

FORECASTING FARM TRACTOR SALES
IN NORTH DAKOTA

By OLIVER S. POWELL

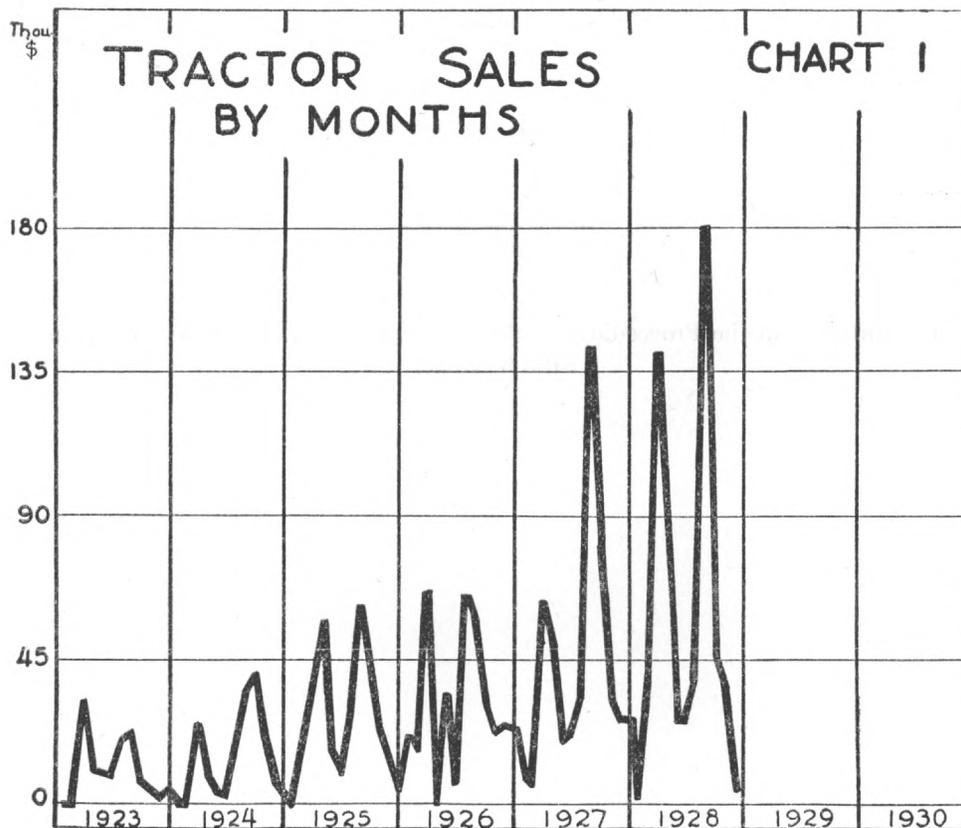
[Reprinted from the Proceedings of the AMERICAN STATISTICAL ASSOCIATION,
March, 1929]

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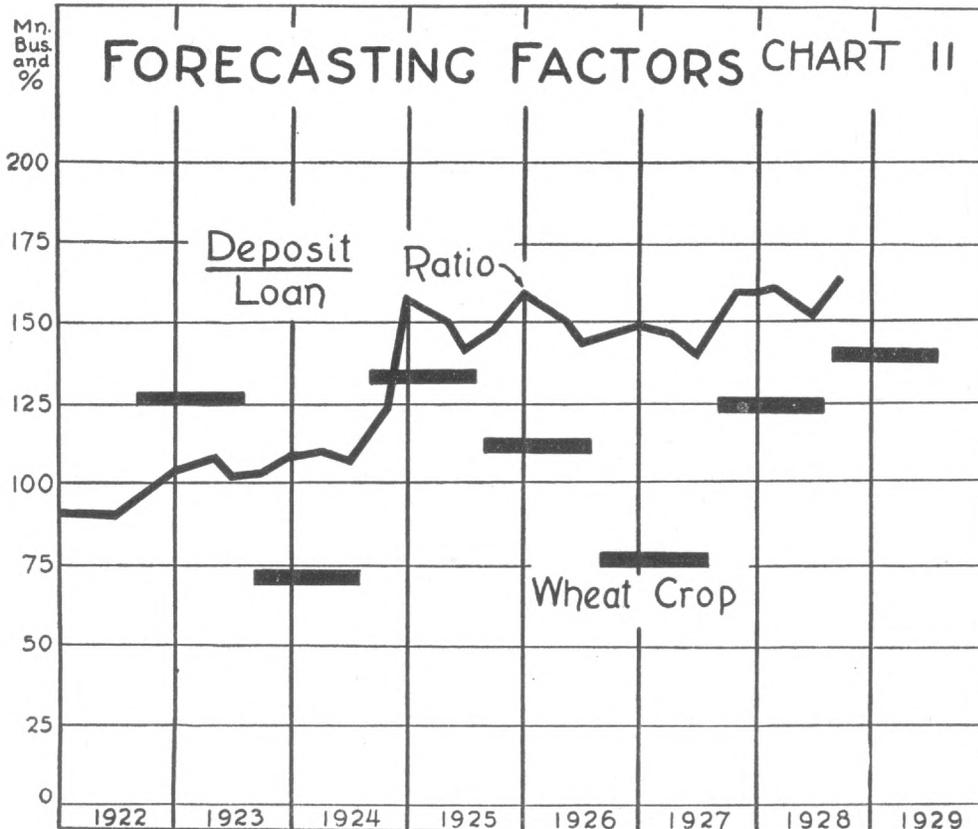
A fragment of research in sales forecasting was undertaken during the past summer in the nature of a case study. The primary purpose was to determine the relative importance of various factors in the farm situation from the standpoint of prospective business.

The company whose sales were analyzed must remain anonymous. Its principal business is the sale of farm tractors and its best organized sales territory is North Dakota. This paper will be confined to the methods of forecasting tractor sales in North Dakota, where the most complete forecasting information was available.



In North Dakota there are two distinct seasonal peaks of tractor sales during the year, the first occurring in March and the second occurring in August. Sales forecasts should be made separately for the two production and selling campaigns during the year. The principal stress in the work so far has been placed on forecasting for the first six

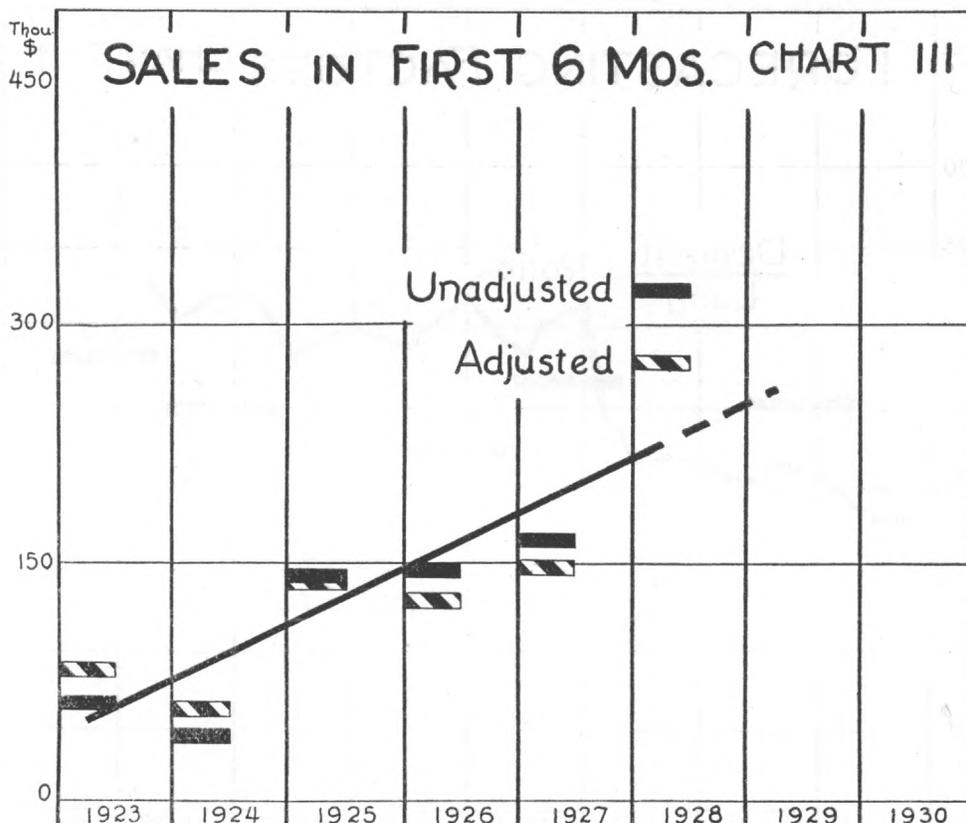
months of 1929, because the production schedule must be arranged three months before the beginning of the sales period in order to assure an adequate supply of parts. In 1926 the lack of a sufficient increase in the manufacturing schedule caused a serious loss of business through inability to deliver tractors. In April of that year, instead of the sea-



sonal volume of sales, there was actually a small excess of returns over sales, owing to the exhaustion of supplies of finished tractors in March. The loss of sales in North Dakota that year was estimated at \$44,000 out of a possible sales volume of \$190,000 in the first six months.

Three forecasting factors have been used. Two of these factors are illustrated in Chart II. The most important is the wheat crop, which influences both the ability to buy and the need for farm tractors. It will be noted that in the last seven years wheat crops were large in 1922, 1924, 1927 and 1928, and small in 1923 and 1926. The second factor is the financial condition of the sales territory in the matter of short-term debt. This has been measured by the ratio of deposits to loans of all country banks in the sales territory. Changes in the financial factor are shown by the continuous curve in the chart. It will be seen that the short-term debt situation was very bad in 1922 and 1923.

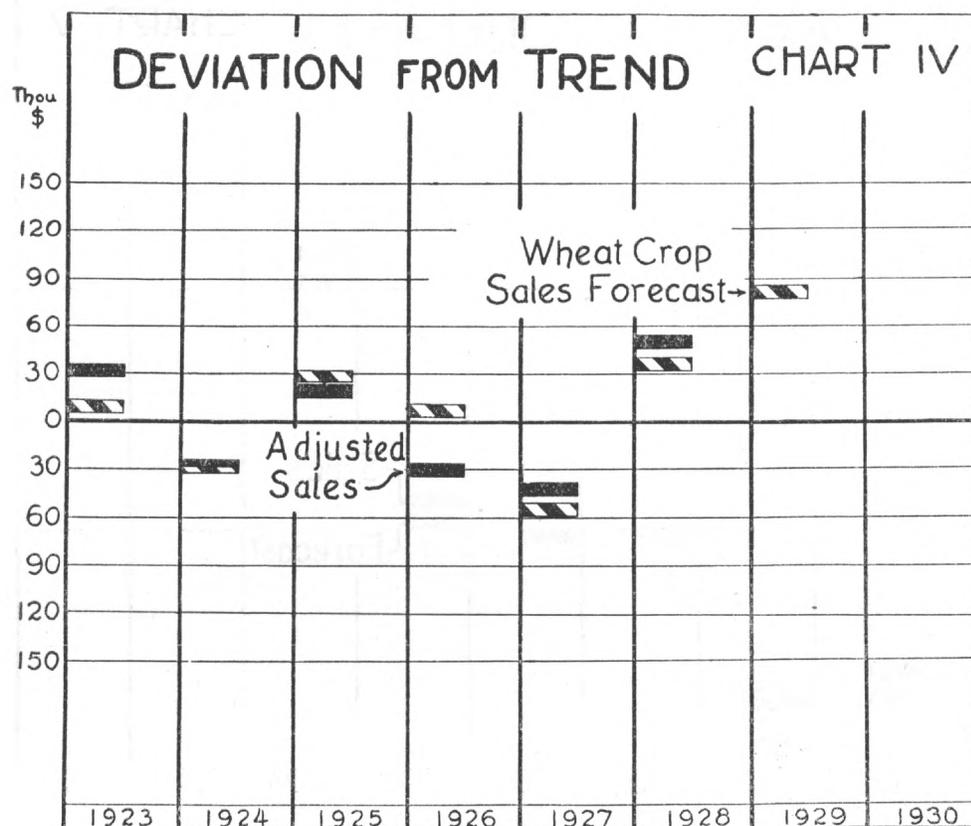
There was a pronounced improvement in the last half of 1924, following the harvesting of the large 1924 crop and its sale at high prices. During more recent years this factor has remained relatively stationary, but it will be noted that there was some reduction in the ratio in 1926 and some improvement in 1927. The third factor is the growing use



of tractors on the larger farms of the wheat belt, which has been brought about by development of new methods and the greater education of the farm population and better advertising. This factor is represented by a straight-line trend, which is shown in Chart III. Other factors which were tested for importance were changes in the price of wheat and changes in farm income from sources other than wheat. Both of these factors apparently are given sufficient weight by means of changes in the deposit-loan ratio. It was found that sales forecasts were not so satisfactory with these additional factors included as with these factors omitted. This, of course, applies only to territory where the wheat crop is the major farm activity.

The first step in the analysis of forecasting sales, using data for the first half of each year, is shown in Chart III. It is believed that there is no trend in the financial factor, namely, the deposit-loan ratio.

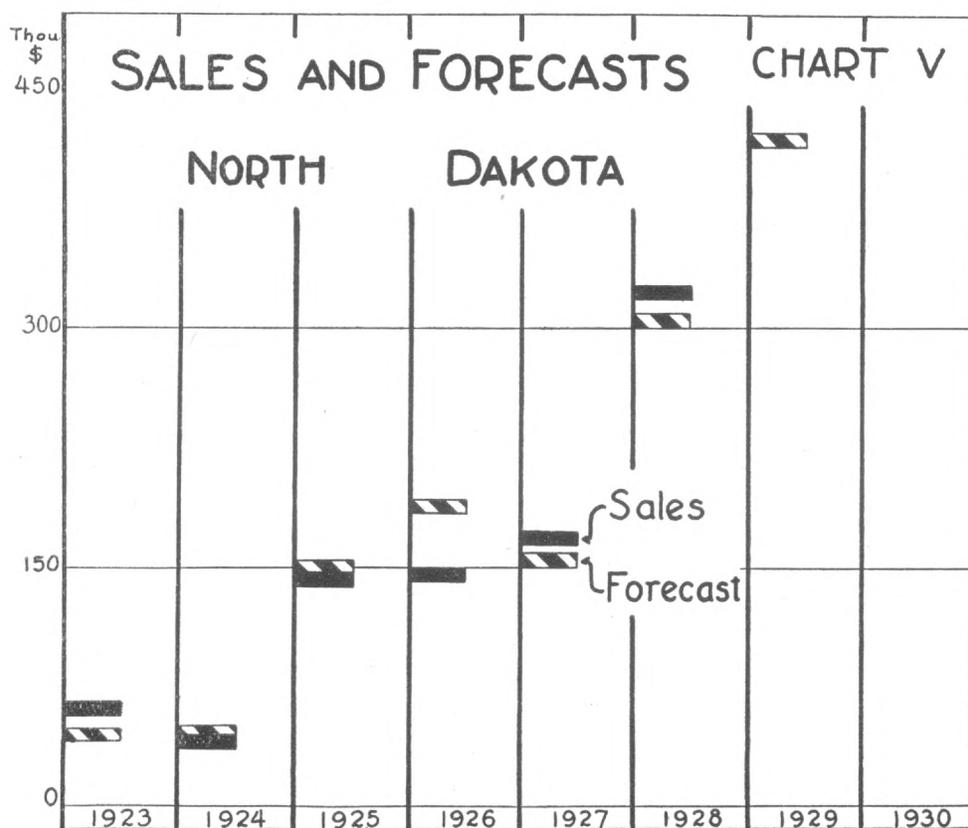
Consequently, before measuring the trend of sales, the effects of the financial factor must be removed. To accomplish this, the six months' sales totals were divided by financial index numbers. To construct these financial index numbers, the June 30 and December 31 deposit loan ratios were reduced to percentages of their averages for the six years, 1922-27. These June and December percentages were then averaged in yearly pairs. The financial index number used as an adjustment for each half year sales total is an average of the June and December indexes for the preceding year. Chart III shows by means of black bars the actual sales volume in the first six months of each of the last six years, and by means of shaded bars, shows these sales totals after adjustment has been made to eliminate the effects of changes in the financial condition of the state. A straight-line trend of these adjusted totals was then computed, as shown on the chart.



In Chart IV the black bars represent deviations of sales (adjusted to remove the effects of financial changes) from the trend of these sales which is shown in Chart III. The shaded bars illustrate the sales expectancies above and below the trend, as indicated by changes in the size of the wheat crop in the preceding year. To compute this sales

expectancy, index numbers of the wheat crop were made by reducing each wheat crop to percentages of the six-year average, 1922 to 1927. The trend of sales with financial adjustment was then multiplied by these wheat crop index numbers, which produced sales expectancy totals varying from the trend, as indicated by the shaded bars in Chart IV. The discrepancy in the first half of 1926 between sales expected and actual sales is clearly seen in this chart. This discrepancy, as stated before, is explained by the exhaustion of supplies in March and the consequent cessation of sales in April.

To complete the sales forecast, it is next necessary to reinsert the financial factor, which is done by multiplying the sales expectancy figures, based on the wheat crop and the trend, by the financial index number. Chart V shows the actual sales volume in the first six months



of each year from 1923 to 1928, inclusive, by black bars, and the complete sales forecast for these months from 1923 to 1929, inclusive, by shaded bars. It will be seen that in each of the last six years, forecasts were very close to actual sales, with the exception of the 1926 period, and that according to this forecast the probable sales in the first half of 1929 will be materially larger than sales in the first half of 1928.

This prediction has been confirmed by salesmen's estimates and advance orders. Similar forecasts have proved valuable for Montana and other sales areas.

In choosing forecasting factors, emphasis was placed on the necessity of using only information which was available in the fall of the preceding year. This has been done with the exception of the December 31 deposit loan ratio. This ratio must be estimated on the basis of conditions at the time of the autumn call for condition reports.

It is interesting to note what errors would have occurred if other methods of estimating the sales volume during the last six years had been employed. During these years the largest sales total during the first half year was \$322,000, which occurred in 1928.

If sales had been forecasted each year to be as large as in the preceding year, the maximum error would have been \$153,000, and the average error would have been \$60,000.

If sales had been forecasted to change with changes in the crop, the maximum error would have been \$68,000, and the average error would have been \$43,000.

If the upward trend only had been used in forecasting sales, the maximum error would have been \$54,000, and the average error would have been \$36,000.

Using the three factors discussed in this paper, the maximum error was \$42,000. This occurred in 1926 because of reasons explained before. The maximum error other than the 1926 error was \$16,000, and the average error \$12,000.

If the 1926 sales total had been increased for the making of forecasting computations by the amount of sales which it is estimated were lost through inability to deliver, the maximum error would have been \$16,000, and the average error would have been \$9,000.

To summarize, the forecasting plan is briefly:

1. Compute a separate forecast for each kind of implement.
2. Compute a separate forecast for each sales territory.
3. Compute a separate forecast for each selling period in the year.
4. Recognize changes in purchasing power, due to the short-term debt situation, as indicated by the deposit-loan ratio.
5. After correcting sales for changes due to financial causes, eliminate the upward trend representing the increasing mechanization of agriculture.
6. The residual changes will be due to farm income factors and internal sales and production management. In the wheat belt, the size of the wheat crop apparently controls these residual fluctuations.

7. Check the sales forecasted against salesmanagers' impressions and advance orders.
8. To complete the picture for the use of the production manager, the probable sales in each month must be computed in two ways:
 - (a) Assuming an average seasonal distribution.
 - (b) Assuming an early season.