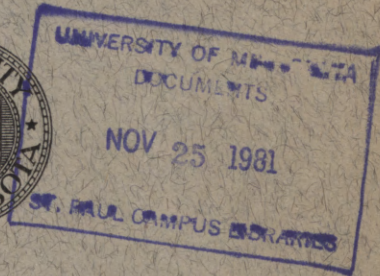


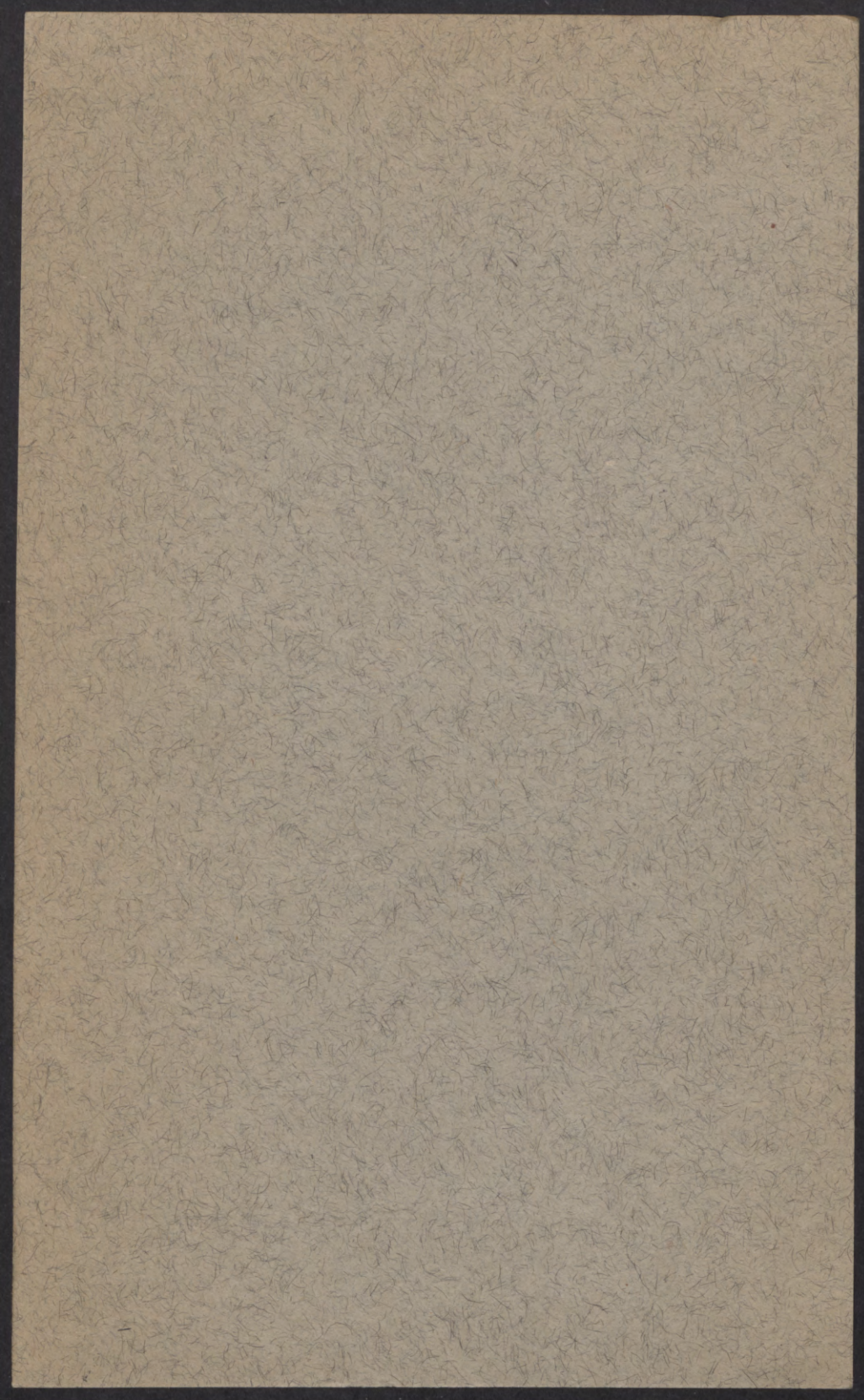
*University of Minnesota
Agricultural Experiment Station*

Factors Influencing Corn Prices

*Rex W. Cox
Division of Agricultural Economics*



UNIVERSITY FARM, ST. PAUL



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SUMMARY

Corn is one of the most important crops in Minnesota. The acreage of 4,533,000 in 1930 exceeded that of any other crop. Altho the main areas of production are in the southern part of the state, corn is grown on more than 80 per cent of all farms. The most significant increase in production occurred before 1921.

Corn is also one of the more important crops in the United States as a whole. In acreage and farm value, it is approximately equal to wheat and cotton combined. Production in the United States has shown much fluctuation from year to year, but the general trend has changed only slightly since 1910. The average or normal production for the period 1922-29 was approximately 2,750 million bushels.

A general rise in the price of corn began in 1897 and continued until 1920. During that period, corn prices rose more rapidly than did the index representing the wholesale prices of all commodities and, in consequence, corn increased in purchasing power. The low level of corn prices in 1920 and 1921 was followed by an upward movement that continued through 1929.

The ratios of the price of corn to the prices of oats and barley have shown an increase from 1870 to the present time. The ratio of corn prices to wheat prices has changed but slightly.

The most important factor influencing the price of corn in any year is the supply available for consumption in the United States in that year. Large or small supplies cause much less fluctuation in the Minnesota farm price than in the Iowa farm price. The Minnesota production is not significant as a factor causing changes in the Minnesota farm price of corn.

The price of No. 3 yellow corn in Chicago is influenced not only by the total supply of corn but also by the distribution of the supply. With a given total supply, the Chicago price is somewhat lower when the proportion of the supply is greater in the cash corn area immediately surrounding the Chicago market.

The quality of the corn also has an important influence on price. When the crop is of high quality, a large proportion is generally of No. 3 grade; in consequence, the price of No. 3 grade is somewhat lower than if other things are the same but the crop of lower quality.

An increase in the number of hogs on farms usually indicates a greater feeding demand for corn and, therefore, higher prices. The amount of oats and barley and the number of beef cattle appear to be factors of only minor influence on price.

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The maximum value of the corn supply corresponds to a crop about 80 per cent of normal. The total value decreases rapidly as the supply increases.

The seasonal movement of corn prices at Chicago shows much variation from year to year. The advance in price from December to June is greater in years when the December-January price, corresponding to a large crop of corn, is relatively low, and the potential feeding demand for corn, as represented by hogs, is relatively high.

The marketing of corn by Minnesota farmers is concentrated within December, January, and February, but there is a considerable variation from year to year of the total percentage marketed during those months.

FACTORS INFLUENCING CORN PRICES

REX W. COX

PURPOSE AND IMPORTANCE OF THE STUDY¹

Corn is one of the most important Minnesota crops. The acreage devoted to corn was approximately 1,450,000 acres in 1900, 2,040,000 in 1910, and 3,288,000 in 1920.² The corn acreage of 4,533,000 in 1930 exceeded the acreage in any other crop.³ Altho production is more important in the southern part of the state, corn is grown on more than 80 per cent of all Minnesota farms.⁴ While sales of corn constituted only 3.3 per cent of the cash income of Minnesota farmers in 1928, corn was an important item in the feed of animals, which, together with their products, constituted more than 70 per cent of the cash income.

Some farmers produce corn mainly for market, and are directly concerned with the market prices of corn and the factors influencing those prices. Other farmers grow corn primarily for feeding, and are interested in the factors influencing prices because the profitableness of their livestock feeding operations is affected by the prices of corn and other feeds. Many of the farmers who feed corn frequently have surplus corn to sell and for that reason are interested in the market. Others do not produce all their feed requirements, therefore are interested as buyers. The general level of corn prices, and the variations in prices from year to year and within the season, are of great importance to Minnesota farmers in their production and marketing programs.

Minnesota prices are, in part, the result of factors that influence the general level of corn prices throughout the United States and, in part, the result of special factors which principally influence Minnesota prices. This study includes both an analysis of the general level of corn prices, as represented by the price of No. 3 yellow corn in Chicago, and a consideration of the particular factors that cause the Minnesota price to vary from the general level and from prices in other regions.

For the United States as a whole, corn is one of the more important crops. In acreage and farm value it is approximately equal

¹ Acknowledgment is made to O. B. Jesness, Chief, and W. C. Waite and Mrs. D. D. Kittredge, of the Division of Agricultural Economics, for suggestions in the preparation of this manuscript, and to Miss Adena Erickson for assistance in the tabulations.

² Minn. State Dept. of Agr. Bull. 63, Minnesota Annual Crop and Livestock Statistics, 1926-1927. Revised data of Minnesota acreage, 1889-1909, supplied by Division of Crop and Livestock Estimates, U. S. Dept. of Agr.

³ Crops and Markets, U. S. Dept. of Agr., Dec. 1930.

⁴ U. S. Census of Agr., 1925, Part I, p. 788.

to wheat and cotton combined. The acreage and production of corn for the period 1923-28 in the principal producing states are given in Table 1. Eight states produce approximately 60 per cent of the total.

The United States produces about two-thirds of the world's corn supply. This is utilized almost entirely within the United States. Exports and imports are very small; the net exports averaging less than one per cent of the production. Argentina, the next largest producer of corn, produces less than 7 per cent of the world's total. Prices of corn in the United States are, in consequence, largely influenced by domestic conditions; only occasionally foreign situations have a marked influence upon price.

Table 1
States Ranked According to Acreage and Production of Corn, 1923-28

Acreage			Production		
States	Proportion of total United States corn acreage	Cumulative proportion	States	Proportion of total United States corn production	Cumulative proportion
	per cent	per cent		per cent	per cent
Iowa	10.9	...	Iowa	15.0	...
Illinois	8.9	19.8	Illinois	11.7	26.7
Nebraska	8.7	28.5	Nebraska	8.2	34.9
Missouri	6.3	34.8	Missouri	6.5	41.4
Kansas	5.9	40.7	Indiana	5.9	47.3
Indiana	4.6	45.3	Minnesota	5.1	52.4
South Dakota	4.5	49.8	Ohio	5.0	57.4
Minnesota	4.3	54.1	Kansas	4.4	61.8
Ohio	3.6	57.7	South Dakota	3.7	65.5

TRENDS OF CORN PRODUCTION AND PRICES

Trends of Corn Production

The production of corn in the United States for the period 1895 to 1929 is shown in Figure 1.⁵ From 1895 to 1905 production increased rapidly, but since 1905 the increase has been comparatively small. The general trend of production is represented by the curve in Figure 1.⁶ The relative position of this trend line indicates the production that may be considered normal at any particular time. Since production has tended to increase, a normal production for the period 1905 to 1929 would be considerably greater than for the period 1895 to 1905. For the last six years a crop of about 2,800 million bushels could have been considered a normal production.

⁵ United States corn production data are from U. S. Dept. of Agr. Yearbooks. Revised data for individual states, 1889-1909, from Division of Crop and Livestock Estimates, U. S. Dept. of Agr.

⁶ Equations of secular trend of production, 1895-1929, United States; $Y = 2743.68 + 17.2143X - .9837X^2$. Five central states, Iowa Illinois, Missouri, Indiana, and Ohio: $Y = 1220.11 + 3.5989X - .1605X^2$. Kansas and Nebraska: $Y = 318.19 - 1.6644X + .2082X^2$. Minnesota: $Y = 79.34 + 5.2107X + .0703X^2 - .0085X^3$.

The figures in the equations refer to millions of bushels. Origin of calculations is 1911.

The trend of corn production in the United States depends on the trends in specific areas. Production of corn in the five central corn-belt states of Iowa, Illinois, Missouri, Indiana, and Ohio is shown in Figure 2. The rate of increase in these states was much less than that in the United States as a whole previous to 1905. Since 1905 not only have the trends of production in the two areas been similar, but the annual fluctuations have been much the same.

The curve that describes the trend of production in Kansas and Nebraska (Fig. 3) is very different from that of the United States and of the five central corn-belt states. There was a significant decline of production in those states following 1906. As indicated by the data in Table 2, this decline was due to the decrease in the average yield per acre, rather than to a decrease in acreage. The average yields per acre of corn in the two states during the three periods 1895-1906, 1907-18, and 1919-29 were 25.0, 20.4, and 24.3 bushels, respectively.

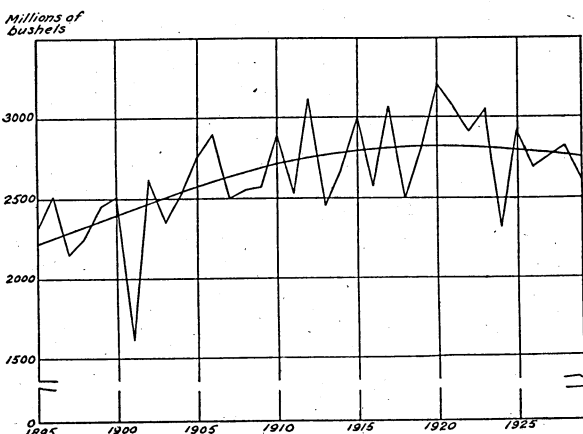


Fig. 1. Production and Trend of Production of Corn in the United States, 1895-1929

Table 2

Average Acreage, Yield per Acre, and Total Production of Corn in Kansas and Nebraska, 1895-1929

Years	Acreage			Yield per acre*			Total production		
	Kansas	Nebraska	Kansas and Nebraska	Kansas	Nebraska	Kansas and Nebraska	Kansas	Nebraska	Kansas and Nebraska
	1,000 acres	1,000 acres	1,000 acres	bu.	bu.	bu.	bu.	1,000,000 bu.	bu.
1895-1906	7,726	7,177	14,904	22.5	27.6	25.0	174	198	373
1907-18	7,391	7,444	14,835	16.8	23.9	20.4	124	178	302
1919-29	5,556	8,295	13,851	20.9	26.4	24.3	116	219	336

* Average yield per acre is equal to the total production for the period divided by the total acreage.

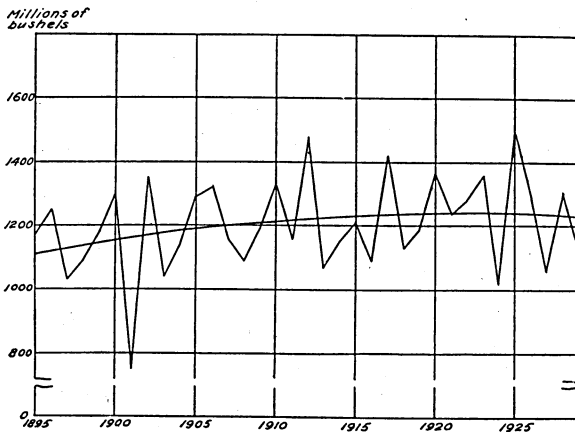


Fig. 2. Production and Trend of Production of Corn in the Five States of Iowa, Illinois, Missouri, Indiana, and Ohio, 1895-1929

Owing to climatic conditions the production in this area varies considerably from year to year, much more so than the production in the five central corn-belt states.⁷ However, changes in production in the United States from year to year are influenced more by changes in production in the five central corn-belt states than by changes in

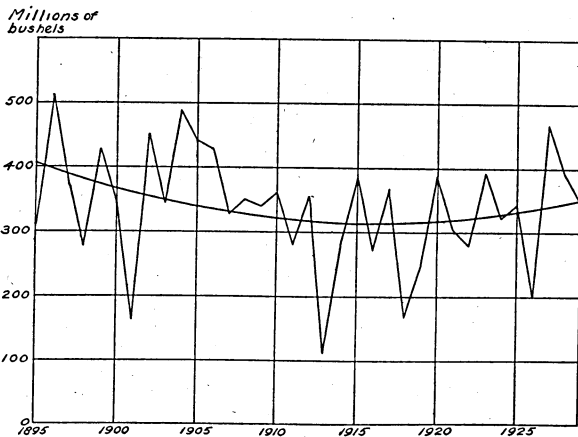


Fig. 3. Production and Trend of Production of Corn in the Two States of Kansas and Nebraska, 1895-1929

⁷ Coefficients of variability of total production in the United States; the five central states (Iowa, Illinois, Missouri, Indiana, and Ohio); Kansas and Nebraska.

United States	9.7
Five central states.....	11.7
Kansas and Nebraska.....	24.1

the two states of Kansas and Nebraska.⁸ This is because of the large total production in the five central states as compared with that in Kansas and Nebraska.

The marked changes that have occurred in the Minnesota acreage, yield per acre, and total production are shown in Figures 4, 5, and 6.⁹ Production in Minnesota continued to increase much more rapidly than in the five central corn-belt states or the United States as a whole until about 1921. Since then the upward trend of production has been much

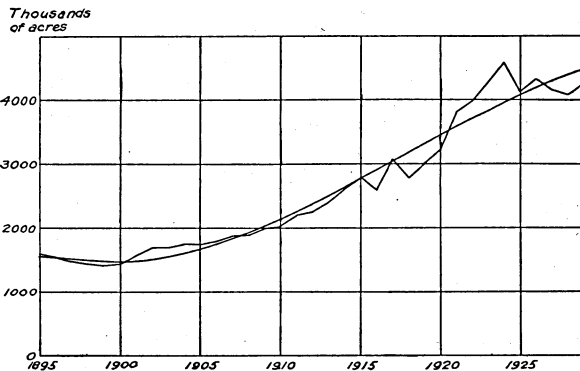


Fig. 4. Acreage and Trend of Acreage of Corn in Minnesota, 1895-1929

less evident. It is difficult to determine future tendencies, as a further extension of acreage will depend on the development of earlier-maturing varieties. The variation of yield per acre in Minnesota from its trend is greater than is the variation of acreage from its trend.¹⁰ The

⁸ This statement has been made on the basis of the relative size of the betas derived in the determination of the coefficient of multiple correlation.

Determination of the effect of deviations from trend of production in the five states of Iowa, Illinois, Missouri, Indiana, Ohio, and in Kansas and Nebraska, on the deviation from trend of production in the United States, 1895-1928.

X_1 = Deviation from trend, U. S. production

X_2 = Deviation from trend, five states production

X_3 = Deviation from trend, two states production

Factors	Beta
X_2 , Deviations, five states	0.7267
X_3 , Deviations, two states	0.3104
Coefficient of multiple correlation, 0.927	

⁹ Equations of secular trend of corn acreage and yield per acre in Minnesota. Acreage: $Y = 2,313,000 + 143,599X + 1665X^2 - 162X^3$. Yield per acre: $Y = 32.9 + 21X - .007X^2$ Origin 1911.

¹⁰ Coefficients of variability of acreage, yield per acre, and total production of corn in Minnesota:

Acreage	5.2
Yield per acre	12.6
Total production	11.2

changes in the yield per acre are of more influence than changes in acreage on the changes in total production from year to year.¹¹

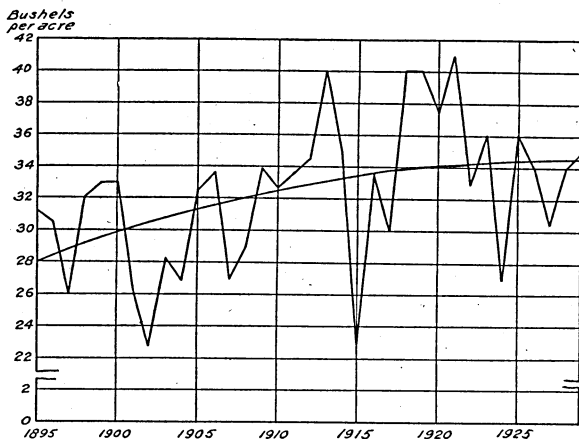


Fig. 5. Yield per Acre and Trend of Yield per Acre of Corn in Minnesota, 1895-1929

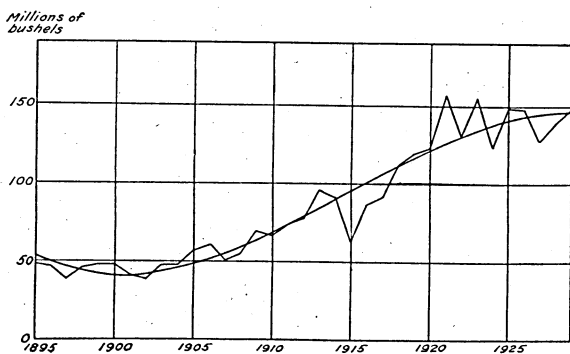


Fig. 6. Production and Trend of Production of Corn in Minnesota, 1895-1929

Relation of the Price of Corn to the Prices of Other Commodities

Increases and decreases of prices in general have become familiar phenomena since the beginning of the World War. These changes have been caused by factors that influence all prices. The movement of all prices may be represented by the index of the general price

¹¹ Determination of the effect of changes in acreage and yield per acre on changes in total production of corn in Minnesota, 1910-1929.

X_1 = Per cent change in production

X_2 = Per cent change in acreage

X_3 = Per cent change in yield per acre

Factors	Beta
X_2 , Acreage	0.5848
X_3 , Yield per acre	1.0253
Coefficient of multiple correlation, 0.997	

level as reported by the United States Bureau of Labor Statistics.¹² The index of the general price level as reported for December, and the average December price of No. 2 mixed corn in Chicago for the period 1885-1929 are given in Figure 7. While both series of prices have tended to rise during the period, the rate of increase has been the greater in the price of corn; in consequence there has been an increase in the purchasing power of corn.

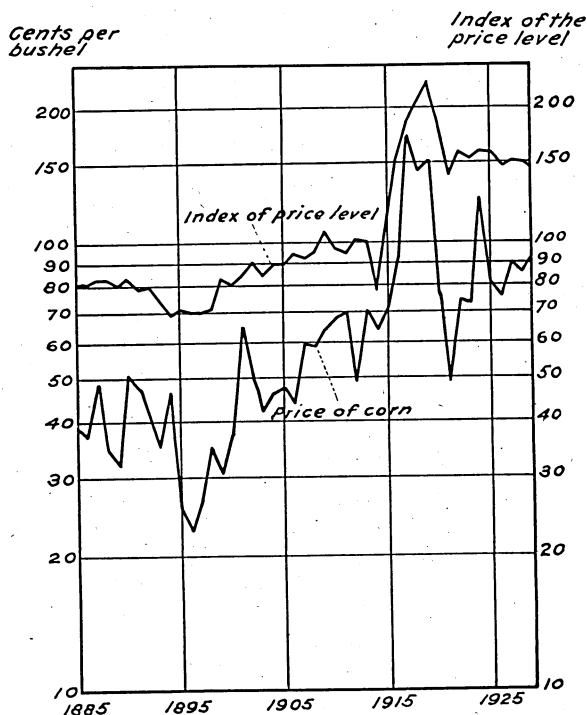


Fig. 7. Average December Price of No. 2 Mixed Corn in Chicago, and the Index of the Wholesale Prices of All Commodities, 1885-1929

The ratios of the United States farm price of corn to the prices of wheat, oats, and barley, as of December 1, 1870-1929, are given in Figure 8. Not only has the price of corn increased in relation to the index of the price of all commodities, but it also has increased in relation to the prices of oats and barley over a long period of time. The ratios of the Minnesota farm prices of corn to the Minnesota farm prices of oats and barley also have increased, as shown by Figure 9. The relationship between the prices of corn and wheat has changed but slightly during this period.

¹² Bureau of Labor Statistics, Wholesale prices of all commodities, base year 1910-14. This index with the base year of 1910-14 is published in the Agricultural Situation, Bureau of Agr. Econ., U. S. Dept. of Agr.

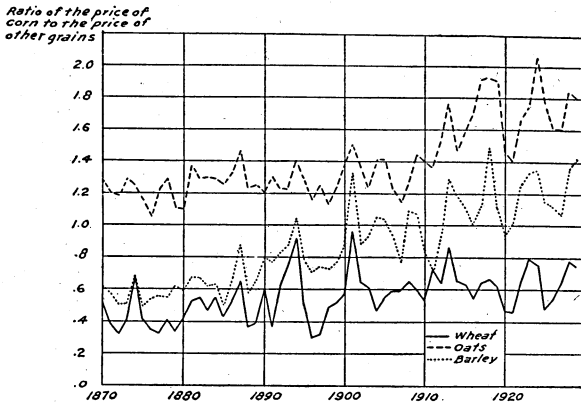


Fig. 8. Ratios of the United States Farm Prices of Corn to the United States Farm Prices of Wheat, Oats, and Barley on December 1, 1870-1929
(Price of corn divided by the prices of the other grains.)

In order to remove the influence of the movement of prices in general, corn prices have been divided by the index of the wholesale prices of all commodities. Throughout the remainder of the bulletin, unless specific exception is noted, the term "price" will refer to the price as adjusted for the influence of this general level of all prices.

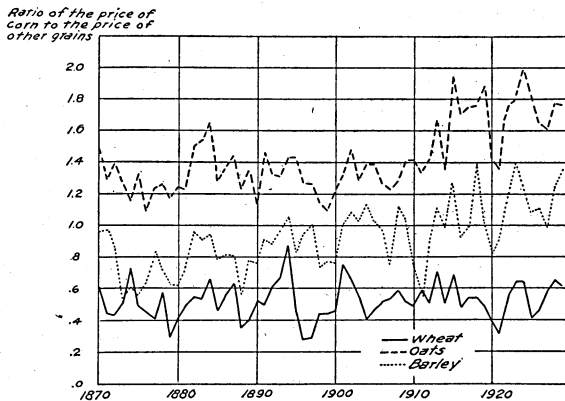


Fig. 9. Ratios of the Minnesota Farm Prices of Corn to the Minnesota Farm Prices of Wheat, Oats, and Barley on December 1, 1870-1929
(Price of corn divided by the prices of the other grains.)

Trends of Corn Prices

From 1897 to 1919, the price of corn as represented by the price of No. 3 yellow corn in Chicago tended upward. The decline in price that occurred in 1920-21 was followed by an upward tendency that continued until the drop in 1930. The trends of the adjusted

average October-June price of No. 3 yellow corn is shown in Figure 10. As the war period and the years immediately following presented unusual conditions, the years 1916-20, inclusive, are omitted in the determination of the trend.¹³

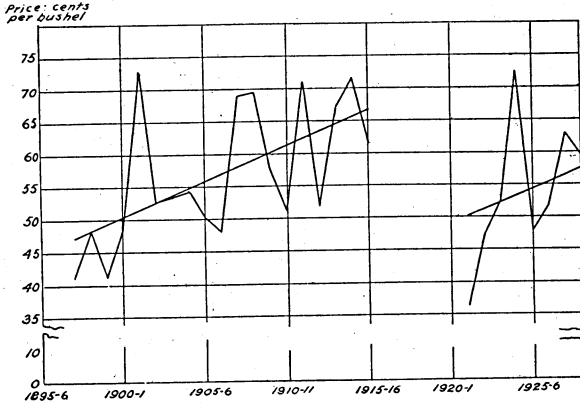


Fig. 10. Average October-June Prices of No. 3 Yellow Corn in Chicago, and Trend, 1897-98 to 1915-16, 1921-22 to 1928-29

SIMILARITY OF PRICES IN MARKETS FOR MINNESOTA CORN

Most of the corn grown in Minnesota is used locally, less than 17 per cent being shipped out of the county where grown. Local prices are, in consequence, of special significance in the case of corn, and particular attention has been given to them in certain sections of the analysis to follow. The price received by producers, as reported by the United States Department of Agriculture, has been used to represent these local prices. The Chicago price has been used largely in the analysis of annual prices, as quotations are available for a longer time than for farm prices. The similarity of the movement of the Minnesota farm price and the Minneapolis price to that of the Chicago price is shown in Figure 11.

Minnesota corn shipped to central markets goes largely to Chicago and Minneapolis. Chicago is the most important central market in the United States. Other important central markets are Omaha, Kansas City, and St. Louis. The primary markets for corn in the United States and the receipts at these markets are given in Table 3.

¹³ Equations of secular trend of the average October-June price of No. 3 yellow corn in Chicago:

$$1897-1915 \quad Y = 56.9 + 1.08X; \text{ origin, } 1906$$

$$1921-1928 \quad Y = 49.0 + 1.08X; \text{ origin, } 1921$$

Table 3
Receipts of Corn at Primary Markets. Average by Groups, 1909-29*

Market	1909-13 1,000 bu.	1914-20 1,000 bu.	1921-25 1,000 bu.	1926-29 1,000 bu.
Chicago	107,215	102,255	115,756	97,034
St. Louis	22,694	22,726	30,949	31,499
Kansas City	19,862	18,402	18,569	32,001
Peoria	17,030	25,709	22,380	24,705
Omaha	24,361	26,112	23,105	22,592
Indianapolis	18,385	20,347	18,767	22,667
Minneapolis	8,693	10,383	12,279	11,028
Total 7 markets.....	218,240	225,934	241,805	241,693
Total 10 markets†	232,934	245,238	266,365	258,693

	Per cent of total receipts			
Chicago	46.0	41.7	43.5	37.5
St. Louis	9.7	9.3	11.6	12.2
Kansas City	8.5	7.5	7.0	12.4
Peoria	7.3	10.5	8.4	9.5
Omaha	10.5	10.6	8.7	8.7
Indianapolis	7.9	8.3	7.0	8.7
Minneapolis	3.7	4.2	4.6	4.3
Total 7 markets	93.6	92.1	90.8	93.3
Total 10 markets	100.0	100.0	100.0	100.0

* Yearbook, U. S. Dept. of Agr., 1928, p. 709; 1930, p. 633. Ann. Rept. Minneapolis Chamber of Commerce, 1929.

† Includes Duluth, Milwaukee, and Toledo.

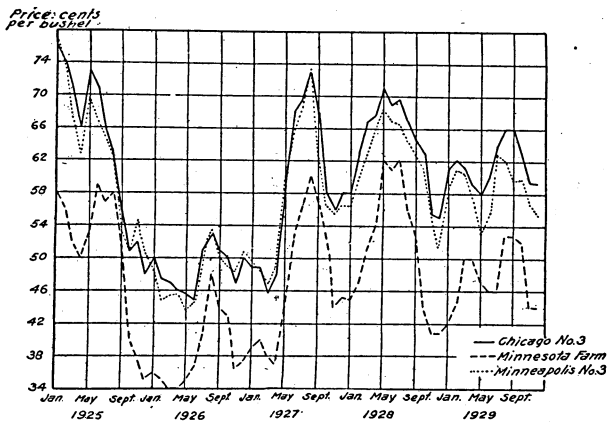


Fig. 11. Average Monthly Prices of No. 3 Yellow Corn in Chicago and Minneapolis, and Minnesota Farm Price on the 15th of the Month, 1925-29

FACTORS THAT INFLUENCE THE AVERAGE SEASONAL LEVEL OF CORN PRICES

The factors indicated by this study to have the greatest influence upon the price of corn in particular years, after adjustments have been made in the price for changes in the general level of all prices, are: the amount of corn available in the particular year, the quality of the crop, the supply of other grains readily substituted for corn in feed-

ing livestock, the number of livestock on farms, and the location of the corn crop. The influence of each of these factors will be considered in the following paragraphs.

Influence of the Supply of Corn

The most important factor influencing the price of corn in a particular year appears to be the total supply of corn available for consumption in the United States. In general, a small supply results in a relatively high price, and a large supply in a relatively low price. The supply is made up of the corn produced in the particular year and the carry-over of old corn from the preceding year. This has been measured by the production of corn in the United States, the stocks of corn on farms November 1, and the visible supply of corn

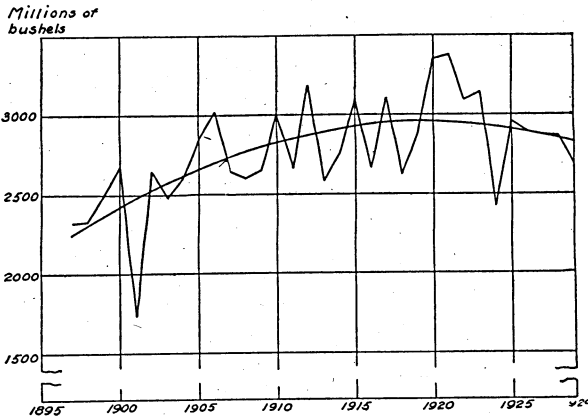


Fig. 12. Total Supply and Trend of Total Supply of Corn in the United States, 1897-1929

on December 1, as reported by the United States Department of Agriculture. The new crop is the more important source of variation in the annual supply of corn, the carry-over being somewhat less than 10 per cent of the annual production.

Figure 12 shows the variation in the total supply of corn for the period 1895-1929. The trend and fluctuation about the trend of corn production in the United States are shown in Figure 1. Examination of the charts shows a considerable growth in the total annual supply of corn during the period. What would have been considered a large supply during the early years might have been considered a small supply in later years. For example, the supply in 1895 was a relatively large supply at that time, but would have been a relatively small supply in recent years. This gradual increase in supply has been represented by a trend line, which may be interpreted as showing the supply that

would have been considered "normal" or usual for the period. Supplies, then, have been judged to be large or small with reference to the normal supply, as indicated by the trend line value for the particular year, by expressing the supply as a percentage of the trend value for that year. For example, the supply for 1924 estimated as normal by the trend line for that year was 2,926 million bushels, while the actual supply in 1924 was 2,423 million bushels, or 83 per cent of this normal or trend value.

Relation of United States Supply of Corn to Minnesota and Iowa Farm Prices, and Price of No. 3 Yellow Corn in Chicago

The supply of corn in the United States from year to year expressed in this manner has been accompanied by certain average prices of corn. Table 4 shows how the price of corn has tended to respond to changes in the supply during each of the two periods 1909-10 to 1915-16 and 1921-22 to 1928-29. The prices to which particular attention has been given are the average October-June price of No. 3 yellow corn in Chicago, and the average October-June Minnesota and Iowa farm prices. The data in Table 4 are shown in Figure 13.

Table 4
Variations in the Chicago, Minnesota Farm, and Iowa Farm Prices with Different United States Supplies of Corn, 1909-10 to 1915-16, and 1921-22 to 1928-29

Price	Size of supply, per cent of normal				
	80	90	100	110	120
	per cent of normal price	per cent of normal price	per cent of normal price	per cent of normal price	per cent of normal price
Average October-June ...					
1909-15					
Minnesota farm	116.9	108.5	100.0	91.5	83.1
Iowa farm	132.6	116.3	100.0	83.7	67.4
Chicago, No. 3 yellow...	126.7	113.4	100.0	86.6	73.3
1921-28					
Minnesota farm	135.0	117.5	100.0	82.5	65.0
Iowa farm	142.7	121.4	100.0	78.6	57.2
Chicago, No. 3 yellow...	133.6	116.8	100.0	83.2	66.4

It will be observed that the slopes of the lines in Figure 13 are not the same. For the period 1909-15 the Minnesota farm prices were less influenced by changes in the United States supply of corn than either the Iowa farm prices or the Chicago prices of No. 3 yellow corn. A United States supply of corn that was 90 per cent of normal increased the Minnesota farm price to 109 per cent of normal, the Iowa farm price to 116 per cent, and the Chicago price to 113 per cent. Similarly, a supply that was 110 per cent of normal decreased the Minnesota farm price to 92 per cent of normal, the Iowa farm price and the Chicago price to 84 and 87 per cent, respectively.

When the prices in two markets are determined largely by the same set of forces, but differ by transportation and handling costs, the lower-priced market will show a greater percentage change in price than the high-priced market for a given change in supply. For example, the price which the Iowa producer receives is roughly equal to the Chicago price less the transportation and handling charge from Iowa to Chicago. If we assume the price in Chicago to be \$1.00 and transportation and handling charges are 15 cents per bushel, the Iowa producer receives about 85 cents per bushel. If the Chicago price decreases 10 cents and the Iowa price also decreases 10 cents, the percentage changes in the Chicago price and the Iowa price are 10 per cent and 11.8 per cent, respectively. Curves showing the relationships between total corn supply in the United States and prices in particular places, in consequence, may be expected to be steeper in the markets with lower prices.

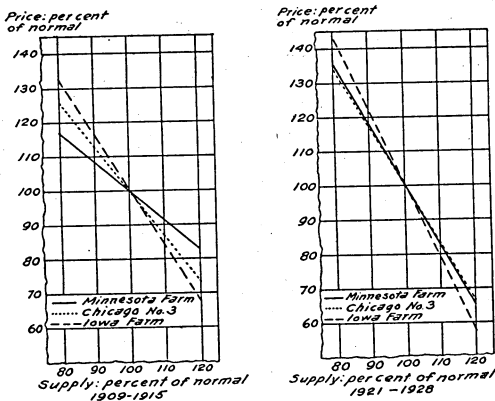


Fig. 13. Relation of the United States Total Supply of Corn to the Average October-June Farm Prices of Corn in Minnesota and Iowa, and the Price of No. 3 Yellow Corn in Chicago, 1909-10 to 1915-16, 1921-22 to 1928-29

Examining Figure 13, we find that the curve for Iowa farm prices, as we would expect from the analysis above, is steeper than the curve for Chicago prices. However, we find that the curve of Minnesota farm prices is not so steep as the other curves, altho Minnesota farm prices are generally lower than either the Iowa farm prices or Chicago prices. This indicates that prices in Minnesota are influenced in part by special local conditions. The percentage of the crop that moves out of the county where grown, averages 17 in Minnesota and 26 in Iowa.¹⁴ These data indicate that local demand for the crop in Minnesota is probably of greater influence on the Minnesota price than is the local demand in Iowa on the Iowa price. There is a tendency for Minnesota

¹⁴ Monthly Crop Reporter. U. S. Dept. of Agr. March, 1916.
Crops and Markets. U. S. Dept. of Agr. March, 1930.

farmers to raise a sufficient number of hogs to consume the corn. The influence of the local demand is a factor of considerable importance in accounting for the comparatively small degree of fluctuation shown by the Minnesota farm price.

The relationships of supply and price have changed somewhat since the war. As illustrated by the steepness of the curves in Figure 13, changes in price accompanying changes in supply have been much greater during the last nine years. For the period 1909-15, a supply 6 per cent above normal decreased the Minnesota price to 92 per cent of normal; for the period 1921-28, a supply 10 per cent above normal decreased the price to 83 per cent of normal.

Relation of Minnesota Production of Corn to Minnesota Farm Prices

The production of corn in Minnesota has an influence upon Minnesota farm prices, altho the influence is slight compared with the total United States production or the production in the six leading states. Table 5 shows the variation in the Minnesota farm price corresponding to changes in the Minnesota production, when the production in the six leading states remains at a normal level. During the period 1897-98 to 1928-29, omitting the years 1916-20, a decrease of 10 per cent in the production of the six leading corn states increased the Minnesota farm price about as much as a 30 per cent decrease in Minnesota production.¹⁵

Table 5
Effect of Production of Corn in Minnesota and in the Six States—Iowa, Illinois, Nebraska, Missouri, Indiana, and Ohio—on the Minnesota Farm Prices of Corn, 1897-1915, 1921-28

Production in Minnesota (Normal production in the six states)		Minnesota farm price	Production in six states (Normal production in Minnesota)		Minnesota farm price
Per cent of normal		Per cent of normal	Per cent of normal		Per cent of normal
90		103.5	90		110.8
100		100.0	100		100.0
110		96.5	110		89.2

As would be expected, the value of the Minnesota crop of corn, considering the usual fluctuations over a series of years, has been influenced more by the production in the state than by that in the six leading states. Assuming a normal production in the six states from year to year during the periods 1897-98 to 1915-16, and 1921-22 to 1928-29, a production in Minnesota which was 90 per cent of normal would have had a total value of 93 per cent of normal, while a production 110 per cent

¹⁵ X_1 = Minnesota farm price; X_2 = Production of corn in Minnesota;

X_3 = Production in the six states.

$r_{12} = -.272$ $r_{13} = -.781$ $r_{23} = -.440$

$R^{1,23} = -.832$

of normal would have had a corresponding value of 106 per cent of normal. These data are given in Table 6.

Table 6

Effect of Production of Corn in Minnesota and in the Six States—Iowa, Illinois, Nebraska, Missouri, Indiana, and Ohio—on the Value of the Minnesota Production, 1897-1915, 1921-28

Production in Minnesota (Normal production in the six states)	Value of Minnesota production	Production in six states (Normal production in Minnesota)	Value of Minnesota production
Per cent of normal	Per cent of normal	Per cent of normal	Per cent of normal
90	93.1	90	99.7
100	100.0	100	100.0
110	106.1	110	98.1

Influence of Other Factors

The analysis of the influence of the other factors upon corn prices, in addition to the corn supply, has been made on the basis of the average seasonal cash price of No. 3 yellow corn in Chicago. The period selected for the seasonal average price is governed by two considerations. It is desirable to have the period as long as possible to let the influence of the factors express themselves completely. In short periods, prices may be influenced considerably by speculative conditions or incorrect market information. In a longer period, these particular conditions are somewhat balanced and their effect is eliminated. On the other hand, the period should be short enough so that the factors exert their influence within the period and no new factors are introduced. In this study an average price for October to June, inclusive, is taken as the seasonal average price. The price in October is influenced, in part, by the carry-over from the old crop, but also largely by the prospective crop, which begins to appear in November and December. The June price is influenced by the supply existing at that time, and possibly, also, by the plantings for the new crop. The first reports of the condition of the new crop are not, however, issued until July, and the June price is probably little influenced by the prospects of the crop appearing later in the year.

Production of Oats and Barley

Both oats and barley are important crops in parts of the leading corn-growing states, and both are used to take the place of, or to supplement, corn in feeding operations. An increase in the size of the two grain crops has an effect on price somewhat similar to that of an increase in the corn supply. A 21 per cent increase in the production of these crops has about the same effect on price as a one per cent increase in the corn supply.

The degree to which barley and oats are used as substitutes for corn during the season depends in part on the existing price ratios between corn and the two substitute feeds. At the same time an increase in the amount of substitution tends to narrow the price ratios. Figure 8, to which a previous reference has been made, shows that the price of corn has been increasing relative to the prices of oats and barley. It will be observed that there are considerable deviations from year to year from the general tendencies, but there appears to be no well defined cycle.

Under usual conditions wheat is not a substitute for corn. For the 1930-31 season the low prices of wheat as compared with those of corn resulted, probably, in a substitution of approximately 150 million bushels. Some low-grade wheat occasionally is fed to stock, and some wheat is used in poultry feeds, but, in general, little whole wheat is used as feed for animals.

Number of Hogs and Beef Cattle on Farms

There are no adequate data on the utilization of the corn crop. The United States Department of Agriculture has estimated, however, that about 40 per cent of the corn crop is fed to hogs and 15 per cent to cattle. Variations in the number of hogs and beef cattle on farms have, in consequence, an important influence upon the demand for corn. In the past, the effect of the factors associated with a 10 per cent increase in the number of hogs on farms has increased corn prices about as much as a 2.9 per cent decline in corn supplies. On the other hand, changes in the number of beef cattle on farms have had only a minor influence upon corn prices when compared with those resulting from changes in the number of hogs. A 28 per cent increase in the number of beef cattle is equivalent to about a one per cent decrease in the corn supply, in affecting price.

Distribution of Production

The price of corn in Chicago is influenced not only by the total supply of corn but also by the distribution of that supply. With a given total corn supply, Chicago prices are somewhat lower when the proportion of the supply is greater in the cash corn area immediately surrounding the Chicago market. On the other hand, when the proportion is large in the area in which feeding operations are rather extensive, less cash corn reaches the Chicago market and prices are somewhat higher. That part of the corn belt west of the Mississippi River is probably an indication of the area where feeding operations are rather extensive. In that area, the relative transportation rates of corn and hogs or pork account for the increased local consumption.

The effect of the distribution of production has been examined by determining the effect of changes in the proportions of the crop produced in the states of Iowa, Missouri, Kansas, Nebraska, Minnesota, and South Dakota. In general, a 10 per cent increase in the proportion of the production in these states had about the same effect as a decrease of 4:1 per cent in the total corn supply of the United States.

Quality of the Corn Crop

The general quality of the crop is an indication of the proportion that will be of the better grades, as No. 2 and No. 3. Since our price is for a particular grade, the price is influenced by the supply of that grade as well as by the total supply of corn. When the crop is of high quality a large proportion is generally of No. 3 and, in consequence, the price of No. 3 is somewhat lower than it would be if other things had been the same but the crop of lower quality. A 5 per cent increase in the quality has about the same effect as a 1.5 per cent increase in the total supply.

Net Influence of Each Factor

A decrease in the supply of corn, the supply of oats and barley, and the quality of the corn crop, tends to cause an increase in price. A decrease in the number of hogs and of beef cattle on farms and the proportion of the crop produced in the states west of the cash-corn area tends to cause a decrease in price. Figure 14 shows the net influence of each of the six factors on price.¹⁶ For example, when the supply of corn was 90 per cent of normal, other factors remaining at their normal levels, the price of No. 3 yellow corn at Chicago tended to equal 117 per cent of normal. Similarly, when the number of hogs was 90 per cent of normal, other factors remaining at their normal levels, the price tended to equal 95 per cent of normal.

Influence of the Six Factors Combined

Table 7 shows the price that might be estimated during the various years from a consideration of all six factors. In 1927-28, the estimated average October-June price was 93.4 cents; the actual price was 94.7 cents. The estimated was 98.6 per cent of the actual. In 1928-29, the estimated was 93.0 per cent of the actual price. The actual and estimated prices are shown, also, in Figure 15.

¹⁶ Appendix, Table 4, page 40.

Table 7

Actual and Estimated Average October-June Price of No. 3 Yellow Corn at Chicago, 1897-98 to 1915-16, 1921-22 to 1928-29

Year beginning October	I Normal price	II Estimated per cent of normal price	III Estimated price	IV Index of the wholesale price of all commodities	V Column III X Column IV*	VI Actual price	VII Per cent estimated is of actual price†
	cents	per cent	cents		cents	cents	per cent
1897-98	47.2	89	42.0	71	29.8	29.6	100.7
1898-99	48.3	90	43.5	72	31.3	35.0	89.4
1899-1900	49.3	86	42.4	83	35.2	34.2	102.9
1900-01	50.4	96	48.4	82	39.7	39.2	101.3
1901-02	51.5	142	73.1	84	61.4	60.7	101.1
1902-03	52.6	94	49.4	89	44.0	46.8	94.0
1903-04	53.7	104	55.8	86	48.0	46.2	103.9
1904-05	54.7	99	54.1	88	47.6	47.9	99.4
1905-06	55.8	90	50.2	89	44.7	44.7	100.0
1906-07	56.9	86	48.9	94	46.0	45.2	101.7
1907-08	57.9	114	66.0	92	60.7	62.4	97.2
1908-09	59.1	111	65.6	96	63.0	67.9	92.7
1909-10	60.1	101	60.7	105	63.7	60.1	105.9
1910-11	61.2	86	52.6	95	50.0	48.7	102.6
1911-12	62.3	112	69.8	98	68.4	69.7	98.1
1912-13	63.4	85	53.9	102	55.0	53.1	103.6
1913-14	64.5	110	70.9	100	70.9	67.2	105.5
1914-15	65.5	115	75.3	100	75.3	71.9	104.7
1915-16	66.6	95	63.3	116	73.4	71.4	102.8
1921-22	50.1	76	38.1	145	55.2	53.3	103.6
1922-23	51.1	97	49.6	159	78.9	74.8	105.5
1923-24	52.2	98	51.2	153	78.3	80.4	97.3
1924-25	53.3	138	73.6	160	117.8	115.2	102.2
1925-26	54.4	88	47.9	157	75.2	75.4	99.7
1926-27	55.5	95	52.7	149	78.5	77.2	101.7
1927-28	56.6	110	62.3	150	93.4	94.7	98.6
1928-29	57.6	96	55.3	152	84.0	90.2	93.0

* The original prices were divided by the index of the wholesale prices of all commodities. In order to make the estimated prices comparable to actual prices, the estimated prices in Column III have been multiplied by the index of wholesale prices of all commodities and the results tabulated in Column V.

† Price in column V expressed as a per cent of price in column VI.

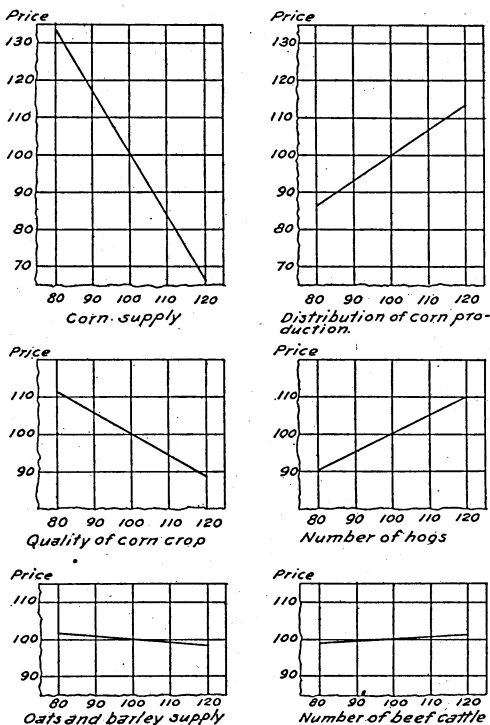


Fig. 14. Net Influence of the United States Total Supply of Corn, Distribution of the Corn Crop, Quality of the Corn Crop, Production of Oats and Barley, Number of Hogs, and Number of Beef Cattle on the Average October-June Price of No. 3 Yellow Corn in Chicago, 1897-98 to 1915-16, 1921-22 to 1928-29

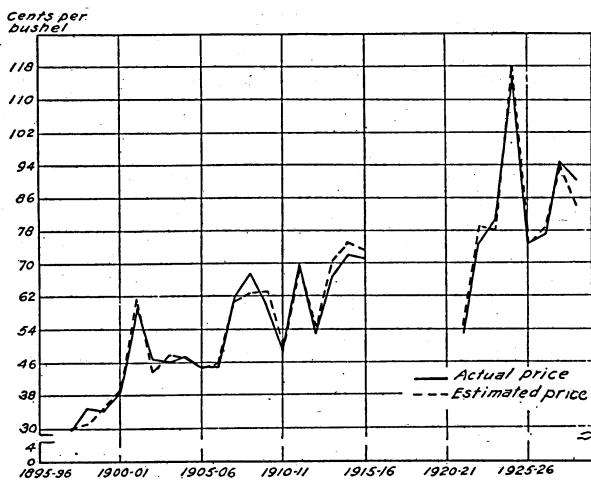


Fig. 15. Actual and Estimated Average October-June Price of No. 3 Yellow Corn in Chicago, 1897-98 to 1915-16, 1921-22 to 1928-29

VALUE OF THE CORN SUPPLY AT CHICAGO PRICES OF NO. 3 YELLOW CORN, WITH VARYING TOTAL SUPPLIES

Table 8 and Figure 16 show what effect changes in the corn supply would have had on the total value of the supply if the other factors had remained at their normal levels throughout the time considered in the analysis. The maximum value tended to accompany a supply about 80 per cent of normal. The supply of corn in 1901 was 70 per cent of normal. With the exception of the supply of that year, it may be said that the smaller supplies tended to have greater total values than the larger supplies.

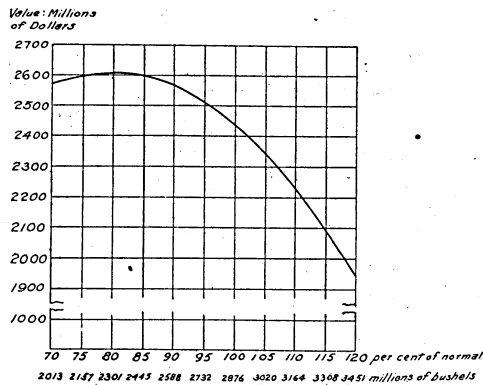


Fig. 16. Effect of Variations in the United States Total Supply of Corn on the Value of the Supply, 1897-98 to 1915-16, 1921-22 to 1928-29

Table 8

Effect of Variations in the United States Total Supply of Corn on the Value of the Supply, 1897-98 to 1915-16, 1921-22 to 1928-29
(Value—per cent of normal)

	Size of supply, per cent of normal										
	70	75	80	85	90	95	100	105	110	115	120
Value of supply, per cent of normal	105.3	106.5	106.9	106.4	105.1	103.0	100.0	96.2	91.5	86.0	79.6

The total value under varying conditions of supply also may be expressed in terms of dollars. In 1927-28, the average October-June normal price of No. 3 yellow corn in Chicago was 56.6 cents (Table 7). The normal supply of corn in 1927 was 2,876 million bushels (Table X, Appendix). On the basis of these normals a supply of corn 80 per cent of normal would be equivalent to 2,301 million bushels. According to Table IV (Appendix) a price of 133.6 per cent of normal, or 75.6 cents,

accompanies a production 80 per cent of normal. The total value of 2,301 million bushels at 75.6 cents per bushel is equal to 1,740 million dollars. This value adjusted to a price level of 150 is equivalent to 2,610 million dollars.¹⁷ In a similar manner the total values may be indicated when the supply is greater or less than 80 per cent of normal. These data are given in Table 9.

Table 9

Effect of Variations in the United States Total Supply of Corn on Value of Supply, 1897-1915, 1921-28 (Value—Total Dollars)

Supply		Price		Value	
I	II	III	IV	V	VI
Per cent of normal	1,000,000 bu.	Per cent of normal	Cents per bu.	From column, II and IV, \$1,000,000	Adjusted to a price level of 150. \$1,000,000
70	2,013	150.4	85.2	\$1,715	\$2,573
75	2,157	142.0	80.4	1,734	2,601
80	2,301	133.6	75.6	1,740	2,610
85	2,445	125.2	70.9	1,733	2,599
90	2,588	116.8	66.1	1,711	2,567
95	2,732	108.4	61.4	1,677	2,516
100	2,876	100.0	56.6	1,628	2,442
105	3,020	91.6	51.8	1,564	2,346
110	3,164	83.2	47.1	1,499	2,235
115	3,308	74.8	42.3	1,399	2,098
120	3,451	66.4	37.6	1,298	1,947

SEASONAL MOVEMENT OF CORN PRICES AND THE MARKETINGS OF CORN FROM MINNESOTA

Seasonal Movement of Corn Prices

Over a period of years, corn prices tend to rise from the early part of the marketing season to May and June by an amount which is about equal to the cost of holding the corn for the intervening period. The movement of prices in individual years, however, differs widely from the average. For example, the increase in price from December and January to May and June tends to be greater in years when the supply of corn is relatively high or when the corresponding December-January price is relatively low. A relatively low price prevailing during December and January encourages an increased consumption of corn on farms, thereby decreasing the amount of corn available for market during May, June, and the later months. On the other hand, a relatively high price during the fore part of the marketing season tends to decrease the feeding of corn, resulting in an increased amount of corn available for the market.

¹⁷ The average index of the wholesale prices of all commodities during October-June, 1927-28 was 150.

The total consumption of corn by hogs is probably best indicated by the total live weight of the hogs marketed; nevertheless, the potential consumptive demand bears quite a close relation to the number of hogs being prepared for the market during the winter period. It is reasonable to expect that the combination of relatively low corn prices during December and January and a large number of hogs on farms would result in an increased consumption of corn and therefore an increase in the price that is above the average seasonal advance. In a similar manner, relatively high prices during December and January, in combination with a relatively small number of hogs being prepared for market, results in a seasonal change in price, that is, at least below the average increase if not an absolute decrease. Recent studies¹⁸ have indicated that the number of market hogs on farms during the winter feeding season bears a direct relation to the corn-hog ratio at a time approximately twelve months earlier. For example, the high corn-hog ratio during December and January, 1926-27, resulted in the breeding of a comparatively large number of hogs and therefore a relatively large number of market hogs during the winter season of 1927-28.

Consequently, a consideration of both the prices of corn during December and January, and the corn-hog ratio of the previous December and January should provide a fairly good indication of the seasonal price movement. In order to combine the December-January price and the December-January corn-hog ratio of the previous season into one index, the price has been divided by the corn-hog ratio.¹⁹ Table 10

Table 10
Seasonal Change in Price of No. 3 Yellow Corn in Chicago, Percentage That the May-June Price is of the December-January Price

Corn price and corn-hog ratio index	Per cent that the May-June price is of the December-January price	
	Range	Average
Below 90	112.6-131.5	122.8
90-105	107.6-112.9	110.7
Above 105	93.4-103.4	96.2

shows that when the index thus obtained is below 90, the May-June price of No. 3 yellow corn averages 123 per cent of the December-January price. When the index is between 90 and 105, and above 105, the May-June price is about 111 and 96 per cent, respectively, of the December-January price. The years included in the study of the seasonal movement of prices extend from 1899 to 1929, omitting the war period.

¹⁸ Elliot, F. F. Adjusting Hog Production to Market Demand. Univ. of Ill. Agr. Expt. Sta. Bull., Bull. 293. 1927.

Vogel, H. A. Factors Affecting Hog Production and Prices in Minnesota, Master's Thesis, Univ. of Minn., 1930. (Unpublished.)

¹⁹ Corn-hog ratio based on Chicago prices.

The actual seasonal movement of corn prices is in accordance with the analysis in the above paragraphs. For example, when the December-January price is 100 per cent of normal, and the corn-hog ratio of the preceding year is 90 per cent of normal, the resulting index is 122, an index which indicates conditions rather unfavorable to an advance in prices during the season. A December-January price of 90 per cent of normal and a corn-hog ratio of the preceding year of 110 per cent of normal results in a combined index of 82, an index that suggests conditions particularly favorable to a seasonal advance above the average.

Table 11 shows the average monthly prices of No. 3 yellow corn in Chicago, when the years are again grouped according to the relative size of the index which represents the relation between the December-January price and the December-January corn-hog ratio of the previous season.

Table 11
Average Monthly Prices of No. 3 Yellow Corn in Chicago, 1899-1900 to 1915-16, 1921-22 to 1928-29

Month	Size of the index representing the relation between the December-January corn price and the December-January corn-hog ratio of the previous year		
	Less than 90	90 to 105	Above 105
	cents	cents	cents
October	54.6	61.7	62.3
November	51.6	54.0	61.2
December	49.7	50.1	62.2
January	48.8	50.5	64.6
February	50.6	51.4	61.5
March	52.7	50.6	61.6
April	56.1	51.4	60.1
May	59.7	54.6	61.1
June	61.1	56.9	60.9
July	62.6	62.0	63.5
August	65.8	63.5	63.3
September	65.1	59.2	60.6

Table 12 and Figure 17 show the indexes of seasonal variation of the average monthly prices of No. 3 yellow corn.²⁰ The average price for the corresponding months is expressed as a percentage of the average of all monthly prices from December to June. The years are again grouped according to the relation between the December-January price and the December-January corn-hog ratio of the previous season. When the index representing the latter relationship is below 90, the index of seasonal variation rises from about 91 in January to 112 in June; and when it is above 105, the seasonal index declines from 105 in January to about 98 in May and June.

²⁰ The original monthly price has been expressed as a percentage of normal price in order to eliminate the influence of the price trend. Consequently, the monthly indexes of seasonal variation are based on averages of the percentage of normal prices (Appendix, Table XVI).

Table 12
Indexes of Seasonal Variation of the Price of No. 3 Yellow Corn in Chicago,
1899-1900 to 1915-16, 1921-22 to 1928-29

Month	Size of the index representing the relation between the December-January corn price and the December-January corn-hog ratio of the previous year		
	Less than 90	90 to 105	Above 105
	per cent	per cent	per cent
December	92.2	96.8	100.7
January	90.6	96.9	104.5
February	93.8	98.5	102.0
March	97.5	96.8	99.3
April	103.5	97.9	96.8
May	109.9	104.2	98.3
June	112.5	108.9	98.4

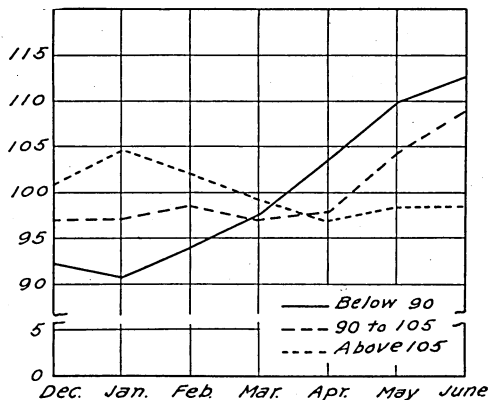


Fig. 17. Indexes of Seasonal Variation of No. 3 Yellow Corn in Chicago, When the Corn-Hog Ratio Index Was Below 90, from 90 to 105, and above 105, Respectively

Marketings of Corn from Minnesota

Table 13 gives the percentage distribution of the marketings of corn by Minnesota farmers, from December to June, 1921-29. The total amount of corn marketed from December to June, inclusive, is considered as 100 per cent. Thus, during the year 1928-29, 34.0 per cent of the total corn marketed from December to June was marketed during December. The marketings of corn in Minnesota are concentrated within December, January, and February, but there is a considerable variation from year to year.

Table 14 shows the values at Minnesota farm prices of the monthly sales of corn, assuming a total marketing of 1,000 bushels during the months December to June. For example, the amount marketed in December, 1928-29, was 34 per cent of the total December-June market-

ings, or 340 bushels. The value of 340 bushels at the December Minnesota farm price of 40 cents was \$136. In a like manner, the values of the marketings during each of the other months were calculated. The total represents the income received by Minnesota farmers from the sale of 1,000 bushels of corn during the months December to June, when the distribution of the sales corresponds to that shown in Table 13.

Table 13
Corn: Monthly Marketings in Minnesota, December to
June, 1921-22 to 1928-29*

Beginning December 1	Percentage of total marketings, December-June, inclusive						
	December	January	February	March	April	May	June
1921-22	21.5	20.2	15.2	10.1	5.1	8.9	19.0
1922-23	24.0	21.3	20.0	12.0	6.7	8.0	8.0
1923-24	24.1	21.4	22.9	11.4	5.8	7.2	7.2
1924-25	13.5	28.1	27.0	12.2	5.5	8.2	5.5
1925-26	15.5	23.9	21.1	14.1	5.6	9.9	9.9
1926-27	14.7	19.1	17.6	7.4	7.4	8.8	25.0
1927-28	13.9	22.2	16.7	12.5	12.5	12.5	9.7
1928-29	34.0	20.1	15.7	7.1	10.1	10.1	2.9

* Original data of monthly marketings in Minnesota supplied by Bureau of Agr. Econ., U. S. Dept. of Agr.

Table 14
Values of the Monthly Marketings of Corn by Minnesota Farmers, Assuming
a Total Marketing of 1,000 Bushels, December to June, 1921-22 to 1928-29

Year	December	January	February	March	April	May	June	Total
1921-22	\$ 49.45	\$ 48.48	\$ 42.56	\$30.30	\$16.32	\$28.48	\$ 60.80	\$286.29
1922-23	84.00	74.55	72.00	43.20	26.13	34.40	35.20	369.48
1923-24	53.58	81.32	91.60	46.74	24.36	29.52	32.40	359.52
1924-25	76.95	162.98	151.20	63.44	27.50	43.46	32.45	557.98
1925-26	54.25	86.04	73.85	47.94	19.04	34.65	36.63	352.40
1926-27	54.39	74.49	70.40	28.12	27.38	38.72	132.50	426.00
1927-28	62.55	102.12	74.89	63.75	65.00	73.75	57.23	502.89
1928-29	142.80	90.45	78.50	35.50	47.47	47.47	13.92	456.11

The individual farmer probably tends to concentrate his sales of cash corn during one or two months rather than to distribute the sales over a period of several months. In many cases, he sells all the cash corn at one time. Columns I and II, Table 15, show the values of 1,000 bushels of corn based on the average December-January and the average May-June Minnesota farm price, respectively. Column IV gives the index which represents the relationship between the Chicago December-January price of No. 3 yellow corn and the corn-hog ratio of the previous season.

The seasonal movement of the Minnesota farm price is similar to that of the Chicago price, as is shown by Figure 11. The high corn price—corn-hog ratio index in 1924-25, 1925-26, and 1928-29, indicated a situation unfavorable to the storage of corn. According to the differ-

ences between values given in Column III, Table 15, the farmer who sold his corn at the average December-January Minnesota farm price in 1924-25 and 1925-26 realized more gross profit than if he had held the corn and sold it at the average May-June price. In 1928-29, the difference between values was about equal to the cost of storage. During the other years, with the exception of 1923-24, the corn price—corn-hog ratio index indicated conditions particularly favorable to the storage of corn. The actual differences between values in these years show that the sale of the corn at the average May-June price realized more gross profit than the sale at the average December-January price.

Table 15
Values of 1,000 Bushels of Corn Based on the Average December-January
and the Average May-June Minnesota Farm Prices, Respectively;
and the Corn Price-Corn-Hog Ratio Index, 1921-28

	Values of 1,000 bushels based on		Difference in value Column II minus Column I III	Corn price- corn-hog ratio index IV
	December- January Minnesota farm price I	May-June Minnesota farm price II		
1921-22.....	\$235	\$320	\$+85	60
1922-23.....	350	435	+85	68
1923-24.....	380	430	+50	95
1924-25.....	575	560	-15	173
1925-26.....	355	360	+5	129
1926-27.....	380	485	+105	74
1927-28.....	455	590	+135	78
1928-29.....	435	475	+40	126

APPENDIX

Classes and Grades of Corn

The price of No. 3 yellow corn in Chicago has been selected for analysis in this bulletin because Chicago is the most important primary market for corn, and No. 3 yellow appears to be the most representative grade. It is believed that a single grade is a more satisfactory basis of analysis than a weighted average of all grades because of the greater homogeneity over a period of time. Table I shows that yellow corn was by far the most important class of corn received in Chicago for the period 1924-27, constituting 58 per cent of the total receipts.

TABLE I

Percentage of Total Receipts of Corn in Chicago as Represented by the Various Classes, 1924-27*

Class	Per cent of total receipts
Yellow	58
White	16
Mixed	16
Sample†	10

* Annual reports of the Chicago Board of Trade.

† Low quality corn not classified.

Table II shows the percentage distribution of receipts of each class according to grades. A comparatively small amount of No. 1 corn is received in Chicago. If grades 2 and 3 are grouped, they constitute at least 45 per cent of the total receipts of any one class.

TABLE II

Percentage Distribution of Receipts of Corn in Chicago According to Grades, 1924-27*

Class	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	per cent	per cent	per cent	per cent	per cent	per cent
Yellow	2.0	23.1	22.4	16.9	20.0	15.6
White	1.6	26.3	22.5	17.3	18.8	13.5
Mixed	1.8	21.6	27.0	18.3	15.8	15.5

* Annual reports of the Chicago Board of Trade.

Trends of Price and Production

Over a period of years, prices and production data are characterized by two distinct movements: the cyclical fluctuations, and the movements associated with the passage of time and which underlie the cyclical changes. The present study involves the determination of the relationship between cyclical changes of price and production. In order to obtain a measurement that is representative of this relationship, the

several sequences of these changes have been isolated by the calculation of a reasonably well fitting curve, designated as the secular trend, or a line that indicates the long-time underlying movement of the particular series.

The secular trend of production is a summary of the effects of certain influences, such as growth of population, increasing development of new lands, and improvement in the technic of production. These influences are variable in their effect from one period to another, and, as a consequence, there is an absence of precision in the description that a secular trend line is supposed to provide. The secular trend line is an approximation rather than a true picture of the desired representation, and the designation of a point on the line as the "normal" situation at a particular time indicates an approach rather than a complete identity with the normal.²¹

A second-degree parabola has been selected to represent the long-time tendencies of the production of corn in the United States and in the leading states. Production increased rapidly to about 1910, but since then any increase has been one of a declining rate. In fact, during the last few years the production has actually declined. The production in Minnesota is represented by a third-degree parabola.

From 1897 to 1920, corn prices rose. The general tendency during this period is probably best represented by a straight line. As the war years, 1916-20 inclusive, have been omitted in the determination of the relation between production and price, the calculation of the straight line trend is based on the period 1897-1915. The great decrease in price that occurred in 1920 necessitated the calculation of a separate trend line for the period 1921-28. An independent straight-line trend calculated for this period failed to describe the actual tendencies of corn prices. While the movement was upward, the relative high prices of two of the eight years resulted in a slope that seemed to exaggerate the upward movement. Consequently, it was thought best to apply to this period the slope obtained in the determination of the trend for the period 1897-1915.

Analysis of the Influence of Factors Affecting the Average October-June Price of No. 3 Yellow Corn in Chicago

An analysis of the changes in the price of corn from year to year involves the selection of the factors which account for the changes and the study of their influence. The preliminary selection of factors rests upon the hypothesis made relative to the identification of the probable supply and demand elements that enter into the determination of price. There are certain factors, such as corn supply, whose relative impor-

²¹ S. S. Kuznets, *Secular Movements in Production and Prices*. 1930.

tance may be assumed without further analysis; while in the case of other factors a preliminary analysis is needed to confirm or deny the implications made by the original assumptions. An endeavor has been made to avoid the selection of any factor whose original consideration can not be justified, or a factor which may be highly correlated with price but whose relationship is one of covariation in the particular period rather than one of cause and effect.

The purpose of the ultimate analysis should function in the selection of the factors that are to be related to price. When the sole purpose is one of forecasting the price, factors that would add to the value of the forecasting equation might appropriately be included. In the present analysis they are excluded. For example, if the sole objective were to forecast the October-June price of No. 3 corn in Chicago, the August or September corn-hog ratio would add to the accuracy of estimates obtained by the application of the regression equation. The corn-hog ratio expresses the relative profitableness of feeding or selling the corn. As the price of corn and the price of hogs are rather closely inter-related, that is, each is somewhat influenced by the other, the August or September ratio can hardly be isolated and regarded as an independent factor that influences the October-June price. If the ratio is high, an increase in the potential demand for corn is indicated, the price of corn tends to rise, and an increase in the price of corn decreases the ratio.

The factors to which particular attention has been given are supply of corn, quality of the crop, location of production, supply of oats and barley, and number of hogs and of beef cattle on farms. The multiple correlation method of analysis has been used in the study of the influence of these factors on the average October-June price of No. 3 yellow corn in Chicago. The time included in the analysis extends from 1897, which year marks the beginning of a general rise in corn prices, to and including the crop year of 1928-29, omitting the war years, 1916-17 to 1920-21, inclusive. With the exception of hogs and of beef cattle on farms, the trend of the respective series has been considered as the normal situation, and the data corresponding to the individual years have been expressed as percentages of normal. In the case of hogs and beef cattle, the number during the current year is expressed as a percentage of the average of the previous five years.²² The constants derived in the multiple correlation analysis are given in Table III.

A certain degree of comparison of the relative importance of the individual factors may be indicated by the relative size of the betas. If the original observations of the various series had been expressed in terms of units of standard deviation, the betas would have become the coefficients in the regression equation. When expressed in this way, a

²² In combining oats production and barley production, each was weighted by the respective number of pounds in a bushel.

change of an amount equal to one standard deviation of any one series contributes to the change in the units of standard deviation of the dependent variable, by an amount equal to the corresponding beta of the independent series. Thus, where a common factor of one of each series is substituted in the equation,

$$\frac{X_1}{\sigma_1} = A + \beta_{12.34567} \frac{X_2}{\sigma_2} + \beta_{13.24567} \frac{X_3}{\sigma_3} \dots \beta_{17.23456} \frac{X_7}{\sigma_7}$$

the betas (β) remain as the contribution of each factor to the dependent variable as thus expressed.

TABLE III

Statistical Constants Derived in the Determination of the Coefficient of Multiple Correlation Between the Average October-June Price of No. 3 Yellow Corn in Chicago and the Factors That Influence This Price, 1897-98 to 1915-16, 1921-22 to 1928-29

Factors correlated with the average October-June price of No. 3 yellow corn*	Constants derived in the determination of $R_{1,234567}$
	Beta
X_2	-.9971
X_3	+.3029
X_4	-.2378
X_5	-.0589
X_6	+.2697
X_7	+.0292

Coefficients of multiple correlation

Original .....	.966
Corrected† .....	.956

* X_1 = Average October-June price of No. 3 yellow corn. X_2 = Corn supply. X_3 = Per cent that the production in Iowa, Missouri, Kansas, Nebraska, Minnesota, and South Dakota is of the total United States production. X_4 = Quality of the corn crop. X_5 = Oats and barley production. X_6 = Number of hogs on farms. X_7 = Number of beef cattle on farms.

† Corrected $R^2 = 1 - \frac{1 - R^2}{M}$, where M = number of independent variables
 $1 - \frac{1 - R^2}{N}$

N = number of observations.

Judging by the relative size of the respective betas, distribution of the corn crop ranks next to the corn supply as a factor influencing the price of No. 3 yellow corn during the period of time included in the analysis. The quality of the crop and the number of hogs on farms assume about the same relative importance, while the production of oats and barley and the number of beef cattle are of only minor importance, relative to the other four factors.

The estimated per cent of normal prices to which reference was made in the first part of this bulletin, were obtained by the application of the regression equation: $X_1 = 205.36 - 1.6894X_2 + .6832X_3 - .5228X_4 - .0783X_5 + .4930X_6 + .0616X_7$ (I)

The standard error of estimate was 4.08.

The net relation between price and any one of the six independent factors involved in the analysis may be determined by substituting in the regression equation the mean values of the other independent variables, allowing these to remain constant while the equation is evaluated for a series of values of the particular variable selected. In order to determine the net effect of the supply of corn on price, the mean values of the other independent variables were substituted in equation (1). The resulting equation and also those which indicate the net influence of the other independent variables are as follows:

Corn supply	$X_1 = 268.22 - 1.6822X_2$
Distribution of the corn crop	$X_1 = 31.48 + .6852X_3$
Quality of the corn crop	$X_1 = 152.58 - .5258X_4$
Oats and barley production	$X_1 = 107.84 - .0784X_5$
Number of hogs	$X_1 = 50.66 + .4934X_6$
Number of beef cattle	$X_1 = 93.86 + .0614X_7$

Table IV gives the data which indicate the net influence of each of the factors when the other factors remain at their normal values. For example, when the corn supply is 90 per cent of normal, and each of the other five independent factors is 100 per cent of normal, the average October-June price of No. 3 yellow corn in Chicago tends to be about 117 per cent of normal. The influence of the distribution of the crop, or of any one of the other factors, may be indicated in the same manner. When the proportion of the crop produced in the states of Iowa, Missouri, Kansas, Nebraska, Minnesota, and South Dakota is 90 per cent of normal, the price of corn tends to approximate 93 per cent of normal.

TABLE IV

Indexes of the Net Influence of the United States Corn Supply, Distribution of the Crop, Quality of the Crop, Production of Oats and Barley, Number of Hogs, and Number of Beef Cattle on the Average October-June Price of No. 3 Yellow Corn at Chicago

Factor	Size of the factor: per cent of normal				
	80	90	100	110	120
	Per cent of normal price	Per cent of normal price	Per cent of normal price	Per cent of normal price	Per cent of normal price
Corn supply	133.6	116.8	100.0	83.2	66.4
Distribution of the corn crop	86.3	93.1	100.0	106.9	113.7
Quality of the corn crop	110.5	105.3	100.0	94.7	89.5
Production of oats and barley	101.5	100.8	100.0	99.2	98.5
Number of hogs	90.1	95.1	100.0	104.9	109.9
Number of beef cattle	98.8	99.4	100.0	100.6	101.2

Table V shows the change in each factor, the other factors remaining at their average values, that would have been necessary to effect a 10 per cent change in price during the period of time included in the analysis.

TABLE V
Percentage Change in Each of the Six Factors Influencing the Average
October-June Price of No. 3 Yellow Corn in Chicago, Necessary
to Effect a Change of 10 per Cent in the Price

Factor	Per cent change in factor necessary to effect a 10 per cent change in price
Corn supply	5.9
Distribution of the corn crop.....	14.6
Quality of the corn crop.....	19.0
Oats and barley production.....	127.5
Number of hogs.....	20.3
Number of beef cattle.....	162.9

Seasonal Movement of Price of No. 3 Yellow Corn in Chicago

The main problem connected with the study of the seasonal movement of price consists in the determination of representative seasonal indexes, which truly reflect this movement and which are free from influences such as secular trend and irregular deviations. In the present analysis, the indexes of seasonal variation have been determined by the application of the ratio to trend method.²³ The use of this method involves the determination of the annual trend and the monthly trend of price, and the expression of the actual monthly price as a percentage of the trend or normal price for that month.

In this study of the characteristics of the seasonal movement of the price of No. 3 yellow corn in Chicago, the period 1899-1900 to 1928-29, omitting the crop years, 1916-17 to 1920-21, has been classified into three groups of years. The basis for this grouping is the relative size of the index representing the relationship between the December-January price of corn and the December-January corn-hog ratio of the previous season. The reasons for the selection of this particular index have been outlined in the first part of this bulletin. The first group includes the years when this index was below 90; the second, when it was between 90 and 105; and the third, when it was above 105.

The multiple frequency tables (Fig. 1, 2, and 3) are constructed by classifying in the form of a frequency distribution, the percentages of the trend price for each month. The average of all items in each column or the corresponding price ratios was selected as the representative price ratio for the particular month. An investigation of the various distributions indicate that the median item, or an average of three or more central items, would not be more representative or serve the purpose better than the average of all items. The movement of the price from December to June is of particular interest and consequently the average ratios or seasonal indexes corresponding to the months December to June, inclusive, in each group of years, are so adjusted that their average is 100. These indexes are given in Table 12.

²³ Helen D. Falkner, Measurement of Seasonal Variation, Jour. Amer. Statist. Assn., vol. 19, p. 167. June, 1924.

TABLE VI—Continued

Frequency Distribution of Monthly per Cent of Normal Price of No. 3 Yellow Corn in Chicago, When the Index Representing the Relation Between the December-January Corn Price and the December-January Corn-Hog Ratio of the Previous Year Was Below 90

Price, per cent of normal	October	November	December	January	February	March	April	May	June	July	August	September
115.0-119.9	1911 .... ....	.... .... ....	.... .... ....	.... .... ....	.... .... ....	1907 1910	1907 1911 1910	.... .... ....	.... .... ....	1904	1911 1913 1910	............
120.0-124.9	1911 1910	1926 1910	1926 1910	.... .... ....	1926
125.0-129.9
130.0-134.9	1907	1907 ....	.... .... ....	1900 1926	1900
135.0-139.9	1907........	............	............
140.0-144.9 1907
145.0-149.9	1907........	............

TABLE VII

Frequency Distribution of Monthly per Cent of Normal Price of Yellow Corn in Chicago, When the Index Representing the Relation Between the December-January Corn Price and the December-January Corn-Hog Ratio of the Previous Year Was 90 to 105

Price, per cent of normal	October	November	December	January	February	March	April	May	June	July	August	September
70.0-74.9	....	....	....	....	....	....	....	....	....	....	....	1920
75.0-79.9	....	1920	....	1920	1920	1906	1920	....	....	....	1920	....
80.0-84.9	....	....	1906 1920	1906	1906	1920	1906	1920	....	1920	....	....
85.0-89.9	1920	1906	1923	1902	1902	1902	1902	....	1920	....	....	1906
90.0-94.9	....	....	1902	1923	....	....	....	1906	1906	....	....	....
95.0-99.9	....	....	1914	....	1923	1923	1923	1902 1923	....	....	....	....
100.0-104.9	....	1914 1923	....	....	....	....	....	....	1902	1906	1906	....
105.0-109.9	1906 1914	....	....	1914	1914	1914	1914	....	1914 1923	1902	....	1902 1914
110.0-114.9	....	1902	....	....	....	....	....	1914	....	1914	1902	....
115.0-119.9	....	....	....	....	....	....	....	....	....	....	1914	....
120.0-124.9	1902	....	....	....	....	....	....	....	....	....	....	....
125.0-129.9	1923	....	....	....	....	....	....	....	....	....	....	....
130.0-134.9	....	....	....	....	....	....	....	....	....	....	....	....
135.0-139.9	....	....	....	....	....	....	....	....	....	1923	....	....
140.0-144.9	....	....	....	....	....	....	....	....	....	....	....	1923
145.0-149.9	....	....	....	....	....	....	....	....	....	....	1923	....

TABLE IX
Production and Total Supply of Corn,* 1895-1929

Year	Millions of bushels			
	United States total supply	Production		
		United States	Five states	Kansas and Nebraska
1895	.....	2,311	1,174	310
1896	.....	2,505	1,247	512
1897	2,332	2,145	1,033	372
1898	2,342	2,261	1,091	278
1899	2,504	2,455	1,176	428
1900	2,679	2,505	1,301	347
1901	1,743	1,614	751	163
1902	2,655	2,620	1,351	451
1903	2,842	2,347	1,044	345
1904	2,615	2,529	1,138	490
1905	2,835	2,749	1,295	443
1906	3,025	2,898	1,318	430
1907	2,645	2,512	1,164	329
1908	2,615	2,545	1,086	350
1909	2,652	2,572	1,191	341
1910	3,004	2,886	1,327	362
1911	2,658	2,531	1,158	282
1912	3,193	3,125	1,475	357
1913	2,591	2,447	1,071	137
1914	2,756	2,673	1,153	282
1915	3,094	2,995	1,210	385
1916	2,657	2,567	1,088	262
1917	3,100	3,065	1,418	368
1918	2,623	2,503	1,126	167
1919	2,882	2,811	1,190	246
1920	3,358	3,209	1,369	389
1921	3,374	3,069	1,245	305
1922	3,092	2,906	1,282	280
1923	3,139	3,054	1,360	394
1924	2,423	2,309	1,017	323
1925	2,960	2,916	1,489	347
1926	2,897	2,692	1,288	200
1927	2,876	2,763	1,061	468
1928	2,872	2,819	1,308	392
1929	2,698	2,622	1,136	345

* Yearbook, U.S. Dept. of Agr. Additional data furnished by the Div. of Crop Estimates, U.S. Dept. of Agr.

TABLE X
Trends of Production and Total Supply of Corn, 1895-1929

Year	Millions of bushels			
	United States total supply	Production		
		United States	Five states	Kansas and Nebraska
1895	.....	2,217	1,113	406
1896	.....	2,216	1,122	398
1897	2,251	2,264	1,130	390
1898	2,312	2,310	1,139	382
1899	2,370	2,354	1,146	375
1900	2,426	2,395	1,154	368
1901	2,478	2,435	1,162	362
1902	2,528	2,474	1,168	356
1903	2,575	2,509	1,175	350
1904	2,620	2,543	1,181	345
1905	2,661	2,575	1,187	340
1906	2,700	2,605	1,193	335
1907	2,736	2,633	1,198	332
1908	2,769	2,659	1,203	328
1909	2,800	2,683	1,208	325
1910	2,827	2,705	1,212	323
1911	2,852	2,725	1,217	320
1912	2,874	2,744	1,220	318
1913	2,895	2,760	1,224	317
1914	2,911	2,774	1,226	316
1915	2,925	2,786	1,230	313
1916	2,936	2,797	1,232	315
1917	2,944	2,805	1,234	315
1918	2,950	2,812	1,236	315
1919	2,953	2,816	1,237	317
1920	2,953	2,818	1,239	318
1921	2,950	2,819	1,240	320
1922	2,945	2,818	1,240	323
1923	2,942	2,814	1,241	325
1924	2,926	2,808	1,240	328
1925	2,912	2,801	1,240	332
1926	2,896	2,791	1,239	336
1927	2,876	2,781	1,238	340
1928	2,854	2,767	1,237	345
1929	2,830	2,752	1,235	350

TABLE XI

Percentage of Normal Production and Supply of Corn, 1895-1929

Year	Per cent of normal			
	United States total supply	Production		
		United States	Five states	Kansas and Nebraska
1895	...	107	105	76
1896	...	113	111	129
1897	104	95	91	95
1898	101	98	96	73
1899	106	104	103	114
1900	110	105	113	94
1901	70	66	65	45
1902	105	106	116	127
1903	96	94	89	99
1904	100	99	96	142
1905	107	107	109	130
1906	112	111	110	128
1907	97	95	97	99
1908	94	96	90	107
1909	95	96	99	105
1910	106	107	109	112
1911	93	93	95	88
1912	110	114	121	112
1913	89	89	88	43
1914	95	96	94	89
1915	106	108	98	123
1916	90	92	88	83
1917	105	109	115	117
1918	89	89	91	53
1919	98	100	96	78
1920	114	114	110	122
1921	114	109	100	95
1922	105	103	103	87
1923	107	109	110	121
1924	83	82	82	98
1925	102	104	120	105
1926	100	96	104	60
1927	100	99	86	138
1928	101	102	106	114
1929	95	95	92	99

TABLE XII
Minnesota Acreage, Production, and Yield per Acre of Corn,* 1895-1929

Year	Acreage			Production			Yield per Acre		
	Actual	Trend	Per cent of trend	Actual	Trend	Per cent of trend	Actual	Trend	Per cent of trend
	1,000 acres	1,000 acres		1,000,000 bu.	1,000,000 bu.		bu.	bu.	
1895	1,575	1,600	98	49.1	52.9	93	31.2	28.0	111
1896	1,550	1,550	100	47.3	48.8	96	30.5	28.4	107
1897	1,490	1,510	99	38.7	45.7	85	26.0	28.8	90
1898	1,450	1,500	97	46.4	43.5	107	32.0	29.1	110
1899	1,442	1,490	97	47.6	42.2	113	33.0	29.5	112
1900	1,450	1,480	98	47.9	41.6	115	33.0	29.8	111
1901	1,575	1,490	105	41.4	41.8	99	26.3	30.1	87
1902	1,700	1,519	126	38.8	42.7	91	22.8	30.5	75
1903	1,700	1,550	110	48.1	44.3	109	28.3	30.8	92
1904	1,775	1,610	110	47.7	46.6	102	26.9	31.1	86
1905	1,750	1,670	105	56.9	49.2	116	32.5	31.2	104
1906	1,800	1,740	103	60.5	52.4	115	33.6	31.5	107
1907	1,900	1,830	104	51.3	56.2	91	27.0	31.8	85
1908	1,900	1,920	99	55.1	60.1	92	29.0	32.0	91
1909	2,004	2,030	99	69.7	64.4	108	34.8	32.3	105
1910	2,040	2,140	95	66.7	69.3	96	32.7	32.5	101
1911	2,200	2,250	98	74.1	74.2	100	33.7	32.7	103
1912	2,266	2,370	96	78.2	79.3	99	34.5	32.9	105
1913	2,400	2,500	93	96.0	84.7	113	40.0	33.1	121
1914	2,600	2,630	99	91.0	90.0	101	35.0	33.3	105
1915	2,800	2,770	101	64.4	95.5	67	23.0	33.5	69
1916	2,600	2,900	97	87.1	100.8	86	33.5	33.6	100
1917	3,060	3,040	101	91.8	106.1	87	30.0	33.8	89
1918	2,780	3,180	87	112.2	111.3	101	40.0	33.9	118
1919	2,998	3,310	91	119.9	116.3	103	40.0	34.0	118
1920	3,288	3,450	94	123.3	121.1	102	37.5	34.2	110
1921	3,820	3,590	106	156.6	125.7	124	41.0	34.3	120
1922	3,979	3,720	107	131.3	129.9	101	33.0	34.3	96
1923	4,297	3,840	112	154.7	133.9	116	36.0	34.3	105
1924	4,595	3,970	116	124.1	137.3	90	27.0	34.4	78
1925	4,136	4,080	102	148.9	140.3	106	36.0	34.5	104
1926	4,343	4,190	104	147.6	142.8	103	34.0	34.5	99
1927	4,172	4,300	97	127.2	144.6	88	30.5	34.6	88
1928	4,081	4,400	93	139.3	145.9	95	34.0	34.6	98
1929	4,258	4,480	95	148.8	146.4	102	35.0	34.6	101

* Bulletin 65, Minnesota Annual Crop and Livestock Statistics, Minn. St. Dept. of Agr. Revised data, 1895-1909, provided by Div. of Crop and Livestock Estimates, U.S. Dept. of Agr.

TABLE XIII

Data Used in the Determination of Supply and Price Relationships
1909-16, 1921-29

	Per cent of normal			
	United States supply	Average October-June Price		
		Chicago No. 3 yellow	Minnesota farm	Iowa farm
1909-10	98	102	103	104
1910-11	109	88	98	86
1911-12	95	118	110	118
1912-13	112	84	81	80
1913-14	90	106	99	110
1914-15	95	110	109	111
1915-16	105	92	99	91
1921-22	113	81	78	75
1922-23	104	99	102	90
1923-24	106	105	107	108
1924-25	82	137	138	147
1925-26	101	87	84	82
1926-27	100	90	92	88
1927-28	100	104	107	106
1928-29	101	95	94	94

TABLE XIV
Monthly Average Deflated Price of No. 3 Yellow Corn in Chicago*, 1897-1916, 1920-29

Year	Cents per bushel												
	October	November	December	January	February	March	April	May	June	July	August	September	Average
1897	38.1	38.3	37.4	38.3	40.4	41.1	44.6	48.7	46.3	47.1	45.7	42.9	42.4
1898	44.4	46.9	54.2	51.3	51.5	47.7	47.3	46.6	46.3	43.4	41.6	40.0	46.8
1899	39.5	38.3	36.1	36.1	38.1	42.9	46.4	46.3	49.4	50.0	49.4	48.8	43.4
1900	51.9	45.7	43.2	44.4	46.3	48.8	52.5	54.4	53.2	60.0	69.1	68.3	53.1
1901	68.3	72.3	76.2	74.7	71.1	72.0	73.8	72.9	73.3	75.6	70.6	68.6	72.4
1902	65.2	59.6	51.1	47.3	47.3	46.6	46.6	53.5	57.0	59.3	61.6	58.6	54.5
1903	52.3	51.8	51.8	49.4	51.7	52.3	56.3	57.6	58.8	57.6	60.5	60.9	55.1
1904	63.2	53.9	48.3	47.7	49.4	53.4	54.5	57.5	63.2	65.5	61.4	60.9	56.6
1905	60.9	51.1	47.2	47.2	47.2	45.5	47.2	52.2	54.4	59.8	60.7	52.2	52.1
1906	50.0	46.2	44.7	44.1	45.3	45.7	46.8	54.2	55.2	55.7	58.8	66.0	51.1
1907	66.3	62.8	63.0	58.2	60.0	70.0	71.4	80.2	79.1	83.0	88.1	87.0	72.4
1908	82.8	67.0	62.1	68.1	68.4	69.5	71.1	74.5	75.8	72.7	70.0	68.3	70.9
1909	57.8	56.7	56.2	61.5	60.6	57.5	53.3	57.1	56.7	59.6	62.1	56.9	58.0
1910	50.5	50.5	46.4	46.9	47.9	47.4	54.3	58.7	59.8	67.7	67.7	69.1	55.6
1911	75.3	70.8	64.2	64.6	66.0	68.7	76.5	77.5	74.3	67.3	77.5	71.8	71.2
1912	63.1	51.0	45.1	45.1	47.1	48.0	53.9	56.4	59.4	60.8	72.5	72.1	56.2
1913	68.0	70.6	66.0	62.0	62.0	64.0	67.7	70.7	73.5	71.7	79.6	76.7	69.4
1914	73.7	67.7	65.3	71.0	73.3	71.3	74.3	75.5	73.3	76.5	79.4	73.3	72.9
1915	62.5	59.4	62.7	64.3	63.2	60.3	61.8	60.0	59.2	64.8	65.9	65.2	62.4
1920	42.3	38.5	40.7	37.6	38.7	39.2	37.7	40.5	43.8	41.7	38.9	36.8	39.7
1921	31.3	32.9	33.1	34.0	38.2	39.3	40.0	41.3	40.1	40.5	39.2	41.0	37.6
1922	43.9	44.9	45.9	44.0	45.0	45.1	48.8	51.6	53.3	57.5	57.5	56.7	49.6
1923	66.7	52.9	46.1	49.4	50.6	50.3	51.0	51.3	55.8	72.7	77.0	75.0	58.2
1924	71.0	71.6	75.0	76.1	74.4	71.3	66.0	72.8	70.6	66.3	62.6	55.8	69.5
1925	51.3	51.6	47.8	49.7	47.5	46.8	46.1	45.8	45.2	50.6	52.6	51.3	48.9
1926	50.3	47.0	50.0	49.3	49.0	45.9	48.3	59.2	67.8	69.4	73.3	67.7	56.4
1927	58.4	55.9	58.1	58.1	62.8	66.2	67.9	70.7	68.9	69.7	66.7	64.5	64.0
1928	62.7	55.6	54.9	61.1	62.2	61.4	59.3	58.0	60.2	63.8	66.0	66.0	61.1
1929	62.9	59.4	59.4	...	...	...	...	...	...	...	...	...	...

* Original price data: Yearbooks, U. S. Dept. of Agr., 1924, p. 612; 1930, p. 637. Ann. Rept., Chicago Board of Trade.

TABLE XV

Average October-June Price of No. 3 Yellow Corn in Chicago, Trend
and per Cent of Trend, 1897-98 to 1915-16, 1921-22 to 1928-29

Year	Cents per bushel			Per cent of trend
	Actual	Deflated	Trend	
1897-98	29.6	41.2	47.2	87
1898-99	35.0	48.4	48.3	100
1899-1900	34.2	41.3	49.3	84
1900-01	39.2	48.8	50.4	97
1901-02	60.7	72.7	51.5	141
1902-03	46.8	52.6	52.6	100
1903-04	46.2	53.5	53.7	100
1904-05	47.9	54.4	54.7	99
1905-05	44.7	50.1	55.8	90
1906-07	45.2	48.0	56.9	84
1907-08	62.4	68.8	57.9	119
1908-09	67.9	69.5	59.1	118
1909-10	60.1	57.6	60.1	96
1910-11	48.7	51.4	61.2	84
1911-12	69.7	70.8	62.3	114
1912-13	53.1	51.9	63.4	82
1913-14	67.2	67.2	64.5	104
1914-15	71.9	71.5	65.5	109
1915-16	71.4	61.4	66.6	92
1921-22	53.3	36.3	50.1	73
1922-23	74.8	47.1	51.1	92
1923-24	80.4	52.7	52.2	101
1924-25	115.2	72.5	53.3	136
1925-26	75.4	48.0	54.4	88
1926-27	77.2	51.9	55.5	93
1927-28	94.7	63.0	56.6	111
1928-29	90.2	59.5	57.6	104

TABLE XVI

Monthly Average Deflated Price of No. 3 Yellow Corn in Chicago, per Cent of Trend

Year	October	November	December	January	February	March	April	May	June	July	August	September
1897	79.2	79.6	77.6	79.3	83.5	84.7	91.8	100.0	94.9	96.3	93.3	87.4
1898	90.2	95.1	109.7	103.6	103.8	96.0	95.2	93.6	92.8	86.8	83.0	79.7
1899	78.5	76.0	71.5	71.3	75.1	84.4	91.2	90.8	96.7	97.7	96.3	94.9
1900	101.0	88.7	83.7	85.9	89.4	94.0	101.0	104.4	101.9	114.7	131.9	130.1
1901	129.8	137.2	144.3	141.2	134.2	135.6	139.0	137.0	137.5	141.6	132.0	128.0
1902	121.4	110.8	94.8	87.6	87.4	86.0	85.8	98.3	104.6	108.6	112.6	106.9
1903	95.4	94.4	94.2	89.7	93.7	94.6	101.6	103.8	103.8	105.8	108.4	108.9
1904	112.9	96.1	85.9	84.7	87.6	94.5	96.5	101.6	111.5	115.3	107.9	106.8
1905	106.7	89.3	82.4	82.2	82.1	79.0	81.8	90.3	94.0	103.1	104.5	89.8
1906	85.9	79.2	76.5	75.4	77.3	77.9	79.6	92.0	93.6	94.2	99.3	111.3
1907	111.6	105.5	105.7	97.5	100.3	117.1	119.2	133.7	131.6	137.9	146.1	144.0
1908	136.9	110.6	102.3	112.0	112.3	113.9	116.4	121.7	123.7	118.4	113.8	111.1
1909	93.8	91.9	90.9	99.4	97.7	92.6	85.7	91.7	90.9	95.4	99.2	90.7
1910	80.4	80.3	73.7	74.3	75.8	75.0	85.8	92.6	94.2	106.4	106.3	108.3
1911	117.8	110.6	100.2	100.6	102.6	106.7	118.6	120.0	114.8	103.9	119.4	110.6
1912	97.1	78.3	69.2	69.1	72.0	73.3	82.2	85.8	90.3	92.3	109.8	109.1
1913	102.7	106.3	99.4	93.2	93.1	96.1	101.5	105.8	109.9	107.0	118.6	114.1
1914	109.8	100.4	96.7	105.0	108.3	105.2	109.4	111.0	107.6	112.2	116.3	107.3
1915	91.4	86.7	91.4	93.6	91.9	87.5	89.6	86.8	85.5	93.5	95.0	93.8
1920	87.2	79.2	83.6	77.0	79.1	80.0	76.8	82.3	88.8	84.6	78.7	74.3
1921	63.1	66.2	66.5	68.1	76.4	78.4	79.7	82.1	79.6	80.2	77.5	80.9
1922	86.4	88.2	90.2	86.1	88.1	88.1	95.1	100.4	104.5	111.4	111.2	109.5
1923	128.5	101.7	88.5	94.6	96.7	96.0	97.1	97.5	105.9	137.7	145.8	141.8
1924	134.0	134.8	141.0	142.8	139.3	133.3	123.1	135.6	131.2	123.0	115.9	103.1
1925	94.6	95.0	87.9	91.2	87.2	85.7	84.3	83.6	82.2	92.0	95.5	92.9
1926	91.0	84.8	90.1	88.7	88.0	82.3	86.4	105.7	120.9	123.7	130.2	120.2
1927	103.5	98.9	102.7	102.5	110.6	116.3	119.1	123.8	120.5	121.6	116.2	112.2
1928	110.5	98.0	96.1	108.2	109.7	107.8	104.1	102.0	105.3	112.0	113.3	113.2

TABLE XVII

Index Numbers of Wholesale Prices of All Commodities by Months and Years, 1885-1927* 1910-14 = 100

Year	January	February	March	April	May	June	July	August	September	October	November	December
1890	80	80	80	81	81	81	81	85	85	85	83	83
1891	82	83	85	85	84	81	81	81	80	80	79	79
1892	77	77	75	74	74	74	76	77	77	77	79	80
1893	83	84	82	81	80	78	76	74	76	77	75	74
1894	73	71	69	69	69	69	69	71	73	70	70	69
1895	69	69	69	73	73	74	73	72	71	72	72	71
1896	70	69	69	68	67	66	66	66	66	68	70	70
1897	68	68	68	67	66	66	66	69	71	70	70	70
1898	70	71	71	71	71	71	70	70	70	70	70	71
1899	71	73	73	74	74	75	76	77	80	81	81	83
1900	83	84	84	84	82	81	82	81	82	81	81	81
1901	81	80	80	80	79	79	80	81	82	82	83	84
1902	83	83	82	84	85	86	86	85	86	92	89	90
1903	91	91	88	88	86	86	86	86	87	86	85	85
1904	87	89	88	87	85	85	85	86	87	87	89	89
1905	88	89	88	88	87	87	87	88	87	87	88	89
1906	89	89	88	89	90	90	87	89	90	92	93	94
1907	93	95	94	94	96	96	97	97	97	98	94	92
1908	91	90	90	91	91	91	92	92	92	93	94	95
1909	94	95	95	97	98	99	99	100	101	102	104	105
1910	105	104	106	107	105	104	104	103	102	99	97	97
1911	96	94	95	92	92	92	93	96	97	97	96	95
1912	96	97	99	102	102	101	101	102	103	103	102	102
1913	102	102	102	102	101	101	102	102	104	103	102	100
1914	100	100	100	99	99	98	99	103	103	99	99	98
1915	100	101	101	101	102	101	102	102	101	104	106	110
1916	115	117	121	123	125	125	125	129	132	138	148	152
1917	156	160	165	176	186	189	191	193	191	186	186	186
1918	188	189	190	193	194	195	200	203	208	206	207	206
1919	202	197	199	202	206	207	216	220	214	215	221	227
1920	237	237	239	249	251	248	245	236	230	215	200	182
1921	173	163	158	151	148	144	144	144	144	144	143	142
1922	141	144	145	145	150	152	158	158	156	157	158	159
1923	159	160	162	162	159	159	153	153	157	156	155	154
1924	154	154	153	151	150	147	150	152	152	155	155	160
1925	163	164	164	159	158	160	163	163	163	160	161	159
1926	159	158	154	154	155	155	154	152	154	153	151	150
1927	150	149	148	147	147	146	147	149	150	150	150	150
1928	151	151	150	152	154	153	154	155	157	153	151	151
1929	152	151	153	152	150	151	154	153	153	151	148	148
1930	146	144	142	142	140	136	132	132	132	129	126	...

* Farm Economics, Cornell Univ., No. 45, June, 1927, p. 699, No. 57. The Agricultural Situation, U. S. Dept. of Agr.

TABLE XVIII

Data Used in Analysis of Factors Influencing the Average October-June
Price of No. 3 Yellow Corn in Chicago, 1897-98 to 1915-16, 1921-22
to 1928-29

Year	Per cent of normal					
	United States supply of corn	Distribution of corn production	Quality of the corn crop	Oats and barley production	Number of hogs on farms	Number of beef cattle on farms
1897-98	104	99	104	104	98	93
1898-99	101	90	101	101	98	92
1899-1900	106	100	105	106	99	96
1900-01	110	120	103	103	101	99
1901-02	70	86	89	89	89	96
1902-03	105	108	97	114	92	95
1903-04	96	97	100	94	98	92
1904-05	100	99	104	104	104	92
1905-06	107	104	109	109	110	98
1906-07	112	104	108	104	115	109
1907-08	97	97	100	77	118	102
1908-09	94	99	104	84	104	98
1909-10	95	99	101	98	87	91
1910-11	106	100	105	103	100	87
1911-12	93	98	97	81	99	83
1912-13	110	111	103	119	97	85
1913-14	89	90	99	93	95	89
1914-15	95	106	102	94	107	97
1915-16	106	96	92	123	109	109
1921-22	114	98	101	79	99	100
1922-23	105	99	102	89	114	92
1923-24	107	105	95	95	107	89
1924-25	83	104	76	105	89	87
1925-26	102	102	101	106	84	84
1926-27	100	89	87	89	91	81
1927-28	100	106	90	92	101	82
1928-29	101	102	100	115	95	87

TABLE XIX

Average December-January Price of No. 3 Yellow Corn, per Cent of Normal;
and Average December-January Corn-Hog Ratio, per Cent of 11.4

Year	Average per cent of normal December-January price of No. 3 yellow corn	Average December-January corn-hog ratio of preceding year, per cent of 11.4	Index representing relationship between corn price and corn-hog ratio
1900	85	121	70
1901	143	118	121
1902	91	88	103
1903	92	118	78
1904	85	95	89
1905	82	90	91
1906	76	102	75
1907	102	132	77
1908	107	68	157
1909	95	86	110
1910	74	116	64
1911	100	144	69
1912	69	81	85
1913	96	132	73
1914	101	106	95
1915	93	89	104
1920	80	82	98
1921	67	111	60
1922	88	130	68
1923	92	97	95
1924	142	82	173
1925	90	70	129
1926	89	121	74
1927	103	132	78
1928	102	81	126

