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MATERIALS FOR A THEORY OF WHEAT PRICES

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WHEN I left this inspiring university just eleven years ago next month, at the end of nearly three years of graduate study, I considered myself well trained in economic theory. The subject had interested me deeply, and under the guidance of Allyn A. Young and H. J. Davenport I had at least had as fine an opportunity for the study of economic theory as a student could wish. As a student during the next year at the University of Wisconsin and subsequently through two years of endeavoring to expound Alfred Marshall to students, I improved my command of theory as it stood then and, in the main, still stands.

Now, after several years' work on wheat prices, I entitle this paper "Materials *for* a Theory of Wheat Prices." I shall not present and am not ready to present a theory of wheat prices. I doubt if anyone can write today a theory really adequate to account for wheat price movements as we observe them in the markets of the world. At the Bureau of Agricultural Economics, at the Kansas State Agricultural College, at the Food Research Institute, in many business offices, and elsewhere, people are reaching conclusions regarding the behavior of wheat prices. Some of these conclusions appear inconsistent—mutually contradictory. About the only conclusions I am prepared to reject are those involving the assumption that the movements of wheat prices can be explained simply and completely by reference to only a few factors. Wheat prices react to a great number of influences, the relationships are complex, and the effect of a given statistical development may be great this year and small or nearly negligible next year. That much appears to me clear.

TWO PECULIAR CYCLES

Today I wish merely to present two tendencies in wheat prices which I have recently uncovered. Specifically, I undertake to present evidence that major wheat price movements, extending through periods from two to about twelve months in length, are largely dominated by two peculiar cyclical tendencies. The cycles are not of conventional regular character and I have hesitated to apply the term, but it is the best I find. The first, which I shall

subsequently call the "long cycle," is a tendency for any three-year period of high wheat prices to be followed by declining prices, whatever the crop developments; and conversely, for a three-year period of low wheat prices to be followed by rising prices, whatever the crop developments. The second cyclical tendency, superimposed on the first and both obscuring and modifying it, is a very strong tendency for any large, sharp price rise during the crop season, reflecting what may be called a "crop scare," to be followed by an almost equal, but usually more gradual and prolonged, price decline. Such sharp price increases occurred in fifteen of the 33 years included in that part of the investigation.

The price statistics on which the present paper is based are weekly average prices of the Chicago May wheat future.[1] Two advantages are obtained by using futures prices: first, there is substantially no regular seasonal tendency in movements of prices of Chicago wheat futures, such as might obscure other price tendencies; second, by using futures prices one may follow price tendencies from the closing months of one crop year into the next crop year without having them obscured by such changes as occur in cash wheat prices in the transition from the price level of the end of one crop year to the frequently lower level of the beginning of a new crop year.

Those of you who are familiar with futures price quotations will be puzzled by the fact that prices for the May, 1930, wheat future, for example, are shown as though they were quoted regularly through fourteen months from the first of April, 1929 to the end of May, 1930. As many of you know, the May, 1930 future was first traded in July, 1929. The prices shown in previous weeks for the May, 1930 wheat future are hypothetical prices obtained by taking the quotations on the December future and adding a constant amount equal to the spread shown between the December and the May futures when trading in the May future became regular. This method had to be applied in every year, sometimes over a longer period than in 1929. Because of the stability of the spread between prices of the December and of the May futures, hypothetical prices arrived at by this method necessarily approximate very closely prices that would have been registered if trading had been active.

[1] For convenience in charting and in averaging, prices for only four weeks in each month are shown, the weeks omitted (four in each 12-month period) being weeks almost equally divided between adjacent months.

To render the price fluctuations in different years more fairly comparable, each weekly price during any crop year has been divided by the average July-June wholesale price index number.[2] The prices shown in the figure are on the basis of cents per bushel at the 1913 price level. The result, however, is not in any full sense a price series corrected for changes in the wholesale price level, since the same division is used for the price of each week in any one fourteen-month price series. The price fluctuations shown in the figures reflect changes in the price of wheat futures as they

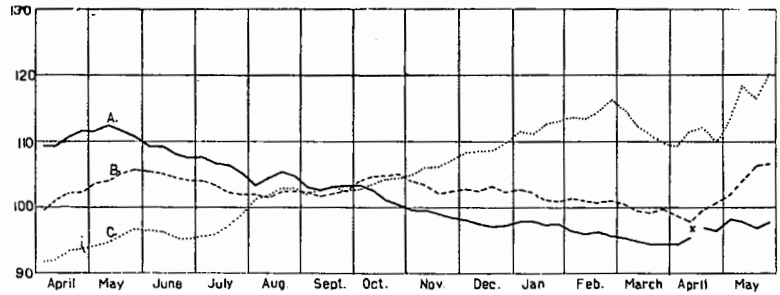

FIGURE 1. DEFLATED WEEKLY AVERAGE PRICE OF CHICAGO MAY WHEAT FUTURE, APRIL TO SECOND FOLLOWING MAY, 1887-88 TO 1913-14 AND 1924-25 TO 1928-29, BY TYPES OF YEARS, CLASSIFIED ACCORDING TO PREVIOUS 3-YEAR AVERAGE PRICE

(Cents per bushel at 1913 price level)

A—Average for 10 years preceded by high 3-year average price.
B—Average for 12 years preceded by intermediate 3-year average price.
C—Average for 10 years preceded by low 3-year average price.
Calculated from weekly averages of daily highs and lows compiled by the Food Research Institute from annual Reports of the Chicago Board of Trade and from the Chicago Daily Market Record. See appendix, table 1, page 723 for years included in each of above series.

actually occurred without either addition or deduction on account of changes in the general wholesale price level during the course of the fourteen months covered by each series.

THE LONG CYCLE

The principal evidence of the tendency in wheat prices which I characterize as a peculiar long cycle, appears in figure 1. At first glance the differences between the three curves in figure 1 may not appear great enough to deserve much emphasis. Please bear in

[2] The United States Bureau of Labor Statistics "All Commodities" index number and (prior to 1890) Snider's index number.

mind, however, that the scale used for this figure was chosen, not to bring out the differences between these curves, but to render them directly comparable with the subsequent figures, for which the scale was chosen to show conveniently the occasionally wide price fluctuations in individual years. Consider also how the figure would look if all three curves were started at the same point at the left: the spread between the two outside curves would then reach the equivalent of twenty cents in the last week of February and more in May. Consider also that the curves of upward and of downward slope represent, not the tendencies in extreme years, but in each case the average tendency in approximately one-third of the total number of years covered by the investigation.

The curve with a downward slope shows weekly the average price in those 10 out of 32 years which were immediately preceded by three years for which the average price, at the 1913 price level, was higher than in the case of any of the other 22 years. In making the selection of years the only adjustment made, other than for general wholesale price level, was to take account of the lower relative level of wheat prices since the war than before the war. All the three-year averages for the post-war years were raised by a uniform percentage to bring them on a level with the general average deflated price for the pre-war period.

The curve of rising tendency shows similarly the average weekly price during ten years which were immediately preceded by three years for which the average price was lower than in the case of any of the other 22 years. The curve of horizontal tendency represents the average weekly price during the twelve years not assigned to either of the other two groups, *i. e.,* years preceded by three years for which the average price fell in an intermediate range.

I am sorry I cannot show you the figures depicting the price movements during the individual years composing the three groups. The declining curve is made up of ten individual years all of which exhibit to a striking degree the characteristics of the curve of averages, differing chiefly in that substantial fluctuations are superimposed on the characteristic downward trend. The twelve years whose averages are represented by the curve of horizontal tendency mostly resemble the average curve except for fluctuations superimposed on a generally horizontal trend. Of the ten years whose averages are represented by the curve of rising tendency, only two (1908-09 and 1924-25) resemble at all closely the curve of aver-

ages.[3] While declines in wheat prices usually take place gradually over a long period, increases are usually short and sharp, followed by stability or, more often, by subsequent decline. The sharp increases, coming at different times during the season in different years, produce a curve of averages that is relatively smooth, but quite unrepresentative of the characteristics, in detail, of most of its components.

INTERPRETATION OF THE LONG CYCLE

Regarding the indicated tendency for high prices to be followed by a decline, and for low prices to be followed by a rise, the first reaction may be that this is a perfectly natural and obvious tendency and deserving of little comment. If we were dealing with cash prices, such an observation might be well founded. In the case of future prices, there is no necessity for such a tendency. At the end of one crop year cash prices may be high but the price of next year's May future relatively low. According to a commonly accepted theory regarding the operation of speculative markets, the price of a new crop future represents the price expected in the delivery month and is related to cash prices during the old crop season only to the extent that the supply and demand situation in one crop year bears on the price to be expected in the next crop year. The tendency for years of high wheat prices to be followed by declining prices of wheat futures, and *vice versa* is not necessarily to be expected. More than that, if the speculative market actually worked as described by many theorists, it would be quite impossible for such things to happen.

I am among those who believe that statistics frequently lead us to generalize on the basis of relationships that have occurred merely as a result of chance—what statisticians call the fluctuations of sampling. The best tests I have been able to devise indicate that it is totally unreasonable to account for the facts I have been describing on the basis of chance.

It may be suggested that the tendencies shown in figure 1 rest on a tendency for acreage to be expanded and for production to be large after several years of high prices, and *vice versa.* But if the speculative market worked as it is commonly supposed to work, futures prices would not show the characteristics de-

[3] In both these cases, however, the rise was greater than the average.

scribed even as a result of such a cyclical tendency in production. As a matter of fact, the speculative market working as it does work, I consider that the tendency for high prices to be followed by increased production accounts for part of the tendencies described. But at the most only a relatively small part of this tendency may be so explained. In the main, some other explanation is required. To find the explanation is the next task. I hope this paper may interest some of you in helping toward the solution.

CROP SEASON PRICE CYCLES

The second peculiar type of cycle in wheat prices is well exemplified in the movements of wheat prices during the crop year recently ended, 1929-30. The long decline in wheat prices after late July, 1929, has seemed to many very difficult of explanation. It has been attributed in various degrees to the stock market crash, to the general commodity price decline, to the nearly world-wide business depression, to the Federal Farm Board, to the Canadian Wheat Pool, to a British boycott, to the German and Italian tariffs, to the collapse of silver prices, and to numerous strange and unusual events in addition. Undoubtedly several of these have had some influence, but much ingenuity has been wasted in looking for unusual circumstances to explain an event which was really not of unusual character. In its main features, the course of wheat prices during 1929-30 closely resembled the course of wheat prices in well over one-third of the thirty-three years for which I have studied the record.

The chief explanation, if I may use that term—the chief explanation for the long decline in wheat prices after late July, 1929—lies simply in the sharp price increase just preceding it. For the evidence on this point I call your attention to figures 2 to 7, which I shall summarize very briefly. These figures show the price record for the Chicago May wheat future through each of the years—fifteen out of thirty-three—in which a large, sharp price increase occurred between May and early autumn, roughly the season of important crop developments. With only a few exceptions, such a rise was followed by an approximately equal decline: a short sharp decline when the peak was reached early in the season; a prolonged irregular decline when the peak was reached later. If I may venture an explanation—in years in which the peak was reached early in the season, when the size of the

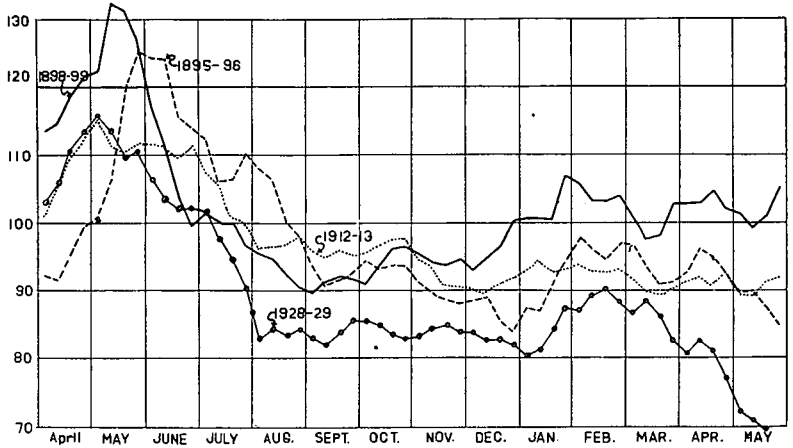

FIGURE 2. MAY PEAKS; WEEKLY AVERAGE DEFLATED PRICE OF CHICAGO MAY FUTURE IN SELECTED YEARS

(Cents per bushel at 1913 price level)

All the cases in the 33 years in which price peaks were reached in May are shown here except those in which subsequent crop scares resulted in one or two additional peaks, for which see figure 6. A sharp price rise in April-May tends to be followed by a similar sharp decline to levels below those from which the rise began.

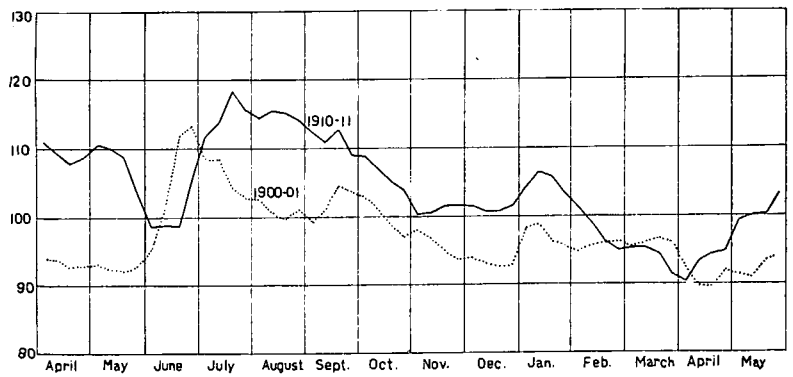

FIGURE 3. JUNE-JULY PEAKS; WEEKLY AVERAGE DEFLATED PRICE OF CHICAGO MAY FUTURE IN SELECTED YEARS

(Cents per bushel at 1913 price level)

A sharp price rise in June-July tends to be followed by a decline to a level similar to that from which the rise started. The decline tends to be less sharp than from a May peak.

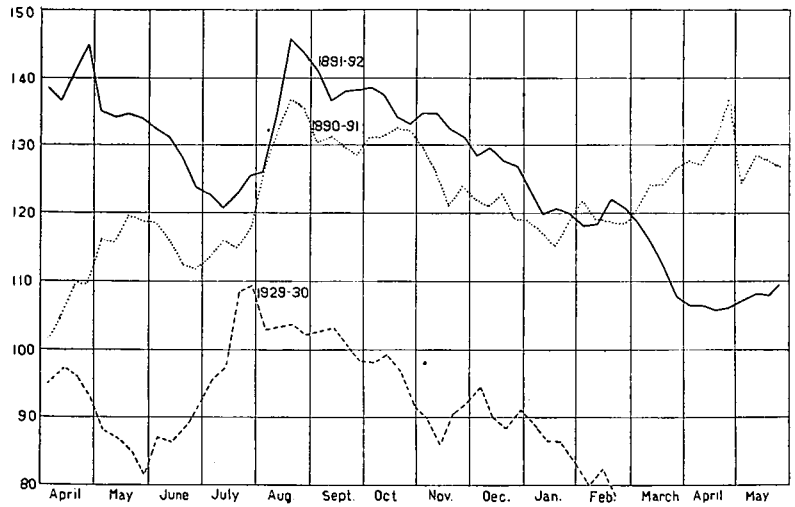

FIGURE 4. JULY-AUGUST PEAKS; WEEKLY AVERAGE DEFLATED PRICE OF CHICAGO MAY FUTURE IN SELECTED YEARS

(Cents per bushel at 1913 price level)

A sharp price rise to a peak in late July or August tends to be followed by a long, frequently interrupted, but persistent decline.

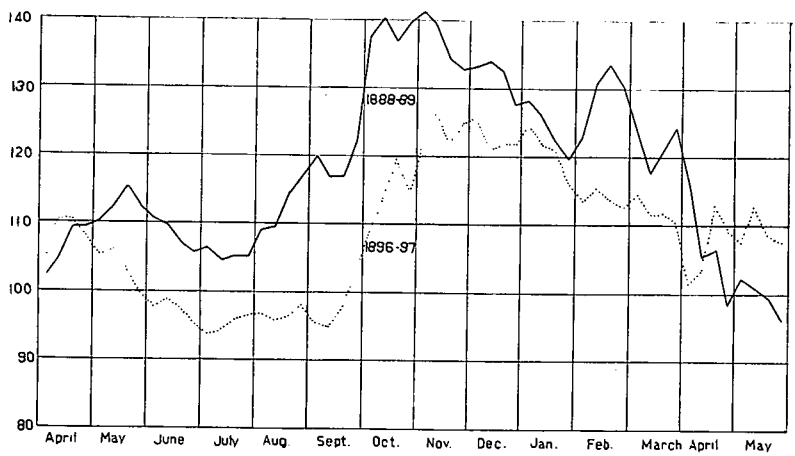

FIGURE 5. AUTUMN PEAKS; WEEKLY AVERAGE DEFLATED PRICE OF CHICAGO MAY FUTURE IN SELECTED YEARS

(Cents per bushel at 1913 price level)

A sharp price rise in late summer or early autumn tends to be fairly well held for several weeks, to be followed by a long irregular decline.

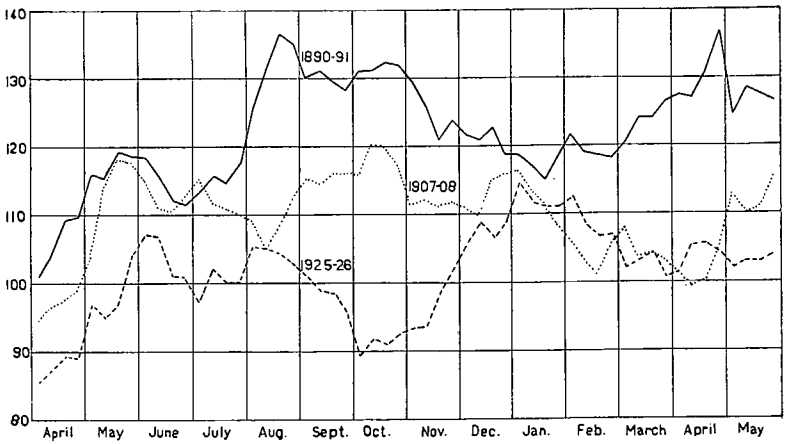

FIGURE 6. MULTIPLE PEAKS; WEEKLY AVERAGE DEFLATED PRICE OF CHICAGO MAY FUTURE IN SELECTED YEARS

(Cents per bushel at 1913 price level)

Extraordinarily unfavorable crop developments are capable of checking the decline from an early price peak and developing new and even higher peaks, from which a decline tends to ensue similar to that from a single peak occurring at such a time.

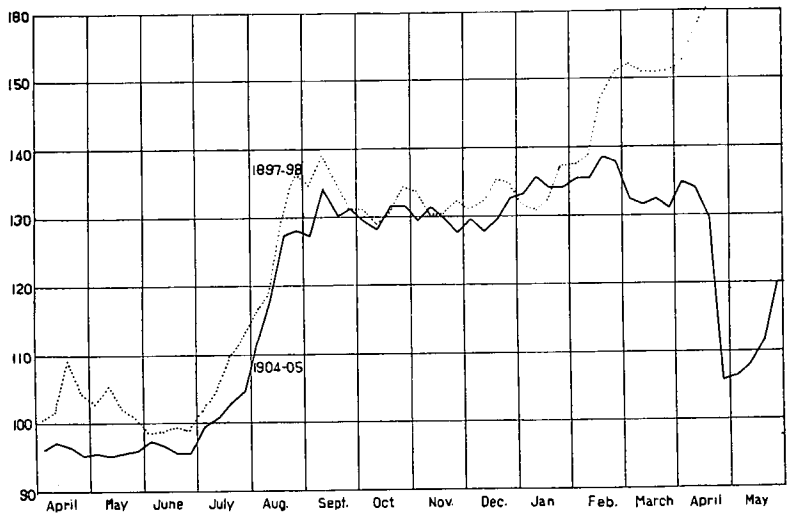

FIGURE 7. TWO EXCEPTIONS; WEEKLY AVERAGE DEFLATED PRICE OF CHICAGO MAY FUTURE IN SELECTED YEARS

(Cents per bushel at 1913 price level)

crop was still quite uncertain, those who had helped prices up were readily and quickly persuaded that they had been mistaken and prices dropped sharply. When the peak was reached later, those who had helped prices up were more confident in their opinions and changed them more slowly, with many temporary returns toward their original optimistic views.

Among the relatively few exceptions to this general rule of behavior after a sharp price rise, all but two are cases shown in figure 6 in which subsequent extraordinarily unfavorable crop developments were able to stem the tide of decline following the initial price increases and to produce one, or even two new price peaks. But after the last sharp rise, the tendency to decline reasserted itself as though that rise had been the initial one.

What I consider to be the only real exceptions to the general rule of prompt decline after a large and sharp price increase during the crop season are shown in figure 7. Circumstances in those years were quite as exceptional as the behavior of wheat prices. In 1897 the world harvested what was, relative to the level of wheat consumption at the time, the smallest crop in the 33 years under review. Worse than that, this shortest of all crops immediately followed a year in which the harvest had been below average. In these circumstances, it proved possible to maintain the level of prices reached on a sharp rise in the late summer, and at the very close of the crop year prices again rose dizzily. The second exception, unlike the first, was peculiar to the United States. In 1904 the United States harvested its smallest crop in 33 years (relative to domestic requirements). The previous crop had been short and wheat stocks at the beginning of the year were low. Under these circumstances the high levels reached by a sharp price increase in late summer were maintained for many months, though in this case a collapse in prices occurred more than two months before the first new wheat from the next crop was marketed.

I have said, rather loosely, that the long decline in wheat prices after late July, 1929, is explained by the previous sharp rise. But of course no scientist can long remain content to say that objects thrown into the air fall back just because they have always been observed to fall. He must at least find a more complicated and intellectually satisfying way of saying the same thing. Usually in the process he learns new facts of value. Again I invite your attention to what is to me a most interesting problem for explanation.

Appendix

Table 1. Years Included in Each of the Three Series Shown in Figure 1

Series A	*Series B*	*Series C*
1889–90	1887–88	1895–96
1891–92	1888–89	1896–97
1892–93	1890–91	1897–98
1893–94	1894–95	1901–02
1898–99	1905–06	1902–03
1899–00	1906–07	1903–04
1900–01	1907–08	1904–05
1910–11	1909–10	1908–09
1927–28	1911–12	1924–25
1928–29	1912–13	1925–26
	1913–14	
	1926–27	