

UNIVERSITY OF IDAHO  
AGRICULTURAL EXPERIMENT STATION

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Department of Agricultural Economics

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FACTORS RELATING TO THE PRICE  
OF IDAHO POTATOES

By  
R. B. Heflebower

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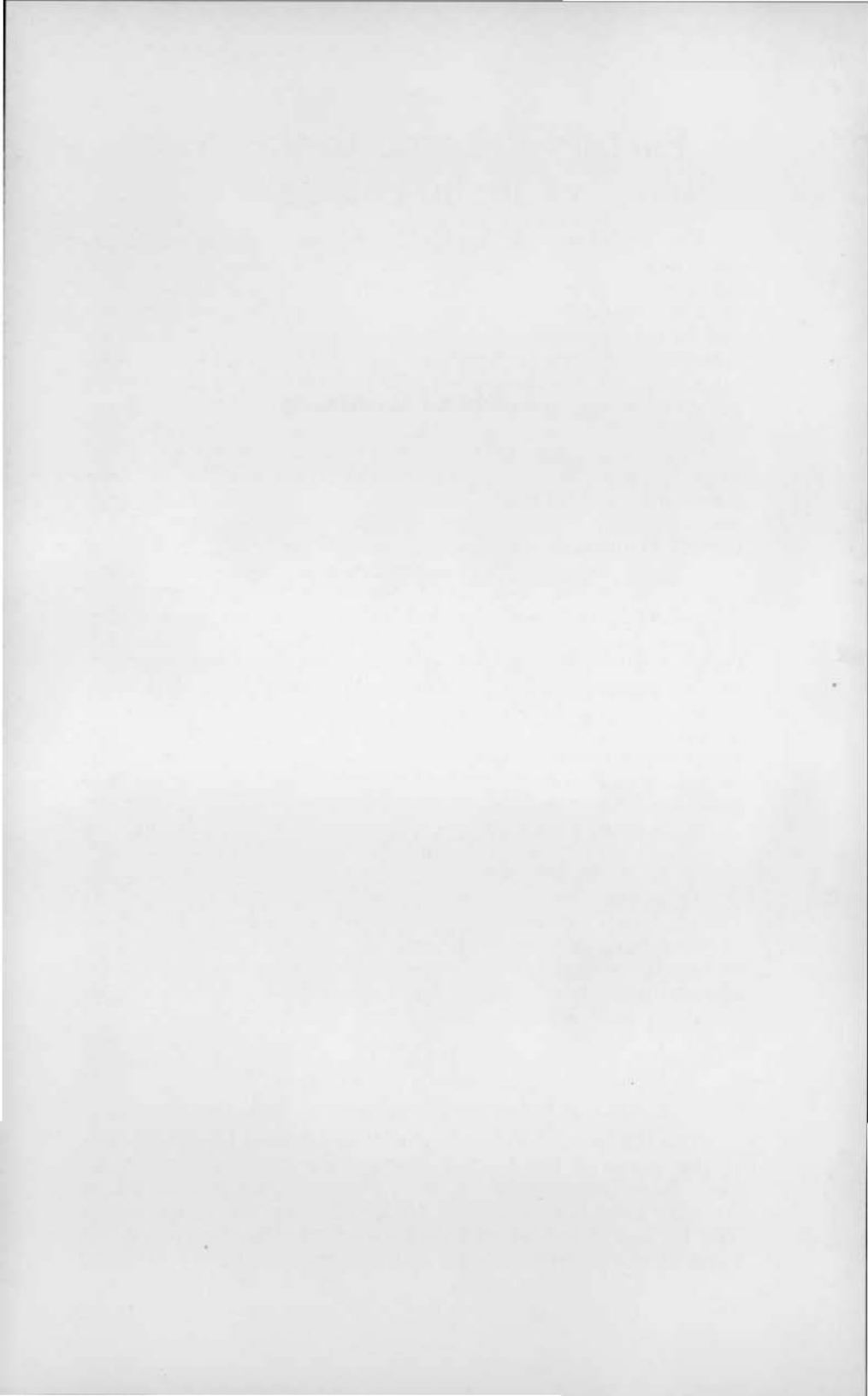
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# Factors Relating to the Price of Idaho Potatoes

The potato grower has to face two decisions during each crop year. First, in the spring the question arises, how many acres of potatoes shall be planted, if any at all. The answer should be based on the prospects for potato prices and on the probable prices of competing crops, with due consideration of the maintenance of a reasonably balanced cropping system. Second, when the crop is grown the farmer must decide whether to sell at harvest or hold for a higher price.

Upon what basis is the farmer to anticipate the probable price of potatoes? In the majority of the seasons between 1909 and 1928 farmers have increased the acreage of potatoes after one or two years of relatively high prices. Conversely the potato acreage has usually been reduced after a year of low prices. The result has been either overproduction or underproduction. However, the practice of doing the opposite to the movement of acreage described above will not always be correct. Notably in 1916 and in 1924 an improved price in the preceding year did not result in an increased acreage. Conversely in 1921, 1927, and 1928 lower prices the preceding year did not prevent an increased acreage. Nor is the theory sound that every two or every three years potato prices are high or low. (Chart I.) The farmer needs a more accurate basis for anticipating the probable price of potatoes. This is made possible by a study of the factors affecting the price and then by applying the results to the production estimates based upon intentions to plant, as explained below.

After the crop is produced the grower must decide when to sell. This problem again calls for a study of the causes of price variation between seasons. If when the September or October estimates of production are released the farmer can estimate the average price for the season, he has a basis for deciding whether to sell or hold.

## PART I

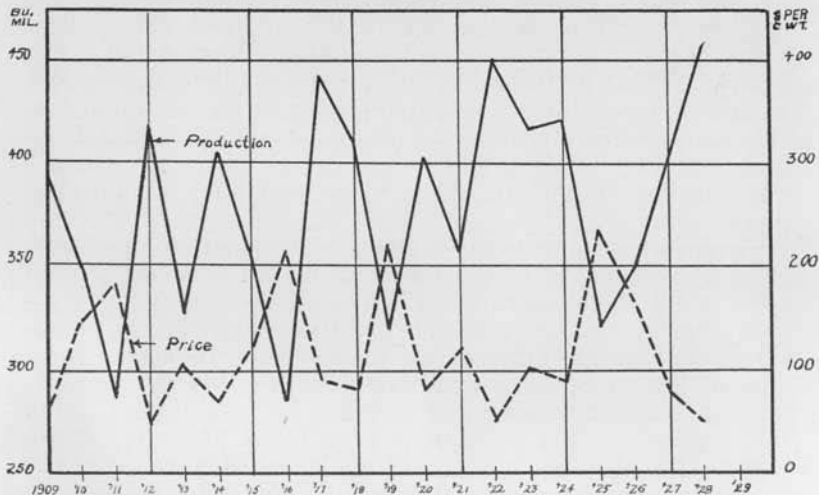
### PRELIMINARY ANALYSIS

#### Relation of Production to the Price of Idaho Potatoes

The Idaho price is not necessarily affected by production in the whole of the United States. Freight charges are so large in relation to the value of potatoes that production in the Far East has relatively little effect on the Idaho price. The United States should be divided into the Far West, the Central States, and the Far East. By making such a division

it has been possible to determine to what degree changes in production in each of these regions has affected Idaho prices.

CHART I



Annual Production of Potatoes in the United States and the Deflated Idaho Prices, 1909-1928.

Source of Data: Table III.

Price usually decreases when production is large and vice versa. However, the degree of price change cannot be estimated from this chart.

The prices used as representative of what the growers actually received in Idaho were the United States Market News Service quotations for "U. S. No. 1 Russets, Wagonloads Cash to Growers" at Idaho Falls. A seasonal average was taken for each crop year which was then adjusted for changes which occurred in the prices of all commodities during the war period.

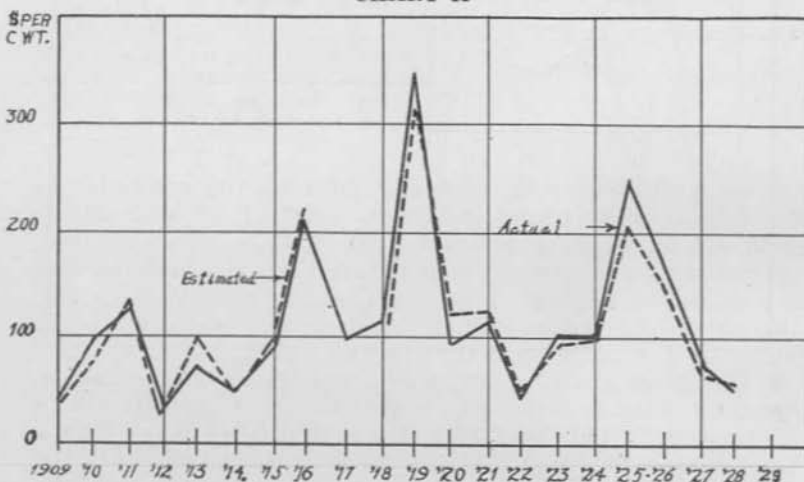
A detailed study showed that 94 per cent of all variations in the prices of Idaho potatoes were the result of variations in production in the three chief regions of the United States and variations in the general level of prices. This high degree of accuracy in measuring price movements shows that production may be used as a basis for estimating prices. The estimated prices shown in Chart II correspond very closely to actual prices.

#### Use of the Price Study

The potato grower is anxious to know before he plants about what the price will be at digging time. Since price variations are largely the result of changes in production, what is needed is an estimate of the probable production.

Variations in potato production may be due to variations in acreage or variations in yield per acre. At least half of the changes in production is due to acreage changes. In March of each year the United States Department of Agriculture gathers information on farmers' intentions to plant potatoes. These estimates, made two months before the crop

CHART II



Actual and Estimated Prices of Potatoes at Idaho Falls, 1909-1928.

Source of Data: Table V.

The estimated prices correspond closely to the actual prices. Estimates of prices enable the producer to anticipate the season's average price.

is planted, correspond very closely to actual plantings. Then by multiplying this intended acreage by normal yields an estimate of production is obtained. With these estimated production figures, a forecast of the probable price can be made. These price estimates made before the crop is planted show the general movement of prices and form the best available basis upon which to decide what acreage of potatoes to plant. (Chart III.)

When to sell is the perplexing question which faces the potato grower in October. If he stores, can better prices be expected? By using the production figures issued in September and again, more accurately, in October, the probable average price for the season can be estimated. (Table I.) In most seasons prices are lower than the season average in the fall, and rise toward spring. The seasonal index represents what per cent, on the average, each month's price is

of the seasonal average. The gradual rise from December to March probably represents the average cost of storage, including loss from spoilage.

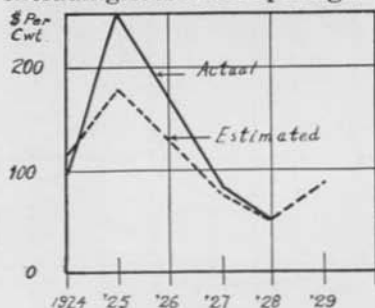


CHART III

Actual Prices of Idaho Potatoes and Price Estimates Based upon Intentions to Plant, for Designated Seasons.

Source of Data: Table XIII.

Price estimates based upon production estimates made before the crop is planted show the direction of price movement.

By multiplying this seasonal index by the estimates of seasonal average prices shown in Chart II, an estimate is obtained of monthly prices. (Chart IV.) The monthly estimates of prices are less accurate than the estimates of the seasons' average prices. The movement of prices throughout the season is very irregular and prices are often higher in the fall than in the spring.

This price analysis can be of great use to the grower in deciding when to sell. An examination of Chart III shows that except in 1913 and 1920, the actual price was at some time during the season above the estimated price. If the forward-looking grower will adopt the principle that the estimated price is his base line, below which he will not look with favor upon price offers and above which he will seriously consider selling, he should profit. He may forego the maximum price for the season but he will not receive the minimum. This analysis when applied with due regard to prevailing circumstances gives the most sound basis available to the grower upon which to decide when to sell.

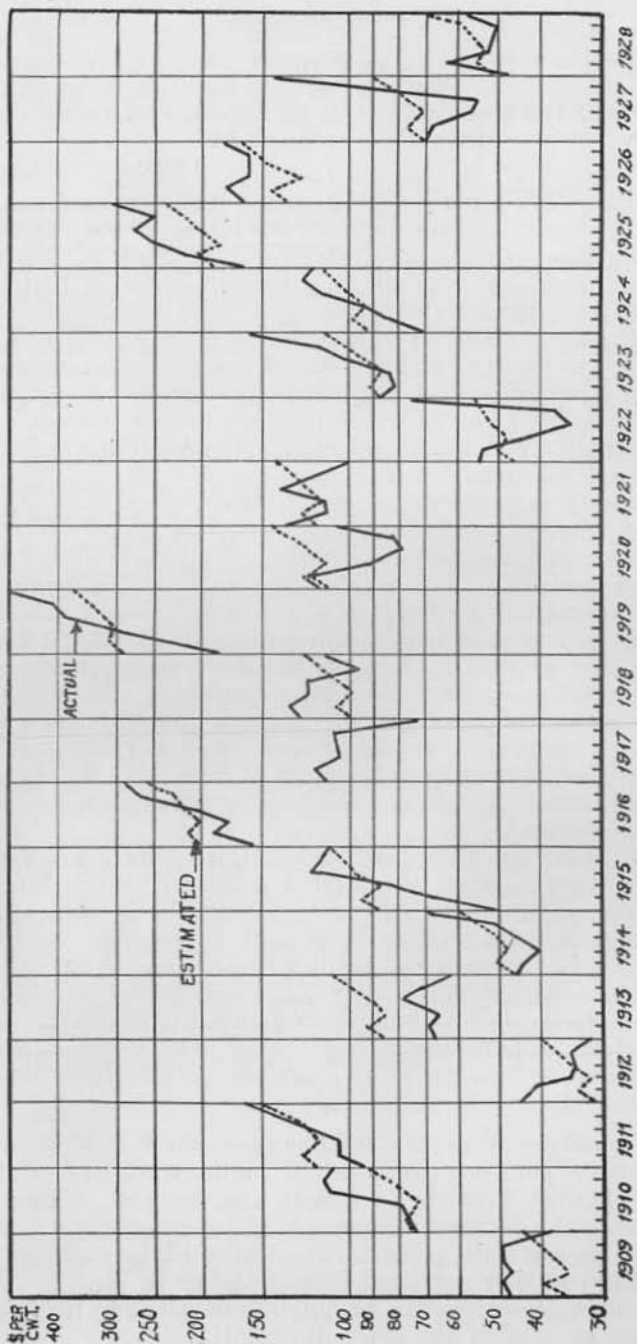
TABLE I  
Seasonal Index of Idaho Potato Prices

	Per cent		Per cent
October .....	89.4	January .....	97.2
November .....	96.5	February .....	102.3
December .....	90.3	March .....	114.4

An explanation of how these conclusions were reached is presented in Part III. The steps through which one would go to estimate the price in a particular season are explained in Appendix A.



CHART IV



Actual and Estimated Monthly Prices of Potatoes at Idaho Falls,  
October to March, 1909-1928.

Source of Data: Table VI.

If at any time during the season the actual price exceeds the estimated the grower will do well, as a rule, to sell.

**PART II****THE DIFFERENTIAL OBTAINED BY IDAHO POTATOES ON  
THE CHICAGO MARKET**

The production of potatoes has grown rapidly in Idaho since 1924. This has brought about the problem of marketing a bulky commodity in distant consuming areas. Declining production in California and the obtaining of a price differential on the Chicago market have facilitated the marketing of this increased Idaho output. Idaho growers must receive higher prices in Chicago than are received by Central State producers in order to offset heavy freight charges. The continued growth of production in Idaho, or even the maintenance of the industry at its present size, makes necessary a policy which will at least preserve if not enlarge this price differential.

The analysis so far has applied to the total price received by Idaho producers. The analysis of the causes of the price differential cannot as a whole proceed on different lines than that used above. To account for this differential, however, involves a study of the reasons why Central States potatoes are more or less valuable in comparison to Idaho potatoes. First, it is clear that Idaho potatoes have been singled out in the market as distinct from other potatoes. Idaho potatoes are given a distinct price. Second, the Chicago price of Idaho Russets has tended to vary from year to year in the same direction as that of Round Whites, but the size of the price differential between the two varieties changes from season to season.

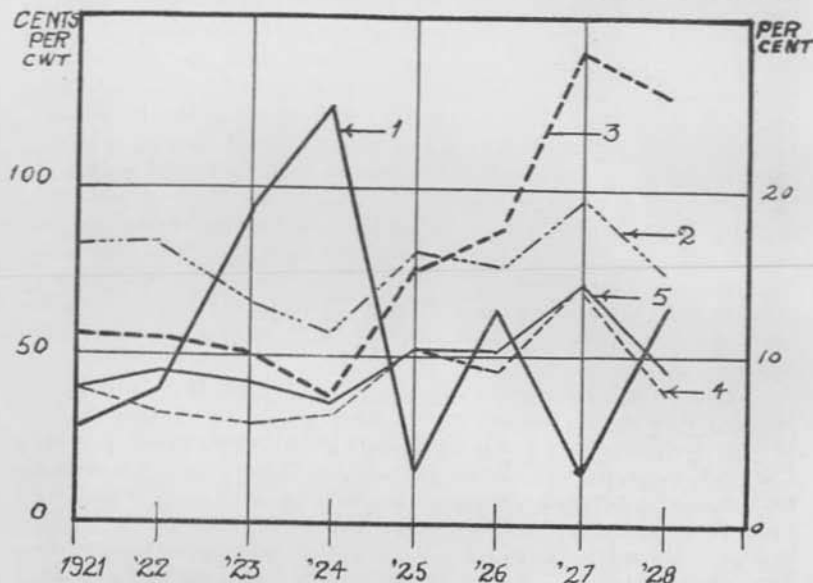
Since Idaho potatoes have been singled out as a distinct product in the market, the logical place to search for an explanation of the price differential would be in the supply of Idaho potatoes in relation to the supply from other states. The period in which Idaho potatoes have been a factor on the Chicago market dates from 1921 and hence no adjustment need be made for changes in general price level. The supply of Idaho potatoes in relation to that of all potatoes as affecting the Chicago price might be viewed in terms of production, shipments, or unloads.

**Effect of Production, Shipments, and Unloads on the Price Differential**

The more potatoes produced in Idaho, the more of this distinct product there is to supply the market. Chart V shows Idaho production as a percentage of production in the Central States and the price differential of Idaho potatoes on the Chicago market averaged from October to March. Except for 1926, the larger the proportion of potatoes produced in Idaho, the smaller the price differential.

CHART V

The proportion of the Idaho crop which will go east is affected by conditions in the Pacific Coast markets. If the production on the Pacific Coast is larger than usual in reference to production east of the Rockies, one would expect that more Idaho potatoes would be shipped east and relatively oversupply the demand for Idaho potatoes in the latter area. Chart V shows the Far Western production as a proportion of production in the United States. In 1925-26 and 1927-28, when the price differential practically disappeared, the production in the Far West was an unusually large part, 17.68 and 19.89 per cent respectively, of United States production. In those years Pacific Coast markets were relatively more heavily supplied than eastern markets. A higher percentage



Average Monthly Price Differential Obtained by Idaho Potatoes on the Chicago Market Compared with Data on the Supply of Idaho Potatoes, 1921-1928.

Curve 1, Average Price Differential.

Curve 2, Western Production as per cent of U. S. Production.

Curve 3, Idaho Production as per cent of Central States Production.

Curve 4, Idaho Shipments as a per cent of Total Surplus Late Crop State Shipments.

Curve 5, Idaho Unloads as per cent of Total Unloads at Chicago.

Source of Data: Table VII and Table VIII.

The variations in the supply of Idaho potatoes in relation to the supply from other regions.

of Idaho potatoes was available for eastern markets and Idaho potatoes brought practically no premium on these markets. This is probably the most important factor affecting changes in the price differential, for as shown on p. 15 Far West production and Central States production had the greatest effect on the Idaho price.

Chart V shows the proportion of all of the shipments from all of the nineteen surplus-producing late crop states which originate in Idaho. In 1925-26 and 1927-28, when the price differential disappeared, Idaho shipped 10.45 and 14.03 per cent respectively of shipments from all surplus late crop states.

Production and shipment data give an idea of the number of Idaho potatoes which might be available in Chicago in relation to other potatoes. But the proportion of potatoes actually unloaded in Chicago which came from Idaho represents the actual supply situation. These data are presented in Table XIII C and Chart V. The two seasons, 1925-26 and 1927-28, in which the price differential practically disappeared, were years in which the proportion of total unloads coming from Idaho greatly increased over preceding years. In these two years the increase in the proportion of unloads coming from Idaho was so large that it exceeded the power of advertising to expand the demand sufficiently to pay the differential. However, the fact that the differential was obtained in 1926-27 and 1928-29 in spite of heavy Idaho unloads, shows that advertising has increased demand somewhat.

Thus as a rule, these factors which show the supply of Idaho potatoes in relation to the supply of all potatoes affect the price differential which Idaho potatoes receive on the Chicago market. No doubt such factors as quality of stock and advertising are important. People will not long pay more for Idaho potatoes unless high standards are maintained. By advertising, more people can be encouraged to pay a higher price. When potatoes are high, as in 1925-26, it is more difficult to persuade consumers to pay a price differential than when the total price is low, as in 1927-28. Yet the major factors influencing the price differential are the supply of Idaho potatoes in reference to the supply in other regions, and the supply west of the Rockies in relation to the supply east of the Rockies. Therefore, in so far as the potato industry in Idaho depends on the maintenance of the price differential there is a fairly definite limit to what the state should produce and market. In such years as 1923-24 and 1924-25 when the general potato market was low, the price differential resulted in a fairly good price for Idaho potatoes. (Chart I). In high price seasons, such as 1925-26 and 1926-27, Idaho producers could prosper even

if no price differential existed. However, in any year the price differential means added income. In only four out of the last eight seasons has the price differential been sufficiently large, when differences in freight rates are allowed for, to bring the Idaho producer a higher price per hundred pounds than that received by the Wisconsin grower. (Table VIII).

Considering heavy freight charges, and average prices of about \$1.05 per cwt. "Wagonloads Cash to Grower" at Idaho Falls, the existence of the price differential in the east is probably essential to the continued prosperity of the industry at its present output. The price differential makes possible profitable marketing of the surplus which cannot be used by nearer consuming areas.

### PART III

#### DETAILED ANALYSIS

##### The Effect of Production on Price

Idaho potato prices do not always move opposite to the United States production. In 1927 the United States production was smaller than in either 1922 or 1924, yet the Idaho price was lower in the former year. The reason was that in 1927 there was a marked over-production in the Far West, whereas in 1923 and 1924 the over-production was east of the Rockies. Heavy freight charges in relation to the value of potatoes makes nearby production relatively more important as a price determining factor.

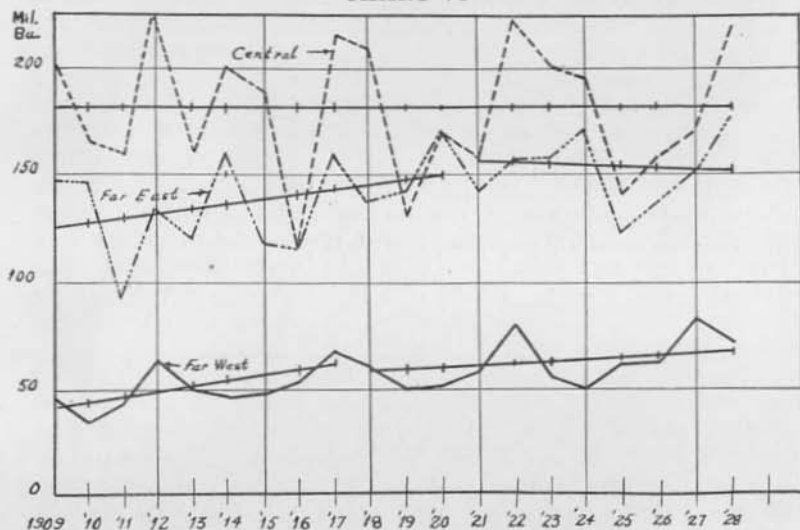
Therefore in this study the United States was divided into three regions. Region A is composed of the eleven western states. Region B includes all states east of the Rockies which do not touch the main body of the Atlantic Ocean. Region C consists of the states on the Atlantic seaboard. \*Lines fitted to the production data for these regions (Chart VI) show the growth or decline of production. The change in the general movement of production in the different regions is noticeable. In order to make data between different periods comparable production data are then treated as deviations from trend. Trend means the line showing the general growth or decline of production. The deviations are reduced to per cents because a production of 10,000,000 bushels above trend in the Far West in 1927 when the trend value was 64,400,000 bushels is less important than a similar excess production in 1912 when the trend value was only 48,030,000 bushels.

\*The Far Western Region includes: Washington, Idaho, Montana, Wyoming, Oregon, Utah, Nevada, Colorado, New Mexico, Arizona, and California. The Central States include: North Dakota, South Dakota, Minnesota, Wisconsin, Michigan, Ohio, West Virginia, Indiana, Illinois, Iowa, Nebraska, Kansas, Missouri, Tennessee, Kentucky, Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Arkansas. The Far Eastern Region includes: Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida.

Even when production is expressed as per cent deviations from trend as in Chart VI, it is sometimes difficult to accurately estimate even the direction of price change from visual examination of the chart. It is impossible to estimate the degree of price change. Therefore methods must be used whereby the net effect of production changes upon the direction and the degree of price change can be measured.

Far West:.....	1909-1917	$y = 38.574 + 2.38x$
	1917-1928	$y = 56.57 + .7136x$
Central States:.....	1909-1928	$y = 181.15 - .01203x$
Far East:.....	1909-1920	$y = 123.3 + 2.2248x$
	1920-1928	$y = 158.8 - .5933x$

CHART VI



Actual Production and Trend of Production of Potatoes in the Far West, in the Central States, and in the Far East, 1909-1920.

Source of Data: Table IV.

The general movement of production varies between the regions of the United States, increasing only in the Far West.

The statistical method known as correlation measures the degree to which two series of data move together; that is, increase or decrease together. A positive correlation is such as one would find between the amount of barley fed to a hog and his weight at the end of a month. A perfect positive correlation would be  $+1.000$ . Since large production means a low price, negative correlation should result between potato production and price. A perfect negative correlation would be  $-1.000$ . The problem here calls for finding the co-variation or co-relation or correlation be-

tween the Idaho price and the per cent deviations from trend of production in each region. The correlation between production in each area must also be found. For instance a correlation of +.0625 between A and C shows that the production in these two areas moved opposite to each other and opposite to the same degree about as often as production in the two areas moved in the same direction. The last preliminary step is to find the correlation of original prices and of the per cent deviations in production from normal in the three regions to the index of price level used in adjusting the prices for Table III.

All of these various correlations must be combined into one multiple correlation. The resulting correlation is .9706.\* This means that 94 per cent of the changes in Idaho potato prices have corresponded to changes in the price level and in the percentage deviations of production from trend in the three regions. The four factors (price level and production in the three subdivisions of the United States) have not in the past had equal importance in bringing about the Idaho price. The price is the result of the pulls of the four factors, some pulling up, some down, or perhaps occasionally all pulling up or down. Table II shows the relative importance of each of the factors in relation to the price.

TABLE II  
Relative Importance of Various Factors in Determining  
the Idaho Potato Price

	Coefficient of Determination
A. Deviations from trend of production in the Far West.....	20.1
B. Deviations from trend of production in the Central States.....	32.5
C. Deviations from trend of production in the Far East.....	16.6
D. Price Level.....	25.0
Total.....	94.2

The real purpose of correlation analysis is to be able to estimate prices. The multiple correlation coefficient and the per cent determination are valuable only as measures of the reliability of the estimated prices.† Price estimates are found by the use of a regression equation. If the correlation

\*For an explanation of the process of multiple correlation and the calculation of the multiple regression equation see Wallace, H. A. and Snedecor, G. M., "Correlation and Machine Calculation," Iowa State College, 1925. This multiple correlation is corrected by the formula in which M is the number of independent variables and N is the number of observations. Corrected  $R^2 = 1 - \frac{1-R^2}{N}$

†Regression equation:  $\text{Log } X = 1.54232 - .00584a - .005878b - .006003c + .0045457D.$



had been 1.000 a regression equation based upon this correlation should have given estimates of prices exactly the same as the actual price. But since the correlation is only .9706, estimated prices will differ slightly from actual prices. In Table V are given the actual prices, the estimated prices, the deviations of estimated from actual prices in cents and the deviations in per cent.\* The actual prices and estimate prices are shown in Chart II. The estimated prices have a standard error of 13 per cent. That means that 65 per cent of all actual prices did not fall more than 13 per cent above or 13 per cent below the estimated price. The reliability of price estimates varies inversely with the size of the standard error.

The estimates, when a price index of farm commodities was used instead of a wholesale price index of all commodities, are also shown in Table V. These latter estimates are noticeably more accurate in the period of price disturbance 1916-1921. During that time the price of farm products did not fluctuate with the prices of other commodities. Thus in periods of rapid and drastic changes in the price level an index of farm products prices seems to be a better guide in forecasting the effect of price level change on potato prices than is an index of wholesale prices of all commodities.†

The steps to be taken in estimating the season's average price, for future seasons, are explained in Appendix A.

#### USE OF THE PRICE ANALYSIS

Production is the result of acreage and yield. The acreage of potatoes fluctuates more widely than does that of most other crops. By the use of intentions to plant changes in potato acreage may be anticipated. As shown in Chart VIII, yields rarely are above or below trend in all three regions at the same time. Weather, diseases, and pests, the causes of variations in yield, are rarely national in their effect. Comparison of the average deviations of acreage and of yield from their respective trends shows that acreage has varied as much as have yields. (Table VI). The anticipation of potato acreage will remove much of the uncertainty of potato prices at harvest time.

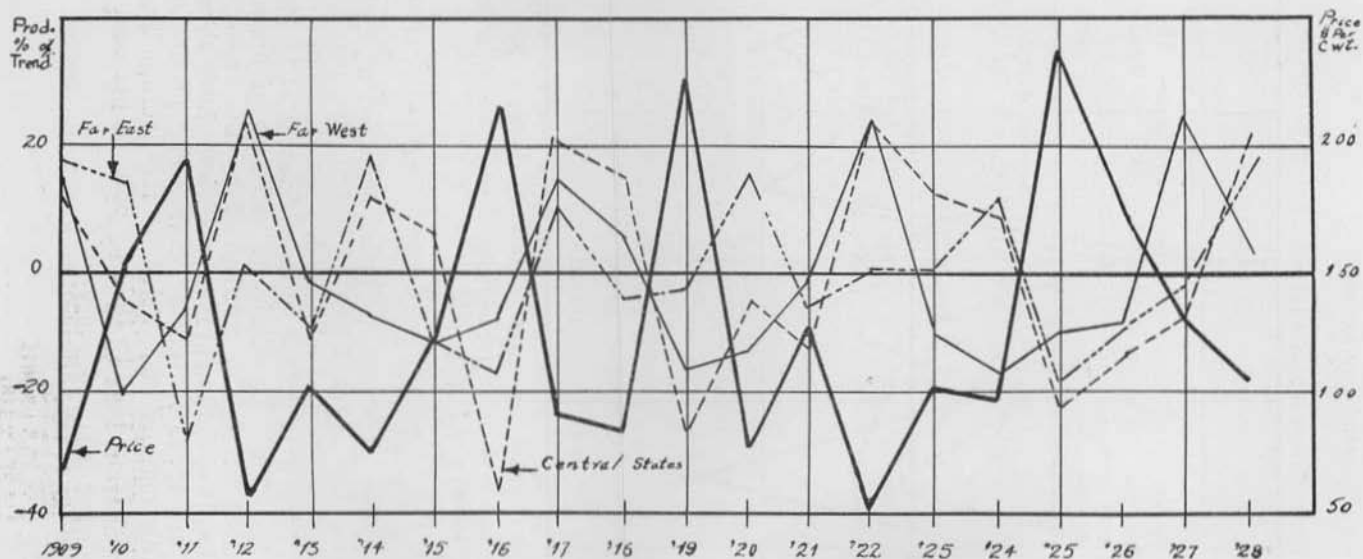
\*See Smith, B. B., *Correlation Theory and Method Applied to Agricultural Research*, the U. S. Dept. Agr. Minn. Pub. 1926, p. 56.

†The multiple correlation when the farm products price index was used is .9673 with a percentage standard error of 12.5, but since the estimates are less accurate in recent years the all-commodity index is used in most of this analysis.

Regression equation:  $\text{Log } X = 1.57128 - .006436a - .00555b - .0058897c + .0029314D$ .



CHART VII

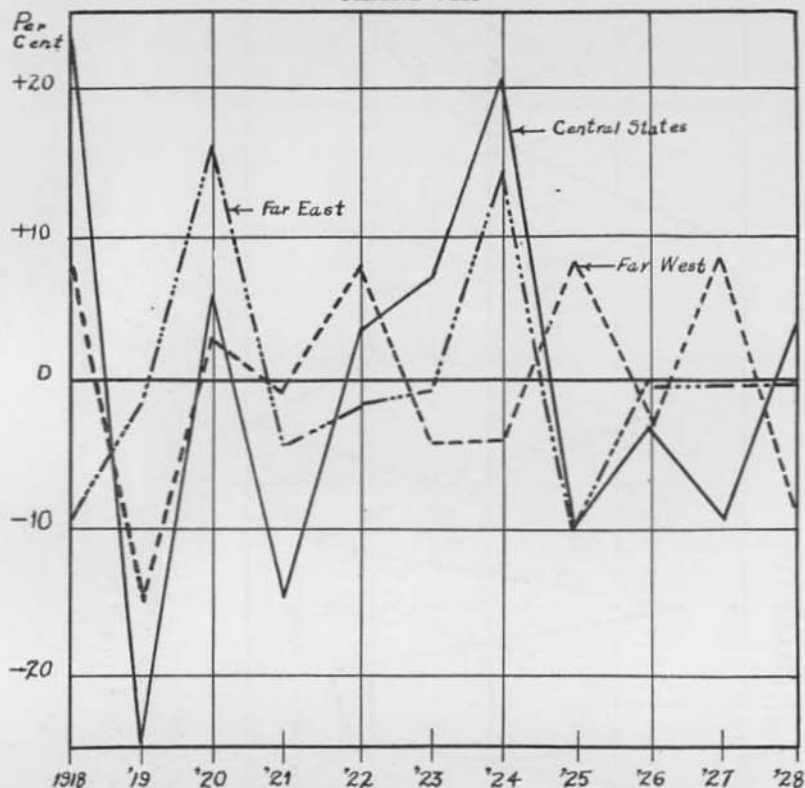


Deflated Idaho Potato Prices and per cent Deviations from Trend of Production in the Far West, in the Central States, and in the Far East, 1909-1920.

Source of Data: Tables III and IV.

Production does not increase or decrease in all three regions at the same time. The net effect on price of these various production changes must be measured.

CHART VIII



Per cent Deviations of Actual Yield per Acre of Potatoes from Trend of Yield in Designated Areas, 1918-1928.

Source of Data: Table X.

Variations in Yield per acre do not usually occur in the same direction in all three regions at the same time.

By reducing the intentions to plant, released annually by the Department of Agriculture in March, two per cent for average abandonment, the intended acreage has corresponded very closely to actual acreage from 1924 to 1928 as shown in Chart IX. To obtain an estimate of production, the intended acreage is multiplied by the trend of yield.\* With improved cultural methods, yields have shown a decided upward trend in recent years. The production estimated in this manner has varied on the average from actual production from 1924 to 1928 by only 10 per cent in

\*Formulae for trend of yields, 1918-1928:

Far West,  $y = 129.6 + 1.885x$

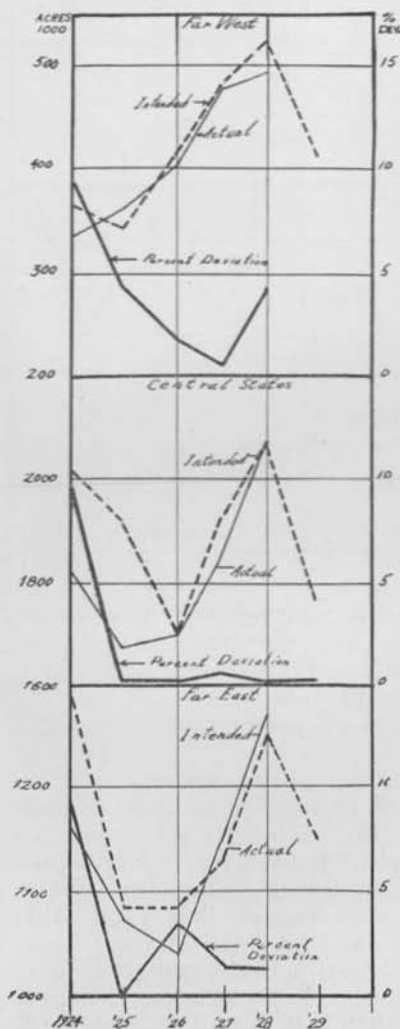
Central States,  $y = 69.3 + 3.067x$

Far East,  $y = 114.95 + 2.118x$

the Far West, 7.7 per cent in the Central States, and 5.2 per cent in the Far East. (Table VII and Chart X).

By using these estimates of production in the multiple regression equation (page 21) estimates of the season's average price may be made before the crop is planted (Chart III).

CHART IX



Actual Acreage, 1924-1928, and Intended Acreage of Potatoes, 1924-1929, in Designated Regions.

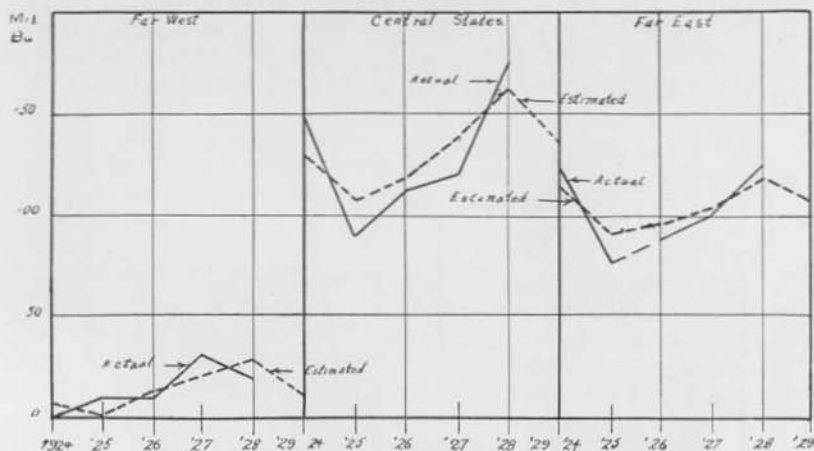
Source of Data: Table XI.

Farmers' intentions to plant correspond very closely to actual plantings.

The use of the price analysis as a guide to marketing is fully explained in Part I. The seasonal index of prices is found by taking the average (geometric) of the ratios for each month to its season average. In the earlier years there is some indication that the movement of prices in over-production years is downward from fall to spring and vice versa in under-production years. (Chart IV). But apparently the trade is coming to realize the significance of the available production data and the fall prices are being more accurately adjusted to the market situation. Therefore it does not seem desirable to calculate a different seasonal index for under-production and for over-production years as an indicator of the seasonal movement of prices in the future. The seasonal index which is presented in Part I is not an indication of what the monthly prices will be for there is no regular seasonal movement in potato prices. This index only shows that after the whole crop is harvested there is a tendency for the price to rise, due to storage costs.

Steps to estimate the probable price on the basis of intentions to plant or on actual production data are explained in Appendix A.

CHART X



Actual Production, 1924-29, and Estimated Production of Potatoes, 1924-28, in Designated Areas.

Source of Data: Table XII.

Estimates of production based on intentions to plant and trend of yield show whether production will increase or decrease.

## APPENDIX A

### ESTIMATING THE PRICE IN FUTURE SEASONS

To estimate the price in the fall the following steps should be taken:

I. Production data (Issued monthly September to December in "Crops and Markets," published by the United States Department of Agriculture).

(a) Formula for trend of production in Far West:  
 $y = 56.57 + .7136x$ , giving values in millions of bushels of 65.8 for 1929-30, 66.5 for 1930-1931, and 67.2 for 1931-32.

(b) Formula for trend of production in Central States:  
 $y = 181.15 - .01203x$ , giving values in millions of bushels of 180.90 for 1929-30, 180.89 for 1930-31, and 180.88 for 1931-32.

(c) Formula for trend of production in Far East:  
 $y = 158.8 - .5933x$ , giving values in millions of bushels of 152.1 for 1929-30, 151.5 for 1930-31, and 150.9 for 1931-32.

II. Take the difference between actual production and trend of production for each area. For instance, if actual production in the Far West in 1929 is 63.5 million, the trend is 65.8, and the actual deviation is  $-2.3$  million. To find per cent deviation divide  $-2.3$  by the trend or 65.8, which gives  $-3.5$  per cent. Similarly, if production in the Central

States in 1929 is 192.5 million, it would be +6.4 per cent deviation from trend. If production in the Far East in 1929 is 160.5 million, it would be +5.5 per cent deviation from trend.

III. Although the general price level (the Index of the Wholesale Prices of All Commodities) for the whole season cannot be entirely anticipated, large changes in the price level probably will not occur in the near future. Data can be used for August and September, which are issued monthly in "The Agricultural Situation," published by the United States Department of Agriculture.\*

IV. The regression equation is:  $\text{Log } X = 1.54232 - .005843a - .005878b - .006003c + .0045457D$ , in which "a" is the per cent deviations from trend of production in the Far West, "b" the same for the Central States, "c" the same for the Far East, and "D" is the index of price level.

Using the values assumed above for 1929 we have

$$\begin{aligned} \text{Log } X &= 1.54232 - (.005843 \text{ times } -3.5) - (.005878 \\ &\text{times } 6.4) - (.006003 \text{ times } 5.5) + .45457 \\ &= 1.54232 + .02045 - .03762 - .03302 + .45457 \\ &= 1.94670 \end{aligned}$$

By reference to a table of logarithms, it will be found that the anti-logarithm or price equal to  $\text{Log } 1.94670$  is 88.5 cents.

On the basis of the production data assumed, the estimated season average price for "U. S. No. 1 Russets, wagonloads cash to grower," at Idaho Falls would be 88.5 cents per cwt.

To estimate before the crop is planted the probable October to March price, the following steps should be taken:

V. Intentions to plant are issued in the March "Crops and Markets" as a per cent of the acreage harvested the previous year. The latter is issued in the preceding December "Crops and Markets." North Central and South Central form the region denoted Central States. North Atlantic and South Atlantic form the Far East.† Reduce these intentions to plant two per cent.

VI. Find trends of yields for each region as follows:

- (a) Trend of yield in Far West:  $y = 129.6 + 1.885x$ , giving values in bushels per acre in 154 for 1930, 156.0 for 1931, and 157.9 for 1932.
- (b) Trend of yield in Central States:  $y = 69.3 + 3.067x$ , giving values in bushels per acre of

\*No great error would result in the near future from using the price level as 100.

†In this study West Virginia was put in the Central States whereas "Crops and Markets" classifies it as South Atlantic. No great error will result from assuming the same percentage change of production in West Virginia as in the Central States.

109.2 for 1930, 112.0 for 1931, and 115.1 for 1932.

- (c) Trend of yield in Far East:  $y = 114.95 + 2.118x$ , giving values in bushels per acre of 142.2 for 1930, 144.3 for 1931, and 146.5 for 1932.

VII. Multiply intended acreage for each region reduced two per cent, by trend of yield for each region. This gives the production as estimated before the crop is planted.

VIII. Calculate the per cent deviations of these estimates of production from their respective trends as explained in I and II above.

IX. Assume the most probable value for the general price level.

X. Put price level and per cent deviations of estimated production from trend into the regression equation as explained in IV above. The result is the price estimate made before the crop is planted.

### APPENDIX B

#### TABLE III

United States Production, Idaho Prices, and Adjusted Idaho Prices of Potatoes, 1909-1928

Season	U. S. Production Thousands of Bushels	Idaho Prices \$ per Cwt.	Price Level Index Per cent	Adjusted Idaho Prices \$ per Cwt.
1909	394,553	.48	69.5	.69
1910	349,032	1.00	64.1	1.47
1911	292,737	1.27	64.5	1.89
1912	420,647	.37	68.1	.54
1913	331,525	.70	67.4	1.04
1914	409,921	.50	66.5	.75
1915	359,721	.92	74.0	1.24
1916	286,953	2.14	102.0	2.10
1917	442,108	1.09	125.0	.87
1918	411,860	1.20	135.0	.83
1919	322,867	3.45	153.1	2.25
1920	403,296	1.00	121.3	.78
1921	361,659	1.17	95.5	1.22
1922	453,396	.49	105.9	.46
1923	416,105	1.04	102.8	1.02
1924	421,585	1.03	106.7	.98
1925	323,465	2.50	105.7	2.36
1926	354,328	1.70	99.7	1.70
1927	402,741	.81	101.1	.81
1928	462,943	.53	100.5	.55

#### Source of Data

U. S. Production 1909-1926 from U. S. D. A. Yearbook 1927; for 1927 and 1928 from Dec. 1928, *Crops and Markets*.

Price Data 1909-1917 taken from dealers' books as average of range of prices paid to farmers for sacked Rurals at Idaho Falls.

1918-28 average of monthly range of prices for "Bulk U. S. No. 1 Russets, Wagonloads Cash to Grower" at Idaho Falls as reported by the Market News Service.

Price Index, Bureau of Labor Statistics Wholesale All-Commodity Index on a 150 base as compared with 1913.

**TABLE IV**  
**Production and Trend of Production of Potatoes and Per Cent Deviation of Actual from Trend**  
**in the Far West, Central States and Far East, 1909-1928**

Season	FAR WEST			CENTRAL STATES			FAR EAST		
	Production Millions Bushels	Production Trend Millions Bushels	Per cent Deviation	Production Millions Bushels	Production Trend Millions Bushels	Per cent Deviation	Production Millions Bushels	Production Trend Millions Bushels	Per cent Deviation
1909	47.0	40.89	+14.94	201.2	181.14	+11.07	146.4	125.52	+16.63
1910	34.6	43.27	-20.04	167.8	181.13	- 7.36	146.6	127.75	+14.76
1911	42.3	45.65	- 7.34	157.9	181.11	-12.82	92.5	129.97	-28.83
1912	60.4	48.03	+25.75	223.4	181.10	+23.36	136.8	132.20	+ 3.48
1913	50.0	50.41	- .81	159.9	181.09	-11.70	121.6	134.42	- 9.54
1914	48.9	52.79	- 7.37	202.0	181.08	+11.55	158.9	136.65	+16.28
1915	48.6	55.17	-11.91	190.1	181.07	+ 4.99	121.0	138.87	-12.87
1916	54.1	57.55	- 5.99	115.0	181.05	-36.48	117.9	141.10	-16.44
1917	67.8	59.93	+13.13	217.5	181.04	+20.14	156.8	143.32	+ 9.41
1918	61.6	58.0	+ 6.21	211.7	181.03	+16.94	138.6	145.55	- 4.77
1919	48.9	58.7	-16.70	130.0	181.02	-28.18	144.0	147.77	- 2.55
1920	51.6	59.4	-13.13	171.6	181.01	- 5.20	172.4	150.00	+14.93
1921	59.6	60.1	- .83	157.4	181.00	-13.04	144.7	156.8	- 7.70
1922	76.7	60.9	+25.94	225.2	180.98	+24.43	156.5	156.2	+ 0.20
1923	55.3	61.6	-10.39	203.7	180.97	+12.56	157.1	155.6	+ 1.00
1924	50.3	62.3	-19.26	197.9	180.96	+ 9.36	173.4	155.0	+11.90
1925	57.2	63.0	- 9.21	140.9	180.95	-22.13	125.4	154.4	-18.80
1926	58.1	63.7	- 8.79	157.1	180.93	-13.17	139.1	153.8	- 9.60
1927	80.1	64.4	+24.38	170.9	180.92	- 5.54	151.0	153.3	- 1.50
1928	67.3	65.13	+ 3.38	219.3	180.91	+21.22	175.4	152.7	+14.90

Source of Data

Production Data from Yearbooks U. S. D. A. 1909-26. For 1927 and 1928 data from Dec. 1928 Crops and Markets.  
Trends Calculated as follows: Far West, straight line 1909-17, straight line 1918-28; Central States, straight  
line 1909-28; Far East, straight line 1909-1919, straight line 1920-28.

TABLE V  
Estimated Prices and Deviations of Estimated Prices from Actual Prices

Season	Actual Prices \$ Per Cwt.	Estimated Prices Using All Commodities Index \$ Per Cwt.	Deviations \$ Per Cwt.	Per cent Deviations	Estimated Prices Using Farm Products Prices Index \$ Per Cwt.	Deviations \$ Per Cwt.	Per cent Deviations
1909	.48	.40	+.08	+ 2.0	.33	+.04	+ 9.1
1910	1.00	.81	+.19	+24.2	.86	+.14	+16.3
1911	1.27	1.34	-.07	- 5.2	1.34	-.07	- 5.2
1912	.37	.35	+.02	+ 5.7	.36	+.01	+ 2.8
1913	.70	.95	-.25	-26.3	1.00	-.30	-30.0
1914	.50	.52	-.03	- 5.3	.57	-.07	-12.3
1915	.92	.99	-.08	- 7.0	.97	-.05	- 5.2
1916	2.14	2.25	-.11	- 4.9	2.32	-.18	- 7.8
1917	1.09						
1918	1.00	1.12	+.08	+ 6.7	1.28	-.08	- 6.3
1919	3.45	3.28	+.17	+ 5.0	3.60	-.15	- 4.2
1920	1.00	1.29	-.29	-22.0	1.12	-.12	-10.7
1921	1.17	1.27	-.10	- 7.9	1.16	+.01	+ 0.9
1922	.49	.53	-.04	- 8.2	.49	0.0	0.0
1923	1.04	.98	+.06	+ 6.1	.92	+.12	+13.0
1924	1.03	1.03	0.0	0.0	1.04	-.01	- 0.9
1925	2.50	2.09	+.41	+19.6	2.01	+.49	+24.2
1926	1.70	1.52	+.18	+12.4	1.40	+.30	+21.4
1927	.81	.79	+.01	+ 2.0	.79	+.02	+ 2.5
1928	.53	.58	-.05	- 8.6	.57	-.04	- 7.0

Actual Prices—Table III.

All-Commodity Index—Table III.

Source of Data

Farm Products Price Index used 1909-1927 issued in "Index Numbers of Farm Prices," Mim. Circ.

U. S. D. A. June 1927. For 1928-29 index from current issues of "Farm Economics," Cornell University.



TABLE VI  
ACTUAL AND ESTIMATED PRICES OF IDAHO POTATOES BY  
MONTHS 1909-1928

Season	October		November		December	
	Actual \$ Per Cwt.	Estimated \$ Per Cwt.	Actual \$ Per Cwt.	Estimated \$ Per Cwt.	Actual \$ Per Cwt.	Estimated \$ Per Cwt.
1909	.48	.36	.50	.39	.49	.36
1910	.75	.72	.77	.78	.80	.73
1911	.90	1.20	1.05	1.29	1.05	1.21
1912	.45	.31	.42	.34	.35	.32
1913	.68	.85	.70	.92	.68	.86
1914	.47	.47	.45	.51	.40	.48
1915	.50	.88	.68	.95	.80	.89
1916	1.55	2.01	1.92	2.17	1.80	2.03
1917	1.15	*	1.22	*	1.05	*
1918	1.28	1.00	1.33	1.08	1.28	1.01
1919	1.84	2.93	2.49	3.16	3.17	2.96
1920	1.17	1.15	1.25	1.24	.91	1.16
1921	1.33	1.14	1.13	1.23	1.13	1.15
1922	.55	.47	.55	.52	.43	.48
1923	.87	.87	.82	.95	.84	.88
1924	.70	.92	.85	.99	.92	.93
1925	1.68	1.87	2.28	2.02	2.52	1.89
1926	1.71	1.35	1.81	1.47	1.63	1.37
1927	.70	.70	.68	.77	.57	.72
1928	.48	.51	.63	.56	.52	.53

Season	January		February		March	
	Actual \$ Per Cwt.	Estimated \$ Per Cwt.	Actual Estimated	Estimated \$ Per Cwt.	Actual \$ Per Cwt.	Estimated \$ Per Cwt.
1909	.50	.39	.50	.41	.38	.45
1910	1.08	.78	1.15	.82	1.12	.92
1911	1.20	1.30	1.45	1.38	1.65	1.53
1912	.34	.34	.35	.36	.32	.40
1913	.78	.92	.70	.97	.63	1.08
1914	.47	.51	.51	.54	.70	.60
1915	1.23	.96	1.18	1.01	1.13	1.13
1916	2.05	2.19	2.72	2.30	2.93	2.57
1917	1.05	*	1.08	*	.72	*
1918	1.25	1.09	.95	1.14	1.18	1.28
1919	3.96	3.19	4.01	3.35	5.15	3.74
1920	.78	1.25	.83	1.32	1.05	1.47
1921	1.38	1.23	1.15	1.30	1.00	1.45
1922	.35	.52	.38	.54	.75	.61
1923	1.04	.95	1.18	1.00	1.59	1.11
1924	1.17	1.00	1.28	1.05	1.25	1.17
1925	2.81	2.03	2.56	2.13	3.17	2.38
1926	1.60	1.48	1.60	1.55	1.82	1.73
1927	.56	.77	.98	.81	1.43	.91
1928	.61	.57	.50	.59	.57	.67

\*Not calculated.

**SUPPLY FACTORS AFFECTING THE PRICE DIFFERENTIAL**  
**TABLE VII**

**A**

**Proportions That Idaho and Far Western Production Are of Production  
in Designated Areas, 1921-1928**

Season	Idaho Production Millions Bushels	Idaho Production as a per cent of		Far Western Production as a per cent of	
		Central States Per cent	United States Per cent	Central States Per cent	United States Per cent
1921	11.8	7.52	3.27	37.87	16.46
1922	15.0	6.65	3.31	34.06	16.93
1923	12.1	5.92	2.90	27.15	13.29
1924	11.1	5.58	2.62	25.42	11.89
1925	14.3	10.15	4.43	40.60	17.68
1926	16.2	10.31	4.58	36.98	16.41
1927	24.4	14.27	6.06	46.87	19.89
1928	19.0	8.66	4.10	30.69	14.57

Source of data: Idaho Production: 1921-1926 U. S. D. A. Year books; 1927 and 1928 Dec. 1928, Crops and Markets.

U. S. Production: Table III.

Far Western and Central States Production: Table IV.

**B**

**Proportion That Idaho Shipments Are of Shipments in Designated  
Areas, 1921-1928**

Season	Idaho Shipments Cars	Surplus Sale Crop State Shipments Cars	I as Per cent of II	U. S. Total Shipments Cars	I as Per cent of IV
1921	14,670	200,000	7.34	238,546	6.15
1922	16,203	188,292	8.61	254,309	6.37
1923	15,626	194,244	8.04	242,142	6.45
1924	11,942	184,200	6.48	252,581	4.73
1925	18,271	174,823	10.45	221,659	8.24
1926	17,329	180,883	9.58	236,886	7.32
1927	28,244	201,349	14.03	269,934	10.46
1928	13,075*	135,578*	9.64	214,566*	6.09

\*Thru March only.

Source of Data

Shipment data from reports of Market New Service Representative at Idaho Falls.

## C

## Unloads of Idaho Potatoes and All Potatoes at Chicago, 1921 to 1928

Season	Idaho Unloads Cars	Total Unloads Cars	Percentage from Idaho
1921	1499	13077	11.5
1922	1547	13912	11.1
1923	1538	14436	10.7
1924	1000	15915	6.3
1925	1831	11839	15.5
1926	2625	14927	17.6
1927	4600	16177	28.4
1928	2120*	8350*	25.4

\*Sept.-March only.

Source of data:

1921-25 Reports of Market News Service Representative at Idaho Falls. 1926-28 From Annual Reports of Chicago Office of same service .

TABLE VIII  
CHICAGO PRICES OF IDAHO RUSSETS AND OF WISCONSIN  
ROUND WHITES WITH THE DIFFERENTIAL

Season	Prices of Idaho Russets \$ Per Cwt	Prices of Wisconsin Round Whites \$ Per Cwt.	Differential \$ Per Cwt.
1921-22	2.64	1.84	.36
1922-23	1.38	.98	.40
1923-24	2.06	1.21	.95
1924-25	2.26	1.00	1.22
1925-26	3.80	3.61	.27
1926-27	2.83	2.20	.61
1927-28	1.90	1.73	.16
1928-29	1.61	.88	.65

Source of Data:

Price of Idaho Russets as Reported by Market News Service Representative at Idaho Falls.

Price of Wisconsin Round Whites 1923-1928 from same source, 1921 and 1922 from the files of Wisconsin State Department of Markets.

**TABLE IX**  
**FREIGHT RATES ON POTATOES FROM WAUPACA, WISCONSIN**  
**AND FROM IDAHO FALLS TO CHICAGO, AND THE PRICE**  
**DIFFERENTIAL RECEIVED BY IDAHO POTATOES**  
**ON THE CHICAGO MARKET 1921 TO 1928.**

Season	Idaho Falls to Chicago Cents Per Cwt.	Waupaca to Chicago Cents Per Cwt.	Difference Cents Per Cwt.	Price Differ- ential on Idaho Potatoes Cents Per Cwt.	Idaho Competitive Differential Cents Per Cwt.
1921	88½	23.0	65.5	35.5	-30.0
1922	83	21.5	61.5	41.5	-20.0
1923	77	20.5	56.5	95.1	+38.6
1924	77	20.5	56.5	123.7	+67.2
1925	77	20.5	56.5	14.0	-42.5
1926	77	20.5	56.5	62.5	+06.0
1927	77	20.5	56.5	16.2	-40.3
1928	77	20.5	56.5	65.0	+08.5

Source of Data.

Rates, Idaho Falls to Chicago supplied by the Union Pacific System.

Rates, Waupaca to Chicago supplied by the Green Bay and Western Railroad.

Price differential on Idaho Potatoes at Chicago see Table VI.

**TABLE X**  
**ACTUAL YIELD AND TREND OF ACREAGE AND OF YIELD PER**  
**ACRE OF POTATOES IN DESIGNATED AREAS 1918-1928,**  
**WITH PER CENT DEVIATIONS OF ACTUAL FROM TREND**  
**Far West**

Season	Acreage Thous- ands	Trend of Acreage Thousands	Per cent Devia- tion from Trend	Actual Yield Bushels	Trend of Yield Bushels	Per cent Devia- tion from Trend
1918	432	413.9	+ 4.4	142.6	131.5	+ 8.3
1919	438	416.3	+ 5.2	111.6	133.4	-15.8
1920	367	418.7	-12.4	140.6	135.3	+ 4.4
1921	441	421.1	+ 4.7	135.1	137.1	- 1.5
1922	516	423.5	+21.8	148.6	139.0	- 7.2
1923	407	425.9	- 4.4	136.0	140.9	- 3.6
1924	341	428.3	-20.4	138.3	142.8	- 5.5
1925	363	430.7	-15.7	157.7	144.7	+ 8.3
1926	406	433.1	- 6.3	141.5	146.6	- 3.4
1927	481	435.5	+10.5	161.8	148.5	+ 8.7
1928	493	437.9	+12.6	136.4	150.3	- 8.7
Average Deviation,			14.0			6.7

## Central States

Season	Acreage Thousands	Trend of Acreage Thousands	Per cent Devia- tion from Trend	Actual Yield Bushels	Trend of Yield Bushels	Per cent Devia- tion from Trend
1918	2478	2409.1	+ 2.9	85.4	72.4	+18.1
1919	2340	2343.8	- .2	55.6	75.4	-25.3
1920	2068	2278.4	- 9.2	83.0	78.5	+ 6.3
1921	2277	2213.1	+ 2.9	69.1	81.6	-15.9
1922	2522	2147.7	+17.4	89.3	84.6	+ 4.7
1923	2161	2082.3	+ 3.8	94.2	87.7	+ 6.8
1924	1818	2016.9	- 9.9	110.9	90.8	+22.0
1925	1663	1951.6	-14.8	84.6	93.8	- 9.6
1926	1677	1886.2	-11.1	93.7	96.9	- 3.1
1927	1845	1820.9	+ 1.3	91.4	100.0	- 9.0
1928	2057	1755.5	+17.2	107.3	103.0	+ 3.9
Average Deviation,			8.2			11.3

## Far East

Season	Acreage Thousands	Trend of Acreage Thousands	Per cent Devia- tion from Trend	Actual Yield Bushels	Trend of Yield Bushels	Per cent Devia- tion from Trend
1918	1300	1264.5	+ 2.8	106.6	117.1	- 8.5
1919	1235	1251.5	- 1.3	116.6	119.2	- 1.7
1920	1222	1238.5	- 1.3	141.0	121.4	+16.5
1921	1223	1225.5	- .2	118.3	123.5	- 4.1
1922	1269	1212.5	+ 4.7	123.3	125.6	- 1.6
1923	1248	1199.5	+ 4.1	125.8	127.7	- .8
1924	1168	1168.5	- 1.6	148.0	129.8	+14.6
1925	1066	1173.6	- 9.2	117.6	131.9	- 9.8
1926	1039	1160.6	-10.5	133.8	134.1	- 0.0
1927	1150	1147.6	+ .2	135.8	136.2	- 0.0
1928	1275	1134.6	+12.4	137.5	138.3	- 0.0
Average Deviation,			4.4			5.2

## Source of Data

Acreage and Yields from U. S. D. A. Yearbooks, 1918-26; from Dec. 1928 *Crops and Markets* for 1927 and 1928.

Trend, a straight line 1918 to 1928.

TABLE XI  
INTENDED AND ACTUAL ACREAGE OF POTATOES IN DESIGNATED REGIONS WITH PER CENT  
DEVIATIONS OF ACTUAL FROM INTENDED

Season	WESTERN STATES			CENTRAL STATES			EASTERN STATES		
	Intended Acreage Thousands	Actual Acreage Thousands	Per cent Deviation	Intended Acreage Thousands	Actual Acreage Thousands	Per cent Deviation	Intended Acreage Thousands	Actual Acreage Thousands	Per cent Deviation
1924	379	341	- 9.5	2011	1818	- 9.6	1921	1168	-9.5
1925	346	363	+ 4.9	1716	1663	- .3	1070	1066	-0.0
1926	414	406	- 1.9	1681	1677	- 0.0	1073	1039	-3.2
1927	485	481	- .8	1906	1845	- .3	1134	1150	+1.4
1928	516	493	- 4.5	2056	2051	- 0.0	1251	1275	+1.9
1929	412			1799			1147		
Average Deviation,			4.3			2.0			3.0

Source of Data

Intentions to plant from the March or April issue of *Crops and Markets* in respective Years.

Actual plantings, Table X.

TABLE XII  
ACTUAL PRODUCTION AND PRODUCTION ESTIMATED FROM  
INTENTIONS TO PLANT AND TREND OF YIELDS  
Far West

Season	Intended Acreage Thousand	Trend of Yield Bushels	Estimated Production Millions Bushels	Actual Production Millions Bushels	Per cent Deviation
1924	378.5	142.8	54.1	50.3	- 7.0
1925	346.0	144.7	50.1	57.2	+14.2
1926	414.0	146.6	60.7	58.1	- 4.3
1927	485.0	148.5	72.0	80.1	+11.3
1928	516.0	150.3	77.6	67.3	-13.4
1929	412.0	152.1	62.7		
Average Deviation					10.0

## Central States

1924	2011	90.8	182.6	197.9	8.4
1925	1716	93.8	161.0	140.9	12.5
1926	1681	96.9	162.9	157.1	3.6
1927	1906	100.0	190.6	170.9	10.3
1928	2056	103.0	211.8	219.3	3.6
1929	1799	106.0	190.7		
Average Deviation					7.7

## Far East

1924	1291	129.8	167.6	173.4	7.9
1925	1070	131.9	141.1	125.4	11.1
1926	1073	134.1	143.9	139.1	3.3
1927	1134	136.2	154.5	151.0	2.3
1928	1251	138.3	173.0	175.4	1.4
1929	1147	140.4	161.0		
Average Deviation					5.2

**TABLE XIII**  
**ACTUAL PRICES OF IDAHO POTATOES 1924-28 AND PRICE ESTIMATES BASED ON INTENTIONS TO PLANT 1924-29, WITH PER CENT DEVIATIONS OF ACTUAL FROM ESTIMATED.**

Season	Actual Price \$ Per Cwt.	Estimated Price \$ Per Cwt.	Per cent Deviation
1924	1.03	1.13	— 8.8
1925	2.50	1.82	+37.4
1926	1.70	1.32	+28.8
1927	.81	.79	+ 1.6
1928	.53	.51	+ 4.0
1929		.91	
Average Deviation			16.0

**TABLE XIV**  
**AVERAGE PRICES, WAGON LOADS CASH TO GROWERS CAR LOADS CASH TRACK, CALIFORNIA PACK AND CAR LOTS OUT WEIGHT AT CHICAGO AND AT LOS ANGELES, BY MONTHS FROM OCTOBER TO MARCH INCLUSIVE.**

Season	Wagon Loads Cash to Grower \$ Per Cwt.	Car Loads Cash Track Calif. Pack \$ Per Cwt.	Car Loads Outweight Los Angeles \$ Per Cwt.	Car Loads Outweight Chicago \$ Per Cwt.
1921-22	1.17		2.17	2.20
1922-23	.49	.68	1.36	1.41
1923-24	1.04	1.29	1.95	2.15
1924-25	1.03	1.27	1.99	2.25
1925-26	2.50	2.94	3.55	3.88
1926-27	1.70	1.98	2.65	2.84
1927-28	.81	1.09	1.70	1.88

Source of Data:

Reports of Market News Service Representative at Idaho Falls.