The Secular Movement of Corn Prices

By Geoffrey S. Shepherd

AGRICULTURAL EXPERIMENT STATION
IOWA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS

C. F. CURTISS, Director

AGRICULTURAL ECONOMICS SECTION

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Errata: p. 193, table I, under "Consumption of corn in bushels per head," read 3.7 instead of .37 in column headed "Human."

p. 222, appendix IX, in column headed "J," read (1x3.7) instead of (1x0.37).

p. 223, appendix IX, in column headed "J," read (1x3.7) instead of (1x0.37).

CONTENTS

SUMMARY

PERIOD 1866 TO 1919

The price of corn declined after the Civil War from 50 cents a bushel at the farm in 1866 to 34 cents in 1896. After that date the direction of the trend changed; it turned upward, rising more rapidly than it had previously fallen. By the outbreak of the recent World War, the price had risen to 65 cents a bushel.

During the inflation period of the World War, the price of corn rose as high as $1.40 a bushel at the farm. Since the war, the price has fallen to about 75 cents.

If these prices are reduced to purchasing power, the movements are considerably reduced. The decline from 1866 to 1896 disappears entirely, leaving only a steady and gradual rise from 1866 to 1919. During this period the production of corn kept pace with the increasing population of livestock consuming corn. The rise in the purchasing power of corn was due mainly to the increasing purchasing power of the livestock to which the corn was fed. This, in turn, resulted from the fact that from 1866 to 1919 the demand for meat increased faster than the supply of it.

DEVELOPMENTS SINCE THE WAR

Since the war, the trend of the purchasing power of corn has fallen about 25 percent.

This lower purchasing power is not due to any increase in corn production, for production has fallen off about 5 percent. It is due to a decrease in the demand for corn and an increase in the supply of it.

In the first place, the number of horses and mules has fallen off 30 percent since the war. Cattle numbers have been reduced. The numbers of hogs on farms have also decreased, altho the numbers of hogs slaughtered have not.

In the second place, the purchasing power of hogs and beef cattle has fallen about 25 percent. This has reduced the demand for corn per head of livestock. Changes in livestock production practices have also had a similar tho less important effect in reducing the demand per head.

Finally, improvements in corn production methods and the northwestward movement of the Corn Belt have increased the supply of corn.

PROSPECTS FOR THE FUTURE

The price of corn will be affected in the future as in the past by the movements of the general price level. The future course of this general price level is uncertain. The outlook for the purchasing power rather than the price of corn will therefore be considered.

First as to the prospective demand for corn. The number of horses and mules may be expected to continue to decrease. The trend of cattle numbers will probably be horizontal. Hog slaughter is likely to increase slowly, altho the numbers of hogs on farms are declining. The total hog demand for corn will probably continue at about its present level.

The supply of corn is likely to continue to increase, due to continued improvement in corn production methods, the northwestward spread of the Corn Belt and perhaps to decreased competition from the smaller grains.

The trend of the purchasing power of corn, therefore, is likely to move slowly downward in the future. Those who are in a position to continue to cut the cost of producing corn should be able to preserve their profits—in some cases to increase them—but those on small, rough farms may not.

The Secular Movement of Corn Prices

By Geoffrey S. Shepherd[1]

One of the problems of Corn Belt agriculture is the instability of its prices. This is especially true of its major products, corn, hogs and cattle.

Among these three, the price of corn deserves particular study. Its fluctuations are rapid and irregular, and at times become very great. On four different occasions since the world war, the price of No. 3 yellow corn at Chicago has risen or fallen more than 25 cents in two months.[2] The coefficient of variability of the series of monthly prices (the standard deviation of the prices divided by their mean) for the period November, 1923, to December, 1929, inclusive, is 15.5.

On account of these fluctuations in the price of corn, farmers with cash corn to sell face the possibility of gaining or losing heavily.

The indirect effect of these fluctuations in the price of corn is still greater than their direct effect. Corn is the chief raw material used in producing cattle and hogs, and changes in its price are soon felt thru the entire producing structure. Price relationships between corn and livestock are thrown out of balance, and livestock production and feeding are expanded or contracted. This in turn results in further price disturbances. Cyclic price movements appear; the livestock industry swings from prosperity to depression and back again. Meanwhile the price of corn continues its erratic course, leaving a trail of fresh disturbances behind it.

One fact, therefore, appears evident; the working out of a broad policy for meeting the problems which arise from the fluctuating prices of hogs, cattle and corn calls first of all for an understanding of the movements of corn prices.

These fluctuations in corn prices are complicated. They are the result of several kinds of movements, ranging from long time and intermediate to rapid short-time movements, all running on concurrently.

These different kinds of movements can be easily identified. To begin with, the price of corn has passed thru marked *long time* or *secular* changes, downward in direction after the Civil War, and upward after 1896. Next, the price of corn has felt

[1]The author acknowledges the criticisms and suggestions of Dr. A. G. Black, Chief of the Agricultural Economics Section, and of Drs. J. A. Hopkins and T. W. Schultz of the same section.

2. 1923 From $1.04 in Oct. to 71c in Dec., a fall of 33c.
   1924 From .77 in May to $1.09 in July, a rise of 32c.
   1927 From .71 in April to 99c in June, a rise of 28c.
   1927 From 1.09 in Aug. to 84c in Oct., 1927, a fall of 25c.
   The basic data here come from U. S. D. A. Statistical Bul. 28, Corn Statistics, page 124, 1930.

the effects of *general price inflation and deflation*; it rose to great heights during the recent war, and fell to very low levels after it. A *cyclic* movement with a period of about eight years can also be perceived, altho it is obscured by large and irregular *year* to *year* movements. There is also a marked seasonal variation which has passed thru gradual modifications in the course of time and is still changing. Finally, the price of corn exhibits rapid and irregular *short-time* fluctuations, not only from month to month and from week to week, but also from day to day, from hour to hour and from minute to minute.

The presence of these different kinds of movements in the same price series, each kind having its own set of causes behind it, seems at first to complicate the problem of explanation. But as a matter of fact, it really simplifies it. It shows that the task of explaining corn price movements is not one problem, but consists of several different, separate problems—first, the explanation of secular movements; next, the explanation of annual movements; and so on to the shorter and shorter fluctuations.

Each of these problems is separable from the others. Consider, for example, the question of annual fluctuations. It can be handled as a separate problem, because on the one side, it takes the data of the secular trend problem as they stand and uses them as the base from which to measure its own fluctuations; on the other side, shorter-than-annual fluctuations are submerged in the annual data, which are averages of these shorter movements.

We shall use this one-thing-at-a-time-method, then, and begin with the most fundamental group, the long-time or secular movements in the price of corn. Then the cyclic and year to year movements will be taken up. After that, the shorter and shorter time movements will be studied, until the difficulties in the way of applying statistical methods become prohibitive.

The first section of this study accordingly deals with the long-time or secular movements of the price of corn. The present bulletin covers this first section.

PERIOD FROM 1866 TO 1919

The price series to be used for the purpose of showing the secular movements of the price of corn should have these characteristics: It should extend back for as long a period as possible; it should represent the price of corn for the country as a whole; and it should directly reflect prices received by farmers.

The United States Department of Agriculture has compiled the average price of corn at the farm for the country as a

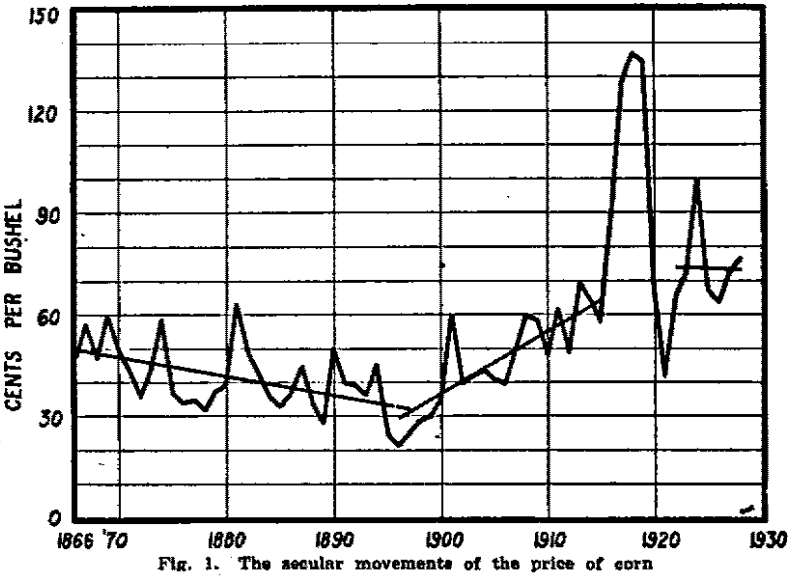

Fig. 1. The secular movements of the price of corn

whole, annually since 1866. This series meets the requirements given above.[3]

The secular movement of the price of corn from 1866 down to the present time, as represented by this series, is shown in fig. 1.

The nature of the general movement can be more clearly seen if a line is passed thru the irregular annual fluctuations so that about as many of them fall on the one side as on the other. For this purpose, a free-hand curve could be drawn in, or a straight or curved line mathematically fitted to the data by the method of least squares. For reasons given below,[4] a broken straight line trend is used, fitted by the least squares method. The insertion of this trend brings out the nature of the secular movements unobscured by the annual fluctuations about the general trend.

The long decline from 1866 to the depression in the late 90's, and the shorter but more rapid rise thereafter to the world war period, are both clearly shown. The period since the war is still short; its trend, such as it is, appears roughly horizontal. The trend since the war is 124 percent higher than it was at the lowest previous point (1896) and 13 percent higher than it was just before the war.

[3] These data are given in the U. S. D. A. yearbooks, and in table I of U. S. D. A. Statistical Bulletin No. 28, "Corn Statistics," under the heading "Farm Value, December 1."

[4] The reasons for the selection of the trend lines used, and the equations to the lines, are given in Appendix I. The data related to the other charts in the bulletin have been similarly removed to the appendix.

What was the reason for the long decline until 1896 and the subsequent shorter and steeper rise to 1914?

The generally accepted explanation gives as the reason for the decline the overproduction of grain which accompanied the westward expansion of agricultural settlers into the Middle-west from 1850 onward. The production of grain increased faster than did the demand at the existing prices, until after the depression of the late '90's. After that date, altho production still continued to increase, it was outstripped by the growth of demand; the result was a rising level of prices.

The explanation is well presented in the following quotation:

"A Case of Overproduction.—At no time in the history of American agriculture has there been a more pronounced case of overproduction than that of the cereals during the two or three decades before the Civil War. A similar experience following the War, say, from 1870 to 1890, however, attracted more attention, and, no doubt, caused greater hardship. In the latter period the markets were hopelessly glutted. Wheat in the Northwest was worth, some years, no more than 35 to 50 cents a bushel. This meant that the farmers were getting from $3 to $10 per acre out of the crop, and there was hardly a living to be made from such returns.

"It was a case of too much product in relation to the demand for such commodities. The English markets as well as our own were flooded. A generation of English farmers were ruined by American competition. We had precluded all possibility of prosperity by producing more than any one wanted, not of goods in general, for this is manifestly impossible, but of a certain few goods, the demand for which is distinctly inelastic. People will not eat much more when food is cheap than when it is dear.

"Wheat has been taken as the leading instance of overproduction, but what has been said applies equally well to substantially all other farm products. When wheat was 40 cents a bushel, corn was 15 or 20 cents; oats were about the same or less; live hogs were as low as $1.75 per hundred, on western farms; and dressed hogs, as low as $2.25 per hundred. The bounty of nature, coupled with the wisdom of man, plus his faith in the increase of land value, had well-nigh brought a whole generation of farmers to bankruptcy. Literally, however, farmers are seldom bankrupt. No matter how poor they are, the nature of farm credits is such as to permit them to continue the business almost indefinitely. Instead of failing they reduce their standard of living and continue to farm."[8]

The general tenor of the exposition is that thruout this period Malthus' law was reversed; the food supply pressed upon the population.

Appearances, however, may be misleading, especially where prices are concerned. The behavior of the general price level during the war has shown the necessity of looking below the surface of prices into the purchasing power that they represent.

This procedure can be applied here. The first step is to convert the corn prices into purchasing power by dividing the price of corn each year by the index number of general prices

[8]The quotation is taken from pages 8 and 9 of the 1921 edition, B. H. Hibbard, Marketing Agricultural Products, D. Appleton & Co. New York. See also J. D. Black, Agrarian Reform in the United States, p. 24.

for that year. For this purpose the index of all commodity prices at wholesale given in the Aldrich Report[6] was used up to the year 1890; the similar Bureau of Labor Statistics index was used thereafter.

This method is open to several objections. In the first place, corn is not sold for "all commodities." It is sold only for those things which farmers buy. In the second place, corn is not sold for goods at wholesale; it is sold to pay for goods at retail, to pay for machinery, livestock, land and many other things.

These objections are valid. We do not, however, have an index of prices of the products farmers buy which extends back before 1910. The Aldrich Report and the Bureau of Labor Statistics series of all commodity wholesale prices are the only series which are long enough for our purpose. We shall employ them, therefore, of necessity. There is a rough correspondence between the movements of wholesale and retail prices and between farmer-purchased goods and all goods, so that the results will not be far wrong.

Figure 2 shows the results of this operation of converting the prices into purchasing power by dividing them each year by the general price level index for that year.

The long decline in *price* up to 1896 and the subsequent steeper rise is changed to a steady and gradual rise in *purchasing power* of 0.53 percent per year thru the whole period. This rise in purchasing power is maintained steadily from the beginning of the period in 1866 to its end in 1919. It persists thru the depression in the 90's and the period of prosperity from 1900 to 1914, carries thru the World War, and lasts until the post-war depression of 1920. The straight line fitted by the method of least squares to the entire length of this series

[6]The full title of this report is "Report on Wholesale Prices, on Wages, and on Transportation," by Mr. Aldrich. Senate Report No. 1394, 52nd Congress, 2nd Session, 1893.

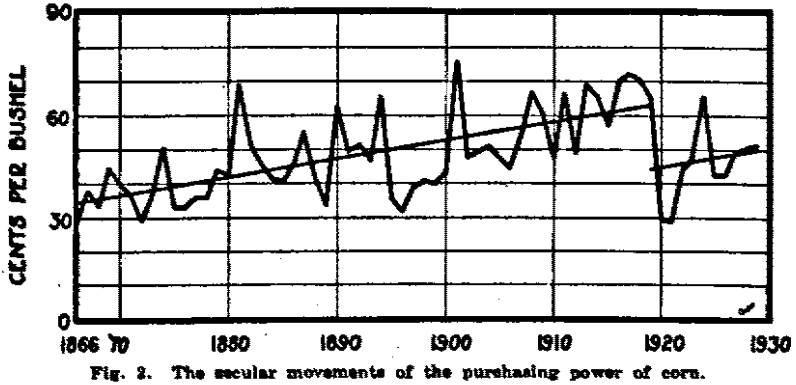

Fig. 2. The secular movements of the purchasing power of corn.

reveals no sag in the trend of corn purchasing power at the time of westward expansion of settlement. The purchasing power of corn was low during the years from 1895 to 1900, inclusive, but that was not the result of expanded acreage. It was the result of a succession of heavy yields. These six years constitute a longer succession of bumper crops than has ever occurred at any other time.

The effect of these large crops upon the purchasing power of corn can be removed by the method described in Appendix II. If, then, a straight line, broken at 1890 (the same date that in the case of the line which when fitted to the price data revealed the sag in the price series) is fitted to the purchasing power data thus corrected, the broken lines fall almost exactly upon the single straight line fitted to the whole length of the series. This demonstrates the absence of any secular decline in corn purchasing power due to over-expansion at the time of the westward expansion.

The curve showing the purchasing power of wheat similarly shows no overproduction effect, no decline in the middle of the period. Its trend is horizontal thruout. The purchasing power of hogs rises steadily from beginning to end. It shows the effect of underproduction relative to the demand, rather than of overproduction.

CHANGES IN THE DEMAND FOR CORN

The inference from the preceding section is that no general oversupply of corn relative to the demand for it occurred during the period of the westward expansion of settlement in the Middlewest,[7] except temporarily during the bumper crops of 1895-1900. This conclusion is based upon the behavior of the purchasing power of corn, which expresses indirectly the relationship between supply and demand.

If the demand for corn could be statistically measured and expressed in an annual series covering the period under consideration and compared directly with the corn production series over the same time, the relationship between supply and demand could be measured directly. What is needed here is not a measure of corn consumption, which obviously is always equal to corn production (plus the initial carry-over from the previous crop and minus the final carry-over). What is required is a measure of the changes in the demand for corn in the schedule sense.

This demand may change for different reasons. It may increase or decrease with changes in the population of livestock.

[7]The terms supply and demand are used in the schedule sense.

which move the demand curve to the right or left. It may also be affected by changes in the price of livestock, which move the demand curve per head of livestock up or down.[8] It may also be modified by changes in livestock feeding methods and in the demand for human consumption in the form of breakfast foods, etc.

These changes may affect the slope and the inflection of the livestock demand curve as well as the location of it. The simplest plan is to deal with the different changes separately, one at a time. This plan is followed in the next section.

EFFECT OF CHANGES IN LIVESTOCK POPULATION

We will begin with the changes in the demand for corn which are due to changes in livestock and human population.

What constitutes the demand for corn? From what sources does it arise?

These questions are dealt with in an article entitled, "The Corn Crop" in the 1921 Yearbook of Agriculture.[9]

A chart (fig. 3) from this article showing the sources of the demand for corn and their relative proportions, is reproduced herewith. It shows that about 90 percent of the corn crop is fed to livestock. (This includes part of the 6.5 percent which is ground in merchant mills). The remaining 10 percent is used for human food on farms, for exports and for other uses, in the proportions shown in the chart.

The changes that have taken place in these different items can be considered by taking up each item in turn, in the order of its importance.

THE LIVESTOCK DEMAND FOR CORN

Hogs, cattle, horses and mules consume over 80 percent of the total corn crop. The changes that have taken place in the population of these classes of livestock since 1866 are shown in fig. 4.

The secular trend of the population data for all of these classes of livestock is upward from 1866 until after the recent

[8] Let us suppose that in response to an increased demand due to a growing population, the numbers of livestock increased 50 percent, while the price of livestock remained unchanged. Livestock would then consume a 50 percent larger quantity of corn at the same price per bushel as before; the demand curve for corn would have shifted to the right.

If the population of livestock, however, remained constant but the price of livestock rose, the feeder would feed each hog more corn until the price of corn rose and the price of livestock fell enough to make further feeding unprofitable. The feeder then would pay more for a given quantity of corn than before; the demand for corn per head of livestock would have increased, for the demand curve for corn would have shifted upwards.

This question is further discussed in Appendix III.

[9] By C. E. Leighty and C. W. Warburton, economists, Bureau of Plant Industry, and O. C. Stine and O. E. Baker, agricultural economists, Bureau of Agricultural Economics. pp. 161-226, United States Department of Agriculture Yearbook, 1921.

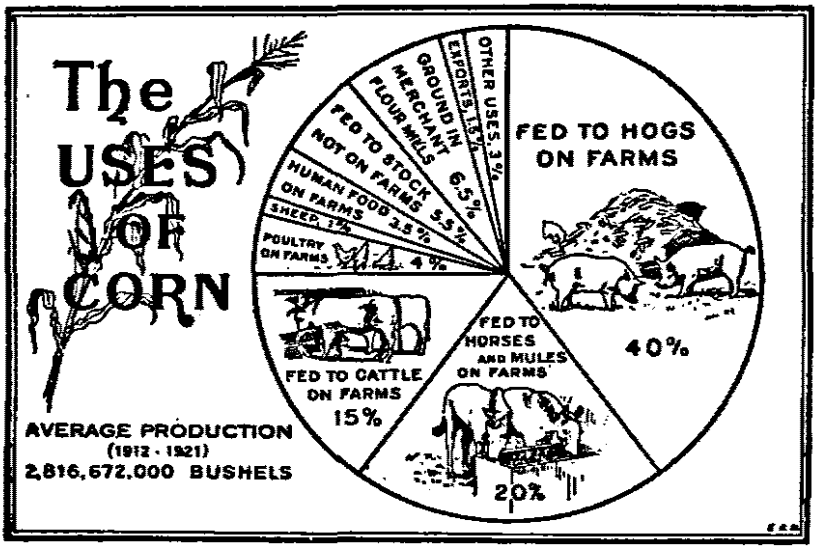

Fig. 8. The uses of corn.

World War. Hog numbers declined after 1923, cattle numbers after 1918 and numbers of horses and mules after 1919.

It is evident that the combined demand for corn from these sources increased substantially from 1866 to about 1920 owing to increases in numbers. The effect of changes in feeding methods is considered later.

LIVESTOCK NOT ON FARMS

The next most important item is the livestock not on farms, which consume 5.5 percent of the total corn crop.

Annual data on the numbers of livestock not on farms are not available. All that can be used are the data given in the decennial census reports, and they run back no farther than 1900. The data for intercensal years therefore must be interpolated, and no data are available before 1900.

The method of handling this item is discussed in Appendix IV, under the heading, "Livestock Not on Farms." Briefly, the method is to multiply the annual data showing the numbers of livestock on farms by a correction factor based on the ratio between the numbers of livestock on farms and those not on farms. The data thus corrected approximate the numbers of livestock on farms and elsewhere in the United States.

POULTRY ON FARMS

The next most important source of the demand for corn comes from poultry on farms, which consume 4 percent of the corn crop.

This item is so small that the changes in it are not shown by a chart. The poultry population increased steadily from about 100 million at the beginning of the period to about 450 million in 1930.

DEMAND FOR HUMAN FOOD AND OTHER USES

The two items, "human food on farms" and "other uses," take 3.5 and 3 percent of the crop, respectively. To these should be added most of the 6.5 percent of the total crop which is ground in merchant mills.

The first of these items probably expanded more slowly than the growth of total population, because that proportion of the total population which is engaged in agriculture has declined since early times. The second and third uses, which include among other things the amount used for human food elsewhere than on farms, probably expanded more rapidly.

There seems to be no very accurate way of handling these items. Probably the best thing to do is to lump them together and regard their total as growing *pari passu* with the growth of total population.

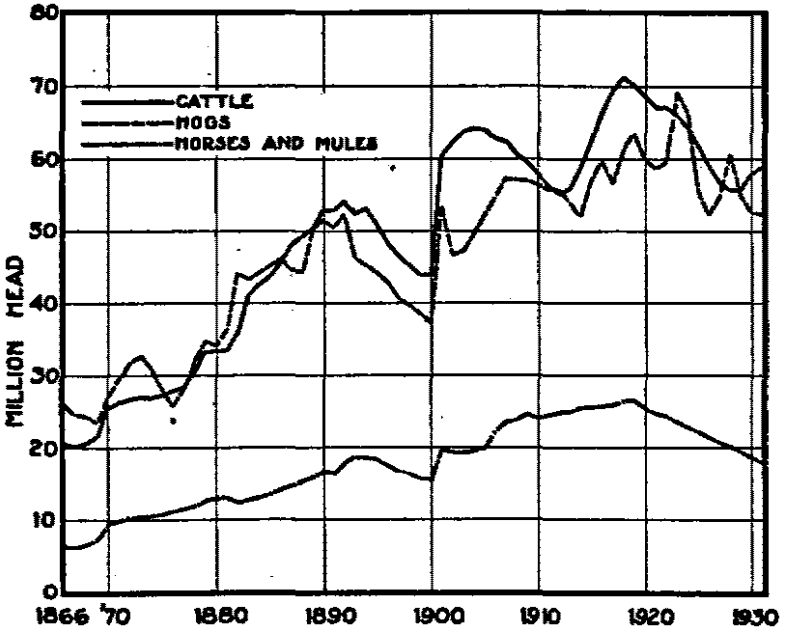

Fig. 4. Numbers of hogs, cattle, horses and mules on farms in the United States, 1866 to 1931.

EXPORT DEMAND

The next element is the exports, which are shown as constituting 1.5 percent of the total consumption of corn.[10]

Exports data show not the export demand but only the export consumption, two things, of course, which are different. A big crop of corn would cut the export demand curve farther over to the right than a small crop would, and greater exports would result; but that fact would not affect the position of the demand curve itself; that position would remain unchanged, or at least unaffected by big or small crops of corn.

The measurement of the change in the export demand for corn is thus somewhat difficult. It is considered in detail in Appendix V. On the basis of the discussion given there, the inference can be made that the export demand for corn increased about 25 million bushels during the period from 1875 to 1918.

This amount is so small—about 1 percent of the total crop—and its computations involve so many unprovable assumptions, that it had best be ignored.

DEMAND FROM SHEEP

The smallest item shown in the chart is the amount consumed by sheep. It is given as 1 percent. The numbers of sheep on farms fluctuate about a very slowly rising trend for the entire length of the series.

AN ANNUAL MEASURE OF CHANGES IN THE DEMAND FOR CORN DUE TO CHANGES IN LIVESTOCK AND HUMAN POPULATION

The preceding sections have shown the changes that have taken place in the different elements constituting the total demand for corn. It would simplify matters if these changes could be resolved into one quantitative measure representing changes in total demand.

If the consumption of corn per head were the same for the different kinds of livestock, the numbers of the various kinds could be added together and the total handled as a unit.

It is clear, however, that this cannot be done. The average hog, or horse, consumes more corn than does the average steer. What is needed is a system of weights to be given each kind of livestock according to the relative amount which each consumes. These weighted figures can then be added and the total used as a unit.

The average number of bushels of corn consumed per head of each species can be used as the basis of this weighting. The weights can be derived by applying the proportions of the total corn consumption ascribed in fig. 4 to the different kinds of livestock to the production of corn on the one hand and the

[10]This figure like the others is based on the period 1912-1921. If the whole period from 1866 to 1930 is considered, exports for that period average 3.1 percent of the total production.

numbers of livestock of each kind on the other, using averages for the period 1912-1921 from which these proportions were originally worked out.[11]

The weights obtained by this method are given in table I.

TABLE I. ESTIMATED AVERAGE CONSUMPTION OF CORN PER HEAD OF LIVESTOCK FOR THE PERIOD OF 1912-1921 (ALL BASIC DATA ON POPULATION AND PRODUCTION IN 000)

	Cattle	Hogs	Horses & Mules
Average number	64,560	57,846	25,550
Proportion of crop fed to each kind	15	40	20
Consumption of corn in bushels per head	6.6	19.7	22.3

(Average corn Production for the period, 2,866,261 Bu.)

	Poultry	Sheep	Human
Average number	345,896	43,370	100,900
Proportion of crop fed to each kind	4	1	13
Consumption of corn in bushels per head	.33	.61	.37

(Average corn production for the period, 2,866,261 Bu.)

These weights can now be applied to the data related to the different sources of demand. The figures showing the population of hogs, cattle, etc. thus weighted can then be added and the total used as a quantitative measure of the changes in the domestic demand for corn which are due to changes in livestock and other population.

This series, together with the computations involved, is shown in Appendix IX. The series is based on the numbers of livestock on farms and elsewhere, and upon the corn used for human food and other uses. The only item left out of account is export demand. This is because it is so small and difficult to measure with accuracy.

Figure 5 shows this quantitative measure of the effect of population changes on the demand for corn compared directly with the annual corn production figures all thru the period. It shows that since 1860 there has been a rough correspondence between the growth in the production of corn on the one hand and the growth of the population consuming the corn on the other.

[11]This method was suggested to the writer by C. M. Purves, of the Bureau of Agricultural Economics.

[12]This 13 percent includes the 3.5 percent used for human food on farms, the 3 percent used for other uses, and the 6.5 percent ground in merchant mills. Part of the last two items should not be ascribed directly to human consumption, but how large a part is not known. The best that can be done here is to regard them as growing at an equal pace with human population.

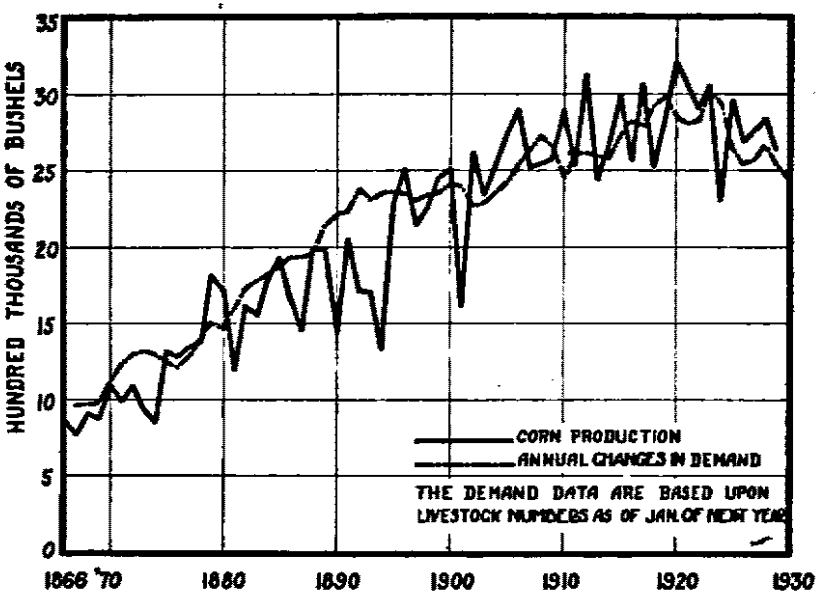

Fig. 5. Changes in the demand for corn due to changes in livestock and other population compared with corn production.

There is no evidence of relative overproduction from 1866 to 1896, nor of relative underproduction during the period following. The only period of decreased relative production appears to be that from 1881 to 1894, which had previously been considered the most acute part of the overproduction period. After that time, corn production increased slightly more rapidly than the growth of livestock and other population.

One more step has yet to be taken.

There might have been a relative increase in the production of the other feed grains, oats and barley, at the time of the westward migration, even tho there was no overproduction of corn then.

Figure 6, however, shows that the trend of oats and barley production added together on a poundage basis from 1869 to 1928 is a straight line. If this oats and barley production were added to corn production and the totals plotted, the upward curvature of the trend of this total feed series would be less than that of the corn series alone. It appears, then, that during the expansion of settlement into the Middlewest, there was a relative undersupply of total feed grains, rather than an oversupply.

EFFECT OF CHANGES IN LIVESTOCK PURCHASING POWER

It was shown in the preceding section that the increase in

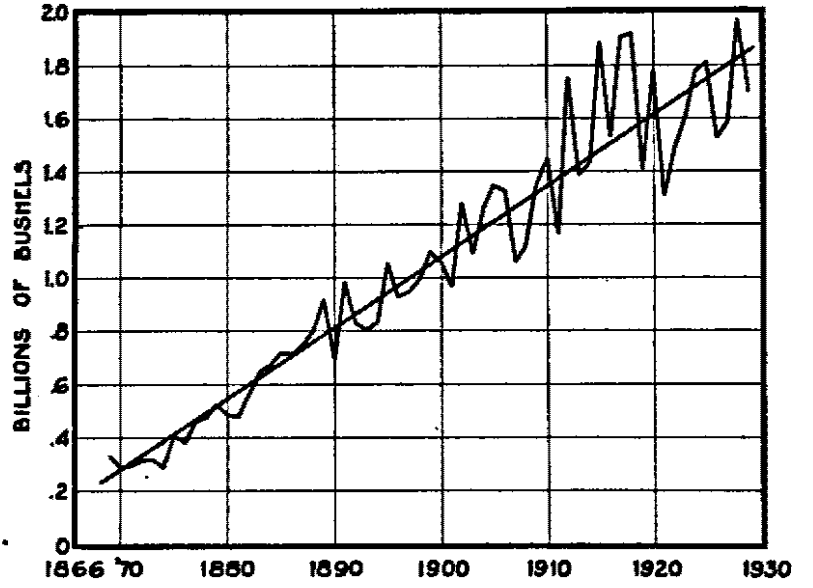

Fig. 6. Oats plus barley production, 1866-1928.

the population of livestock and others consuming corn that has taken place since 1866 was accompanied by a commensurate increase in the production of corn.

One would have expected, then, to find the purchasing power of corn remaining at about the same level thruout the period. Actually, however, as we have seen, the trend of corn purchasing power rose steadily from beginning to end.

This rise may be regarded as the residual change left in after the influence of the changes in population and in corn production have been taken out. It was the result of other changes which have not yet been taken into account.

INCREASE IN THE PURCHASING POWER OF HOGS

One of these other changes is the increase in the purchasing power of hogs that took place during this period.

The effect of such a change upon the demand for corn has been noted in a previous footnote. If the population of hogs, for example, remained unchanged but the price of hogs rose, a higher price per bushel would be paid for a given quantity of corn than before; the demand curve for corn would have shifted upwards. More corn would be fed to hogs and more hogs would be fed, until either the price of hogs fell as a result of the increased production of hogs, or the price of corn rose enough to curb this expansion in the hog industry or both.

In order to measure the total increase in demand for corn, therefore, it is not sufficient merely to know how much the livestock increased. It is necessary also to know whether the price of livestock increased, remained constant, or fell.

An index of the changes in the prices of all livestock to which corn is fed could be worked out by weighting the different livestock prices according to the relative importance of each of the classes of livestock as consumers of corn. This, however, would involve some troublesome steps. What price, for example, should be used as representative of horses? Their product is not meat but power. Some of the smaller items would also be difficult to handle.

Probably the most accurate method is to take hog prices alone as representative of changes in the price of all livestock. These hog prices, reduced to purchasing power by division each year by the current index of general prices at wholesale, are shown in fig. 7.

This chart shows one reason why the purchasing power of corn rose from 1866 to 1919, even tho the livestock and other population consuming corn did not increase any faster than the increase in the production of corn. The chart shows that the purchasing power of hogs rose steadily from the beginning to the end of the period.

Thus the demand from hogs increased; feeders, receiving

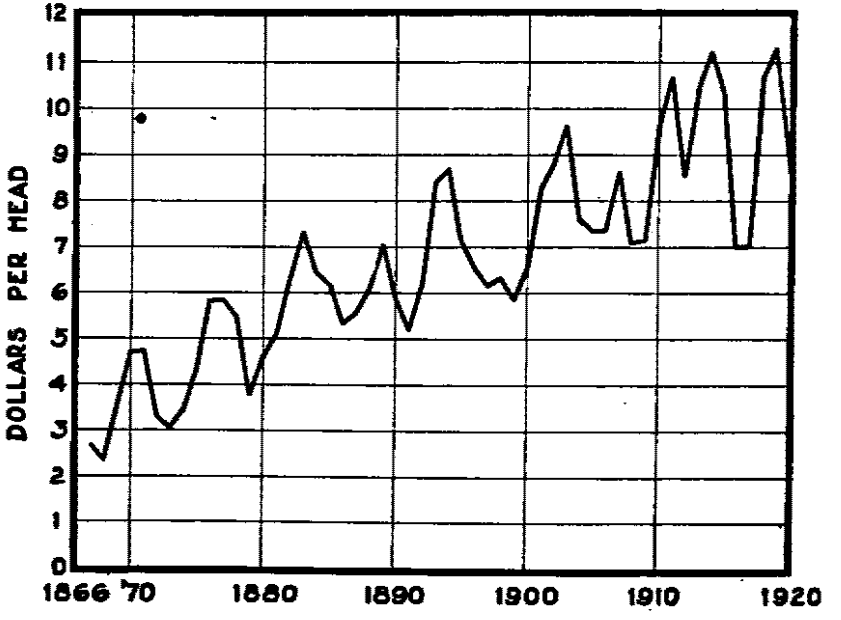

Fig. 7. Purchasing power of hogs per head, on farms Jan. 1; 1866-1922.

higher prices for their hogs, paid higher prices per bushel for corn.[13]

This increase in the purchasing power of hogs was associated with an increase in their production. It must have been due, then, to an increase in the demand for hogs. That is, the demand for meat all thru this period must have increased faster than the supply of it.

EFFECT OF CHANGES IN FEEDING METHODS

Changes in production practices and feeding methods also affected the demand for corn per head of livestock on farms. These changes cannot be statistically measured.

In the case of cattle, the continued westward movement of agricultural settlement after 1866 cut into the western range areas, and shifted the emphasis from grass feeding on the western ranges to grain feeding in the feedlots of the Corn Belt. The 4 or 5-year-old Texas long-horn range steer was gradually displaced by Corn Belt baby beeves and 2-year-olds. This shift in emphasis meant that as the westward movement progressed, more corn was required per head of beef cattle The cattle demand for corn therefore increased faster than the increase in the numbers of cattle on farms.

Changes in the methods of hog production have also taken place, but their effect is not so great as in the case of the beef cattle industry.

The effect of these changes in production methods is roughly indicated by the slight rise in the production of corn relative to the index of population numbers toward the latter end of the period. If oats and barley are added to the corn production, the rise in this total feeds production is greater than in corn production alone.

The extent of these changes cannot be statistically measured at the present time, and further work on this part of the problem must wait upon later investigation.

POST-WAR CHANGES IN THE PURCHASING POWER OF CORN

It was shown in fig. 2 that the war raised the purchasing power of corn very little. It was also shown that the post-war depression lowered it very much. The trend of corn purchasing power now is 25 percent lower than it was before the war. Corn, therefore, is worth now only 75 percent as much as it was before the war. What is the reason for this?

The explanation is to be found in changes that have taken place since the war, not only in the demand for corn, but also in the supply of it.

[13]See Appendix VI.

POST-WAR CHANGES IN THE DEMAND FOR CORN*

EFFECT OF CHANGES IN LIVESTOCK POPULATION

Reference to fig. 5 shows the changes that have taken place in the demand for corn due to changes in livestock and human population.

The chart appears to show that there has been a decrease since 1923 in the numbers of livestock consuming corn. The index of changes in demand due to population changes turns definitely downward after the war. The average for the five years just before the post-war depression[14] was 2,885 million bushels. For the last five years of the post-war period (1926-1930) the average fell to 2,615 million bushels. This is a percentage reduction of 9.4.

Let us examine the changes in the numbers of the individual kinds of livestock, to see which kind has suffered the heaviest losses in numbers, and to discover why these losses have occurred. It is also necessary to ascertain whether the index of changes in demand for corn due to population changes has been made unreliable by the various readjustments that have taken place since the post-war depression.

The post-war changes in the smaller items, poultry and human consumption and so forth, have been small. They are discussed in Appendix 7. Only the important livestock items will be discussed here.

HORSES AND MULES

Figure 4 showed that the number of horses and mules on farms has decreased 30 percent since 1919. This of course is due to their steady displacement by tractors, trucks and automobiles.

This displacement is greater than is generally recognized. Census data show that the number of tractors on farms has doubled every five years since 1920. In 1920 there were 246,000 tractors on farms in the United States. In 1925 there were 506,000. In 1929, four years later, there were estimated to be 853,000. During the same time, the numbers of horses and mules on farms decreased by more than 5 millions.[15]

CATTLE

It is also shown in fig. 4 that a marked reduction in cattle numbers has taken place since the war. Their numbers have fallen nearly 20 percent.

Opinion is divided as to whether this reduction was cyclic, or was simply the result of liquidation induced by post-war

[14]The last year of the five is 1920, for the livestock index is as of Jan. 1, and is paired with the corn crop and purchasing power as of December of the year before.
[15]Data from table 584, p. 1042, U. S. D. A. Yearbook of Agriculture, 1930.

depression. In any case, the decline came to an end in 1928. Since that time, cattle numbers have been increasing.

HOGS

Finally, fig. 4 shows that since the war the number of hogs on farms has decreased. The trend thru the cycles turns downward. It would appear from this that the hog demand for corn has been cut down by a reduction in hog numbers.

Investigation shows, however, that changes induced by the post-war depression have affected the accuracy of the hogs-on-farms data as a measure of the hog demand for corn.

This is revealed by the data plotted in fig. 8. This chart shows in greater detail the changes that have taken place since 1900. It shows not only the numbers of hogs on farms, but also the Federal inspected and estimated total slaughter of hogs.[18]

Inspection of the chart reveals the fact that previous to the war the total slaughter curve followed a course almost indentical with that of the hogs-on-farms curve. Since the war, however, they have parted company. The total slaughter curve has continued upward, while the hogs-on-farms curve

[18]Data from Preliminary Report, Statistics of Meat Production, etc., Bureau of Agricultural Economics, Washington, D. C., April, 1930, and from p. 845, 1929 U. S. D. A. Yearbook.

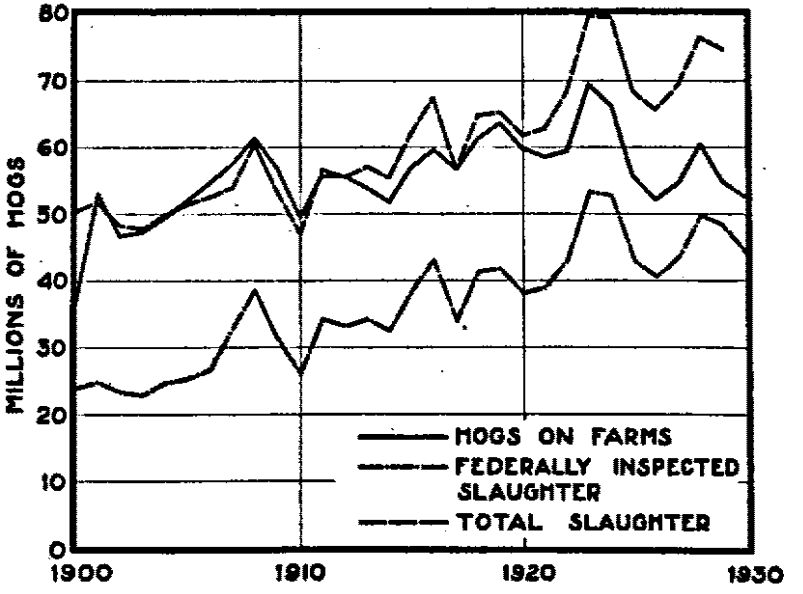

Fig. 8. Numbers of hogs on farms, Federal inspected slaughter and total slaughter, 1900-1931.

has swung downward; for 1929, the total slaughter curve is 40 percent higher than the other. The divergence between the two series is still greater if the slaughter figures are expressed in pounds, for since 1904 the trend of the average weights of hogs slaughtered has been upward.

The reasons for the divergence between the numbers of hogs on farms and total hog slaughter are discussed in Appendix VIII. Changes in the geographical distribution of the hog production and in production methods are bringing more hogs under Federal inspected slaughter and are increasing the production of pork per head of hogs on farms. The extent of these increases is not accurately known.

The numbers of hogs on farms, then, are becoming unreliable as an index of changes in the total hog demand for corn.

EFFECT OF CHANGES IN FEEDING METHODS

Further unreliability is introduced by the fact that changes in feeding methods since 1920 have reduced the demand for corn per head of hogs marketed. Between 1910 and 1920, supplement feeds as tankage, fishmeal, linseed oilmeal, soybean and peanut meal, alfalfa, etc. began to come into use. Since that time their use has steadily increased and this increase has reduced the amount of corn fed per 100 pounds of hog gain.

No data are available as to the extent of the reduction for the Corn Belt as a whole; but an indication of the change that has been made can be gathered from the records of the feeding experiments conducted by the Animal Husbandry Section of the Iowa Agricultural Experiment Station. These records show that prior to 1910 the average requirement at the experiment station was about 450 pounds of corn per 100 pounds of hog gain. Today it is only about 350 pounds. From 450 pounds to 350 pounds is a reduction of 25 percent.[17]

The general use of modern feeding rations, however, spreads slowly. For the Corn Belt as a whole, the reduction in corn requirements per 100 pounds of hog gain has probably not been great. The average based on Humboldt County cost route records for 1922-24, inclusive, was 425 pounds.[18] This is only 5 percent less than the experiment station requirements before 1910.

How much the total demand for corn has been affected by changes in the number of hogs and in hog production methods therefore is not known. Further research in this field is required.

[17]The information concerning feeding changes was supplied by Prof. C. C. Culbertson, in charge of research in the Animal Husbandry Section of the Iowa Agricultural Experiment Station.

[18]Iowa State College Agricultural Experiment Station Bulletin 255 (revised), An Economic Study of the Hog Enterprise in Humboldt County, by J. A. Hopkins, Jr.

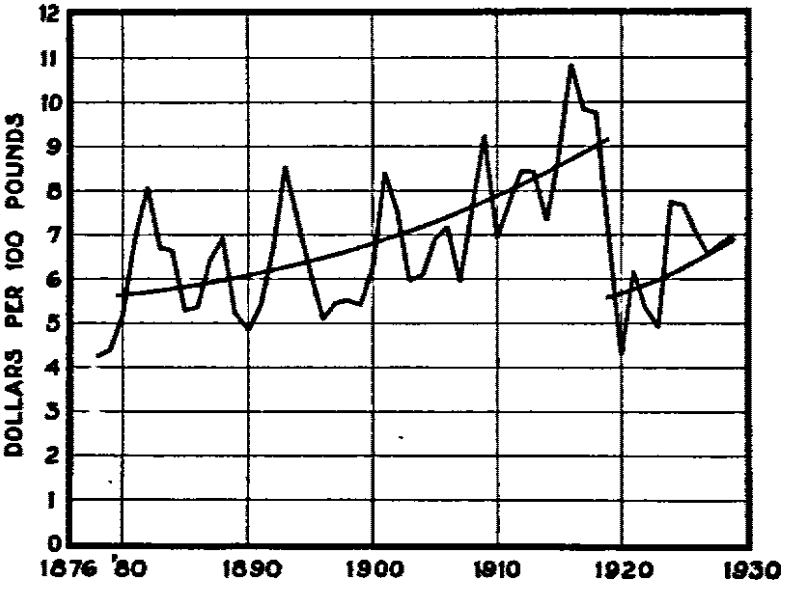

Fig. 9. Post-war changes in the purchasing power of hogs, per 100 pounds at Chicago.

EFFECT OF CHANGES IN LIVESTOCK PURCHASING POWER

Fortunately the extent of the vertical changes in the position of the hog demand curve for corn since the war can be accurately measured.

Figure 9 shows the change in the purchasing power of hogs per 100 pounds at Chicago that has taken place since the war.[19] Evidently the trend of hog purchasing power has fallen more than 25 percent. This is approximately the same percentage reduction that has taken place in the purchasing power of corn.

One would expect to find a close connection between the price of hogs and corn, because the one is the finished product and the other is the raw material. The closeness of their relationship is shown by the fact that the trend of the farm corn-hog price ratio has remained unchanged at about 15 for at least 50 years.

One further question remains. Was the post-war reduction in the purchasing power of hogs due to an increase in the supply of hogs or to a decrease in the demand for pork?

This question again carries the investigation out of the

[19]The data are given in the form of annual averages of monthly prices on p. 853 of the 1930 U. S. D. A. Yearbook. These data are then reduced to purchasing power by division by the corresponding index of the general price level, compiled by the Bureau of Labor Statistics.

field of the present worker. Other studies,[20] however, indicate that the biggest factor has been a decrease in the demand, not for pork but for hogs, due to a widening of the spread between live hog and retail pork prices. The fact that this has resulted in an increase rather than a decrease in the number of hogs slaughtered indicates further that there has also been an increase in the supply of hogs.

POST WAR CHANGES IN THE SUPPLY OF CORN

In spite of the 25 percent reduction in the purchasing power of corn, the production of corn since the war has fallen off very little. The slight decline in the trend is shown in fig. 10. Corn acreage reached a rounded peak during 1910-1915 at about 105 million acres and has declined slowly since then. At the present time the average falls at about 100 million acres.

Evidently the supply of corn, the amount which producers will supply at a given series of prices, must have substantially increased. The purchasing power of corn has fallen 25 percent, but farmers are producing almost as much corn as before, in spite of the lower return.

[20]Conducted by Mr. H. M. Conway, of the research department of the National Livestock Marketing Association at Chicago.

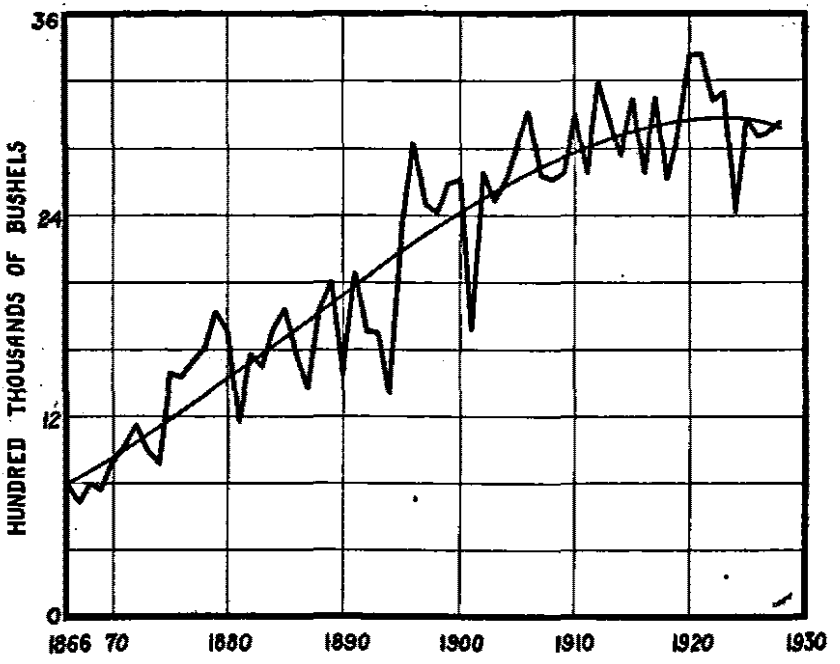

Fig. 10. Trend of corn production, 1866 to 1928.[21]

[21]The data in the chart include stocks of old corn on farms Nov. 1. The reason for this is that a cubic parabola had been fitted to this series, and using it saved the labor of fitting a similar trend line to a series showing corn producion alone.

There are several reasons for this. One reason is the reductions that have been made in the cost of producing corn. Power farming is developing; larger fields and implements are coming into use; better varieties of corn are being grown; more modern rotations are being followed. In some cases standards of living have also been reduced. The fact that corn production has increased in the northwestern part of the Corn Belt during this period shows that part of the increase in the supply has come from newer corn areas with lower real costs of production than those of other parts.

THE FUTURE OF CORN PRICES

What are the prospects for the trend of corn prices in the future? Is the purchasing power of corn likely to rise and return to pre-war levels? Or is it more likely to follow the lead of wheat and go down?

The answer depends upon three things: first, upon the future course of the general price level; second, upon the future changes in the demand for corn, in turn mainly dependent upon the demand for livestock; and third, upon future changes in the supply of corn, affected by changes in corn production practices and other cost factors.

These three topics will be dealt with in the order given.

THE TREND OF THE GENERAL PRICE LEVEL

Leading authorities in the field of money and banking differ in their opinions as to the future course of the general price level.

Some foresee a gradual slowing down of the world's output of gold, and an increase in the demand for it from such countries as India and China. This would exert a depressing effect on price levels. Others emphasize the effect which improvements in banking systems have in allowing a given quantity of gold to support a larger and larger credit structure. This would have a tendency to raise prices.

No general agreement upon the outlook seems to have been reached. Whether the credit currency of the world is likely to expand faster or slower than the expansion in world production of goods remains a disputed question.

Consequently, the direction of the future trend of the general price level cannot be foreseen. The long-time outlook for corn prices, tied up as it is with these movements of the general price level, is thus rendered uncertain at the outset, before the factors directly affecting corn itself have been approached.

The difficulty, however, can be avoided by the use of the more fundamental concept of corn purchasing power instead of corn price. This leaves questions concerning the course of

the general price level on one side, and permits attention to be focussed on the factors directly affecting corn.

PROSPECTIVE FUTURE DEMAND FOR CORN

The prospects for the purchasing power of corn in the future depend upon the changes in the demand for corn and in the supply of it. Let us consider the factors affecting the demand first, taking up each of the three chief kinds of livestock separately.

EFFECT OF CHANGES IN LIVESTOCK POPULATION

HORSES AND MULES

The preceding section showed that nearly a third of our horses and mules have been displaced since the war by mechanical power in the form of tractors, trucks and automobiles.

The evidence is that this decline will continue for years to come. Agriculture is only part way along the road to mechanization. It seems likely that many more horses and mules will be displaced before their population curve, at present declining so rapidly, begins to flatten out. The January, 1931, figures show no abatement in the rate of decline. The reduction in numbers may be as great during the next 10 years as during the past decade. If it is, it will mean a reduction in the demand for corn of 5 or 6 percent from present levels.

This displacement of horses will, however, begin to slow down some distance short of complete elimination.

CATTLE

Figure 4 showed that the number of cattle on farms has just passed the low point in what appears to be a cyclic movement with a period of 14 or 15 years. If history repeats itself, the number can be expected to increase for the next five or six years and decline again for the next few years after that.

The trend thru these movements should be roughly horizontal. On the one hand, the per capita consumption of beef is declining to some extent; but on the other, the market for our beef is largely domestic and our domestic human population is increasing at about 1 percent per year. In the field of dairy products the demand for milk is increasing, but the efficiency of the average milk cow as a converter of feed is also increasing. All in all, it seems that the result of these conflicting components will be a roughly horizontal trend in the demand for beef and dairy cattle in the United States.[22]

[22]The term "demand for" is less concrete but more accurate than "numbers of." Suppose that the demand for hogs, for example, remained constant, but the supply of feed grains increased. The price of feed grains would fall, and this reduction in the cost of the raw material would increase profits in the hog industry, and cause an increase in the numbers of hogs. But this increase in hog numbers, an effect of lower feed prices, could not then be brought in as a change in a causal factor on the side of the demand for feed grains. The total hog demand for feed grains would have remained unchanged.

Whether the trend of the per capita cattle demand for corn will also be horizontal is a further question which is discussed later in connection with hogs.

HOGS

The outlook for the hog demand for corn is based fundamentally upon the prospects for the domestic and foreign demand for pork. This is a subject calling for extended research. The main outlines, however, appear to be as follows.

The export demand for pork products seems to be weakening. Exports of lard are increasing, but those of other pork products are falling off more rapidly than the increase in the exports of lard. The total of all pork products exports, including lard, averaged 1,305 million pounds for the period 1900-1904; 1,249 million for the period 1905-1909 and 1,149 million for the period of 1925-1929.[23]

What are the prospects for the domestic demand?

The per capita consumption of pork shows a slight upward trend from 1900 to 1928.[24] This may continue, tho some of the recent increase is due to the relatively high price of beef. Lard, however, is increasingly feeling the effect of the competition of vegetable oils and other substitutes.

Per capita domestic demand for pork products, however, is only one of the factors to be taken into account. The other is the growth in the human population of the United States. This has been the fundamental factor underlying the increase in livestock numbers of all kinds in the past, and will continue to be so in the future.

The outstanding feature of the present population situation is the fact that population growth in the United States is now slowing down. The 1940 census is expected to show a deceleration in the rate of population increase ranging from 5 to 8 percent.[25] The birth rate of the United States has fallen 25 percent in the last 13 years, and is now lower than the birth rate of France.[26] Many leading authorities are convinced that not only the United States but northern Europe will reach a stationary population basis within 35 years.[27] Dublin and Lotka predict that by 1970 the United States will reach a stationary population of 150 million. Others set it at about 175 million.

[23] Table 496, pp. 945, 1930, U. S. D. A. Yearbook of Agriculture.

[24] Preliminary Report, Statistics of Meat Production, etc., B. A. E., U. S. D. A., April, 1930.

[25] W. S. Thompson, Population Problems, 1930, page 238.

[26] According to Dr. J. E. Kelley, University of Chicago.

[27] Robert R. Kuczynski, "The Balance of Births and Deaths," Vol. I, Western and Northern Europe.

Dublin and Lotka, Statisticians, Metropolitan Life Insurance Company, Studies in Quantitative and Cultural Sociology of the American Sociological Society, December, 1929. P. 106.

Dr. O. E. Baker, United States Department of Agriculture, Miscellaneous Publication No. 97, "Land Utilization and the Farm Problem," November, 1930, p. 28.

In the next decade, however, the increase in domestic human population will probably more than offset the effect of declines in export demand for pork products. The total demand for pork products, therefore, should slowly increase.

Whether this will result in a similar slow upward trend in the hog demand for corn depends upon changes in the *per capita* hog demand for corn. This in turn depends upon the extent of the spread of the use of modern rations and of other improved production practices that have been previously discussed. It depends also upon further changes in the spread between retail pork and live hog prices.

These questions lie outside of the immediate field of corn price research.

The most that can be done here is to point out that the spread of the use of supplemental feeds and other constituents of a modern feeding ration and the other improvements that are being made in hog production practices are going to reduce the per capita hog demand for corn to some extent. The total hog demand for corn, then, is not going to keep pace with the slow increase in the demand for pork. It is probable that it will not increase at all.

COMPETITION FROM OTHER GRAINS

One more important factor affecting the demand for corn is the prospective competition from other grains.

The present liberal substitution of wheat for corn is not likely to continue, once adjustment has been made between wheat and corn prices and production. In spite of recent cuts in the cost of production of wheat over a period of years, it is likely to cost more to produce wheat than corn. Shifts in production at the overlapping margins between wheat and corn areas will be made, but they will affect the supply of corn, not the demand for it.

The competition from grain sorghums, oats and barley is likely to have more effect upon the demand for corn than wheat is likely to have. There has been some increase since 1900 in the ratio of oats plus barley production divided by corn production, but not enough data are at hand to enable prospective changes in this ratio to be statistically estimated.

PROSPECTIVE FUTURE SUPPLY OF CORN

The final question is the probable future supply of corn.

Supply here of course is taken in the same sense that demand has been taken; that is, in the schedule sense. Supply is, therefore, different from production. Production depends upon two things, price on the one hand and cost of production on the other. Supply is not affected (directly) by price.

What is likely to be the future course of the cost of producing corn? Is it likely to increase, or to decrease? Several conflicting forces are at work here, affecting the cost of corn production in different directions.

MECHANIZATION OF THE CORN BELT

The first force is the continued improvement being made in technical methods of production. Larger farm implements, such as two and four-row cultivators and mechanical corn pickers; the application of more fertilizer; the use of larger fields and modern rotations, the development of surfaced roads and motor trucks—all these changes are reducing costs and thereby increasing the supply of corn.

How much these costs have been cut since the war is not known. The fact, however, that the 25 percent drop in the purchasing power of corn has resulted in only a slight reduction in acreage would indicate that costs have been cut almost as much as purchasing power has.

Is this reduction in the cost of producing corn likely to continue in the future, or has it already begun to reach its limits?

The experience of the Wheat Belt throws some light on this question. Wheat combines have been in successful operation for 40 or 50 years, but they have only come into general use and begun to exert their full force upon wheat production methods and costs within the last five or ten years.

As a German observer[28] has pointed out, in the first stage of the application of a new implement to agriculture, the attempt is made to adapt it to the existing size of the average farm, which is determined mainly by the nature of the implement previously used. In the second stage, enough inertia has been overcome that instead of adapting the new implement to the old size farm, the size of the farm is adapted to the new implement, which only then is able to exert its full effect. This second stage has now been entered by the Wheat Belt, under the influence of the combine; the average size of 100 representative farms selected for study in Montana, for example, has increased, with the general use of the combine, from 600 tilled acres in 1924 to 1,200 acres in 1929.[29]

Perhaps the general adoption of the combine was retarded until efficient tractor and combine motors had been designed and manufactured on a commercial scale. It may not take as long now for power machinery to be generally adopted in the Corn Belt. On the other hand, the retarding factor in the case of the combine may have been the inertia of established farming practices rather than the slow development of suitable

[28] Prof. Dr. G. A. Studensky, Moskau, "Entwicklungslinien der Landwirtschaftlichen Weltproduction." Weltwirtschaftliches Archiv /31/ (2) April, 1930: 471-490.

[29] Letter received from E. A. Starch, Agricultural Experiment Station, University of Montana.

gasoline motors. If that was true of the combine in the Wheat Belt, the adoption of power machinery in the Corn Belt may take as long as the adoption of the combine has taken.

In any case the Corn Belt is still in the first stage of mechanization. The present application of the general-purpose tractor here appears to be an attempt to fit the new machines into the old horse-farm practice. The first mechanical corn pickers were one-row machines, altho two-row implements are more efficient; but these require larger fields than the average at the present time.

TABLE II. AVERAGE SIZE OF FARMS IN IOWA

Year	Acreage
1920	162.0
1921	156.0
1922	157.0
1923	160.0
1924	———
1925	161.0
1926	161.5
1927	162.3
1928	162.4
1929	163.6

The second stage, that of changing the size of farm to fit the new power machinery, may be upon the Corn Belt horizon, but it is not yet here. The average size of Iowa farms has shown only a slight increase in the last few years, as table II shows.[30] Furthermore, most of the increase is due to an increase in hay and pasture acreage in the southern part of the state. In the northwestern area, the heavy corn producing region, the average size of farms has decreased since 1920.

Perhaps the effect of mechanization in the Corn Belt will be exerted only upon farm practices and not upon farm acreage. This, however, is unlikely. Four-row corn planters and cultivators and two-row corn pickers require a larger farm than one of 160 acres in order to reach their maximum efficiency. The corn combine, too, if it is found practical, would require a farm larger than the present average size. The conclusion must be that the Corn Belt is only part way into the stage of mechanization; the second stage still lies before it.

It is possible that we shall see further specialization within the Corn Belt according to the topography of the land. Farms in level areas, laid out in large fields, may be able to specialize on the production of grain for the smaller livestock farms in adjacent rougher areas where large implements could not well be used. This may involve a considerable amount of farm reorganization.

[30] From the "Farm Statistics" tables in issues of the Annual Iowa Yearbook of Agriculture.

THE CORN BORER

A different force, working against cuts in the cost of producing corn, is the corn borer.

This parasite is steadily spreading westward thru the Corn Belt. It has already made its appearance in Illinois. It is expected in Iowa within the next three or four years, altho not in sufficient quantities to do commercial damage; that is not expected to occur for five years or more.[31]

Iowa farmers thus have five or more years before they need to take this menace into their cost accounts. How great its effect will be remains to be seen; it may be reduced by the use of preventive methods, by the removal of all trash, by deep plowing or other means. Even so, the cost of cleaning up the field is an added item of expense. Perhaps the market for cornstalks for the cornstalk industries may develop enough to offset some of this cost.

The words of Secretary of Agriculture Hyde sum up the corn borer situation. "Taken as a whole, the record of the corn borer in the United States still leaves its future economic importance open to question. However, the heavy damage it occasioned over a few years in a limited district in Ontario now largely controlled by better farm methods and the fairly initial damage in a limited district in Massachusetts are indications of the possible menace of this pest to our corn crop. This menace would seem to warrant the control methods which are now enforced to delay its spread, which must continue and which will eventually carry the insect into the main Corn Belt.[32]

GEOGRAPHICAL CHANGES

Another factor is the gradually increasing concentration of corn in the Corn Belt. This has been in progress since the first of the century. The trend of the annual ratios between corn production in the nine Corn Belt states[33] and the thirty-nine other states has increased from 1.28 in 1908 to 1.88 in 1929. This is shown in fig. 11.

Most of this increase, however, is due to the fact that the Corn Belt has moved northwest during the period considered[34] Since the states chosen as the Corn Belt are those in which corn production was the greatest at the present time (not those in

[31]Opinion of Dr. C. J. Drake, head of the Entomology Department, Iowa State College.

[32]U. S. D. A. Yearbook of Agriculture, 1930, p. 55.

[33]Iowa, Illinois, Indiana, Ohio, Missouri, Nebraska, South Dakota, Minnesota, Wisconsin.

[34]This northwestern movement is well shown in figs. 6 and 7 of an article by O. E. Baker, "Changes in Production and Consumption of Farm Products" in the Annals of the American Academy of Political and Social Science, March, 1929, No. 231.

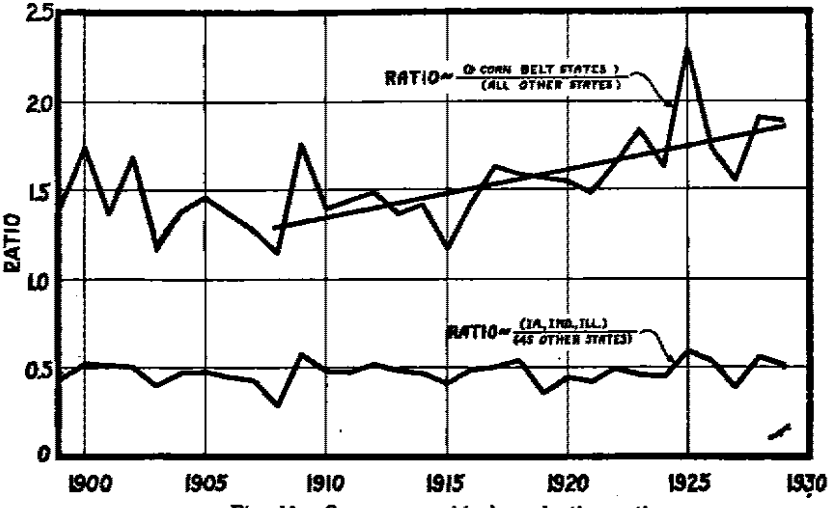

Fig. 11. Corn geographical production ratios.

which corn production was the greatest at beginning of the century) some increase in relative Corn Belt production would be expected from this northwestern movement alone.

If only the three central Corn Belt states, Iowa, Illinois and Indiana, are considered, a similar increase in production relative to the rest of the United States is also evident, but the increase is slight. This is shown by the lower line in fig. 11 Since these three states are the heart of the Corn Belt, the increase in their relative production is evidence of a slightly greater concentration of corn production not only in the Corn Belt as compared with the rest of the states but also within the central states of the Corn Belt itself.

The northwestward movement is much more pronounced than the tendency toward concentration in the heart of the Corn Belt. It is on the northwestern border that acreage is being expanded, and this in the face of the substantial reduction in the purchasing power of corn that has taken place since the war. The introduction of earlier maturing varieties of corn has probably been the biggest factor behind this northwestern movement. The use of larger fields and implements which are well adapted to this territory, and, more recently, the introduction of hybrid seed, have also played their part. This northwestward expansion is likely to continue.

THE OUTLOOK FOR PROFITS

The prospects are that the trend of the purchasing power of corn will be downward, but it does not follow that profits also

will decline. The cost of corn production in some areas is likely to decline as rapidly as the purchasing power does.

Corn growers located in the northwestern part of the Corn Belt, for example, will probably make greater profits than those located in the eastern part, from which the tide of corn production is receding.

Another way of grouping producers is to divide them into those who are able to be in the front rank in adopting improved methods of production, and those who for various reasons—unsuitable topography of land, small size of farm, lack of capital, etc.—lag behind in this respect.

In a period of rising demand and unchanged conditions of supply, both of these classes make extra profits. In a period of falling demand and unchanged supply, both lose. In a period of constant demand during which conditions of supply are changing, however, both classes do not equally gain or lose. The producers in the first group, who are able to put into practice modern low cost methods of production as soon as they are practical, make extra profits; those in the second group, who do not change their production methods, remain with their profits unaffected.

As the use of cheaper methods of production spreads, however, the situation changes. The increased profits going to those who adopt cheaper production methods attract more into production. This is what is taking place at the northwestern border of the Corn Belt and in some of the central sections at the present time. The increased supply then begins to lower prices.

These lower prices still leave those using the cheaper methods with satisfactory profits, since they have cut their costs still further than prices have fallen; but those in the second group, whose costs remained as high as before, are caught between falling prices on the one hand and their own unchanged costs of production on the other. Their profits diminish and may turn into losses.[25]

Now the Wheat Belt is in this situation at the present time (its problem being still further aggravated by a decrease in demand). On the one hand, those with large farms and modern machinery are raising wheat in some cases at a cost as low as 50 cents a bushel. On the other hand, those unable to adopt these methods are facing serious difficulties.

The Corn Belt appears to be on the brink of a similar situation. It will probably enter upon it slowly, and it may be years before the full effects of the situation become evident.

[25]The fact that most of our corn is fed to livestock does not mean that losses in the corn enterprise, due to lower prices, will show up as gains in the livestock enterprise due to lower feeding costs. The result of lower feeding costs would be an increase in the supply of livestock, which would reduce livestock prices to their former ratio to corn prices.

But the experience of the Wheat Belt and Cotton Belt appears likely to be repeated in the Corn Belt, tho on a less severe scale, when the time is ripe.

CONCLUSION

We are approaching the end of a long chapter in American history—the era of headlong development and population growth, during which the demand for food has continuously expanded faster than the supply of it—an era marked by a steady rise in the purchasing power of food.

The recent World War marked the turning point in this movement. Improvements in the technique of food production are now overtaking our slackening population growth. Gradually the increasing supply of food is catching up with the less rapidly growing demand for it. In the future the supply will overhaul and pass the demand. Thereafter the purchasing power of food—including that of livestock and the corn that is fed to it—will cease to rise, and begin to trend downward.

What does this mean for corn and hog producers? It means great opportunities for profit for those who are able by location, access to capital, and ability, to take advantage of rapid improvements in the methods of corn production as they come out. But it means hardship for those who are not.

APPENDIX I

In this bulletin mathematically fitted curves are used wherever advisable and free-hand curves wherever possible.

Free-hand curves are open to one or two serious objections. They are unscientific in that where they are used the work cannot be repeated with accuracy by others; no two investigators will draw in curves alike; and one is always open to the accusation, from himself if not from others, that he bent the curve a little here and there to make the work bear out whatever preconceptions he may have had, while others with different ideas might inflect the curve differently so that the work in their hands would lead to different conclusions.

The use of mathematically fitted curves is admittedly open to some of these objections also; one may reach certain conclusions, partly because he chose a certain type of curve, as easily as because he drew in a free-hand curve where he wanted it to go. But such liberties can be taken with mathematical curves only by breaking a straight line into many short sections, or by using a curved line the equation to which becomes very complicated, involving an almost prohibitive amount of labor; in either case the attempt stands convicted by its own objective characteristics.

In the case of this corn prices series, the secular movement before the war abruptly changes its direction in 1896 from downward to upward. It appears that a straight line broken at 1896 and discontinued at the war period would fit the data reasonably well. The post-war period is too short to be well represented by a trend line, but one is inserted for what it is worth.

The equations to these three consecutive trend lines, all of the type $y = a + bx$, are as follows:

1. 1866 to 1896, inclusive, $y = 41.19 - .5611X$ with origin at 1881
2. 1896 to 1915, inclusive, $y = 46.29 + 1.97X$ with origin halfway between 1905 and 1906
3. 1922 to 1928, inclusive, $y = 73.79 - .1429X$ with origin at 1925

The corn production data are given in table 1 of U. S. D. A. Statistical Bulletin No. 28. The data from 1866 to 1888 have been revised slightly by Dr. O. C. Stine, in charge, Division of Statistical and Historical Research, B. A. E., U. S. D. A. As Dr. Stine stated in a letter to the author under date of April 30, 1929, "These revisions are merely mathematical adjustments to bring the figures at the end of a decade in line with the census figures. The revisions are made by distributing the difference between the estimate and the census figure back thru the previous 10 years, on the assumption of accumulative error. Acreage only was revised in this manner, the production revision being merely the revised acreage times the reported yield." These revisions "have never been published except as charted in the yearbook of 1921." They are shown in table 1 which came direct from Dr. Stine.

The equation for the unbroken trend line in fig. 2, the Secular Movements of the Purchasing Power of Corn, is:

$y = 49.03 + .53x$

With origin halfway between 1893 and 1894.

The trend line fitted to corn production in fig. 10 is a cubic parabola. The equation to it is:

$y = 2283.81 + 1.9956\,x - .4281x^2 - .012369x^3$

with origin at 1897

The trend lines in the rest of the charts were drawn in free-hand.

TABLE III. UNITED STATES: CORN PRODUCTION, REVISED FIGURES
1866-1888

Year	Production (1,000 bushels)
1866	788,677
1867	684,896
1868	798,720
1869	760,935
1870	938,173
1871	1,022,487
1872	1,145,390
1873	991,960
1874	917,838
1875	1,452,550
1876	1,434,083
1877	1,526,653
1878	1,602,298
1879	1,821,175
1880	1,705,238
1881	1,174,962
1882	1,574,400
1883	1,499,812
1884	1,723,363
1885	1,842,386
1886	1,570,272
1887	1,360,991
1888	1,846,549

APPENDIX II

A later study shows that the relationship between fluctuations in the size of the corn crop and in farm purchasing power December 1 for the period 1886-1905 is 1 to 1.5. That is, a crop 10 percent larger than average results in a purchasing power 15 percent lower than average.

The influence of the large crops from 1895 to 1900, inclusive, can be removed according to the method shown in the following table. Columns A and B are taken directly from the original corn production and purchasing power series expressed as percentage fluctuations about their trend value.

TABLE IV

Year	A Production in percent of trend	B 1.5xA	C Purchasing power in percent of trend	C and B	D C and B + 100	E Trend value	DxE / 100 Purchasing power corrected for size of crop
1895	+ 5.8	+ 8.7	−28.4	−19.7	80.3	49.83	40.01
1896	+27.3	+40.95	−36.7	+ 4.25	104.25	50.36	52.50
1897	+ 9.8	+14.7	−23.6	− 8.9	91.1	50.89	46.36
1898	+ 4.6	+ 6.9	−20.7	−13.8	86.2	51.42	44.32
1899	+ 9.8	+14.7	−23.2	− 8.5	91.5	51.95	47.53
1900	+ 8.5	+12.75	−16.9	− 4.15	95.85	52.48	50.30

The equations to the two straight lines fitted to the date thus corrected are:
Period 1866-1896, y equals 42.8 + .477x, origin at 1881.
Period 1896-1915, y equals 54.6 + 68x, origin halfway between 1905-1906.

APPENDIX III

The question may be asked whether there is any difference between the effect of a vertical and horizontal shift in dmand upon the market price for a good.

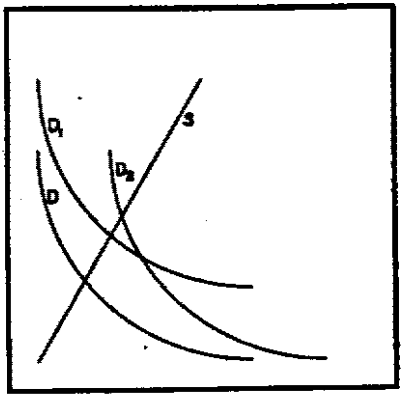

Fig. 12. Effect of vertical and horizontal shifts in the demand curve.

There is. This is shown most clearly if a strongly curved demand curve is considered, as in the chart (fig. 12). The original position of the demand curve is shown at D; the location of the curve after a 10 percent vertical rise is shown at D_1, and after a 10 percent horizontal move to the right, at D_2. The difference between D_1 and D_2 is considerable.

It appears that with conditions of inelastic supply, a shift in demand to the right will result in a higher price than an equal shift in demand upward. The intersection point of the supply curve S and the demand curve D_2 is higher than the intersection point with the demand curve D_1. This situation would be reversed if an elastic supply curve were used.

Apparently, a horizontal shift in demand has the same effect on price as an equal veritcal shift only if the supply curve cuts the intersection of D_2 and D_1; that is, if its slope is such that Δy divided by Δx equals 1.

The main reason, however, for distinguishing between vertical and horizontal shifts in the demand curve is the usefulness of the distinction as a conceptual tool in rational analysis.

APPENDIX IV

LIVESTOCK NOT ON FARMS

It is shown in the text that annual data on the numbers of livestock not on farms are not available. The figures given in the decennial census reports must therefore be used, and even they run back no farther than 1900.

Almost the only thing that can be done with this item is first to decide on *a priori* grounds whether the numbers of livestock not on farms bore a fairly constant relation to the numbers on farms before 1900. If they did, the next thing is to work out what that relation (proportion) has been since 1900, and then to correct the annual data showing the numbers on farms accordingly. The correction formula, if the original datum is called y, and the proportion is designated x, is $\bar{y} = y \frac{x + 100.}{100.}$

Data for 1930 are not yet compiled, but it is safe to assume that the proportion between horses and mules not on farms and those on farms has very heavily declined since 1920 due to the advent of the motor truck and automobile in the cities. This decline was already in progress before 1920, as the reduction in numbers from 1910 to 1920 shown in table V reveals. Probably, however, the proportion remained

fairly constant before 1900 since it changed little between 1900 and 1910.

The proportion between the number of hogs not on farms and those on farms fluctuated rather widely between 1900 and 1920, as table V shows; but that was probably due to the movements of the hog production cycle. The cattle proportion apparently rises steadily from 1900 to 1920. There is no way of telling, however, whether or not this is a continuation of a rise before 1900.

The whole situation is very unsatisfactory. The only redeeming features are that the proportions for hogs and cattle, which fluctuate considerably, are small (about 3 percent), so that the effect of the fluctuations is not great; while the proportion for horses and mules, which is rather high (running over 14 percent), does not fluctuate much.

The procedure that will be followed in compiling the index of demand from all livestock (on farms and not on farms) will be to multiply the annual livestock-on-farms data from 1866 to 1920 by the average

TABLE V. RELATION BETWEEN LIVESTOCK NOT ON FARMS AND LIVESTOCK ON FARMS

A. Not On Farms

	1900	1910	1920
Cattle	1,616,422	1,878,782	2,111,527
Horses and Mules	3,110,789	3,453,160	2,083,861
Swine	1,818,114	1,287,960	2,838,389

B. On Farms

	1900	1910	1920
Cattle	67,719,410	61,803,866	66,652,559
Horses and Mules	21,531,635	24,042,882	25,199,552

	$\frac{A \times 100}{B}$[1]			Average proportion
				1900–1920
	1900	1910	1920	(1900-1910 for horses)
Cattle	2.4	3.0	3.2	2.9
Horses and Mules	14.5	14.4		14.5
Swine	2.9	2.2	4.4	3.2

[1] A is the numbers not on farms; B is the numbers on farms. The figures in this column show the percentage that A is of B.

Sources of data for livestock on farms:
1920 Census Report
Swine table 60, page 598
Cattle, table 37, page 572
Horses and mules, table 21 and 22, pages 547-548

Sources of data for livestock not on farms for 1900:
1910 Census Report
Swine, table 69, page 447
Cattle, table 65, page 430
Horses and Mules, table 67, page 437

Sources of data for livestock not on farms, 1910-1920:
1920 Census Report
Swine; for years 1910 and 1920, table 76, page 617
Cattle; for years 1910 and 1920, table 75, page 615
Horses and Mules; 1910 and 1920, table 74, page 615

proportion existing between it and the figures for livestock not on farms for the period 1900 to 1920 (for horses and mules, however, the average 1900 to 1910 will be used because of the marked decline in their proportion after 1910) plus 100, and dividing them by 100.

This computation, and the index figures obtained are shown in Appendix IX.

APPENDIX V

INCREASE IN CORN EXPORT DEMAND

If the purchasing power of corn had remained constant from 1866 to 1919, an increase in exports would accurately reflect an increase in export demand. The gradual decline in exports since 1877 (except for the period of big crops and business depression in the late '90's) shown in fig. 13, would then be evidence of a gradual decline in export demand.

The purchasing power of corn, however, did not remain constant; it rose gradually from beginning to end of the period, as earlier sections have shown. From 1877 to 1918, the trend of corn purchasing power rose from 40 to 62 cents.

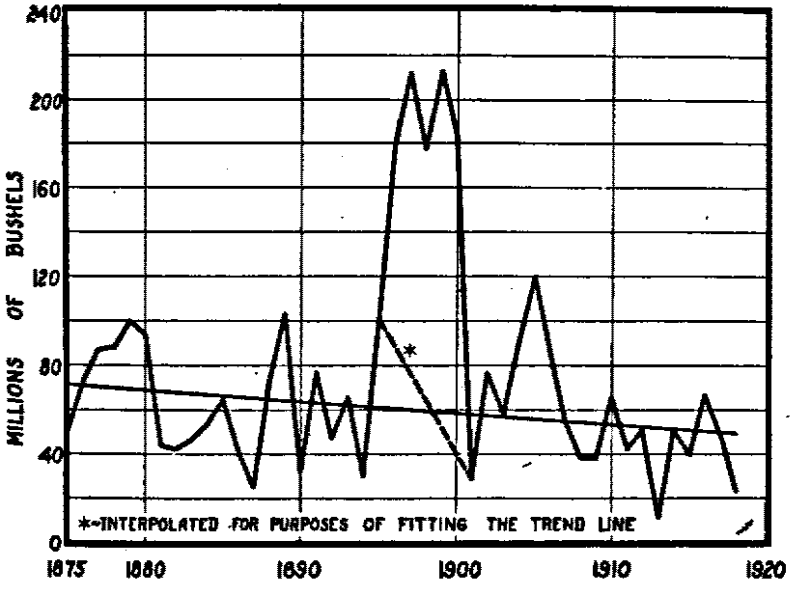

Fig. 13. United States domestic exports of corn.

At the same time, as fig. 13 shows, the trend of exports declined from 70 million bushels to 50 million. Was this decline simply the result of the rise in the purchasing power of corn, the position of the export demand curve remaining unchanged, or does it represent a decline in the export demand for corn in the full schedule sense?

Figure 14 throws light on the answer. It shows the relation between annual fluctuations in corn purchasing power and exports.

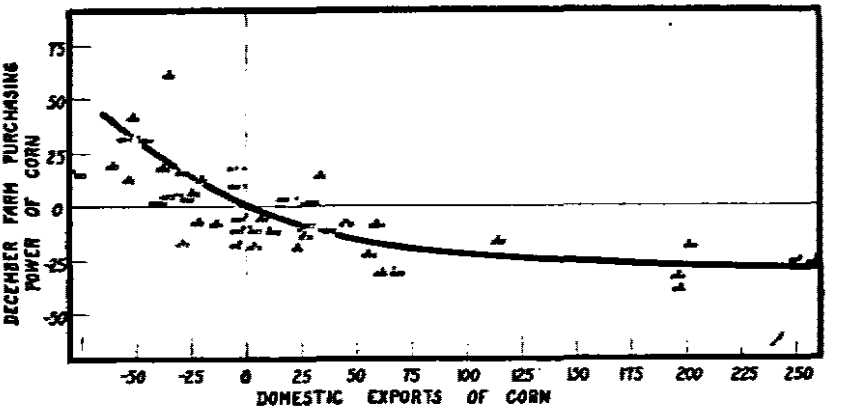

Fig. 14. Exports-and-purchasing-power curve for corn.

The free-hand curve drawn thru the dots indicate that the export demand is very elastic at the lower end but only moderately so in its upper ranges.

It has been previously stated that from 1877 to 1918 the trend of corn purchasing power rose from 40 to 62 cents. This is a percentage (of the mean of 40 and 62) rise of 43.

If the corn exports and purchasing power curve had remained unchanged during this period, reference to fig. 14 shows that this 43 percent increase in the purchasing power of corn would have cut exports down two-thirds.

Actually, exports were cut only one-third, from 70 million bushels in 1877 to 50 million in 1918. The export demand for corn then must have increased 20 or 25 million bushels from 1877 to 1918.

This is only a rough approximatation, because the exports-and-purchasing-power curve based on long-time movements does not necessarily, or even probably, have the same slope as one based on annual fluctuations.

On the one hand, the exports-and-purchasing-power curve based on annual fluctuations might be expected to be more elastic than the exports-and-purchasing-power curve based on long-time changes. The surplus from an occasional bumper crop of corn would be readily taken up by European buyers who could expect to sell it at higher and more normal prices within the next year of two after they had purchased it. A persistent export surplus of corn, however, would not be so readily absorbed. It would have to be sold each year as purchased.

On the other hand, it must be remembered that in general the longer the time on which the individual exports-and-purchasing-power curve data are based, the more elastic is the curve likely to be. Buyers have more time then to adjust the uses to which their purchases are put, so as to take large quantities more easily, ie., at higher prices.

The period of bumper crops and low prices from 1895 to 1900, inclusive, seems to support the latter view rather than the former. During that period of six successive large crops and low prices, the export takings continued to be very great; the export curve remained very elastic right up to the end of the five years.

The assumption is apparently justified, then, that the long-time exports-and-purchasing-power curve should be fully as elastic as the exports-and-purchasing-power curve based on annual fluctuations.

APPENDIX VI

The rise in the purchasing power of hogs cannot be taken as a direct measure of the vertical rise in the position of the demand curve for corn.

Simply because an increase has taken place in the price of a good, it does not follow that there has been an equal vertical rise in the position of the demand curve for it. Whether a shift in the location of a demand curve, either upwards or to the right, will result in an increase in the price or in the quantity taken, or both, depends upon the conditions of supply, that is, upon the slope of the supply curve.

If in this case the number of bushels of corn fed per hog remained substantially unchanged over this whole period and the total numbers of livestock also kept pace with the growth of total corn production, the conclusion would be that the vertical rise in the position of the demand curve was roughly as great as the rise in the marginal cost of production for the larger quantity of corn being produced.

If, however, the number of bushels fed per hog increased, then the vertical rise in the location of the hog-demand curve for corn must have been greater than the rise in the marginal costs of producing the larger production of corn.

This second situation appears to be what actually happened; because, as pointed out in a later section, the consumption of corn per head increased to some extent in the later part of the period.

The conclusion is, then, that a somewhat greater vertical rise took place in the demand curve for corn than is indicated by the increase in the purchasing power of hogs thruout this period.

APPENDIX VII

The changes in the small items have been slight.

The first item is the exports. In the period just before the war they amounted to 1.5 percent of the total crop. After the war they fell off: the simple average of the exports from the United States for the last four years, 1923-1927 inclusive, is 0.7 percent of the total crop. The reduction in exports therefore accounts for only 0.8 percent of the total production of corn.[2]

The amounts taken by merchant mills have decreased. The data are shown in table VI.

TABLE VI.[1] CORN: QUANTITY MILLED IN THE UNITED STATES, CENSUS YEARS 1914-1927 (IN MILLIONS OF BUSHELS)

	1909	1914	1919	1921	1923	1925	1927*
United States	209.3	180.1	113.8	122.2	125.2	105.3	92.7

Compiled from reports of the Census of Manufactures.

*Preliminary report.

[1]Tables VI, VII and VIII are taken from pp. 80 and 81 of U. S. D. A. Statistical Bulletin No. 28, "Corn Statistics," 1928, prepared by the Bureau of Agricultural Economics, Washington, D. C.

[2]It could at the most have accounted for only 1.5 percent of the total production of corn, since this is all that was exported on the average just before the war. Yet it must be remembered that actually the reduction in the export demand must have been very great. Otherwise the 25 percent reduction in the purchasing power of corn after the war would have resulted in greatly increased exports, instead of the slight decrease that actually occurred; for fig. 14 in Appendix V shows that the export demand for corn is elastic, especially in the lower part of the curve. See also the discussion in Appendix V.

The table shows that since 1920 there has been a reduction of about 30 million bushels in the amount of corn taken by merchant mills.

Other industrial uses take only small amounts of corn. The changes in these items are negligible, as tables VII and VIII show.

TABLE VII. CORN: QUANTITY USED FOR THE PRODUCTION OF ALCOHOL AND OTHER DISTILLED SPIRITS
1901-1928
(000 omitted)

Year ended June 30	Corn used	Year ended June 30	Corn used
1915	14,260	1922	3,093
1916	32,070	1923	3,106
1917	33,973	1924	4,835
1918	14,545	1925	7,201
1919	3,890	1926	7,048
1920	2,052	1927	8,383
1921	4,811	1928	6,189

Compiled from reports of the Bureau of Internal Revenue.

TABLE VIII. CORN: GRINDINGS, IN THE MANUFACTURE OF CORNSTARCH GLUCOSE, ETC. 1920-1928
(000 omitted)

1920	48,429
1921	66,852
1922	68,190
1923	71,545
1924	70,857
1925	74,668
1926	78,323
1927	92,119
1928	

Compiled from monthly reports of the Survey of Current Business, United States Department of Commerce. Grindings of corn by the wet process in the manufacture of cornstarch, glucose, etc., as compiled by the Associated Corn Products Manufacturers from reports of manufacturers.

These tables show that there has been a decrease in the quantity used for alcohol and other spirits; but this has been more than offset by the 30 or 40 million bushel increase in the grindings by cornstarch and glucose mills.

It must be remembered, however, that this does not show that the total industrial *demand* for corn remained unchanged. The *amounts* taken remained roughly unchanged, but this was in the face of a reduction in the purchasing power of corn. The total industrial demand for corn then must have decreased considerably since 1920.

APPENDIX VIII

There are several reasons for the lack of agreement between the numbers of hogs on farms and total hogs slaughtered.

In the first place, with the passage of time a larger proportion of total hog slaughter has been coming under federal inspection. The proportion grew from 48 percent in 1900 to about 66 percent in 1925. Most of the increase in this proportion, however, took place before 1920.

A more important change since 1920 is the shifts that have occurred in the geographical distribution of hog production. "Rather significant changes took place in the geographical distribution of hogs between 1920 and 1925 and very slight changes between 1925 and 1929. In 1920 about 37 percent of the hogs in the United States were in the West North-Central states; in 1925 the proportion had increased to 50 percent. In 1920, 31 percent of the hogs of the country were in the South Atlantic and South Central states; in 1925 only 20 percent. Changes in other sections were small, altho there was a tendency for production in both the North-Atlantic and East North-Central states to decline in relative importance. This tendency toward concentration, which has brought half of the hogs in the country into the West North-Central states, where hog production is conducted rather efficiently, accounts for a part of the increase in the output of pork."[4]

An additional effect of these geographical shifts is that it has brought hogs into the area in which the highest proportion of total hog slaughter comes under federal inspected slaughter. This would increase the proportion of federal inspected slaughter to total slaughter.

Furthermore, improvement has taken place in the technique of hog production.

"Apparently the campaign for more sanitary methods of production, which has resulted in appreciably larger litters of pigs saved and reduced the losses from cholera and other diseases,—and the use of better animals"[5] are enabling a given hog population on farms to produce more hogs for market now than formerly.

Finally, either one or both of the two series may be revised in the light of the 1930 census figures. Such a revision might lessen the disparity between the two series.

[4]University of Illinois Agricultural Experiment Station Bulletin 368, Prices of Illinois Farm Products from 1921 to 1929, by L. J. Norton, page 539.

[5]U. S. D. A. mimeographed publication, Regional Changes of Farm Animal Production in Relation to Land Utilization, by O. E. Baker, 1929. Page 25. See also U. S. D. A. Yearbook, 1930, page 848, table 373.

APPENDIX IX

CHANGES IN UNITED STATES DOMESTIC DEMAND FOR CORN DUE TO LIVESTOCK AND OTHER POPULATION CHANGES

1867-1930

(000's omitted)

DATE	A No. of hogs on farms & elsewhere* (No. on farms x 1.032)	B Estimated hog consumption of corn** (Ax19.7)	C No. of horses & mules on farms & elsewhere (No. on farms x 1.145)	D Estimated horse & mule consumption of corn (Cx22.3)	E No. of cattle on farms & elsewhere (No. on) farms x 1.029)	F Estimated cattle consumption of corn (Ex6.6)	G No. of poultry on farms Jan. 1st	H Estimated poultry consumption of corn (Gx0.33)	I U. S. human population	J Estimated human consumption of corn (Ix0.37)	K No. of sheep on farms	L Estimated sheep consumption of corn (Kx0.61)	TOTAL of B.D.F. H. J. and L.	
1867	25.484	502,034	7,125	158,888	20,662	136,369	92,347	30,475	35,078	129,789	39,385	24,025	981,580	
1868	25,095	494,372	7,572	168,856	21,232	140,131	94,898	31,316	36,238	134,081	38,992	23,785	992,541	
1869	24,062	474,021	8,307	185,246	22,055	145,563	97,449	32,158	37,398	138,383	37,724	23.012	998,373	
1870	27,607	543,858	9,469	211,159	26,223	173,072	100,000	33,000	38,558	142,665	28,478	17,372	1,121,126	
1871	30,401	598,900	11,386	253,908	26,996	178,174	102,551	33,941	39,718	146,957	31,851	19,429	1,231,209	
1872	32,814	646,436	11,756	262,159	27,468	181,289	105,102	34,684	40,878	151,249	31,679	19,324	1,295,141	
1873	33,676	663,417	12,059	268,916	27,773	183,302	107,653	35,525	42,038	155,541	33,002	20,131	1,326,832	
1874	31,849	627,425	12,221	272,528	27,704	182,846	110,204	36,367	43,198	159,833	33,938	20,702	1,299,701	
1875	28,960	570,512	12,478	278,259	28,009	184,859	112,755	37,209	44,358	164,125	33,784	20,608	1,255,572	
1876	26,550	523,035	12,096	289,780	28,678	189,295	115,306	38,051	45,518	168,417	35,935	21,920	1,230,487	
1877	28,976	570,827	13,281	296,166	30,084	198,422	117,857	38,893	46,678	172,709	35,804	21,850	1,298,857	
1878	33,294	655,982	13,703	305,577	31,408	207,293	120,408	39,735	47,838	177,001	35,740	21,801	1,407,299	
1879	35,879	706,816	14,487	323,060	34,198	225,707	122,959	40,576	48,998	181,293	38,124	23,246	1,500,708	
1880	35,123	691,923	13,935	310,751	34,222	225,865	125,507	41,417	50,155	185,574	35,192	21,467	1,476,997	
1881	37,408	736,938	15,058	335,793	34,274	226,208	141,517	79,701	51,434	190,306	43,570	26,578	1,595,524	
1882	45,534	897,020	14,149	315,523	36,933	243,758	157,527	51,984	52,713	195,038	45,016	27,460	1,730,783	
1883	44,655	879,704	14,552	324,510	42,366	279,616	173,537	57,237	53,992	199,770	49,237	30,035	1,713,635	
1884	45,615	898,615	14,981	334,076	43,781	288,955	189,547	62,551	55,271	204,503	50,627	30,882	1,819,582	
1885	45,588	917,784	15,501	345,672	45,041	297,271	205,557	67,834	56,550	209,235	50,360	30,720	1,868,516	
1886	47,567	937,070	16,159	360,346	46,830	309,078	221,567	73,117	57,829	213,967	48,322	29,476	1,923,054	
1887	46,041	907,008	16,733	373,146	49,427	326,218	237,577	78,400	59,108	218,700	44,759	27,304	1,930,775	
1888	45,766	901,590	17,593	392,324	50,662	334,369	253,587	83,684	60,387	223,432	43,545	26,623	1,962,022	
1889	51,912	1022,666	18,230	406,529	51,791	341,821	269,597	88,967	61,666	228,164	42,599	25,985	2,114,132	
1890	53,254	1049,104	19,768	440,826	54,333	358,598	258,109	85,176	62,176	232,904	35,935	21,920	2,188,528	2,245,536
1891	52,245	1029,227	18,725	417,568	54,430	359,238	257,360	84,929	64,252	237,732	43,431	26,493	2,155,187	2,269,203†
1892	54,075	1065,278	20,396	454,831	55,635	367,191	256,611	84,682	65,557	242,561	44,938	27,412	2,241,956	2,412,079
1893	47,570	937,129	21,226	473,340	53,897	355,720	255,862	84,434	66,862	247,389	47,274	28,837	2,126,849	2,354,881
1894	46,653	919,064	21,106	470,664	54,635	360,591	255,113	84,187	68,167	252,218	45,048	27,479	2,114,203	2,399,243
1895	45,579	897,906	20,869	465,379	52,344	345,470	254,364	83,940	69,472	257,046	42,294	25,799	2,075,540	2,417,588
1896	44,214	871,016	19,926	444,350	49,621	327,615	253,615	83,693	70,777	261,875	38,299	23,362	2,011,795	2,410,851
1897	41,899	825,410	18,986	423,366	47,797	315,460	252,866	83,446	72,082	266,703	36,819	22,460	1,936,845	2,392,909
1898	41,032	808,330	18,493	412,394	46,413	306,326	255,117	83,199	73,387	271,532	37,657	22,971	1,904,752	2,417,824
1899	39,889	785,813	18,090	403,407	45,260	298,716	251,368	82,951	74,692	276,360	39,114	23,860	1,871,107	2,441,188

CHANGES IN UNITED STATES DOMESTIC DEMAND FOR CORN DUE TO LIVESTOCK AND OTHER POPULATION CHANGES

1867-1930

(000's omitted)

DATE	A No. of hogs on farms & elsewhere* (No. on farms x 1.032)	B Estimated hog consumption of corn** (Ax19.7)	C No. of horses & mules on farms & elsewhere (No. on farms x 1.145)	D Estimated horse & mule consumption of corn (Cx22.3)	E No. of cattle on farms & elsewhere (No. on farms x 1.029)	F Estimated cattle consumption of corn (Ex6 6)	G No. of poultry on farms Jan. 1st	H Estimated poultry consumption of corn (Gx0.33)	I U. S. human population	J Estimated human consumption of corn (Ix0.37)	K No. of sheep on farms	L Estimated sheep consumption of corn (Kx0.61)	TOTAL of B.D.F. H. J. and L.
1900	54,283	1069,375	24,654	549,784	59,186	390,716	250,623	82,706	75,994	281,178	61,504	37,517	2,441,188
1901	54,902	1081,569	22,452	500,679	62,300	411,180	255,149	84,199	77,592	287,090	59,757	36,452	2,401,169
1902	48,298	951,471	22,085	492,496	64,019	422,525	259,675	85,693	79,190	293,003	62,039	37,844	2,283,032
1903	48,710	959,587	22,081	492,063	65,638	433,211	264,201	87,186	80,788	298,916	63,965	39,019	2,309,982
1904	51,084	1006,355	22,321	497,758	65,997	435,580	263,727	88,680	82,386	304,828	51,630	31,493	2,361,695
1905	53,664	1057,181	22,839	509,310	65,859	434,669	273,253	90,173	83,984	310,741	45,170	27,554	2,429,628
1906	56,347	1110,036	25,331	564,881	64,695	426,987	277,779	91,667	85,582	316,653	50,632	30,886	2,541,110
1907	59,134	1164,940	26,981	601,676	64,182	423,601	282,305	93,161	87,180	322,566	53,240	32,476	2,638,420
1908	63,262	1246,261	27,321	609,258	62,557	412,876	286,831	94,654	88,778	328,479	54,631	33,325	2,724,853
1909	58,824	1158,833	28,273	630,488	61,363	404,996	291,357	96,148	90,376	334,399	56,084	34,211	2,659,015
1910	50,878	1002,297	27,529	613,897	59,620	393,492	295,880	97,640	91,972	340,296	52,448	31,993	2,479,625
1911	57,482	1132,395	28,167	628,124	57,849	381,803	303,575	100,180	93,346	345,380	53,633	32,716	2,620,598
1912	57,482	1132,395	28,477	635,037	56,618	373,679	311,270	102,719	94,720	350,501	52,362	31,941	2,626,272
1913	55,728	1097,842	28,686	639,698	57,452	379,183	318,965	105,258	96,094	355,548	51,482	31,404	2,608,933
1914	53,458	1053,123	29,096	648,841	60,440	398,904	326,660	107,798	97,468	360,362	49,719	30,329	2,599,357
1915	58,824	1158,833	29,397	655,553	64,345	424,677	334,355	110,337	98,842	365,715	49,956	30,473	2,745,588
1916	61,610	1213,717	29,486	657,538	68,319	450,905	342,050	112,877	100,216	370,799	48,625	29,661	2,835,497
1917	58,514	1152,726	29,693	662,154	71,549	472,223	349,745	115,416	101,590	375,883	47,616	29,046	2,807,448
1918	63,158	1244,213	30,260	674,798	73,295	483,747	357,440	117,955	102,964	380,967	48,603	29,648	2,931,328
1919	65,842	1297,087	30,269	674,998	72,209	477,173	365,135	120,496	104,338	386,051	48,866	29,808	2,985,612
1920	61,878	1218,997	28,846	643,265	70,868	467,729	372,825	123,032	105,710	391,127	39,025	23,805	2,869,956
1921	60,477	1191,397	28,239	629,730	69,132	456,291	380,520	125,572	107,417	397,443	37,452	22,846	2,823,279
1922	61,465	1210,861	28,079	626,162	69,215	456,819	388,215	128.111	109,123	403,755	36,327	22,159	2,847,867
1923	71,253	1403,684	27,608	615,658	68,075	449,295	395,910	130,650	110,829	410,067	37,223	22,706	3,032,060
1924	68,485	1349,155	27,135	605,111	66,318	437,699	403,605	133,190	112,536	416,383	38,361	23,400	2,964,938
1925	57,346	1129,716	25,413	566,710	63,794	421,040	411,300	135,729	114,242	422,695	38,112	23,248	2,699,138
1926	53,817	1060,195	24,698	550,765	60,837	401,534	418,995	138,268	115,949	429,011	39,730	24,235	2,604,008
1927	56,541	1113,858	23,799	530,718	58,480	385,968	426,690	140,808	117,655	435,324	41,881	25,547	2,632,223
1928	62,353	1228,354	22,082	512,499	57,296	378,154	434,385	143,347	119,362	441,639	44,554	27,178	2,731,171
1929	56,715	1117,286	22,300	497,290	57,369	378,628	442,080	145,886	121,068	447,952	47,171	28,774	2,615,816
1930	52,600	1036,220	21,482	479,049	59,648	393,677	449,775	148,426	122,775	454,268	48,913	29,837	2,541,477

Livestock data from U. S. D. A. Yearbooks; human population data from census resorts.

*Numbers on farms multiplied by a factor to include those not on farms. Factor given in Appendix, "Livestock not on farms."

**Numbers of hogs multizlied by 10.7, the estimated consumption per head. The figure 19.7 is derived by dividing 40 percent of United States average corn production 1912-1921 by the average number of hogs for the same period.

†The livestock figures from 1890 to 1899 show a marked downward movement followed by a jump from 1899 to 1900, the census year. One-tenth of this 1899-1900 difference in these data in the last column has therefore been added cumulatively to the 1890-1899 figures.