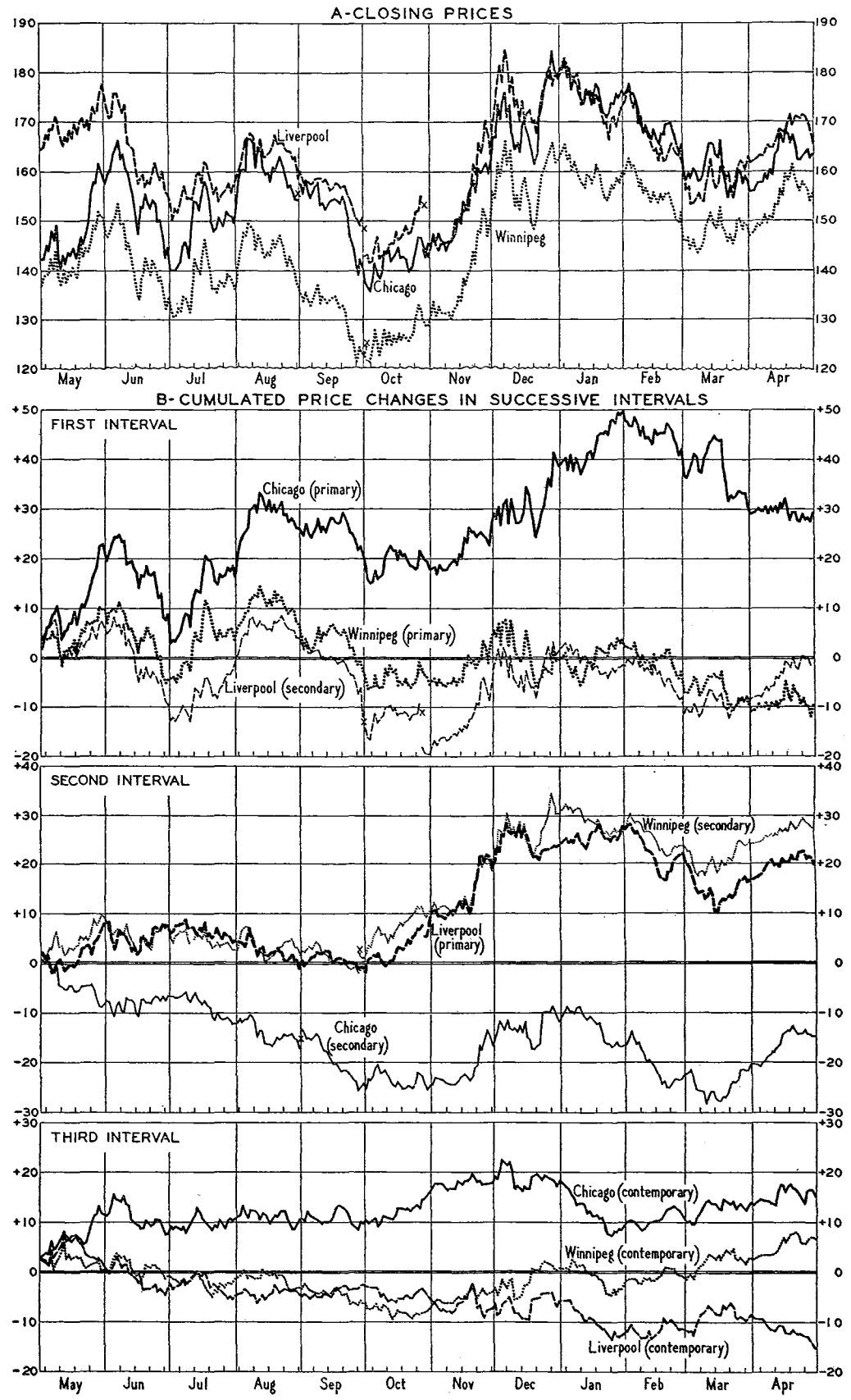
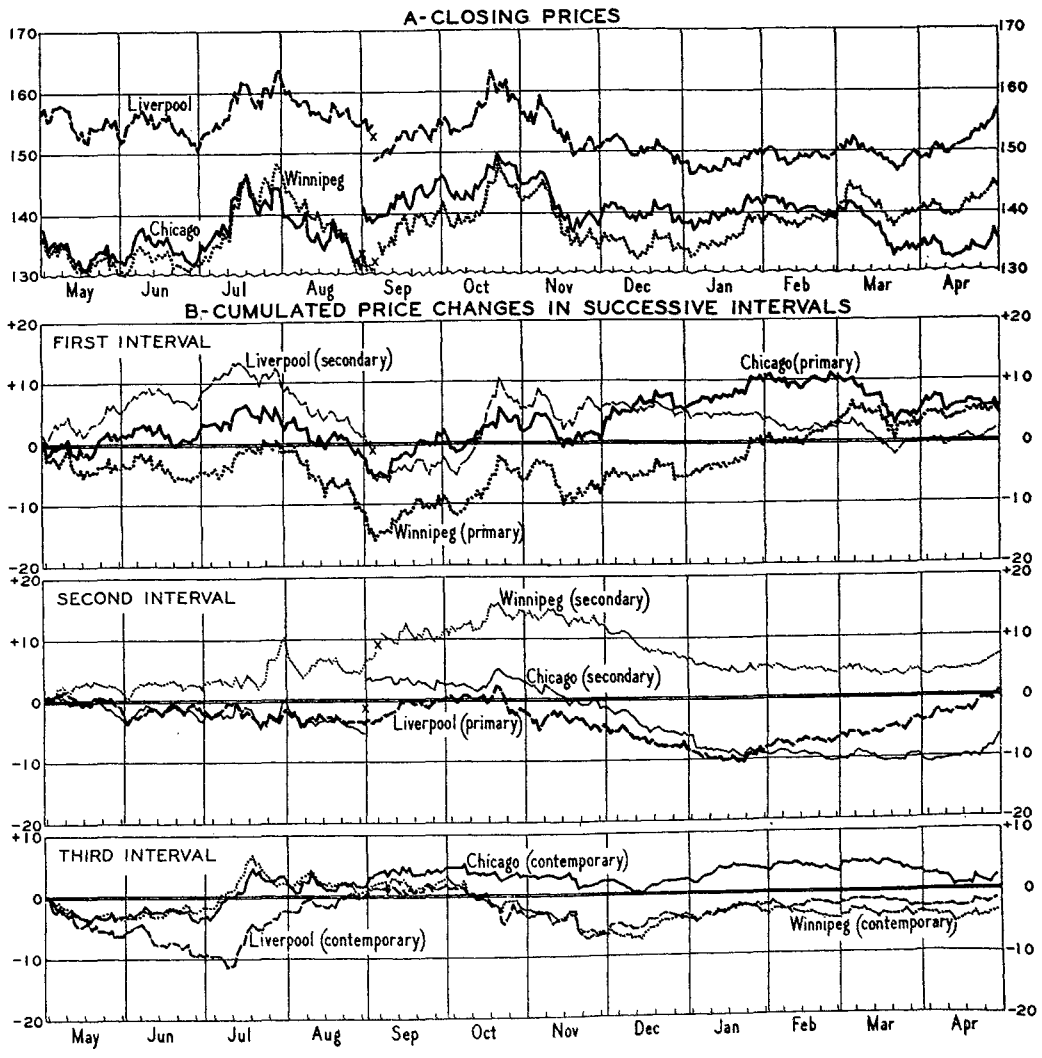


PLATE III.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1926–27*



* Prices and changes in United States cents per bushel. Based for Chicago on the September future May 1–August 31, and on the May future September 1–April 30; for Winnipeg and Liverpool, on the October future May 1–September 30, and on the May futures October 1–April 30, except that in 1926–27 the May futures were used September 6 to April 30, in 1924–25 the Liverpool December future was used October 1–November 13, and in 1925–26 the Liverpool December future was used October 1–October 28.

In each plate, Section A shows the actual price movement in each of three markets, and Section B shows the part of the total price movement contributed by price change during each of three intervals within the day. In general, the First Interval comprises in each day the period when the Liverpool market is closed and Chicago and Winnipeg markets are open; the Second Interval is the period when Liverpool is open but Chicago and Winnipeg closed; the Third Interval is the period when all three markets are open simultaneously.

The First-Interval price changes in Chicago and Winnipeg, occurring during their sessions, are regarded as primary movements; the First-Interval changes in Liverpool, being overnight changes largely in response to Chicago and Winnipeg session changes, are regarded as secondary movements. The Second-Interval price movements in Chicago and Winnipeg are overnight changes, largely in response to Liverpool session changes, and are regarded as secondary; the Second-Interval price changes in Liverpool, occurring during its session, are regarded as primary movements. The Third-Interval price changes, recorded largely when all three markets are open simultaneously, cannot be classed as dominantly either primary or secondary and are designated merely as contemporary.

For the purpose of conveniently studying the contribution to the total price movement of changes occurring in each of the three intervals separately, changes in corresponding intervals on successive days are added together cumulatively to form continuous curves. The relation between individual interval changes and the continuous curves of interval movement is the same as that between daily price changes and the curves of daily closing prices. The curve of daily closing prices is precisely equivalent to a cumulation of daily close-to-close price changes. For any market the actual price change over any number of days is the sum of the changes in the three curves of cumulative interval changes for the same days.

PLATE IV.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1927–28*

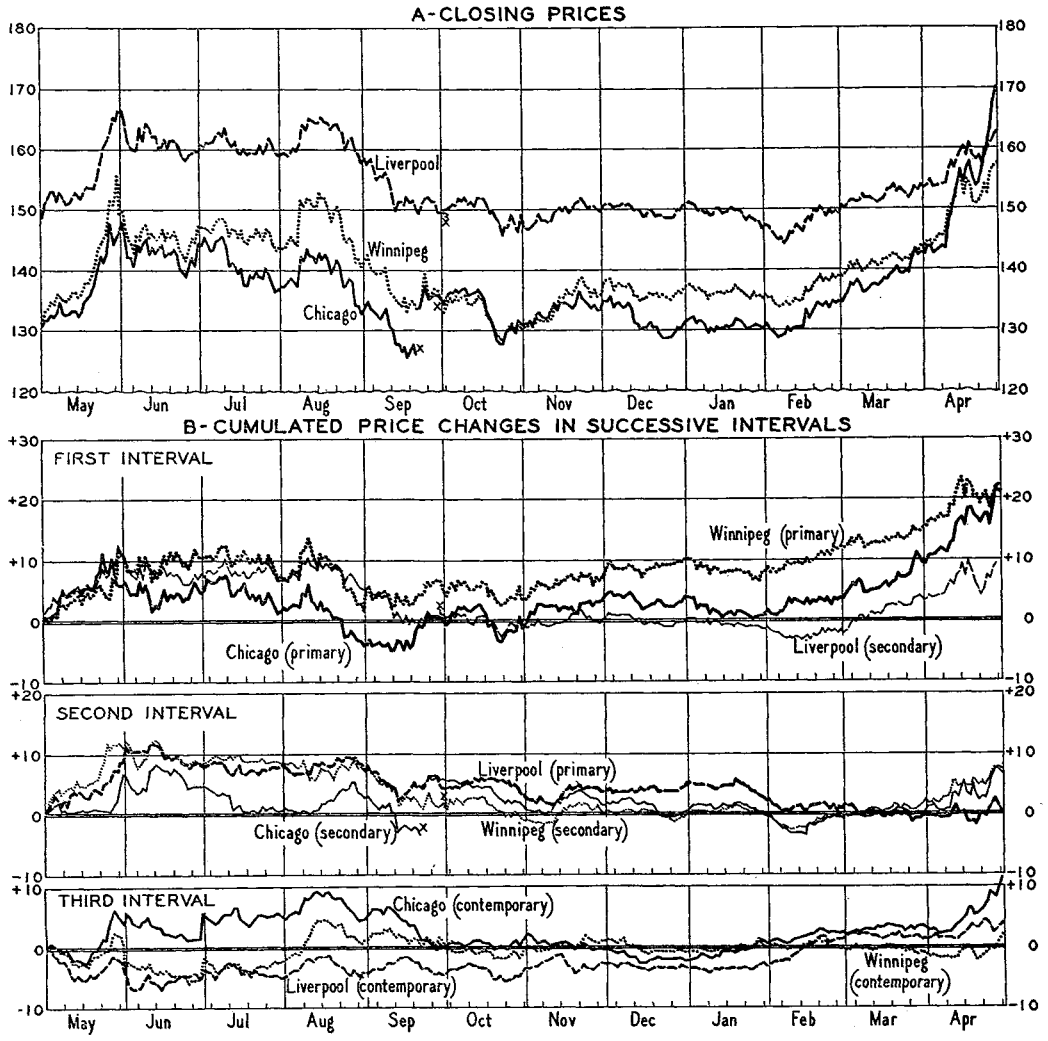


PLATE V.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1928–29*

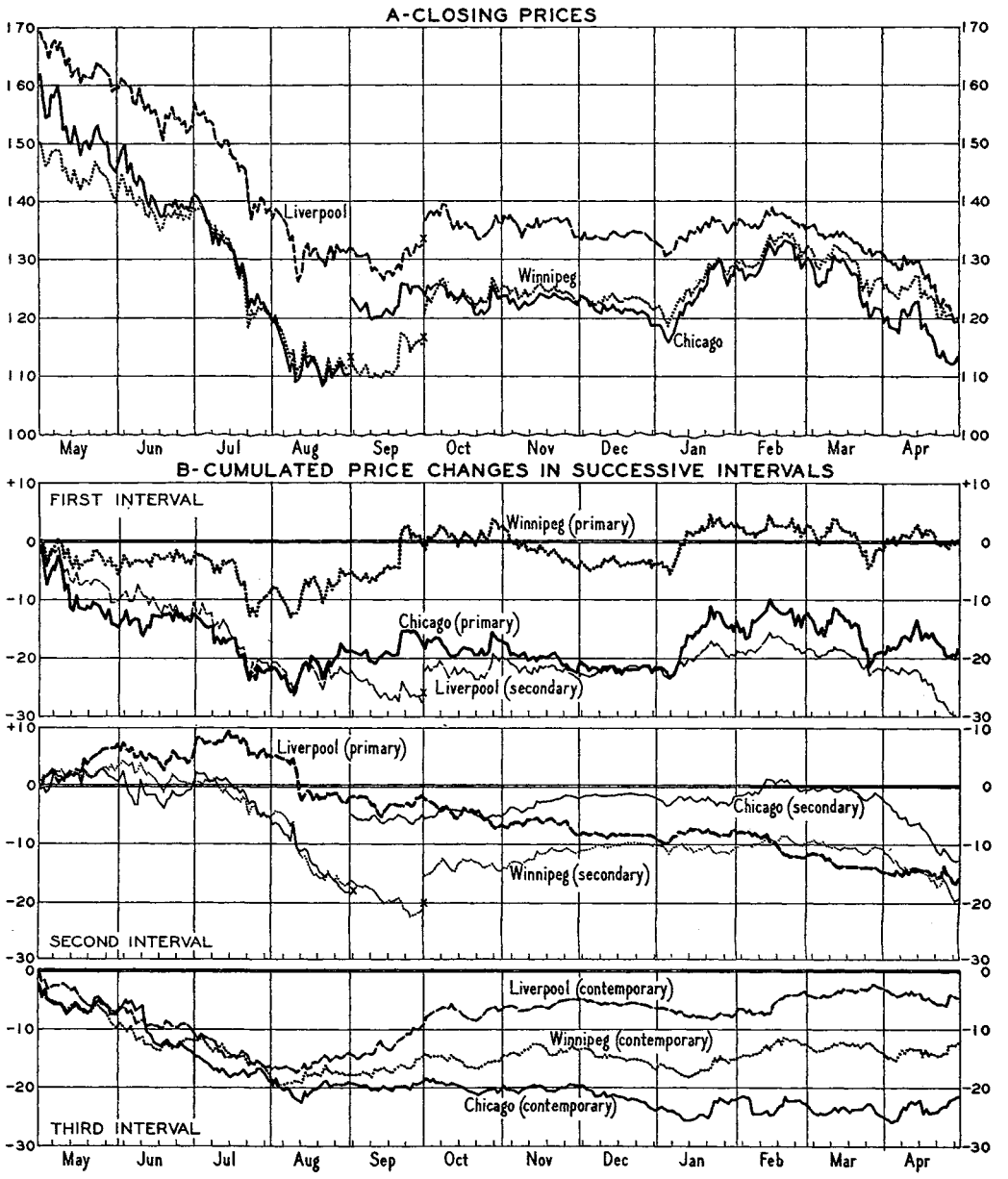


PLATE VI.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1929–30*

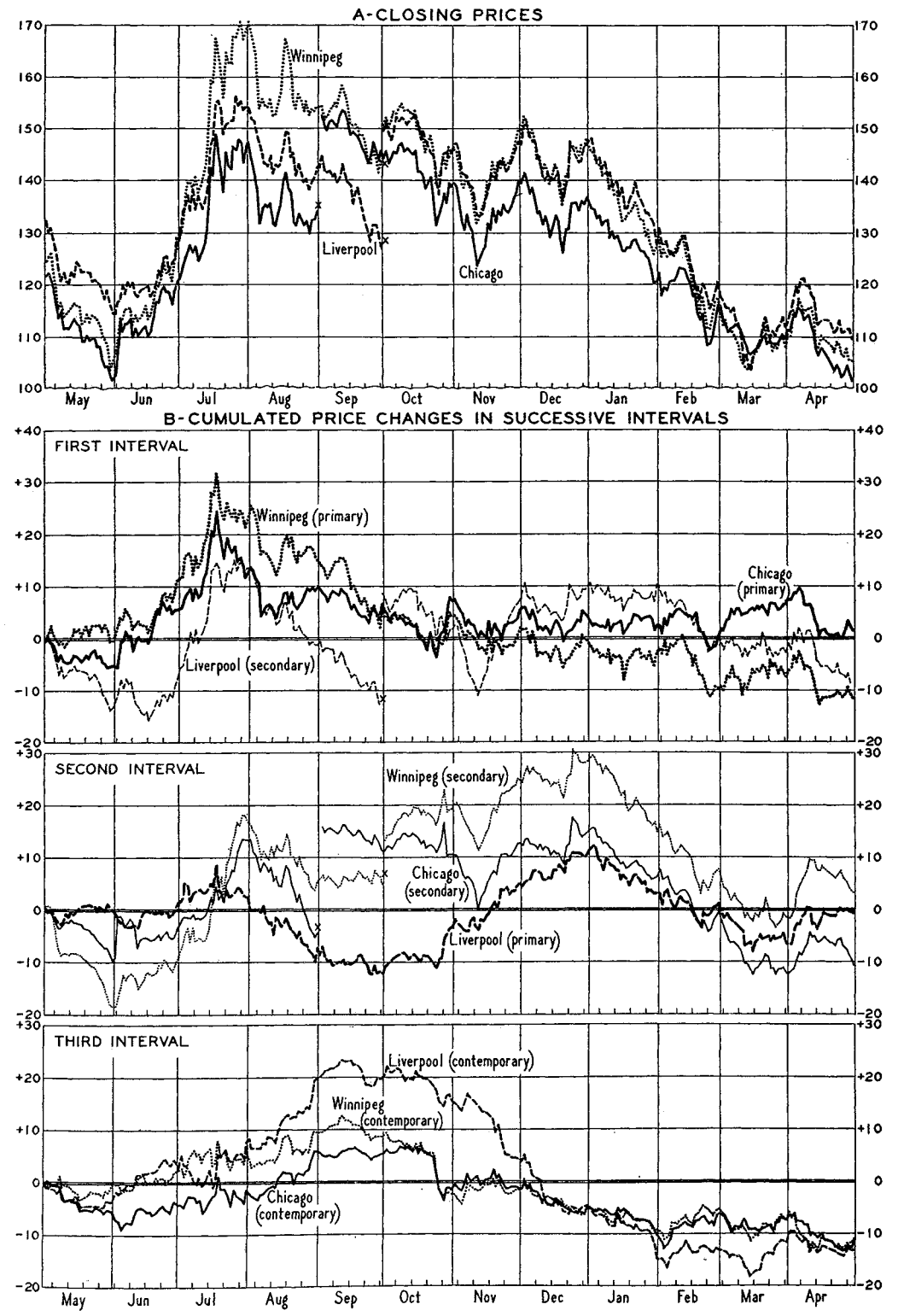
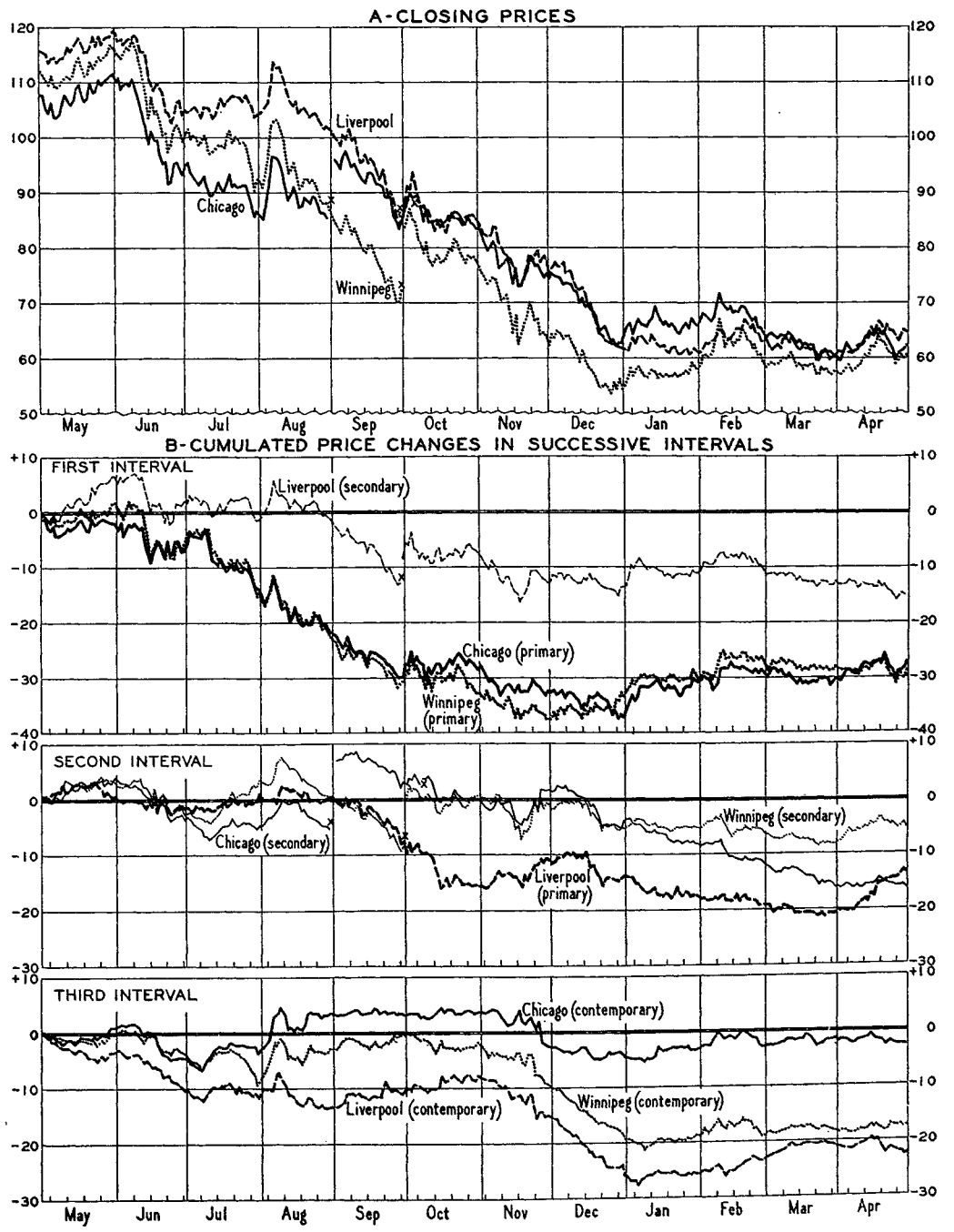


PLATE VII.—DAILY WHEAT PRICES AND CUMULATED INTERVAL CHANGES, 1930–31*



* Prices and changes in United States cents per bushel. Based for Chicago on the September future May 1–August 31, and on the May future September 1–April 30, except that in 1927–28 the September future was used May 1–September 21, and in 1930–31 the 1931 July future was substituted for the May during October 8–April 30, when the May future was under control by the Grain Stabilization Corporation. For Winnipeg and Liverpool, based on the October futures May 1–September 30, and on the May futures October 1–April 30.

Chicago may be attributable to the shorter time interval between Liverpool primary movement and Chicago secondary movement than between Chicago primary movement and Liverpool secondary prevents accepting the slight and irregular tendency to delay in Chicago response as clear evidence of superior independence of Chicago. But the evidence of delay leans in that direction, rather than in the other, as might uncritically be supposed. As between major wheat markets, the existence of a tendency to tardiness of response is certainly not evidence of lack of general independence by the market showing such resistance to price movement elsewhere.[1]

So far our analysis has shown first that Liverpool tends to be a less volatile market in the major movements than Chicago and Winnipeg, and second that some of the 54 major movements were initiated chiefly in Chicago and Winnipeg, some in Liverpool, and some about equally in Liverpool and the North American markets. Now by enumerating and calculating the number and extent of the movements in each category, definite conclusions as to the relative leadership of these markets may be reached. These conclusions may be supported by further data on the volatility of the various markets and on the amount of movement recorded in the different intervals. In this section we shall undertake to bring together all of this evidence of leadership.

Leadership According to the Number of Movements

One way of arriving at an approximate notion of the relative activity of these markets in leading price movements is to classify the 54 major movements of the seven years 1924–31 according to origin, and so find the number of movements originated principally in Chicago and Winnipeg, the number originated predominantly in Liverpool, and the number initiated about equally in the North American markets and Liverpool. In obtaining such a classification it was necessary to analyze carefully the development of each individual movement. The resulting list of movements in each category together with the amount of movement and net change recorded in each interval appears in Appendix Table I. The development of several of these movements was discussed in the previous section. These or any of the other movements may be easily identified in the charts of Plates I to VII, where a graphic representation of their development may be seen.

According to this classification, 32 major movements originated principally in Chicago and Winnipeg, 5 originated predominantly in Liverpool, and 17 originated about equally in the North American markets and Liverpool. In other words, the North American markets were by far the more active leaders, but Liverpool was frequently an active leader and in a few movements it was a dominant leader.

When the major advances and declines are counted separately, it is found that the relative leadership is almost the same for advances as for declines. The number of movements so classified is as follows:

Movements	Major advances	Major declines	Total
Total	26	28	54
Originating in:			
Chicago and Winnipeg	15	17	32
Chicago, Winnipeg, and Liverpool	8	9	17
Liverpool	3	2	5

A further characteristic of the price leadership is revealed by the number of movements of each type recorded in what may be called the summer months, between May 1 and late October or early November, and in what may be called the winter months from late October or early November to April 30. From such a segregation of movements the following enumeration is derived.

[1] We consequently regard as inconclusive the effort of the Federal Trade Commission to determine dominance of leadership as between Chicago and Liverpool from a simple attempt to determine the prevailing direction of delay in price movement (*Report on the Grain Trade* [September 1924], VI, 143–46). Moreover, the data shown in the Commission's *Report* are not adequate to indicate clearly even the existence of delay beyond that necessitated by the differing timing of the sessions. Although the authors of the *Report* concluded "that Liverpool leads Chicago," we are unable to find in their data anything clearly inconsistent with our findings.

Net price movement	Chicago	Winnipeg	Liverpool
	(*Cents*)		
In advances, total	+150.2	+165.4	+123.7
First Interval	+ 89.6	+ 76.5	+ 54.3
Second Interval	+ 31.8	+ 80.9	+ 59.8
Third Interval	+ 28.8	+ 8.0	+ 9.6
In declines, total	−209.9	−214.9	−196.7
First Interval	− 81.3	− 86.7	−122.1
Second Interval	− 97.9	−100.9	− 62.9
Third Interval	− 30.7	− 27.3	− 11.7
	(*Percentages*)		
In advances, total	100	100	100
First Interval	60	46	44
Second Interval	21	49	48
Third Interval	19	5	8
In declines, total	100	100	100
First Interval	39	40	62
Second Interval	47	47	32
Third Interval	14	13	6

As one would expect, about equal amounts of these movements were in general recorded in the First and Second Intervals. The proportion of Chicago declines recorded in these two intervals were not far apart: 39 per cent in the First Interval and 47 per cent in the Second. In Winnipeg the First- and Second-Interval movements, respectively, accounted for 46 and 49 per cent of the advances and 40 and 47 per cent of the declines. Of the Liverpool advances, 44 per cent occurred in the First Interval and 48 per cent in the Second. Third-Interval contributions were largest in Chicago, but in most cases they were below 15 per cent. There are two notable inequalities of proportions. Chicago recorded 60 per cent of its advances in the First Interval and only 21 per cent in the Second. This disproportionate First-Interval contribution represents primarily delayed responses in the First Interval to Second-Interval changes elsewhere.[1] Of the declines in Liverpool, 62 per cent developed in the First Interval and only 32 per cent in the Second Interval. A considerable amount of this First-Interval movement represents independent weakness at the opening which was reflected later during the Second Interval in Chicago and Winnipeg.[2] Considering the independent and dependent character of the interval changes in the two exceptional cases, the leadership of these movements in the aggregate, as well as individually, appears to have been about equally divided between Liverpool and the North American markets. Consequently almost no special allowance needs to be made for a disproportionate leadership of either market.

The last group of movements—those initiated largely in Liverpool — are summarized below.

Net price movement	Chicago	Winnipeg	Liverpool
	(*Cents*)		
In advances, total	+ 64.0	+ 77.6	+78.3
First Interval	+ 15.9	+ 15.9	+50.7
Second Interval	+ 37.0	+ 51.2	+42.3
Third Interval	+ 11.1	+ 10.5	(−17.7)[a]
In declines, total	− 56.2	− 66.7	−65.3
First Interval	− 4.6	− 18.4	−23.4
Second Interval	− 40.3	− 44.1	−25.7
Third Interval	− 11.3	− 4.2	−16.2
	(*Percentages*)		
In advances, total	100	100	100
First Interval	25	20	65
Second Interval	58	66	54
Third Interval	17	14	(−19)[a]
In declines, total	100	100	100
First Interval	8	28	36
Second Interval	72	66	39
Third Interval	20	6	25

[a] The net Third-Interval movement in Liverpool was negative in each of the major advances in which Liverpool was the dominant leader; for details see Appendix Table I.

The Chicago and Winnipeg movements of this group were recorded largely in the Second Interval. In Chicago 58 per cent of the advance and 72 per cent of the decline was Second-Interval movement, whereas 25 per cent of the advance and 8 per cent of the decline was First-Interval movement. In Winnipeg 66 per cent of both the advance and the decline was recorded in the Second Interval; 20 per cent of the advance and 28 per cent of the decline was First-Interval movement. Third-Interval movement was comparatively

[1] This was particularly true in the advances from December 4 to December 31, 1924 (Plate I), May 1 to June 6, 1925 (Plate II), and May 1 to May 27, 1927 (Plate IV).

[2] Note for instance the major declines of February 20 to April 30, 1929 (Plate V), May 1 to May 31, 1929, and August 13 to November 12, 1929 (Plate VI).

slight in each market. In Liverpool, First-Interval movement accounted for 65 per cent and Second-Interval movement for 54 per cent of the advance, but Third-Interval movement was negative and offset some of the advance recorded in the other intervals. The First-Interval movement was partially independent change.[1] In the Liverpool declines, 36 per cent of the movement occurred in the First Interval (to some extent as independent change), 39 per cent occurred as Second-Interval weakness, and 25 per cent developed in the Third Interval. When allowance is made for the independent strength or weakness shown in overnight changes, and for delayed responses, the analysis of interval changes in this group of movements shows that the North American markets contributed relatively little initial movement and were to only a small extent active leaders.

The relative frequency with which Liverpool recorded independent movement in opening prices is noteworthy. In both advances and declines led predominantly by Liverpool, and in declines in which Liverpool shared actively in leadership, Liverpool showed a larger amount of movement in the First Interval than did North American markets, in consequence of independent movement in the overnight changes. This greater tendency of Liverpool to record independent movement at the opening reflects a greater significance of the opening price which we are not in position to explain with entire confidence. Whatever the cause, the characteristic is an important source of exceptions to the general broad tendency for overnight price changes to be secondary or following changes.

From the foregoing analysis of contributions to the 54 major movements, it appears that even after allowance has been made for participation of Liverpool in the leadership of movements initiated largely in North America and in movements of dual origin, approximately two-thirds or more of all major movement was initiated in Chicago and Winnipeg. Put in other words, Liverpool was, in this period at least, a much less active leader of major movement than were the North American markets. The dominant leadership of North American markets was not an exclusive or continuous leadership, however. Liverpool participated in leading every major movement; in 17 of the 54 movements it was an active leader along with the North American markets; in 5 movements it was a dominant leader.

This analysis indicates too that there is no distinguishable tendency of North American markets to initiate advances more readily than declines or of Liverpool to initiate declines more readily than advances.

Volatility

The evidence so far presented leaves no doubt whatever of the dominant leadership of Chicago and Winnipeg in the major movements. Further information on volatility and the development of price movements is needed, however, to provide an adequate basis for conclusions regarding the rôles of these markets in leading and recording price movements in general. It is appropriate, therefore, to introduce at this point some additional data on volatility.

In discussing the inequality of movements above (pp. 42–44) it was found that, in terms of major movements, Winnipeg prices tended to move over a wider range than Chicago prices, and Chicago prices over a wider range than Liverpool prices. Major advances in Winnipeg were on the average 36 per cent larger than in Liverpool and major declines 27 per cent larger. In Chicago major advances averaged 24 per cent larger than in Liverpool and major declines averaged 22 per cent larger. These figures indicate notable differences in the volatility of the three markets.

In terms of interval changes and daily changes the differences in volatility are not so marked. This is shown in the following statement of the sum of the major advances and declines, the sum of all daily close-to-close changes (signs ignored), and the aggregate of all interval changes (signs ignored) recorded during the seven years from May 1, 1924, to April 30, 1931. The percentages of the Chicago and Winnipeg totals, respectively, to those of Liverpool are also given.

[1] This fact is brought out in the review of these movements on page 49 above.

Movement	Chicago	Winnipeg	Liverpool
	(*Cents*)		
Major movement	1,122.6	1,195.4	913.7
Daily change	3,048.4	3,179.0	2,813.0
Interval change	4,642.2	4,883.5	4,430.5
	(*Percentages*)		
Major movement	123	131	100
Daily change	108	113	100
Interval change	105	110	100

According to each of these measures of movement, Winnipeg was more volatile than Chicago, and Chicago more volatile than Liverpool. In a comparison of such totals for shorter periods (i.e., for years or months) only a few exceptions to this tendency were found. This means that prices in the North American markets commonly fluctuate over a wider range than Liverpool prices.

It is significant, however, that the greater stability of Liverpool was much less pronounced in the daily changes and interval movements than in the major swings. Winnipeg recorded only 13 per cent more daily change and 10 per cent more interval movement, while Chicago recorded only 8 per cent more daily change and 5 per cent more interval movement. In the course of a major price movement there occur many interval changes in each direction. The direction and size of the major movement is an expression of predominance of interval changes in one direction over interval changes in the other direction. In Liverpool there is a tendency for the interval changes to average slightly smaller than in North American markets and also for them to be less predominantly in one direction during the course of a major movement.

The facts may be thrown into relief by calculating the daily average gross interval movement (i.e., the arithmetic average of all interval changes, signs ignored), the average daily net change (signs ignored), and the ratio of gross daily movement to net daily movement. These averages (in cents) and ratios are as given below.

The differences in these averages reflect the differences in volatility. The ratios indicate that Chicago and Winnipeg recorded on the average 1.50 cents of interval movement for each cent of daily change, while Liverpool recorded 1.53 cents of interval movement for each cent of daily change. What may be called the "fluctuation ratio" in Liverpool is thus slightly larger than in the North American markets.

Daily average	Chicago	Winnipeg	Liverpool
Net change	1.49	1.55	1.39
Gross interval movement	2.23	2.33	2.13
Ratio, gross to net change	1.50	1.50	1.53

The fluctuation ratio in Liverpool is also larger for the major movements. This is attested by the greater average amount of daily change and interval movement per given amount (say 10 cents) of major advance or major decline. Such ratios, shown in Table 2, disclose that Liverpool recorded 24 cents of daily change and 36 cents of interval movement in recording a net advance of 10 cents,

TABLE 2.—AVERAGE AMOUNT OF DAILY CHANGE AND INTERVAL MOVEMENT PER TEN-CENT MAJOR ADVANCE AND TEN-CENT MAJOR DECLINE, IN THE THREE MARKETS*

(*Cents*)

Market and major movement	Daily change			Gross interval change
	Total	Positive	Negative	
Winnipeg				
Advance	19.4	+14.7	— 4.7	28.8
Decline	23.8	+ 6.9	—16.9	36.0
Chicago				
Advance	20.4	+15.2	— 5.2	30.1
Decline	23.4	+ 6.7	—16.7	35.0
Liverpool				
Advance	24.0	+17.0	— 7.0	36.1
Decline	26.2	+ 8.1	—18.1	39.9

* Calculated from the aggregate daily change and gross interval movement recorded during the major advances and major declines, respectively, in each market.

while Chicago and Winnipeg each recorded approximately 20 cents of daily change and 30 cents of interval movement. Its ratios were likewise greater for each 10 cents of major decline.[1] In other words, Liverpool, while

[1] Another interesting feature of these ratios in Table 2 is that each market recorded slightly more daily and interval movement (i.e., more offsetting

absolutely more stable than the North American markets, was more irregular than they in recording equal net advances or declines. It tended to reflect the interval and daily changes in the more volatile North American markets and at the same time to retain a degree of independence by failing to keep pace with them in the broader price swings.

Briefly, these data show that Liverpool is a more stable market than Chicago or Winnipeg according to almost any appropriate standard of comparison one may select. Chicago and Winnipeg prices are about 5 to 10 per cent more variable in terms of interval movements, 8 to 13 per cent more variable in terms of daily changes, and 23 to 31 per cent more variable in terms of major movements. Liverpool prices are ordinarily more variable than North American prices only in the sense that more movement is recorded for a given amount of daily change or major movement than in Chicago and Winnipeg, where daily changes and major movements tend to be somewhat larger.

Timing of Movements

Finally, some further evidence on the development of price movements, both large and small, is to be found in the amount of interval movement, daily change, and major movement recorded at different times of the day. A brief summary of such data is sufficient to disclose the important facts.

On the basis of the total movement recorded in each interval during the seven years, it appears that nearly half of the change occurs in the First Interval, nearly one-third in the Second Interval, and less than one-fourth in the Third. The exact totals and proportions are as follows:

Interval	Chicago	Winnipeg	Liverpool
	(Cents)		
All	4,642.2	4,883.5	4,430.5
First	2,221.8	2,257.5	2,057.0
Second	1,339.6	1,550.3	1,390.3
Third	1,080.8	1,075.7	983.2
	(Percentages)		
All	100	100	100
First	48	46	47
Second	29	32	31
Third	23	22	22

The North American markets manifestly recorded over two-thirds of their movement during the trading sessions (in the First and Third Intervals) and nearly one-half of it after the Liverpool market closed. Liverpool, on the other hand, recorded almost half of its movement as overnight (Second-Interval) changes and only about one-third in the session before the North American markets opened.[1] Judging by the amount and character of change in these intervals, it would seem that at least two-thirds of all interval movements originated in North American markets.

An investigation of the time at which the daily changes were recorded shows that they too originated chiefly in North American markets. The development of these changes is to be seen in the contributing interval movements in one direction and the partially offsetting interval movements during one or two intervals in the opposite direction. The significant facts are revealed by classifying days according to the direction of the net close-to-close change, and calculating separately for days of advancing prices and days of declining prices the amounts of contributing and offsetting movement in each interval. The totals so calculated are given in Table 3 (p. 58).

To explain briefly, Chicago recorded 1,482.5 cents of daily advances during the seven years. In so doing, it recorded First-Interval advances amounting to 1,025.0 cents. But on a few days there were negative First-Interval movements (totaling 68.3 cents), so that the net contribution in the First Interval to the total daily advances was only 956.7 cents.

movement and irregularity) during major declines than during major advances. This may reflect a greater resistance to declines than to advances. If so, it is notable that it is as true of Liverpool as it is of Chicago and Winnipeg. To some extent it reflects the fact that major declines occur on the average over longer periods than major advances. The average period of major advances was 30 days; that of the major declines was 37 days.

[1] The average sizes of the changes (in cents) in the different intervals are:

Interval	Chicago	Winnipeg	Liverpool
First	1.06	1.07	.97
Second	.64	.73	.65
Third	.62	.61	.55

Likewise, there were positive Second-Interval movements contributing to the advances and offsetting negative Second-Interval movements, reducing the net Second-Interval contribution to 281.9 cents. The same was true in the Third Interval, producing a net contribution of 243.9 cents in that interval. Thus at which advances and declines were recorded in each market.

Owing largely to the fact that First-Interval changes tended to be largest, and therefore to determine the direction of the movement for the day, the offsetting changes within the day were most frequent and greatest in amount

TABLE 3.—AGGREGATE DAILY ADVANCES AND DECLINES AND THE TOTAL CONTRIBUTING AND OFFSETTING MOVEMENT BY INTERVALS, MAY 1, 1924 TO APRIL 30, 1931*

(Cents and percentages)[a]

Market	Net total	First Interval			Second Interval			Third Interval		
		Net	Positive	Negative	Net	Positive	Negative	Net	Positive	Negative
	Daily advances									
Chicago	1,482.5	956.7	1,025.0	68.3	281.9	471.0	189.1	243.9	380.8	136.9
	100.0	**64.5**	**69.1**	**4.6**	**19.0**	**31.8**	**12.8**	**16.5**	**25.7**	**9.2**
Winnipeg	1,584.3	948.1	1,028.6	80.5	381.9	578.2	196.3	254.3	371.5	117.2
	100.0	**59.8**	**64.9**	**5.1**	**24.1**	**36.5**	**12.4**	**16.1**	**23.4**	**7.4**
Liverpool	1,373.5	773.2	884.0	110.8	409.5	554.4	144.9	190.8	331.2	140.4
	100.0	**56.3**	**64.4**	**8.1**	**29.8**	**40.4**	**10.6**	**13.9**	**24.1**	**10.2**
	Daily declines									
Chicago	1,565.9	923.8	86.6	1,010.4	378.0	139.8	517.8	264.1	138.8	402.9
	100.0	**59.0**	**5.5**	**64.5**	**24.1**	**8.9**	**33.1**	**16.9**	**8.9**	**25.7**
Winnipeg	1,594.7	937.4	87.4	1,024.8	356.7	192.8	549.5	300.6	127.1	427.7
	100.0	**58.8**	**5.5**	**64.3**	**22.4**	**12.1**	**34.5**	**18.8**	**8.0**	**26.8**
Liverpool	1,439.5	781.4	120.9	902.3	396.7	125.4	522.1	261.4	107.4	388.9
	100.0	**54.3**	**8.4**	**62.7**	**27.6**	**8.7**	**36.3**	**18.1**	**7.5**	**25.6**

* Calculated by totaling the positive and negative changes in each interval on days of advancing prices and on days of declining prices separately.

[a] Percentages in boldface.

64.5 per cent of the aggregate daily advances in Chicago were recorded in the First Interval, 19 per cent in the Second Interval, and 16.5 per cent in the Third Interval.

Following this line of analysis for the daily advances in other markets and for the daily declines in all markets, evidence is obtained of the extent to which the daily changes developed in each interval through net, gross, and offsetting movements. It appears that the North American markets recorded about 59 to 64 per cent of their daily changes in the First Interval, from 19 to 24 per cent in the Second, and 16 to 19 per cent in the Third. Liverpool recorded about 54 to 56 per cent of its daily changes overnight in the First Interval, 28 to 30 per cent in the Second, and 14 to 18 per cent in the Third. There were slight but no very significant differences in the time during the overnight and Third Intervals in North America and during the session intervals in Liverpool.[1] In the latter market pri-

[1] The numbers of offsetting changes and of contributing changes (the latter having the same direction as the change for the day), during the seven years, were as follows:

	Chicago	Winnipeg	Liverpool
Total days	2,049	2,049	2,025
Number of offsetting changes:			
First Interval	323	310	366
Second Interval	637	619	494
Third Interval	498	471	483
Number of contributing changes:			
First Interval	1,726	1,739	1,659
Second Interval	1,412	1,430	1,531
Third Interval	1,211	1,230	1,214
Days of offsetting changes in one or two intervals	1,264	1,240	1,172
Days of contributing changes:			
In all intervals	785	809	853
In three intervals (Mon.–Fri.)	572	598	644
In two intervals (Sat.)	213	211	209

mary changes were notably less effective in dominating the trend for the day than were the primary changes in Chicago and Winnipeg.

On the whole, these offsetting interval changes constitute only a small proportion of all interval changes and of the total interval movement. The great majority of interval changes were in the direction of the change for the day. But on nearly two-thirds of the days there was at least one offsetting interval change within the day. After allowing for these offsetting movements, it appears that over three-fourths of the daily movement in the North American markets was recorded in their session intervals, and about 60 per cent of it was recorded after the Liverpool close. In Liverpool less than half of the daily movement was recorded in the session intervals and less than one-third was recorded in the session before Chicago and Winnipeg opened for trading. When further allowance is made for the independent or dependent character of the changes in different intervals, it seems a fair estimate to regard from two-thirds to three-fourths of the daily changes as having originated in Chicago and Winnipeg.

Just as some of the interval changes were offsetting movements within the day, so also were some of the daily changes offsetting movements running counter to the dominant trend of the major movements. To obtain a broader picture of when and how these major movements developed, we may consider on the one hand the net amount of all major movements recorded in each interval, and on the other the amount of contributing and offsetting daily changes and the development of these daily changes by intervals. Such data for all major advances and all major declines are summarized in Table 4 (p. 60).

Considering first the net movements for all days (shown in the first four columns), these totals disclose that nearly half or more than half of major advances and declines developed in the First Interval—47 to 58 per cent in Chicago, 47 to 49 per cent in Winnipeg, and 61 to 65 per cent in Liverpool. Considerably less developed in the Second Interval and only a relatively small amount in the Third.[1] On the whole, probably between 60 and 70 per cent of the major movements were initiated in North America and no more than 30 to 40 per cent in Liverpool.

Table 4 shows some differences in the proportions of major advances and of major declines recorded in each interval, but as a rule these differences are relatively small, not regular in occurrence, and not particularly significant when allowance is made for the independent or dependent character of the interval changes included in the totals. Hence these occasional differences indicate no real tendency of North American markets to initiate advances and of Liverpool to initiate declines.

Another interesting feature of the development of these major movements lies in the irregularity of movement reflected by the amount of offsetting daily changes recorded. The ratios of the gross and offsetting daily changes to major movements were discussed above in the section on volatility. The amounts of contributing and offsetting daily changes are shown in the fifth and ninth columns of Table 4 ("total" columns). The fifth column shows contributions to advances, or offsets to declines; and the ninth column shows contributions to declines, or offsets to advances. It is not necessary to review these figures in detail. It is sufficient for present purposes to call attention to the fact that offsetting changes in the aggregate are usually about one-third to one-half the amount of contributing daily changes. This represents a marked irregularity of movement.

The high proportion of these daily changes recorded in the First Interval is also noteworthy. Both contributing and offsetting

[1] The data for major advances and declines combined are as follows:

Movement	Chicago	Winnipeg	Liverpool
	(Cents)		
Total	1,122.6	1,195.4	913.7
First Interval	580.1	577.3	572.6
Second Interval	337.8	432.5	236.6
Third Interval	204.7	185.6	104.5
	(Percentages)		
Total	100.0	100.0	100.0
First Interval	51.7	48.3	62.7
Second Interval	30.1	36.2	25.9
Third Interval	18.2	15.5	11.4

daily changes developed principally in this interval. In other words, the North American markets initiated a large proportion of the price irregularity recorded from day to day. A much smaller amount of irregularity was initiated in Liverpool, as evidenced by occurrence of the movement during the Second Interval.

as overnight changes largely in response to earlier changes in Liverpool. On the other hand, Liverpool recorded the larger portion of its price movement in opening prices as overnight changes, chiefly in response to earlier initial changes in North American markets, considerably less than half in the trading session before the North American

TABLE 4.—AGGREGATE NET MOVEMENT IN SUCCESSIVE INTERVALS CONTRIBUTING TO THE DAILY CHANGES AND TO THE MAJOR ADVANCES AND DECLINES, MAY 1, 1924–APRIL 30, 1931

(Cents and percentages)[a]

Market and major movement	Net movement, all days[b]				Net movement on days of advancing prices[c]				Net movement on days of declining prices[c]			
	Total	First Interval	Second Interval	Third Interval	Total	First Interval	Second Interval	Third Interval	Total	First Interval	Second Interval	Third Interval
Chicago												
Advance	+519.5	+299.3	+123.6	+ 96.6	+790.2	+474.5	+171.8	+143.9	— 270.7	—173.9	— 43.8	— 53.0
	100.0	57.6	23.8	18.6	100.0	60.1	21.7	18.2	100.0	64.2	16.2	19.6
Decline	—603.1	—280.8	—214.2	—108.1	+403.1	+284.0	+ 75.5	+ 43.6	—1,006.2	—570.4	—283.7	—152.1
	100.0	46.6	35.5	17.9	100.0	70.5	18.7	10.8	100.0	56.7	28.2	15.1
Winnipeg												
Advance	+569.0	+269.7	+233.6	+ 65.7	+836.4	+456.5	+246.9	+133.0	— 267.4	—179.5	— 15.5	— 72.4
	100.0	47.4	41.1	11.5	100.0	54.6	29.5	15.9	100.0	67.1	5.8	27.1
Decline	—626.4	—307.6	—198.9	—119.9	+432.4	+281.1	+ 88.6	+ 62.7	—1,058.8	—596.6	—288.8	—173.4
	100.0	49.1	31.8	19.1	100.0	65.0	20.5	14.5	100.0	56.3	27.3	16.4
Liverpool												
Advance	+419.4	+272.7	+127.1	+ 19.6	+713.2	+417.2	+204.0	+ 92.0	— 293.8	—145.1	— 79.3	— 69.4
	100.0	65.0	30.3	4.7	100.0	58.4	28.6	12.9	100.0	49.4	27.0	23.6
Decline	—494.3	—299.9	—109.5	— 84.9	+398.9	+202.0	+133.8	+ 63.1	— 893.2	—497.9	—243.2	—152.1
	100.0	60.7	22.1	17.2	100.0	50.6	33.6	15.8	100.0	55.8	27.2	17.0

[a] Percentages are in boldface type.

[b] The total net movement is the sum of the net movements in the three intervals; it is also the difference between the total net movement on days of advancing prices and the total net movement on days of declining prices. The net movement in any interval for all days is the sum of all movements in that interval that were in the direction of the major movement less the sum of all movements in that interval that were in the opposite direction. "All days" of course means all days falling within periods of major advance or major decline, as the case may be.

[c] The total net movement on days of advancing prices is the sum, for days of advancing prices, of the interval movements in the direction of the movement for the day, less the sum of the interval movements in the opposite direction, which is equivalent to a simple gross sum of the daily movement; it is also the sum of the aggregates of net movement in each of the three intervals. The aggregate net movement in the First Interval on days of advancing prices is the sum of all First-Interval advances on such days, less the sum of all First-Interval declines on such days. Aggregates for days of declining prices and for all intervals may be correspondingly defined. For any interval the difference between the aggregate net movement on days of advance and the aggregate net movement on days of decline is not quite equal to the aggregate net movement on all days because the latter is affected also by a small aggregate net movement for that interval on days of no change in price for the day as a whole (not tabulated here).

In short, this analysis of the time at which interval movements, daily changes, and major movements were recorded discloses that Chicago and Winnipeg recorded the larger portion of their price movements during their trading sessions. More than half of the amount of the movement ordinarily developed after the Liverpool close, a small fraction during the first hour of trading when Liverpool was still open, and considerably less than half

markets opened for trading, and a remarkably small amount during the last two hours of trading, the last hour of which was simultaneous with Chicago and Winnipeg trading. It appears that the North American markets originated about two-thirds of the total major movement, from two-thirds to three-fourths of the daily change, and fully two-thirds of all interval change. Liverpool may be regarded as having originated the remainder.

Conclusion

The present section has dealt with four classes of evidence bearing on the question of relative leadership of Liverpool and of North American markets in the initiation of price movements: (1) the number of major movements in which the general price advance or decline appeared to have originated chiefly on one side of the Atlantic or on the other, or about equally on both; (2) the amount of price change involved in major movements of the three classes of origin; (3) the aggregate amount of net price change recorded in each market during major movements, from day to day, and within the three intervals—volatility measured over three classes of time-intervals; and (4) the amount of movement recorded in each of the three market intervals, for each market.

While the North American markets and Liverpool both participated in leading every major movement, Chicago and Winnipeg were the dominant leaders in a majority of the movements and active leaders along with Liverpool in most of the remaining movements. Liverpool assumed the rôle of dominant leader only occasionally in a very few major movements.

This tendency of the North American markets to be the more active price leaders is shown by the number of major movements classified according to origin, and even more convincingly by the amount of major movement so classified. Of the 54 major movements recorded, 32 were initiated chiefly in Chicago and Winnipeg, 17 were initiated about equally in North America and Liverpool, and only 5 were initiated largely in Liverpool. In terms of amount about two-thirds or more of the major movement appears to have been of North American origin. An independent calculation of the amount of all major movement recorded in the different intervals disclosed that between 60 and 70 per cent of such movement could fairly be regarded as of North American origin.

The examination of interval movements and daily changes revealed that at least two-thirds of all interval movement was initiated in North America and that from two-thirds to three-fourths of all daily change was so initiated. Thus the dominant leadership of Chicago and Winnipeg occurs in both the short and longer movements.

The analysis of the amount of movement in different markets disclosed that the North American markets are more volatile than Liverpool in terms of interval movements, daily changes, and major movements. But the differences in volatility are much greater for major movements than for daily changes, and greater for daily changes than for interval changes. The volatility of Winnipeg is usually greater than that of Chicago. Liverpool records less price variation than the North American markets, but it records more price fluctuation than they for each cent of daily change or of major movement. When the origin of interval changes and daily changes is considered, it appears that the North American markets originate a large proportion of the price irregularity from day to day, and Liverpool, while tending to reflect these irregular movements, retains a degree of independence by failing to keep pace in continuing movements. As a result, Chicago and Winnipeg record a good deal of independent movement which does not appear in Liverpool at all.

There are variations in the activity of the North American markets as price leaders, and these variations have an observable seasonal characteristic. The North American markets tend to be slightly more active leaders of major movements in May–October than in November–April. On the other hand, Liverpool tends to be a slightly more active leader in the winter period than in the summer period. From this it may be inferred that the influence of Liverpool on Chicago and Winnipeg is greater in winter than in summer, and that the influence of North American markets on Liverpool is greater in summer than in winter.

No evidence was found to support the view, occasionally expressed, that Liverpool is a bearish market which originates declines and that North American markets are bullish markets which originate advances. Liverpool originated daily advances and major advances fully as readily as it originated declines. Chicago and Winnipeg were as active in initiat-

ing daily and major declines as advances. No significant difference in their proportionate leadership of advances and declines could be discovered in terms of either the number of movements or the amount of movement. In the light of this evidence one must conclude that there is no bullish tendency in North America or bearish tendency in Liverpool of the sort mentioned. These markets are all basically sensitive; they all lead more or less; and they do not hesitate to lead in either direction.

The general rôles of these markets in price-making may be clarified somewhat by a statement of certain more general conclusions which the results of this investigation support. At the outset, it is clear that prices in none of the three markets are sufficiently dependent on prices in any other to warrant the statement that either of them fixes, determines, or completely leads prices in the others. Liverpool prices do not provide a basis from which Chicago and Winnipeg prices are determined any more than the latter markets provide such a basis. Nor does Liverpool initiate the majority of price movements for the rest of the world. Instead, there is a broad flexible price interdependence and price interaction among the markets, and more or less leading and following by each market. In this interaction Liverpool exercises a sort of arbitrating function, but in so doing it merely exerts an important restrictive price influence on the other markets in much the same way that they exert restrictive price influences on it.

The most important difference in the behavior of these markets is in their volatility and leadership. The limited volatility of Liverpool shows it to be a more stable and less sensitive market than Chicago or Winnipeg, even though it appears to be no less prompt in reacting to price influences. The fact that Chicago and Winnipeg are the dominant leaders signifies that in general they play a more active rôle in price-making than Liverpool. To a large extent they tend to set the pace and to dominate or direct the general course of prices in Liverpool, but the domination is not complete. While Liverpool is primarily a passive or following market, it assumes from time to time an unusually active rôle and effectively directs the general course of prices in North America. The channel of price influences for most movements is primarily through Chicago and Winnipeg to Liverpool, rather than through Liverpool to these export markets, but occasionally the channel of influence is reversed.

It should be emphasized that in this analysis of leadership no specific allowance has been made for movements initiated in Buenos Aires or in other less important markets. Some of the leadership here ascribed to either the North American markets or Liverpool may in fact be traceable ultimately to other markets of the world and especially to Buenos Aires. There can be no doubt that some of the secondary and contemporary movements in Liverpool were affected by initial movements in Buenos Aires which had not yet been reflected in Chicago and Winnipeg. If proper allowance could be made for these movements, it is certain that Liverpool would appear less active in initiating price movements than this analysis suggests. At the same time, some of the leadership which is ascribed to Chicago and Winnipeg is doubtless a reflection of initial movements in other markets.[1] But, as a whole, the evidence is sufficiently definite to leave no doubt that Chicago and Winnipeg, rather than Liverpool, are usually the dominant leaders of price movements. Their leadership, too, evidently exceeds that of Liverpool even if one makes a liberal allowance for rectifying changes that may have been induced by the failure of Liverpool to keep pace.

Finally, the leadership here described must not be regarded as necessarily representing the entire influence or effect of any of the three markets on prices of the other two. In addition to the influence exercised through its initial changes, each market contributes some influence in directing the course of prices in

[1] It will be noted that the leadership of Chicago and Winnipeg is ascribed to them jointly and not individually. Some of the leadership ascribed to both markets may have been leadership of only one or the other. Quantitative corrections for imperfections of this sort are, of course, impossible, since no definite allowance can be made for the initial movements and responses as between Chicago and Winnipeg.

other markets by responding fully to their initial movements, by lagging, by failing to respond, and by affecting (through probable reactions) even their initial changes. The real importance and influence of neither market can be satisfactorily determined in quantitative terms; no more than the approximate activity of these markets in originating and leading price movements can be so determined. It is such reliable approximations that we have endeavored to reach in this investigation.

V. RELATIONSHIPS AMONG INTERVAL CHANGES

The analysis heretofore presented of relationships between corresponding interval changes in different markets as shown by the charts was necessarily concerned primarily with correspondence between the larger movements. A study of the charts alone yields no adequate measure of the degree of correspondence between individual interval changes. To meet this need, a method for summarizing the facts is necessary. Such a summary is here presented, showing quantitatively the degree of correspondence between the related interval changes for the whole seven years and for successive six-month periods. Consideration is given particularly to the degree of relationship in the different intervals, in different seasons, and during periods when prices are generally above export parity.

Degree of Relationship

One way of measuring the relationship between comparable interval changes in the different markets is by means of the familiar coefficient of correlation. Such coefficients for the full seven years from May 1, 1924, to April 30, 1931, are given below.[1]

Interval	Chicago-Winnipeg	Chicago-Liverpool	Winnipeg-Liverpool
First	+.907	+.773	+.787
Second	+.801	+.586	+.674
Third	+.754	+.510	+.531

These coefficients indicate a remarkably close relationship between the interval changes of Chicago and Winnipeg, a broad and significant relationship between those of Chicago and Liverpool, and a slightly better relationship between those of Winnipeg and Liverpool. The degree of relationship is highest in the First Interval and lowest in the Third Interval for each pair of markets, but in each interval a strong tendency for prices in the three markets to move together is indicated.

The interval changes from which these coefficients were calculated are frequently unequal[2] in the two markets compared, because of disturbing influences of one sort or another and readjustments between intervals; but such inequalities are not sufficiently important to obscure the fundamental relationship of movements. The coefficients furnish conclusive evidence of the interrelationship of Chicago and Winnipeg changes, of the response of Liverpool prices to First-Interval changes in Chicago and Winnipeg, of the response of Chicago and Winnipeg prices to Liverpool Second-Interval changes, and of the interrelationship of Third-Interval changes in Liverpool and the North American markets.

Two more elementary measures of relationship throw further light upon the degree and character of correspondence between these interval changes, and they constitute more satisfactory measures than the coefficients of correlation for comparing relationships in different intervals and periods.[3] These measures are the average discrepancies between comparable interval changes and the

[1] In calculating these coefficients, secondary changes extending over holidays occurring in only one of the two markets compared were omitted as not comparable.

[2] From an inspection of the individual changes it was found that, while prices tended to move in the same direction in each interval, equal changes in two markets were exceptional. In the great majority of cases, there were differences of an eighth of a cent or more. Some of these differences (or discrepancies, as they may be called) arose out of price changes of opposite signs in the markets compared. A large majority of them represented unequal changes in the same direction. The larger changes occurred sometimes in one market and sometimes in the other. There was no tendency for the larger changes to occur repeatedly in one market over periods of more than a few days.

[3] The coefficients of correlation were found to give a less satisfactory basis for such comparisons because of their mathematical character and of certain characteristics of the data. The correlation coefficients tend to vary inversely with the deviations of

relative discrepancies calculated as the ratio of average discrepancy to average interval movement. Such average and relative discrepancies are measures of absolute and relative disparity between interval changes and are therefore inverse measures of correspondence. In the subsequent discussion of the inter-market relationships of interval changes, we shall consider disparity on the one hand, and correspondence inversely on the other, in terms of such average and relative discrepancies.

The average disparities of interval changes for the full seven years are shown in the following average discrepancies (in cents).

Interval	Chicago-Winnipeg	Chicago-Liverpool	Winnipeg-Liverpool
First	.47	.70	.67
Second	.43	.59	.56
Third	.42	.59	.58

These average discrepancies, calculated without regard to signs from the differences between comparable interval changes in each pair of markets, tended to be smallest for Chicago–Winnipeg and largest for Chicago–Liverpool. Small disparity of movement may be regarded as signifying close price correspondence. Accordingly, it may be said that Chicago and Winnipeg prices moved together more closely than Winnipeg and Liverpool prices, and that the latter moved together slightly better than Chicago and Liverpool prices.

In terms of these absolute discrepancies, the disparity (and inversely the correspondence) was only slightly different in the three intervals. But since First-Interval discrepancies were greater than Second-Interval discrepancies, the North American markets may be said to have followed Liverpool with less disparity, and consequently better, than Liverpool followed either of the North American markets.

A different relation is found among measures of relative discrepancy. Such a convenient and useful measure is obtained by expressing the average discrepancy as a percentage of the mean of the average changes in the two markets compared.[1] For instance, the First-Interval average discrepancy of .47 cent for Chicago–Winnipeg may be expressed as a percentage of the mean of the 1.06 cents change in Chicago and the 1.08 cents change in Winnipeg, which is 1.07 cents.[2]

the changes from normal and directly with the range of interval movement. This is shown by the formula $r = \sqrt{1 - \left(\frac{\sigma_v}{\sigma_y}\right)^2}$ in which σ_v is the standard error of estimate (the root-mean-square of the deviations of actual changes from the regression line of average relationship) and σ_y is the standard deviation of the "dependent" changes (the root-mean-square of the deviations of these changes from the mean change calculated with regard to signs). The data with which we are dealing here, however, are such that the standard errors, while tending to vary directly with the standard deviations of the changes in the various periods, vary less than proportionally. As a result, the coefficients of correlation for different intervals and periods vary greatly in accordance with the marked differences in the size of changes in these intervals and periods. They are technically unsuited as a basis for comparing the actual discrepancy and correspondence of related interval changes for the additional reason that they measure correspondence in terms of conformity to an empirical average relationship between changes in two markets, which relationship varies from interval to interval and from period to period, rather than in terms of conformity to the expectation of equality of change.

[1] Calculated in this way the relative discrepancy must fall within the range of zero to 200 per cent of the average interval movement. Perfect correspondence of movement would be represented by no absolute discrepancy, or a percentage discrepancy of zero. Perfect disparity of movement (i.e., changes of opposite signs in each case) would be represented by an average discrepancy of twice the mean change, or a percentage discrepancy of 200. Hence the smaller the percentages, the smaller is the relative disparity of movement and the greater the correspondence. Percentages of 100 signify discrepancies equal to the average of the changes in the two markets. They may be regarded also as signifying that one-half of the aggregate movement in any two markets combined consists of discrepancies and the other half of parallel or corresponding movements. A percentage of 50 signifies that one-fourth the aggregate movement consists of discrepancies and three-fourths of parallel movements, one-half of which is recorded in each market.

[2] The average changes (in cents) for the seven years are:

	Average prices		
Interval	Chicago	Winnipeg	Mean
First	1.06	1.08	1.07
Second	.62	.71	.66
Third	.61	.61	.61
	Chicago	Liverpool	Mean
First	1.05	.97	1.01
Second	.62	.66	.64
Third	.61	.56	.59
	Winnipeg	Liverpool	Mean
First	1.07	.96	1.01
Second	.71	.66	.68
Third	.61	.56	.58

The relative discrepancies calculated as ratios of average discrepancy to average interval movement for the seven years as a whole are as follows:

Interval	Chicago-Winnipeg	Chicago-Liverpool	Winnipeg-Liverpool
First	.44	.69	.66
Second	.65	.92	.82
Third	.69	1.02	1.00

The correspondence as indicated inversely by these ratios, or relative discrepancies as they may be called, reveals that Liverpool overnight responses followed the North American primary movements better than Chicago or Winnipeg overnight responses followed Liverpool primary movements. The ratios indicate a much larger relative discrepancy (or inversely a poorer correspondence) in the Second Interval than in the First.

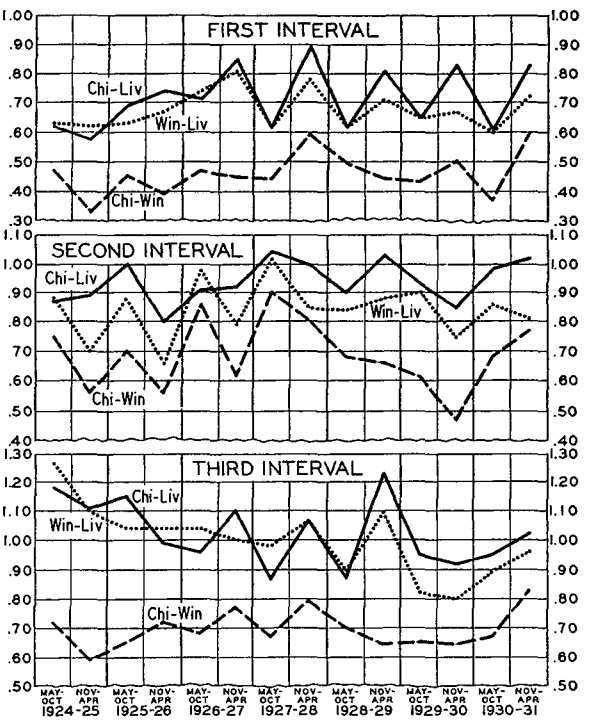
The proportion of parallel movements (as shown inversely by the ratios) was manifestly greatest in the First Interval and smallest in the Third. But in view of the fact that the First-Interval changes were actually largest and Third-Interval changes smallest, this means also that a larger absolute amount of parallel movement was recorded in the First Interval than in the Second or the Third Interval. That is to say, correspondence between the comparatively large First-Interval changes was considerably greater for each pair of markets than between the smaller Second-Interval changes, and it was somewhat greater between Second-Interval changes than between the still smaller Third-Interval changes. Liverpool, therefore, really followed North American primary changes more closely than the other markets followed Liverpool primary changes.

Seasonality

In the previous section (pp. 51–52) it was seen that the North American markets tended to be more active leaders in summer than in winter, and Liverpool tended to be a more active leader in winter than in summer. It now appears that there is likewise a notable seasonality in the degree of correspondence between the related interval changes of these markets and hence in the effectiveness of their leadership. This seasonality is reflected in the correspondence as shown inversely by the discrepancy ratios for the summer (May 1 to October 31) and winter (November 1 to April 30) periods.

In order to compare the correspondence in these successive six-months periods the relative discrepancies are shown in Chart 2. Thus

Chart 2. — Relative Discrepancies between Comparable Interval Changes for Chicago–Winnipeg, Chicago–Liverpool, and Winnipeg–Liverpool, by Seasons, May–October and November–April, 1924–31*



* The relative discrepancy is expressed as the ratio of the six-month average of discrepancies between comparable interval changes to the six-month average of interval changes.

exhibited, the seasonality of correspondence is most conspicuous between the North American markets and Liverpool in the First and Second Intervals.

Liverpool First-Interval changes tend to correspond more closely with Chicago and Winnipeg First-Interval changes in summer than in winter. The relative discrepancies were smaller in the summer months than in the following winter months in six of the seven years. The only exception was the year of abnormally large price movement, 1924–25. Such relative discrepancies for the

full seven years are significantly smaller in summer than in winter. The ratios are:

Season	Chicago-Liverpool	Winnipeg-Liverpool
Summer	.65	.63
Winter	.74	.68

In general, Liverpool overnight responses tended to follow the North American markets more closely in summer than in winter.

Between Second-Interval changes the seasonality is different. Here the correspondence tends to be closer in winter than in summer. For Winnipeg–Liverpool the ratios in winter months were smaller than in the preceding summer months in every year except 1928–29. For Chicago–Liverpool the winter ratios were smaller in only three years—1925–26, 1927–28, and 1929–30. In three of the other years (1924–25, 1926–27, and 1930–31) they were only slightly larger. For the seven years the relative discrepancies average larger in summer than in winter for both pairs of markets. The ratios are:

Season	Chicago-Liverpool	Winnipeg-Liverpool
Summer	.95	.90
Winter	.89	.75

Thus the overnight changes in Chicago and Winnipeg tended to follow Liverpool primary changes more closely in winter than in summer.

Between Third-Interval changes there is little evidence of seasonality of correspondence in the ratios of Chart 2 or in the summer and winter ratios for the seven years. The latter ratios, shown below, indicate a slightly closer correspondence in summer than in winter.

Season	Chicago-Liverpool	Winnipeg-Liverpool
Summer	1.00	.98
Winter	1.04	1.00

Chart 2 discloses no regularity in the tendency, however, and no seasonality in the degree of correspondence between Third-Interval changes may be inferred.

Between Chicago and Winnipeg the seasonality of correspondence is most pronounced in the Second Interval. Relative discrepancies were smaller in winter than in the preceding summer in six of the seven years for Second-Interval changes; they were smaller in four years for First-Interval changes and in three years for Third-Interval changes. The relative discrepancies for the seven summer and winter periods by intervals are as follows:

Season	First Interval	Second Interval	Third Interval
Summer	.44	.72	.68
Winter	.43	.59	.69

These figures show that Chicago and Winnipeg overnight (Second-Interval) changes tended to correspond more closely in winter than in summer, and that there was little evidence of seasonality of correspondence between First-Interval changes or Third-Interval changes.

In short, this analysis of seasonality points to the conclusion that there are definite seasonal differences in the correspondence of North American and Liverpool changes in the First and Second Intervals, but none in the Third. There is likewise a seasonality of correspondence between Chicago and Winnipeg changes in the Second Interval, but very little or no seasonality in the other intervals. In Chicago and Winnipeg, overnight changes are more closely related in winter than summer; it is equally significant that in winter they tend to follow Liverpool primary changes more fully than in summer. The responses in Liverpool have just the reverse seasonality. Overnight changes there tend to follow the Chicago and Winnipeg primary changes more closely in summer than in winter. This signifies that the North American markets are most effective leaders in summer as well as most active leaders in this season; while Liverpool is at once most effective and most active as a price leader in winter.

Abnormal Spreads and Interaction

Another highly significant aspect of price behavior in these markets is the effect on interaction and correspondence of the elevation of prices in Chicago and Winnipeg above export parity.[1] The question of importance is

[1] Export parity for wheat has been defined as "such a price in an exporting country as will enable the wheat merchant in the customary course of trade to

whether or not the maintenance of prices above export parity, with abnormal spreads, creates a condition of price independence and diminished sensitivity; and whether it consequently decreases price interaction between markets, reduces the correspondence of changes, and increases discrepancies.

In the seven-year period, 1924–31, there were three years (1925 – 26, 1929 – 30, and 1930–31) during which Chicago prices were above export parity most of the time. There was one year (1929 – 30) when Winnipeg prices were often so high as seriously to restrict exports. In reviewing the major movements in these years it was noted that delayed responses and maladjustments occurred from time to time; but discrepancies of this sort occurred in other years as well. From the cumulated curves it is impossible to determine whether or not the inter-market relationships were to any important degree affected. However, by comparing the correspondence of interval changes in these years with the correspondence in other years when spreads were more nearly normal, some conclusion can be reached as to what effect, if any, there was upon the relationships between changes in the various markets.

purchase wheat and deliver it c.i.f. port of destination, so that the importer may unload it and sell it to millers and merchants at going prices as of type, grade, and quality, with a profit to the exporter and importer" ("Speculation, Short Selling, and the Price of Wheat," WHEAT STUDIES, February 1931, VII, 245). Because of interrelationships between cash and futures prices, the inter-market spread in dominant futures tends to reflect the competitive position of basic North American wheats relative to Liverpool prices. Futures prices may accordingly be spoken of as "in line" or above export parity. When the Liverpool-Chicago or Liverpool-Winnipeg spread in comparable near futures is less than the shipping differential (including freight, insurance, fobbing costs, and other incidental expenses), it usually signifies that basic North American wheats are at a premium in Liverpool and, hence, that export sales from North America tend to be restricted. However, at such times wheat of some classes and grades and even basic wheats in some locations may be exported in limited quantities. We here speak of Chicago and Winnipeg futures as being above export parity when the spread in comparable futures is so narrow as seriously to hamper export sales for considerable periods of time. The futures employed in this study are not always the near futures, and their spreads occasionally differ slightly from those obtaining for near futures.

Considering first the Chicago – Winnipeg relationship in 1925–26, it appears that the relative discrepancies (as shown in Chart 2, p. 65) in none of the three intervals were conspicuously large as compared with the discrepancies in other periods. The ratios were about average in each interval. During 1929 – 30 the relative discrepancies were slightly above average in the First Interval during the winter period; but they were about normal or below in the Second and Third Intervals. They were normal or below in all intervals during the summer. In 1930–31 the discrepancies were below average in summer and somewhat above average in winter for all intervals. A comparison of the correspondence in periods of abnormal spreads and periods of more normal price differentials can be made most easily with the numerical ratios. Below is a tabulation of the Chicago–Winnipeg ratios for the three years of non-competitive prices, individually and collectively, the ratios for the four years when prices were at approximately competitive levels, and the ratios for the seven years as a whole.

Interval and season	1925 –26	1929 –30	1930 –31	Average: Three years	Average: Four other years	Average: Seven years
First Interval						
Summer ..	.45	.43	.37	.42	.47	.44
Winter ...	.39	.50	.60	.47	.40	.43
Second Interval						
Summer ..	.70	.61	.68	.66	.78	.72
Winter ...	.56	.47	.77	.56	.62	.59
Third Interval						
Summer ..	.65	.65	.67	.65	.69	.68
Winter ...	.72	.64	.83	.72	.65	.69

A comparison of these discrepancy-ratios reveals that only five of the eighteen ratios for the three years of abnormal prices were larger than the comparable ratios for the other four years as a whole. The three-year average ratios for abnormally high Chicago prices were larger than the four-year ratios for normal prices only in two cases—the First and Third Intervals during the winter. In most instances the correspondence of Chicago and Winnipeg interval changes was closer during periods when Chicago prices were above export parity than when prices were at

competitive levels. Poorer correspondence at such times was exceptional.

While a comparison of this sort is not wholly conclusive, since it does not show what the ratios would have been in each of the three abnormal years had spreads been about normal,[1] it does point convincingly to the conclusion that, so far as Chicago and Winnipeg are concerned, the interaction of prices and correspondence of movement are very little affected by the elevation and maintenance of Chicago prices above export parity.

As between Chicago and Liverpool the case is substantially the same. The ratios of relative discrepancies in Chart 2 for the six semi-annual periods of relatively high prices are in only a few cases abnormally large. For purposes of comparison the ratios are given below.

Interval and season	1925–26	1929–30	1930–31	Average: Three years	Average: Four other years	Average: Seven years
First Interval						
Summer ..	.69	.65	.61	.66	.64	.65
Winter ...	.74	.83	.83	.79	.70	.74
Second Interval						
Summer ..	1.00	.93	.98	.99	.92	.95
Winter ...	.80	.85	1.02	.86	.93	.89
Third Interval						
Summer ..	1.15	.95	.95	1.02	.97	1.00
Winter ...	.99	.92	1.02	.97	1.11	1.04

According to these figures, the relative discrepancies were slightly above average in all three intervals in the summer of 1925. During the winters of 1929–30 and 1930–31 they were somewhat above average in the First Interval. In the latter period they were somewhat above average in the Second Interval. As compared with the deviations from average in other periods, however, most of these cases are not conspicuous, and it is doubtful whether the discrepancies were materially increased because of the comparatively high Chicago prices. Ratios in the three abnormal years as a whole were notably higher than in the four other years only in the case of First-Interval winter changes and Second-Interval summer changes. Thus, for Chicago–Liverpool the evidence again points to the conclusion that the maintenance of prices above export parity does not materially increase discrepancies or reduce the price interaction and correspondence of fluctuations.

Another comparison throws further light upon this question. The ratios of discrepancies to changes in Chart 2 (p. 65) are in most of the six-months periods greater for Chicago–Liverpool than for Winnipeg–Liverpool. This suggests that the relatively high Chicago prices did have a tendency to increase discrepancies and reduce correspondence. It may be that to a moderate extent this was the effect. But since the Winnipeg–Liverpool relationship was so frequently closer than the Chicago–Liverpool relationship in other periods, it is not safe to conclude that the differences are entirely, or even largely, the consequence of the abnormally high prices in Chicago relative to other markets. That the correspondence between Chicago changes and those of other markets was slightly reduced in a few instances (such as the winter of 1929–30 for the First Interval, and the winter of 1930–31 for the First and Second Intervals) is perhaps true, but the effect was manifestly only slight. The correspondence between Winnipeg and Liverpool in 1929–30, the only year in which Winnipeg prices may be regarded as above export levels, does not appear to have been affected, for the discrepancy-ratios are about average or below in each instance.

Summary

The principal results of this quantitative analysis of the inter-market relationships between interval changes may be stated briefly.

First, there was found to be a definite relationship between interval changes in the three markets, indicating the response of Liverpool opening prices to Chicago and Winnipeg primary changes, the response of Chicago and Winnipeg opening prices to Liverpool primary changes, and the interrelationship of contemporary changes. In terms of correlation coefficients and relative discrepancies the

[1] It must be recognized that Chicago prices occasionally rose above export parity for brief periods in some of the four years here classified as normal, but it does not appear that the exclusion of changes for such periods would result in a materially higher degree of correspondence for the remaining portions of the four years.

relationship and price interdependence was closer between Chicago and Winnipeg than between Chicago and Liverpool or Winnipeg and Liverpool. As a rule it was slightly closer between Winnipeg and Liverpool than between Chicago and Liverpool.

In terms of the absolute discrepancies, Liverpool followed Chicago and Winnipeg First-Interval changes with more disparity of movement than the latter markets followed Liverpool Second-Interval changes. But the correspondence of movement as measured by correlation coefficients and relative discrepancies was closest between First-Interval changes, less perfect between Second-Interval changes, and poorest between Third-Interval changes, so that Liverpool actually followed primary changes in Chicago and Winnipeg more closely than Chicago or Winnipeg followed Liverpool primary changes.

The correspondence of certain interval changes in these markets exhibited an unmistakable seasonality. Liverpool was found to follow Chicago and Winnipeg First-Interval changes more closely in summer than in winter. The North American markets, on the other hand, tended to follow Liverpool in the Second Interval more closely in winter than in summer.

This seasonality of correspondence among interval changes assumes especial significance when considered in conjunction with the seasonality of leadership disclosed in the last section. There it was found that the North American markets tend to be more active leaders in summer than in winter, and that Liverpool tends to be a more active leader in winter than in summer. It now appears that this more active leadership of Chicago and Winnipeg in summer is also a more influential leadership than in winter, for in this season Liverpool responds more fully to their initial movements. Correspondingly, Liverpool is a more influential as well as a more active leader in winter than in summer. This seasonality appears to be related to certain seasonal characteristics for basic price influences. Chicago and Winnipeg are more effective in directing the course of Liverpool prices in summer, when Northern Hemisphere and particularly North American crop developments are the center of interest, than in winter, when increased attention is given to Southern Hemisphere markets and crop developments. Liverpool apparently attaches greater relative importance to North American prices in summer, and gives greater consideration to prices and influences elsewhere in winter. As a result, its influence on North American markets in winter months is increased. This greater influence is due in part to fewer disturbing influences to modify the opening response of North American markets in this season. That this latter factor is important is suggested in part by the fact that Chicago and Winnipeg overnight changes correspond more closely in winter than in summer, while changes in the other two intervals show almost no seasonality of correspondence.

Finally, the elevation of Chicago and Winnipeg prices above export parity did not significantly affect the correspondence of their interval changes with those of Liverpool and thereby produce larger than usual discrepancies of movement. On this account one may conclude that the maintenance of prices above export parity has relatively little, if any, effect on the price interaction, on the correspondence of price changes over brief intervals, or on the sensitivity of the markets studied. In maintaining prices above export parity, Chicago and Winnipeg do not achieve isolation and escape the effect of price changes abroad, or even of minor world influences which affect outside markets. Their prices do not assume the independent characteristics of "domestic" prices when wheat is on a domestic basis, but retain their usual sensitivity and interaction.

This study is the work of Robert D. Calkins with the advice of Holbrook Working and the aid of the staff of the Institute

APPENDIX

TABLE I.—NET AMOUNT OF THE MAJOR PRICE MOVEMENTS, CLASSIFIED ACCORDING TO MARKET OF ORIGIN, AND NET CHANGES IN EACH INTERVAL

(Cents per bushel)

Period	Chicago				Winnipeg				Liverpool			
	Net price movement	Net First-Interval change	Net Second-Interval change	Net Third-Interval change	Net price movement	Net First-Interval change	Net Second-Interval change	Net Third-Interval change	Net price movement	Net First-Interval change	Net Second-Interval change	Net Third-Interval change
Movements originating principally in Chicago and Winnipeg												
Major advances: Total	+305.3	+195.1	+59.2	+51.0	+326.0	+184.6	+ 99.3	+42.1	+217.4	+167.1	+22.6	+27.7
1924-25 June 9-July 26	+ 29.6	+ 18.2	+ 2.9	+ 8.5	+ 43.0	+ 20.6	+ 13.1	+ 9.3	+ 33.9	+ 24.0	+10.9	— 1.0
Nov. 3-Nov. 13	+ 16.1	+ 9.2	+ 5.4	+ 1.5	+ 19.7	+ 13.3	+ .3	+ 6.1	+ 16.4	+ 10.3	+ .8	+ 5.3
Dec. 31-Jan. 28	+ 26.1	+ 15.8	+ 6.1	+ 4.2	+ 32.5	+ 21.0	+ 9.7	+ 1.8	+ 23.2	+ 16.9	+ .1	+ 6.2
Apr. 3-Apr. 11	+ 23.8	+ 14.2	+ 6.4	+ 3.2	+ 27.4	+ 15.5	+ 8.0	+ 3.9	+ 14.8	+ 13.4	+ 1.7	— .3
1925-26 July 3-July 17	+ 18.0	+ 17.6	— .6	+ 1.0	+ 15.7	+ 16.2	+ .8	— 1.3	+ 9.4	+ 6.7	+ .6	+ 2.1
July 22-Aug. 8	+ 18.7	+ 15.0	+ .7	+ 3.0	+ 12.6	+ 7.2	+ 2.3	+ 3.1	+ 12.0	+ 15.4	— 1.3	— 2.1
Dec. 21-Dec. 29	+ 23.0	+ 17.1	+ 7.1	— 1.2	+ 17.5	+ 8.5	+ 9.0	0.0	+ 7.1	+ 5.4	+ 2.4	— .7
1926-27 June 28-July 30	+ 12.5	+ 4.7	+ 1.0	+ 6.8	+ 16.9	+ 5.2	+ 7.4	+ 4.3	+ 11.9	+ 6.7	— .3	+ 5.5
Sept. 4-Oct. 22	+ 11.6	+ 11.0	+ 1.4	— .8	+ 13.9	+ 12.4	+ 3.4	— 1.9	+ 9.4	+ 9.7	+ 3.2	— 3.5
1927-28 Feb. 8-Apr. 30	+ 40.9	+ 20.4	+10.5	+10.0	+ 23.3	+ 12.6	+ 8.3	+ 2.4	+ 18.3	+ 12.0	+ .2	+ 6.1
1928-29 Jan. 5-Feb. 20	+ 17.4	+ 11.5	+ 3.8	+ 2.1	+ 16.2	+ 8.8	+ 2.2	+ 5.2	+ 6.8	+ 6.9	— 1.1	+ 1.0
1929-30 May 31-July 8	+ 25.8	+ 16.0	+ 7.6	+ 2.2	+ 35.0	+ 17.1	+ 14.5	+ 3.4	+ 20.3	+ 12.9	+ 3.5	+ 3.9
July 8-July 17	+ 21.3	+ 14.7	+ 6.3	+ .3	+ 27.2	+ 15.7	+ 14.2	— 2.7	+ 20.3	+ 14.4	+ 5.2	+ .7
1930-31 July 30-Aug. 7	+ 10.9	+ .3	+ 3.1	+ 7.5	+ 12.9	+ 1.9	+ 4.3	+ 6.7	+ 10.5	+ 6.4	— .5	+ 4.6
Dec. 29-Feb. 10	+ 9.6	+ 9.4	— 2.5	+ 2.7	+ 12.2	+ 8.6	+ 1.8	+ 1.8	+ 3.1	+ 6.0	— 2.8	— .1
Major declines: Total	—337.0	—200.5	—70.0	—66.5	—344.8	—210.4	— 55.2	—79.2	—232.3	—150.4	—20.8	—61.1
1924-25 July 26-Aug. 26	— 14.7	— 10.0	+ .5	— 5.2	— 19.9	— 12.5	— .9	— 6.5	— 6.0	— 4.8	— .1	— 1.1
Oct. 8-Nov. 3	— 10.0	— 6.5	— .2	— 3.3	— 14.3	— 11.4	— 1.1	— 1.8	— 9.7	— 9.0	+ 2.3	— 3.0
Jan. 28-Feb. 11	— 26.9	— 20.9	— 6.1	+ .1	— 31.9	— 25.3	— 7.9	+ 1.3	— 18.1	— 8.1	— 3.5	— 6.5
Mar. 23-Apr. 3	— 31.5	— 27.6	— .1	— 3.8	— 34.2	— 26.3	— 5.1	— 2.8	— 18.8	— 8.7	— 8.1	— 2.0
Apr. 11-Apr. 16	— 17.3	— 6.1	— 2.6	— 8.6	— 17.5	— 5.6	— 2.7	— 9.2	— 8.1	— 6.3	— 1.2	— .6
1925-26 June 6-July 3	— 26.1	— 22.2	+ .9	— 4.8	— 22.7	— 15.6	— 1.4	— 5.7	— 23.1	— 18.1	+ 1.0	— 6.0
July 17-July 22	— 10.2	— 5.4	— 4.0	— .8	— 10.2	— 6.5	— 2.8	— .9	— 6.7	— 1.5	— 2.4	— 2.8
Aug. 8-Oct. 3	— 34.4	— 15.4	—16.6	— 2.4	— 30.6	— 18.1	— 5.7	— 6.8	— 22.3	— 21.1	— 2.3	+ 1.1
1926-27 July 30-Sept. 4	— 14.5	— 10.1	— 4.6	+ .2	— 17.6	— 16.3	— .1	— 1.2	— 8.9	— 11.9	— .3	+ 3.3
1927-28 Aug. 11-Sept. 17	— 16.9	— 7.9	— 3.4	— 5.6	— 18.6	— 11.5	— 4.0	— 3.1	— 13.0	— 9.6	— 3.8	+ .4
1928-29 May 1-June 18	— 29.0	— 12.9	— 3.4	—12.7	— 17.0	— 3.0	— .5	—13.5	— 18.4	— 11.9	+ 2.6	— 9.1
1929-30 July 17-July 20	— 11.0	— 9.3	— 2.9	+ 1.2	— 12.3	— 8.8	— 5.2	+ 1.7	— 5.8	— 3.0	— 6.9	+ 4.1
Aug. 1-Aug. 13	— 15.6	— 8.4	— 7.3	+ .1	— 18.1	— 11.8	— 6.1	— .2	— 11.4	— 9.1	— 1.6	— .7
Dec. 3-Dec. 20	— 15.7	— 6.8	— 4.5	— 4.4	— 17.0	— 7.7	— 4.7	— 4.6	— 14.6	— 5.8	+ 1.9	—10.7
Apr. 5-Apr. 30	— 14.4	— 8.0	— 2.2	— 4.2	— 12.0	— 8.3	— 3.1	— .6	— 8.8	— 8.2	+ 2.2	— 2.8
1930-31 May 31-July 30	— 25.8	— 12.3	— 9.4	— 4.1	— 26.6	— 16.9	— 1.0	— 8.7	— 15.9	— 6.3	— .1	— 9.5
Oct. 15-Dec. 29	— 23.0	— 10.7	— 4.1	— 8.2	— 24.3	— 4.8	— 2.9	—16.6	— 22.7	— 7.0	— .5	—15.2
Movements originating about equally in Chicago and Winnipeg and Liverpool												
Major advances: Total	+150.2	+ 89.6	+31.8	+28.8	+165.4	+ 76.5	+ 80.9	+ 8.0	+123.7	+ 54.3	+59.8	+ 9.6
1924-25 Aug. 26-Oct. 8	+ 23.5	+ 9.7	+10.4	+ 3.4	+ 38.0	+ 11.4	+ 20.2	+ 6.4	+ 29.8	+ 14.5	+11.6	+ 3.7
Dec. 4-Dec. 31	+ 18.8	+ 14.3	+ 6.7	— 2.2	+ 22.9	+ 11.5	+ 12.1	— .7	+ 18.3	+ 8.5	+ 9.8	0.0
Feb. 11-Feb. 28	+ 21.8	+ 15.4	+ 5.7	+ .7	+ 18.9	+ 15.1	+ 10.9	— 7.1	+ 11.2	+ 6.4	+ 8.2	— 3.4
Mar. 17-Mar. 23	+ 16.8	+ 7.9	+ 4.6	+ 4.3	+ 16.3	+ 8.6	+ 5.7	+ 2.0	+ 10.1	+ .2	+10.5	— .6
1925-26 May 1-June 6	+ 31.4	+ 22.7	— 5.5	+14.2	+ 21.7	+ 11.1	+ 6.9	+ 3.7	+ 15.7	+ 8.1	+ 4.7	+ 2.9
1927-28 May 1-May 27	+ 18.2	+ 10.4	+ 1.5	+ 6.3	+ 21.4	+ 7.8	+ 11.8	+ 1.8	+ 13.5	+ 7.6	+ 7.3	— 1.4
1929-30 Dec. 20-Dec. 31	+ 10.8	+ 4.8	+ 5.4	+ .6	+ 12.6	+ 5.7	+ 7.3	— .4	+ 10.9	+ 5.4	+ 4.8	+ .7
Mar. 14-Apr. 5	+ 8.9	+ 4.4	+ 3.0	+ 1.5	+ 13.6	+ 5.3	+ 6.0	+ 2.3	+ 14.2	+ 3.6	+ 2.9	+ 7.7
Major declines: Total	—209.9	— 81.3	—97.9	—30.7	—214.9	— 86.7	—100.9	—27.3	—196.7	—122.1	—62.9	—11.7
1924-25 Feb. 28-Mar. 17	— 46.6	— 23.5	—12.2	—10.9	— 50.4	— 17.8	— 19.1	—13.5	— 38.5	— 14.1	—17.9	— 6.5
1925-26 Dec. 7-Dec. 21	— 14.4	— 7.6	— 5.1	— 1.7	— 17.6	— 14.6	— 6.4	+ 3.4	— 14.4	— 7.9	— 7.1	+ .6
1926-27 Oct. 22-Nov. 20	— 11.9	— 5.6	— 4.4	— 1.9	— 13.4	— 6.8	— 2.6	— 4.0	— 9.9	— 5.2	— 3.5	— 1.2
1928-29 July 2-Aug. 11	— 31.7	— 11.2	—13.3	— 7.2	— 27.5	— 8.2	— 12.3	— 7.0	— 31.3	— 14.2	—10.1	— 7.0
Feb. 20-Apr. 30	— 19.9	— 5.7	—13.6	— .6	— 14.3	— 3.1	— 10.3	— .9	— 18.1	— 13.9	— 3.7	— .5
1929-30 May 1-May 31	— 20.5	— 6.0	— 9.2	— 5.3	— 19.2	— .6	— 18.4	— .2	— 16.9	— 12.2	— .9	— 3.8
Aug. 13-Nov. 12	— 27.3	— 3.9	—25.5	+ 2.1	— 29.1	— 16.3	— 8.6	— 4.2	— 29.6	— 31.3	— 2.1	+ 3.8
1930-31 Aug. 7-Oct. 15	— 26.2	— 13.9	— 7.8	— 4.5	— 33.5	— 15.4	— 18.5	+ .4	— 33.4	— 17.4	—15.4	— .6
Feb. 10-Mar. 30	— 11.4	— 3.9	— 6.8	— .7	— 9.9	— 3.9	— 4.7	— 1.3	— 4.6	— 5.9	— 2.2	+ 3.5
Movements originating principally in Liverpool												
Major advances: Total	+ 64.0	+ 15.9	+37.0	+11.1	+ 77.6	+ 15.9	+ 51.2	+10.5	+ 78.3	+ 50.7	+42.3	—14.7
1925-26 Oct. 3-Dec. 7	+ 40.3	+ 18.1	+12.6	+ 9.6	+ 45.1	+ 13.5	+ 27.2	+ 4.4	+ 50.3	+ 26.9	+24.5	— 1.1
Mar. 8-Apr. 30	+ 5.3	— 8.2	+10.8	+ 2.7	+ 12.1	— 1.3	+ 9.2	+ 4.2	+ 10.2	+ 5.6	+ 8.7	— 4.1
1929-30 Nov. 12-Dec. 3	+ 18.4	+ 6.0	+13.6	— 1.2	+ 20.4	+ 3.7	+ 14.8	+ 1.9	+ 17.8	+ 18.2	+ 9.1	— 9.5
Major declines: Total	— 56.2	— 4.6	—40.3	—11.3	— 66.7	— 18.4	— 44.1	— 4.2	— 65.3	— 23.4	—25.7	—16.2
1925-26 Dec. 29-Mar. 8	— 26.2	— 5.7	—14.9	— 5.6	— 22.4	— 8.8	— 14.6	+ 1.0	— 21.7	— 9.2	—10.0	— 2.5
1929-30 Dec. 31-Mar. 14	— 30.0	+ 1.1	—25.4	— 5.7	— 44.3	— 9.6	— 29.5	— 5.2	— 43.6	— 14.2	—15.7	—13.7

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