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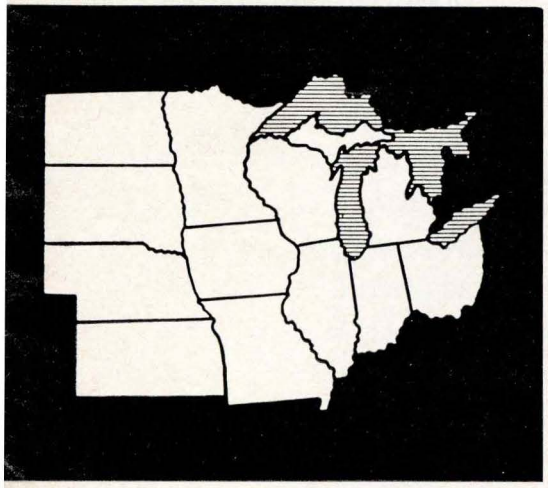
EFFECTS OF THE FEDERAL PROGRAMS FOR CORN AND OTHER GRAINS ON CORN PRICES, FEED GRAINS PRODUCTION AND LIVESTOCK PRODUCTION

Agricultural Experiment Stations of

Illinois	Missouri
Indiana	Nebraska
Iowa	North Dakota
Kansas	Ohio
Michigan	South Dakota
Minnesota	Wisconsin

BY GEOFFREY SHEPHERD AND ALLEN RICHARDS



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FOREWORD

The North Central Regional Research Committee on Agricultural Price Policy (NCM-11) has been conducting research on the impact of agricultural price and income policies on agricultural producers, marketing agencies and consumers. To date the work has been organized and conducted on the basis of commodities important in the North Central Region. This is the second regional publication dealing with the effects of the corn programs. The first publication was entitled "Effects of the USDA Corn Storage Program on Corn Carryover Stocks and Utilization," published in January 1957 as North Central Regional Publication No. 77.

It is intended that the present publication will add to our specific knowledge of the effects of the programs for corn and other feed grains on corn prices, feed grain production and livestock production. Representatives of the Agricultural Experiment Stations in the North Central Region on the Agricultural Price Policy Committee are as follows:

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SUMMARY

Effects on United States Average Corn Prices

What effect have the federal programs for corn and other grains had on corn prices? Three alternative hypotheses concerning the effects of the programs on corn prices are investigated in this study:

(1) The Commodity Credit Corporation loans and storage operations pegged corn prices at the "effective" corn loan rates—that is, at the loan rates minus the cost of storage borne by farmers.

(2) The CCC loan operations and the withholding of CCC owned stocks from the market had no effect on corn prices, since a bushel of corn is still a bushel of corn and exerts the same influence on price no matter who owns it.

(3) The CCC storage operations stabilized corn prices to an extent commensurate with the size of the storage stocks.

Simple comparison of corn loan rates and prices each year since the CCC program started in 1933 shows that the first hypothesis must be rejected. In 1947, for example, the November-May United States average farm price of corn was 83 cents per bushel higher than the loan rate. The reason for this was clear enough; the stabilization stocks of corn carried over from the preceding year were too small to fill in the shortage caused by the small size of the 1947 crop. The next year, 1948, when the corn crop was large, the November-May average price was 24 cents below the loan rate. The same thing happened again in 1954; in 1955, the price was 37 cents below the loan rate. These differences between the loan rate and the price of corn are greater than the storage and other costs involved in the program. Evidently, the first of the three hypotheses is not confirmed by the facts; the loan program does not peg the price of corn closely at the effective loan rate.

Statistical price analysis leads to rejection of the second hypothesis (that the CCC operations have no effect on corn prices). It gives tentative support to the third (that the CCC operations do support prices) but indicates that the extent of the support in recent years probably is somewhat less than if the stocks were consumed and taken entirely out of the market.

Effects on the Corn Price Surface

Each crop year from 1933 to 1940, the corn loans were made at a uniform or flat rate per bushel over the commercial corn area. Beginning with the 1941 crop year, geographical differentials in the loan rates were introduced, based chiefly on moving averages of open market price differentials over recent periods of years.

The flat loan rates before 1941 and differential loan rates after 1941 did not have much effect on the unevenness and variability of the geographical corn price surface over the area (that is, on relative corn prices at different points over the area). The corn price surface, as represented by dollar-and-cent differentials between Nebraska and Iowa, and Ohio and Iowa, behaved much the same under the flat loan rates and under the differential loan rates as it did before the program began in 1933.

When the geographical price differentials are deflated by division of the United States average price of corn each year, they show some tendency to be lower and more stable after 1941 than before. It is difficult to determine how much of this can be attributed to the corn loan program, and how much to the existence of price ceilings during World War II, changes in freight rates, changes in relative livestock numbers and corn production, the increasing use of trucks and other factors.

These findings have a bearing on the question of whether it would be desirable to replace the existing relatively stable geographical differentials in loan rates by differentials which would vary each year inversely with the relative variations in corn production in different parts of the commercial corn area. This variation in loan rate differentials would conform more closely with the variation in price differentials that existed under the open market. The findings, however, show no rigidifying effect that can clearly be attributed to the flat loan rate or to the relatively stable differential rates rather than to other factors. There is no clear evidence that the present relatively stable differential rates need to be replaced by a system of differential rates that vary from year to year inversely with year-to-year variations in the size of the corn crop in different parts of the commercial corn area.

Effects on Corn and Other Feed Grains Acreage and Production

The corn acreage allotment programs before World War II reduced corn acreage about 10 percent but did not appreciably affect total feed grains production. Acreage allotment programs were put into effect again in 1954 and 1955; they did not appreciably affect corn acreage or production, chiefly because compliance with the program was low. The acres diverted from wheat and cotton under the wheat and cotton programs, however, and put into feed grains other than corn, increased total feed grains production about 10 percent.

The number of commercial corn counties has increased from 566 in 1938 to 932 in 1958. This increase has taken place mostly around the fringes of the Corn Belt and in the South. This appears to indicate that corn production has been moving out of the Corn Belt.

The corn acreage and production data, however, show the opposite. They show that the acreage of corn in the 1958 commercial corn area has declined 8.5 percent in recent years below the 1948-50 level, but that the acreage of corn outside the area has declined further, 23.5 percent below the 1948-50 level. They also show that corn production in the commercial corn area has risen 5 percent since 1948-50, but that outside the area, it has declined 7 percent.

The data by states show that the acreage and production of corn is increasing in the four states, Iowa, Illinois, Indiana and Ohio, and *decreasing* in the southern states.

Thus, corn acreage and production is not being driven out of the commercial corn area. On the contrary, it is moving into the commercial corn area.

Effects on Livestock Production

Livestock production became more variable after 1933 when the corn loan program began than it was before. On the face of it, this could be regarded as evidence that the corn loan program had an unstabilizing influence on livestock production rather than a stabilizing influence.

Consideration of the main facts of the whole situation, however, leads to a different conclusion. The corn loan program was a relatively small factor after 1933 compared with the other events that took place: the most severe drouths in history in 1934 and 1936, which reduced corn production 40 percent in those years; all-out production of hogs as a war measure in 1943; price ceilings and rationing during World War II; a doubling of the price level after the war; a drop in total feed concentrate production of 25 percent from 1946 to 1947 and a rise of 40 percent from 1947 to 1948; and war in Korea in 1950. These were the chief factors that caused the large variations in livestock production that took place after 1933. The controlling effect of feed supplies on pork production is shown by the correlations of 0.87, between corn consumption October-September and pork production 3 months later, and of 0.94, between total concentrates fed and pork production over the period 1926-54.

After 1947, on the average, the CCC corn loan program removed about 80 percent of the excess over average corn production in large crop years and returned it in small crop years. It thus had a substantial stabilizing effect on corn consumption. The correlation between corn consumption and pork production during this period, however, when no very small corn crops occurred, was lower than for the longer period which included the short crops of 1934, 1936 and 1947. Apparently, the CCC program during 1948-56 could have had only a partial stabilizing effect on pork production.

The effects of the CCC program on beef production were too small to be measured with any accuracy.

Effects of the Federal Programs for Corn and Other Grains on Corn Prices, Feed Grains Production and Livestock Production*

BY GEOFFREY SHEPHERD AND ALLEN RICHARDS

This is the second report in a series dealing with the effects of the federal corn program on producers, processors and distributors, and consumers.

The first report showed the effects of the corn stabilization program on corn utilization and the size and location of corn stabilization stocks.[1] The present report covers a broader field. It analyzes the effects of the corn and other feed grains programs on the prices and production of these grains and livestock.

EFFECTS OF CORN STORAGE OPERATIONS ON UNITED STATES AVERAGE CORN PRICES

This section tests three alternative hypotheses:

(1) The Commodity Credit Corporation (CCC) commodity loans and storage operations pegged corn prices at the "effective" corn loan rates—the loan rates minus the cost of storage borne by farmers.

(2) The CCC loan operations and the withholding of CCC owned stocks from the market had no effect on corn prices, since a bushel of corn is still a bushel of corn and exerts the same influence on price no matter who owns it.

(3) The CCC storage operations stabilized corn prices to an extent commensurate with the size of the storage stocks.

The corn stabilization program is implemented by corn storage and unstorage operations, backed up in some years by acreage control programs designed to reduce corn production when corn supplies become excessive. In conducting its storage operations, the CCC does not directly impound surplus corn (the excess over average production) in years of big crops. The CCC merely sets the rates in dollars and cents per bushel at which it will underwrite nonrecourse loans to farmers and accepts any eligible corn which eligible farmers deliver in satisfaction of unredeemed loans. It then releases this corn for domestic use in later periods of small crops or increased demand when prices are above the prevailing loan rate plus 5 percent and reasonable carrying charges, as currently provided by law. It can, however, sell for domestic use at any price corn which is going out of condition or threatening to go out of condition. There are no minimum price restrictions on sales for export.

Whenever the stabilization stocks are insufficient to fill in the shortages, prices rise above the loan rates; sometimes they rise above the legal minimum CCC sales prices. Table 1 and fig. 1 show that the November-May average United States farm price of corn exceeded the loan rate in 1947, for example, as much as 83 cents per bushel—well above the minimum sales price.

The chart also shows that in several recent years the farm price of corn declined below the loan rate. The price declined as much as 24 cents below the loan rate in 1948 and 1954, and 37

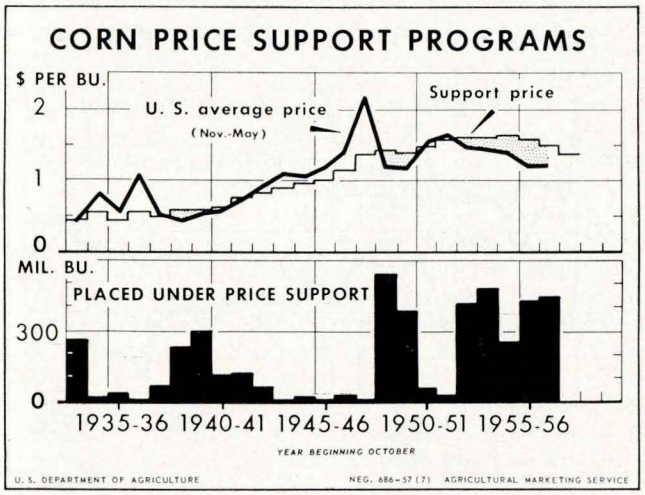

Fig. 1. United States average price of corn, loan rate (support price) and quantity of corn placed under price support 1933-56.

*/Project NCM-11, North Central Regional Research Committee on Agricultural Price Policy, Subproject No. 3, Corn.

1/Geoffrey Shepherd and Allen Richards. Effects of the USDA corn storage program on corn carryover stocks and corn utilization. Iowa Agr. Exp. Sta. Res. Bul. 446 (North Central Regional Publication No. 77). 1957.

TABLE 1. CORN: U. S. LOAN RATES, U. S. AVERAGE FARM PRICES, AND DIFFERENTIALS BETWEEN THEM, SUPPORT PRICES AND QUANTITY PLACED UNDER SUPPORT, 1933-56.

Year beginning October	Announced national average loan rate*		Average loan per bushel sealed	Average price Nov.-May†	Average price minus announced loan rate	Average price minus average loan rate	Placed under price support				Under loan or owned by CCC at end of crop year
							Loans‡	Purchase agreements	Total	Percentage of production	
	(dollars per bushel)	(percentage of parity)	(dollars per bushel)	(dollars per bushel)	(dollars per bushel)	(dollars per bushel)	(million bushels)	(million bushels)	(million bushels)	(percent)	(million bushels)
1933	0.45	60	0.45	0.45	0.00	0.00	268	.....	268	11.2	82
1934	0.55	68	0.55	0.83	0.28	0.28	20	.....	20	1.4	.....
1935	0.45	55	0.45	0.55	0.11	0.11	31	.....	31	1.3	.....
1936	0.55	66	0.55	1.06	0.51	0.51	.....	.....	.....	.....	.....
1937	0.50	58	0.50	0.51	0.01	0.02	61§	.....	61§	2.3	45
1938	0.57	70	0.57	0.44	—0.13	—0.13	230	.....	230	9.0	258
1939	0.57	69	0.57	0.55	—0.02	—0.02	302	.....	302	11.7	471
1940	0.61	75	0.61	0.58	—0.03	—0.03	103	.....	103	4.2	403
1941	0.75	85	0.73	0.74	—0.01	—0.01	111	.....	111	4.2	197
1942	0.83	85	0.77	0.90	0.07	0.13	56	.....	56	1.8	8
1943	0.90	85	0.84	1.12	0.22	0.28	8	.....	8	0.3	6
1944	0.98	90	0.89	1.07	0.09	0.18	21	.....	21	0.7	9
1945	1.01	90	0.92	1.15	0.14	0.23	3	.....	3	0.1	.....
1946	1.15	90	1.08	1.38	0.23	0.30	26	.....	26	0.8	9
1947	1.37	90	1.31	2.20	0.83	0.89	1	1**	1		
1948	1.44	90	1.39	1.20	—0.24	—0.19	377	174	551	15.3	493
1949	1.40	90	1.34	1.18	—0.22	—0.16	332	55	387	11.9	650
1950	1.47	90	1.40	1.55	0.08	0.15	52	2	54	1.8	488
1951	1.57	90	1.58	1.66	0.09	0.08	25	1	26	0.9	306
1952	1.60	90	1.56	1.47	—0.13	—0.09	315	102	417	12.7	580
1953	1.60	90	1.56	1.42	—0.18	—0.14	377	94	471	14.7	736
1954	1.62	90	1.58	1.38	—0.24	—0.20	204	55	259	8.5	870
1955	1.58	87	1.55	1.21	—0.37	—0.34	361	60	421	13.0	1,060
1956††	1.50	84	1.42‡‡	1.21	—0.29	—0.21	402	75	477	13.8	1,295
1957††	1.40	77									

*/Applies to commercial area only in years when acreage allotments are in effect.

†/Average price received by farmers in period when most of the corn is placed under price support. In recent years, loans have been available from time of harvest through May.

‡/Excludes purchase agreement corn placed under loan in the following year during the period 1948 to date.

§/Included 14 million bushels of 1937 corn placed under loan for first time in 1938 under short term loan program.

**/Purchase agreements not available prior to 1947.

††/Loans were made to noncooperators at $1.25 per bushel in 1956 and at $1.10 in 1957.

‡‡/Includes corn placed under loan at $1.25 as well as at $1.50 per bushel.

Compiled from reports of Commodity Stabilization Service. Data published currently in: U. S. Dept. Agr., Agricultural Marketing Service. The feed situation.

Source of Table: U. S. Dept. Agr. Agricultural outlook charts, 1956. Nov. 1955. Table 35, p. 68; U. S. Dept. Agr. Grain and feed statistics through 1954. U. S. Dept. Agr. Stat. Bul. 159. March 1955. Table 48, p. 46; U. S. Dept. Agr. Agricultural Marketing Service. The feed situation. May 1956. p. 21, and later issues.

cents below in 1955. Figure 2 shows that the prices of oats and barley behaved in a similar way.

When prices decline substantially below the loan rates, large quantities of grain are put under loan or purchase agreements. This is shown in table 1 and fig. 1. In most recent years, from about one-fifth to about one-half of these loans or purchase agreements on corn were redeemed before the end of the marketing year; the remainder were taken over by the CCC.

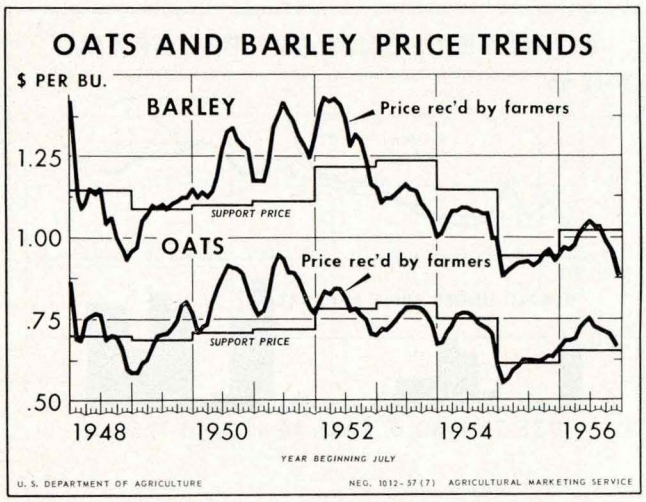

Fig. 2. United States average farm prices of oats and barley, monthly, and CCC loan rates, annually, 1948-56.

These figures are based on United States average farm prices and loan rates. The individual situations in different parts of the country and in different months might differ considerably from the average. But fig. 3, based on Iowa average farm prices and loan rates, pinpoints

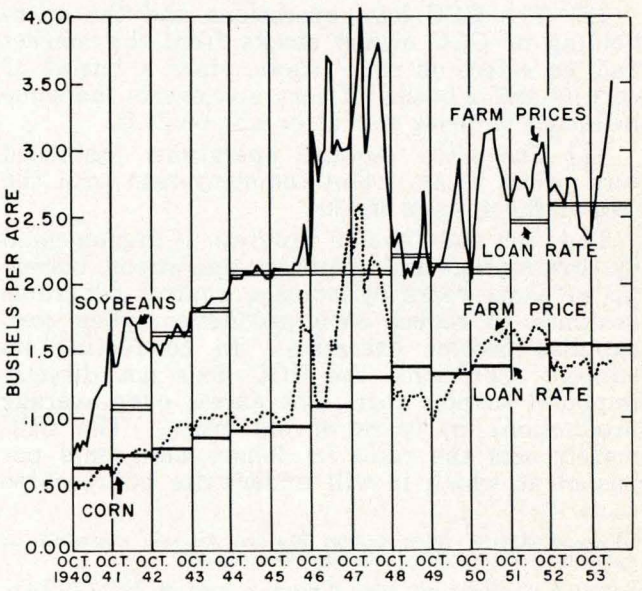

Fig. 3. Iowa average farm prices of corn and soybeans, monthly, and Iowa CCC loan rates, annually, 1940-53.

the situation in a smaller area and shows much the same situation as figs. 1 and 2.

Why Do Corn Prices Decline Below the Loan Rates?

It is easy to see why corn prices rise above the loan rates in short crop years when storage stocks are too small to fill out the shortage. Buy why do corn prices fall below the loan rate in years when crops and stocks are large, even though the CCC stands ready to make loans on all eligible corn offered at the loan rate and eventually take the corn over at that rate if the borrower wishes?

The question can be broken down into three parts:

1. *Why does the actual United States average loan rate differ from the announced United States average loan rate?* The actual United States average loan per bushel sealed usually runs several cents lower than the announced United States average loan rate. Table 1 shows that the two rates were the same during the flat loan rate period. During the period since 1940, however, when geographical differentials in loan rates were in effect, the actual rate ran several cents lower than the announced rate every year but 1951 (when it was 1 cent higher). It fell as much as 9 cents below the announced rate in 1944 and 1945.

These differences between the announced loan rate and the actual loan rate result from several factors.

The institution of geographical and grade differentials in loan rates in 1941 made it necessary (1) to devise a procedure for weighting the schedule of county loan rates to assure that they would result in a United States average loan rate equal to the announced loan rate for all corn and (2) to develop a schedule of county base loan rates from which the premiums and discounts could be computed in determining the amount to be loaned on each lot of corn placed under loan by each producer.

In devising a procedure for weighting the schedules of base county loan rates, the "normal" distribution of corn production was computed based on average corn production over the preceding 2 or 3 years. The resulting United States average of the base rate was weighted by the premiums and discounts on the basis of the estimated historical quantity of corn subject to such premiums or on discounts based on inspected receipts.

The base rate schedule of county loan rates was announced as applicable to corn grading No. 3 with moisture content of 13.5 percent or less. For 1955, for example, the base county rates (prior to applying the 75-percent factor for the noncommercial area) for No. 3 corn, 13.5 percent or under moisture, were weighted by the most recent county production data, and the resulting state averages were weighted by the 1950-54 average production. This weighted average was $1.5947 per bushel. When adjusted for (a) premiums and discounts (grade, mixed and moisture) and (b) for the grades of corn ineligible for loans, at historical market price differences, the United States average of the base county rates was $1.58 per bushel, the approved United States average loan rate for all corn. For the noncommercial corn area, the base county rates were adjusted to 75 percent of the rate used in weighting the schedules.

These differences in the loan rate for geographical location and quality reduce the average amount loaned per bushel below the announced United States average loan rate. There are several possible reasons for this reduction: (1) The United States average announced loan rate is weighted by the historical average quantities of corn *produced* in each county and state, whereas the United States average actual loan rate is weighted by the quantities of corn *put under loan* in each county and state. Relatively large quantities of corn are placed under loan in the counties and areas where the loan rate is below the United States average loan rate. (2) The premiums for corn grading better than No. 3 are not applied to the amount loaned if the corn is stored on the farm (such premium is applied only at the time of settlement on delivery of corn to CCC), while the discounts (moisture and mixed) are applied in all cases at the time the loan is made, for example, 2 cents per bushel on mixed corn. (3) The actual loan rate to producers in the noncommercial area is 25 percent (17.5 percent in 1956) below those used to determine the United States average support rate. (4) There is a deduction for storage from the time of storage until maturity date of loan on corn stored in approved warehouses. (5) In 1956 and 1957, still another factor existed. Considerable quantities of corn were stored under support in the commercial corn area at the lower rate for producers who did not comply with acreage limitations. But this lower rate existed only in these 2 years.

Examination shows that reasons 2, 3 and 4 have only a small effect. Relatively small quantities of corn have been placed under loan in the noncommercial area, and the 75-percent factor was applied only in those years when allotments were in effect. Relatively small quantities are stored in warehouses (in 1955 less than 10 million out of 361 million bushels) so the effect of the deductions for storage is relatively small. Further, the adjustment for moisture on ear corn stored on farms is not applied to the loan rate on ear corn stored on farms, as the quantity is determined by measurement and the adjustment for moisture is made by adjusting the bushels or the quantity placed under loan rather than by a reduction in the loan rate. Also, very little of the corn that is sealed grades "mixed." Thus, these three factors (items 2, 3 and 4) could not account for much of the difference between the amount loaned per bushel and the United States average support rate.

This is shown empirically by the fact that on

TABLE 2. AVERAGES OF BASE COUNTY LOAN RATES AND ACTUAL LOAN RATES, 1955.

State	Base county loan rates per bushel for No. 3 corn—13.5 percent moisture		Actual average loan per bushel
	Range—Commercial county rates	Estimated state average loan rate for all counties*	
	(dol./bu.)	(dol./bu.)	(dol./bu.)
Iowa	1.49 - 1.58	1.528	1.520
Ohio	1.61 - 1.67	1.630	1.619
Indiana	1.59 - 1.62	1.602	1.601
Illinois	1.58 - 1.64	1.601	1.601
Missouri	1.56 - 1.64	1.604	1.597
Nebraska	1.51 - 1.55	1.528	1.523
Pennsylvania		1.750	1.740
Delaware		1.740	1.740

*/Prior to applying the 75-percent factor in the counties outside the commercial area.

a state basis the actual average loan per bushel is approximately equal to the estimated state average loan rates. Table 2 shows the data for a few states having a large number of commercial counties for 1955.

This table clearly indicates that in 1955 the average amount loaned (the actual loan rate) in each state was close to the estimated average loan rate for that state.

The difference between the United States average announced loan rate and the actual United States average loan rate, then, must be almost entirely due to item (1)—the fact that, beginning with 1941, relatively larger quantities were placed under loan in those counties and states where the loan rate is below the United States average support rate.

Iowa is a state where all the county corn loan rates, basis No. 3, are below the United States average loan rate. About 18.9 percent of the total United States corn production (based on 1955 weighting of the loan rate schedule) is produced in Iowa, but 29.1 percent of the total United States quantity of corn was placed under loan in Iowa. In contrast, the county loan rates in Ohio (commercial area) are above the United States average loan rates; Ohio corn production averages 6.5 percent of the United States average, but only 4.3 percent of the United States total placed under loan was in Ohio. These differences in weighting are the chief reasons why the United States actual average loan per bushel is lower than the United States announced average loan rate.

The chief reason, therefore, the United States actual average loan rate (the average loan per bushel) usually runs lower than the United States announced average loan rate is simply a matter of statistical weighting. The actual loan rate is weighted by the quantities of corn put under loan in each county and state, whereas the announced rate is weighted by the historical quantities of corn produced in each county and state. The quantities of corn put under loan have been relatively heavier than the quantities of corn produced in the states where the loan rate is below the United States average loan rate, and these heavier weights pull the actual average loan rate down.

2. Why is the effective loan rate lower than the actual loan rate? The fact that the actual average loan rate usually runs several cents lower than the announced loan rate, as shown earlier in table 1, is only one reason why corn prices in big crop years decline some distance below the announced loan rate. Table 1 showed that corn prices fall below the actual average loan rate too. Why is this?

A farmer who is considering taking out a CCC loan on his corn is confronted by some money costs and some red tape. The service fee for taking out a loan is 1 cent per bushel on corn stored on the farm or ½ cent per bushel for corn stored in a warehouse. The fee for a purchase agreement is ½ cent per bushel. The interest rate on the loan is 3.5 percent; this, however, is not a net cost, because the farmer has the use of the money he borrows.

The farmer also incurs the costs of keeping the corn in storage. These costs are not all to be charged to the loan, unless the farmer otherwise would have sold all of his corn right after harvest; most farmers do not do this, because, in most years, the corn is too wet to sell until it has dried for several months on the ear in the crib.

"The cost" of taking out a loan, therefore, is not a single simple figure. Even the cash expense differs from farm to farm, according to the type of storage structure, whether the farmer already has storage structures to hold the corn, or whether he would have to add to those he already has, whether he is a livestock farmer who would not incur the costs of shelling and delivery if he did not put his corn under loan, and so forth. The range of cash costs of storage estimated by different farmers in a recent survey is given in table 3.

More farmers in this survey estimated the cash expenses for storing corn at 10-12 cents per bushel per year than at any other figure. Forty percent of the farmers sampled in Illinois estimated their costs at this level, though the figure for the Iowa farmers was only 26 percent. This means that, in Iowa particularly, one cannot say what "the" storage expense was; the estimated expense is not a single figure, but a series of rates

TABLE 3. PERCENTAGE OF OPERATORS GIVING VARIOUS ESTIMATES OF CASH EXPENSES FOR STORING CORN IN IOWA AND ILLINOIS.

Cash expense per bushel per year	Iowa	Illinois
(cents)	(percent)	(percent)
0	6	1
1-3	16	15
4-6	18	14
7-9	16	18
10-12	26	40
13-15	10	10
Over 15	8	2
Total	100	100

Source: Ernest J. Mosbaek. Participation in the corn support program. Unpublished M.S. thesis. Iowa State College Library, Ames, Iowa. 1955.

for different farmers, ranging all the way from 0 to over 15 cents, with a wide dispersion about the average.

Accordingly, an average cost figure would not mean much. Perhaps the best way to summarize the information in table 3 is to say that most of the farmers (92 percent in Iowa, and 98 percent in Illinois) estimated their cash expenses for storing corn up to 15 cents per bushel, with the majority up to about 10 cents. That is, the effective loan rate is considered to be about 10 cents per bushel lower than the actual loan rate for most farmers, and up to 15 cents lower for some.

3. Why does the open market price decline below the effective loan rate? Figure 1 showed that the United States average farm price of corn in big crop years declines as much as 34 cents per bushel below the actual loan rate. This is below the effective loan rate for most farmers. Why does this decline below the effective loan rate take place?

One reason the open market price of corn—the United States average farm price—declines below the effective loan rate might be that the open market price is an average of all the grades of corn that are being sold on the open market, whereas the effective loan rate is the rate for No. 3 corn, with a moisture content of 13.5 percent or less. If the average grade of the corn being sold on the open market were lower than No. 3, this would be one reason the open market average price of corn would run below the effective loan rate.

What are the facts of the matter?

Analysis of the carlot inspections of corn in Chicago from 1940 to 1954 shows that the quantity of corn which grades No. 4, No. 5 and sample grades, is about 21 percent higher than the quantity that grades No. 1 and No. 2. That is, the average grade of the corn received at Chicago—which is a fairly representative sample of the corn produced in the commercial corn area—is substantially lower than No. 3. This is one reason the average farm price for corn runs lower than the loan rate for No. 3 corn.

Another reason corn prices decline below the effective loan rate might be the small extent of participation in the support program by farmers. Table 1 showed earlier that on a national basis, the highest percentage of a given year's corn production that was placed under support (both loans and purchase agreements) since the beginning of the corn support program was 15.3 percent in 1948.

The story is much the same for Iowa, the major corn producing state. Table 4 shows the percentages of the Iowa corn crop put under loan in each of the years since 1950. The percentages range from 2 to 23.3.[2]

2/ There is, however, considerable variation between counties in Iowa. One county, Fremont, placed 40.9 percent of its production under loan in 1952 and 48.4 percent in 1953. In the same years another county, Allamakee, placed 5.4 percent and 4.5 percent of its production under loan.

TABLE 4. PERCENTAGES OF THE IOWA CORN CROP PUT UNDER CCC LOAN, PERCENT OF IOWA FARMS COMPLYING WITH ACREAGE ALLOTMENTS AND PERCENT OF IOWA CORN ACRES ON FARMS COMPLYING WITH ACREAGE ALLOTMENTS BY YEARS, 1950-55.

Years	Percent of corn crop put under loan	Percent of corn farms complying with acreage allotments	Percent of corn acres on farms complying with acreage allotment
1950	4.0	51.3	54.5
1951	2.0	-----	-----
1952	20.0	-----	-----
1953	22.0	-----	-----
1954	16.3	44.4	48.6
1955	23.3	50.7	54.5

These percentages could be low because only small percentages of farmers participated in the corn acreage allotment program. A farmer is not eligible to get a CCC loan if there is an acreage allotment program and he is not participating in it.

This could not have been a reason in 1951, 1952 and 1953, for corn acreage allotments were not in effect in those years; but what about 1950 and 1954 and 1955, when corn acreage allotments were in effect?

Table 4 shows the percentages of Iowa farms that participated in the acreage allotment programs in 1950, 1954 and 1955. The percentages of the total Iowa corn *acres* run about 10 percent higher than the percentages of Iowa *farms*. These percentages all run much higher than the percentages of the corn crop put under loan.

Does this mean that nonparticipation in the corn acreage allotment program is not a limiting factor on corn loans?

It does not necessarily mean this. One would expect the percentage of the corn crop put under loan to be substantially smaller than the percentages of the corn acreage put under allotment, because most farmers who put their corn under loan do not put a high percentage of their total corn crop under loan. If they put only half their corn crop under loan, for example, that would mean that the loan percentages for the state would run only half as high as the acreage percentages.

The data, therefore, do not show directly whether nonparticipation in the corn acreage allotment program is a limiting factor on the percentage of the corn crop put under loan. Information from another source, however, indicates that nonparticipation is not an important factor. Table 5, taken from a survey of Iowa and north-

TABLE 5. IMPORTANT FACTORS CAUSING IOWA AND ILLINOIS FARMERS TO NOT SEAL CORN, 1952 AND 1953.

Factors	Iowa	Illinois
	% of operators who sold corn	% of operators who sold corn
Corn did not grade No. 3 or better	8	9
Producer did not have storage	34	29
Expected to feed corn	8	1
Afraid govt. would not remove corn before storage was needed next year	13	6
Need cash sooner than would get under loan	1	2
Differential too small	23	24
Did not believe in program	8	26

Source: Ernest J. Mosbaek. Participation in the corn support program. Unpublished M. S. thesis. Iowa State College Library, Ames, Iowa. 1955.

ern Illinois farmers in 1952 and 1953, shows the reasons that farmers gave for not sealing their corn.

According to this table, the most important reasons in Iowa were lack of storage space and the small size of the differential between the market price and the loan rate. In addition, farmers still remembered what happened in 1949, when many of them were "stuck" with corn sealed from the previous year, which the CCC was not able to take over by the time the 1949 crop began to be harvested.

"Did not believe in program" was an important reason in Illinois; 26 percent of the Illinois farmers listed that as a reason for not sealing corn. But only 8 percent of the farmers in the Iowa sample listed that as a reason for not sealing corn. The reason for this difference in beliefs is not known.

Noncompliance may have become more important since 1953, because compliance has declined substantially since that time. The figure for the commercial corn area as a whole in 1957 was only 14 percent of total production.[3]

"Before" and "After" Analysis of Corn Prices

The preceding sections show the chief reasons the first hypothesis tested, that the CCC program pegged the price of corn at the effective loan rate, is not confirmed by the facts. The question then arises: How much stabilizing effect on corn prices *did* the program have? Did it have no effect (the second hypothesis) ? Or did it have an effect commensurate with the size of the stocks withheld from the market (the third hypothesis) ?

A few years ago, Elmer Working made a study of the combined effects of the corn loan programs and the World War II price ceilings.[4] He compared the coefficients of variation of the monthly prices of No. 3 yellow corn at Chicago for three 5-year periods—1909-13, 1923-27 and 1928-32—prior to corn loans and three 5-year periods—1938-42, 1942-45 and 1948-52—since corn loans. The deflated pre-loan coefficients averaged 20.1; the post-loan coefficients averaged 13.2, only two-thirds as large as the pre-loan coefficients. Working concluded then that "corn price controls—including both the corn loan programs and the price ceilings of World War II—have substantially reduced the variability of corn prices."[5]

This conclusion seems reasonable, and it appears to be based on a good statistical foundation. Working said, "At first I used the calendar years 1937 to 1941 for one period, but this showed a larger coefficient of variation for deflated corn prices than did any of the three pre-loan periods, due to the influence of the 1936 drouth on 1937 corn prices. Consequently, I decided to use the years 1938 to 1942 in spite of the overlap of one year with the 1942-45 period."

Shifting this one period by 1 year, however, changes the conclusion materially. If Working had stayed with the original period, 1937-41, the table in his article shows that the coefficient of variation would have declined only from 20.1 in the "pre-loan" period to 19.1 in the "post-loan" period. He would have had to conclude then that the corn loan program brought about practically no reduction in corn price variability.

The difficulty here is that from the "pre-loan" period to the "post-loan" period, several catastrophic events were taking place—the most severe drouth in United States crop history, two world wars, with inflations and deflations that doubled and halved prices, etc. These different events all exerted their effects on corn prices. One man might ascribe the resultant behavior of corn prices to one of these events; another man might ascribe it to another. Both would be wrong. When several diverse forces are at work, one cannot ascribe the net result of their influence to any one of them by simple before-and-after statistics.

In the present case, there would be as much justification for calling the periods "pre-war" and "post-war" periods (or the "pre-inflation" and "post-inflation" periods) and then concluding that the war (or the inflation) had had this or that effect on corn prices. The more valid method is to compare prices after 1933, not with prices before 1933, but with what prices would have been without the loan program. This is attempted in the next section.

Multiple Correlation Analyses of Corn Prices

The chief factors that determine the price of corn can be ascertained by means of multiple correlation analysis. After the effects of these factors are taken into account, any unexplained price residuals can be examined to see whether they can logically be attributed to the corn program.

R. J. Foote published an analysis of corn prices in 1953[6] and brought it up to date in 1957. His study included the three chief factors that appeared to determine corn prices over the period 1921-50, omitting the war years 1943-45: (1) the total supply of feed grains Oct. 1 each year (reflecting changes in supply); (2) the prices of livestock and livestock products (reflecting the total demand for all goods and services in the country, and also reflecting a part of the livestock demand for corn); and (3) the number of grain-consuming animal units (reflecting the rest of the livestock demand for corn). In his study, these factors accounted for (explained) 95 percent of

3/ U. S. Dept. Agr., Agricultural Marketing Service. The feed situation. Jan. 1958. p. 25.

4/ Elmer Working. The effectiveness of free market prices in allocating resources within agriculture. Jour. Farm Econ. 35:784-794. Dec. 1953.

5/ Ibid, pp. 788-89.

6/ R. J. Foote. Statistical analyses relating to the feed-livestock economy. U. S. Dept. Agr. Tech. Bul. 1070. June 1953. pp. 6, 10. See also: R. J. Foote, John W. Klein and Malcolm Clough. The demand and price structure for corn and total feed concentrates. U. S. Dept. Agr. Tech. Bul. 1061. Oct. 1952. p. 38.

the year-to-year variation in the price of corn.

These factors are given in tabular form annually in table 6. The data have been brought up to date since 1950, the latest year included in Foote's original analysis. Charts of the data similar to those used in graphic multiple correlation analysis are shown in fig. 4. The lowest section of fig. 4 shows the unexplained variations in the price of corn remaining after the influence of the factors shown above has been taken into account.

The unexplained residuals (the variations that are not explained by the factors used in fig. 4) are given in table 7. They can be related to the storage operations of the CCC. If a correlation is found, the next step would be to determine by logical economic principles whether the correlation is only accidental, or whether the one can be considered the cause of the other.

After the CCC was set up in 1933, its Oct. 1 stocks of corn grew to large proportions during two different periods—1938-41 and 1948-56.

The lower part of fig. 4 indicates that the 1938-41 operations had only a small effect on corn prices. But during 1951-56, corn prices rose to as much as 50 percent higher than their normal relationship to the factors shown.

We have taken the differences between the actual price of corn and the estimated price each year during these two periods and plotted them

TABLE 6. U. S. AVERAGE FARM PRICE OF CORN, NOVEMBER TO MAY, AND RELATED VARIABLES, 1921-56.

Period beginning	X_0 Price of corn Nov.-May	X_1 Supply of feed concentrates*	X_2 Grain-consuming animal units fed annually*	X_3 Price received by farmers for livestock & products (Nov.-May)†
	(cents per bushel)	(mil. tons)	(millions)	
1921	51	136	152	123
1922	73	126	163	132
1923	76	129	162	128
1924	108	114	151	144
1925	69	129	149	151
1926	66	123	152	150
1927	83	123	153	151
1928	83	126	153	160
1929	78	122	154	148
1930	60	113	152	110
1931	33	122	156	78
1932	24	138	159	67
1933	45	115	154	74
1934	83	82	131	106
1935	56	114	138	118
1936	106	90	138	123
1937	51	123	138	114
1938	44	130	148	108
1939	55	136	156	107
1940	58	140	156	122
1941	74	151	167	159
1942	90	172	192	194
1943	112	164	193	196
1944	107	158	173	206
1945	115	155	168	215
1946	138	157	160	278
1947	220	133	154	305
1948	120	167	160	285
1949	118	176	166	258
1950	155	179	172	329
1951	166	169	172	318
1952	147	167	159	278
1953	142	173	157	270
1954	138	182	162	240
1955	121	196	166	224
1956	121	200	163	237

*/ Year beginning October.

†/ Index numbers, 1910–14=100.

Source: R. J. Foote. Statistical analyses relating to the feed-livestock economy. U. S. Dept. Agr. Tech. Bul. 1070. June 1953. p. 6. Data for recent years from Gordon King and H. Weingarten, AMS, USDA.

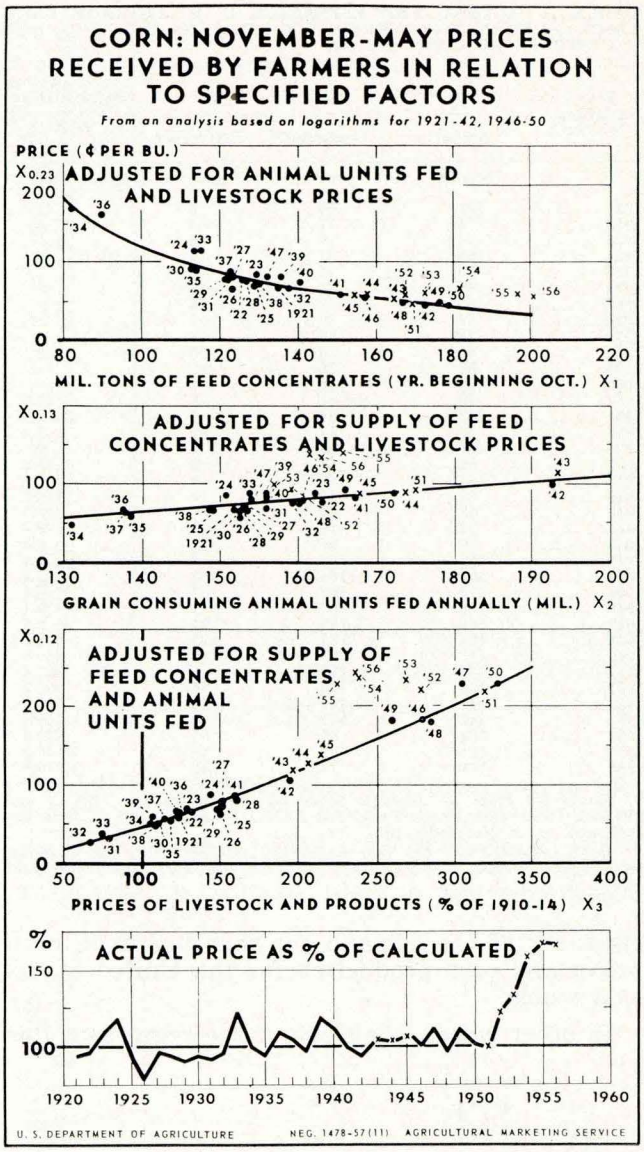

Fig. 4. United States average farm prices of corn, November-May, in relation to (1) the supply of feed concentrates, (2) the number of grain consuming animal units fed and (3) the prices of livestock and livestock products. The lowest section of the chart shows the unexplained residuals.

against the CCC stocks of corn the next Oct. 1[7] in fig. 5. The correlation is not very high, but it is positive, indicating that the withholding of the CCC stocks had some supporting effect on corn prices.

The slope of the regression line drawn freehand through the dots up to 1954 indicates that an increase in CCC stocks withheld from the market of 300 million bushels, for example, raised the price of corn about 24 cents. Now 300 million bushels is about 10 percent of an average corn crop of 3 billion bushels, and 24 cents is about 16 percent of an average price of $1.50. The elasticity of the relationship between these two percentages is -0.625; this is about the same as the

7/ One might expect a higher correlation with the stocks of corn on the preceding Oct. 1. But that correlation turns out to be lower than the one shown in fig. 5.

TABLE 7. ACTUAL AND ESTIMATED U. S. AVERAGE FARM PRICE OF CORN, THE DIFFERENCE BETWEEN THE TWO, AND CCC STOCKS OF CORN, 1921-55.

Year beginning October	Price of corn per bushel			Stocks of corn under loan or owned by CCC on following October†
	Actual	Computed*	Difference	
	(cents)	(cents)	(cents)	(million bushels)
1921	51	54	3	.....
1922	73	77	—4	.....
1923	76	70	6	.....
1924	108	91	17	.....
1925	69	76	—7	.....
1926	66	85	—19	.....
1927	83	87	—4	.....
1928	83	89	—6	.....
1929	78	86	—8	.....
1930	60	65	—5	.....
1931	33	36	—3	.....
1932	23	25	—2	.....
1933	45	37	8	81.6
1934	83	84	—1	.....
1935	56	59	—3	0.4
1936	106	97	9	.....
1937	51	49	2	45.2
1938	44	47	—3	257.8
1939	55	46	9	471.1
1940	58	52	6	403.1
1941	74	75	—1	196.6
1942	90	97	—7	8.3
1943	112	108	4	6.0
1944	107	104	3	9.3
1945	115	108	7	0.1
1946	138	137	1	9.1
1947	220	199	21	0.2
1948	120	127	—7	492.8
1949	118	108	10	649.7
1950	155	154	1	487.4
1951	166	160	6	306.2
1952	147	124	27	580.0
1953	142	107	35	736.0
1954	138	87	51	870.0
1955	121	72	49	1,060.0
1956	121	73	48	1,295.0

*/ Computed from an analysis based on logarithms for 1921-42 and 1946-50, U. S. Dept. Agr. Tech. Bul. 1070. Data for 1952 to date are estimates as of November 1957.

†/ Data indicated for the year beginning October 1952, for example, refer to November 1952-May 1953 price of corn and the government stocks on Oct. 1, 1953.

elasticity of the demand for corn based on corn prices and corn production for the United States as a whole.

In other words, the slope of the regression line up to 1954 indicates that the withholding of the CCC Oct. 1 stocks had about the same effect as if the stocks had been completely removed from the market, or never produced in the first place. The dots after 1954, however, lie below the regression line; this indicates that the withholding of the stocks had less effect after 1954 than it had up to that time.

Another investigation of the effects of the corn loan program was published by Gordon King of the AMS, USDA, 3 years after Foote's analysis was published.[8] One part of his study used the same variables as Foote used, but included only the years when CCC loans and stocks were small. This part of King's study yields results similar to Foote's results, when the price residuals are plotted against CCC stocks. The last two sentences in King's report state: "Estimated prices are compared with actual prices to test the assumption that quantities withheld from the market (stocks owned by CCC plus old-crop grain resealed) do not affect the November-May average price of corn received by farmers. Although no firm conclusion is reached, the results suggest that these stocks are usually isolated in such a way as not to affect the market price."[9]

The positive correlation shown in fig. 5 (and in a similar chart based on King's results), however, results almost entirely from the position of the dots for the years after 1950, which were not included in Foote's original multiple correlation analysis. (The years after 1951 were not included in King's analysis.) The years after 1950 and 1951, therefore, represent an extrapolation of the data beyond the periods in the analysis.

8/ Gordon A. King. Some economic effects of supporting feed grain prices. Jour. Farm Econ. 38:1415-1426. Dec. 1956.

9/ King, op. cit., p. 1426.

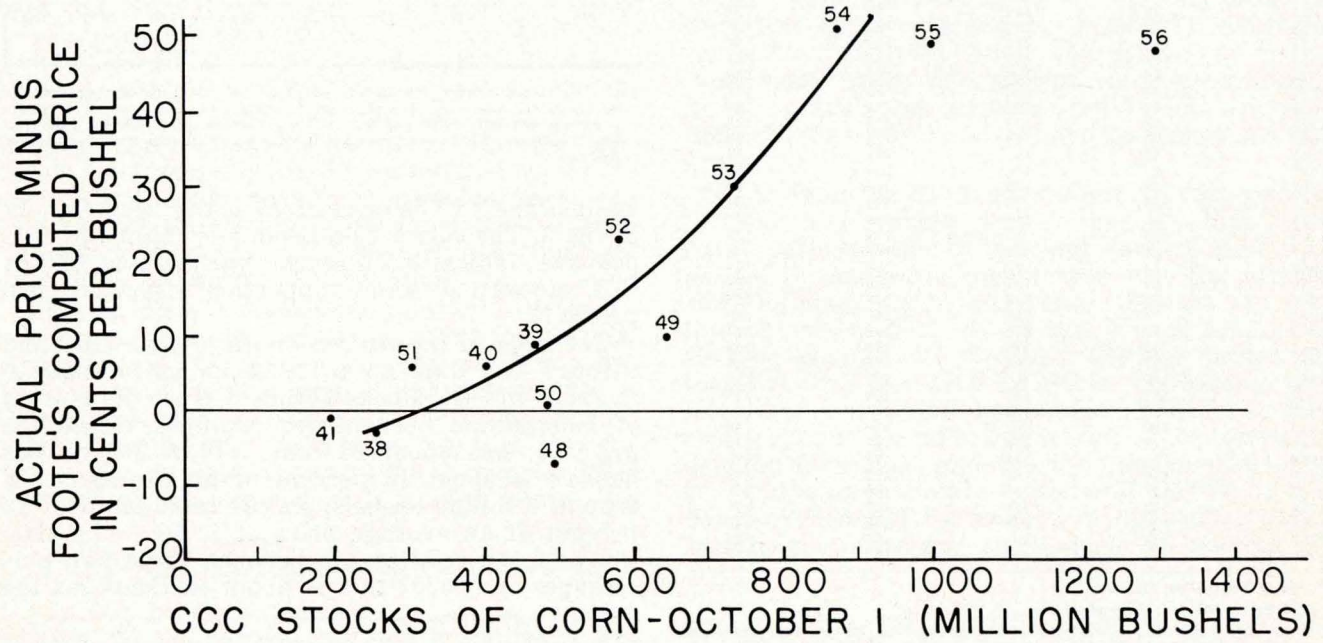

Fig. 5. Residuals shown in the lowest section of fig. 4 and the third column of table 7 plotted against the CCC stocks of corn the following Oct. 1.

It should be recognized that King's conclusion is valid only on the assumption that CCC stocks are withheld from the market so as to have no effect on the supplies of feed grains, no effect on grain-consuming animal units fed, and no effect on the prices of livestock and livestock products. These are rather stringent assumptions.

The conclusions indicated by Foote's and King's studies, therefore—that the withholding of the CCC stocks effectively supports prices—need to be interpreted with some reservations. King expresses reservations of this sort concerning the results of his study. It is possible that the higher prices during recent years were partly due to structural changes in relationships.

Analysis of post-war data. During most of the years included in Foote's analysis (1921-50, omitting 1943-45) and all of the years included in King's analysis, CCC loans and stocks were either small or nonexistent. This provided their analyses with a good "CCC-free" base from which to measure the effect of CCC operations in years when they were large, but it has the disadvantage that structural changes in relationships may have taken place since the end of the periods included in the analyses.

An analysis based on the years since World War II should be more free of this danger of structural change in relationships, although it may be subject to other weakness, such as the shortness of the series and the difficulty of sorting out the effects of the CCC during the period when it was operating on a large scale. An analysis of this sort, based on the data given in table 8, is offered below.

Figure 6 shows the total supply of corn each year since the end of the war, plotted against the November-May average farm price of corn. The dots for the years 1950-57, when CCC stocks of corn were large, lie above and to the right of the dots before 1950 when CCC stocks were small or zero. The residuals from these charts show very little relationship with livestock prices or production. But when the CCC stocks are subtracted from the total supply, the dots fall more closely

TABLE 8. FEED GRAIN AND CORN: PRICES RECEIVED BY FARMERS AND RELATED FACTORS, UNITED STATES, 1946-57.

Marketing year beginning*	Feed grain supply				Corn supply	
	Carryover* CCC stocks†	Total supply	Feed grain prices‡ (Nov.-May) 1947-49=100	Livestock and livestock product prices‡ (Nov.-May) 1947-49=100	Carryover Oct. 1 CCC stocks†	Total supply
	(mil. tons)	(mil. tons)			(mil. bu.)	(mil. bu.)
1946	-----	134.0	88	96	-----	3,389
1947	0.3	108.0	135	105	9	2,639
1948	-----	143.8	76	98	-----	3,729
1949	15.3	151.2	75	89	493	4,051
1950	20.9	153.2	95	113	650	3,920
1951	14.9	143.0	102	109	487	3,666
1952	9.0	141.5	92	95	306	3,780
1953	16.6	146.7	87	92	580	3,980
1954	22.4	156.5	84	82	736	3,979
1955	29.3	170.8	73	77	870	4,266
1956	34.7	174.4	76	81	1,060	4,621
1957§	40.1	192.3	63**	89**	1,295	4,823

*/ Corn and sorghum grain Oct. 1, oats and barley July 1.

†/ Under loan or owned by CCC.

‡/ Index of prices received by farmers for feed grains and livestock and livestock products.

§/ Preliminary.

**/ November-December average.

Source: U. S. Dept. Agr., Agricultural Marketing Service. The feed situation. Jan. 1958. p. 23.

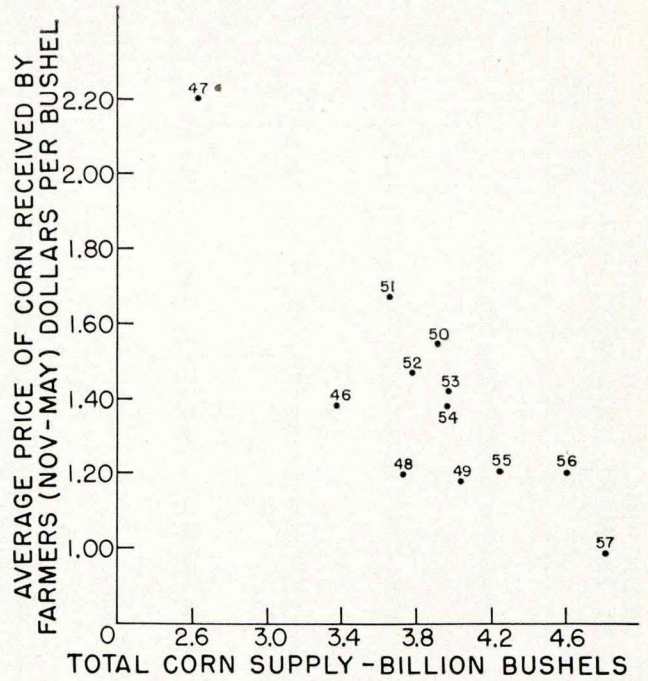

Fig. 6. November-May average price of corn received by farmers plotted against total corn supply, 1946-57.

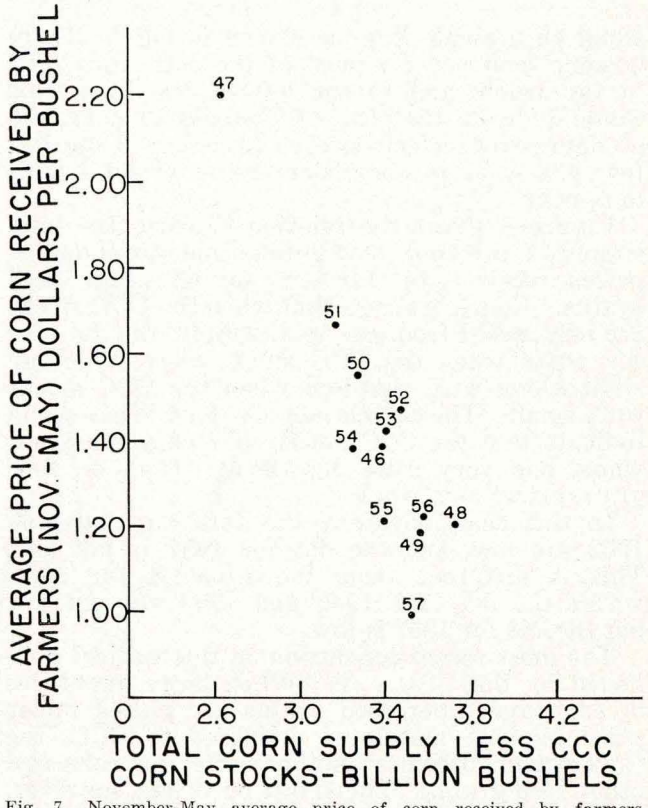

Fig. 7. November-May average price of corn received by farmers plotted against total corn supply less CCC stocks, 1946-57.

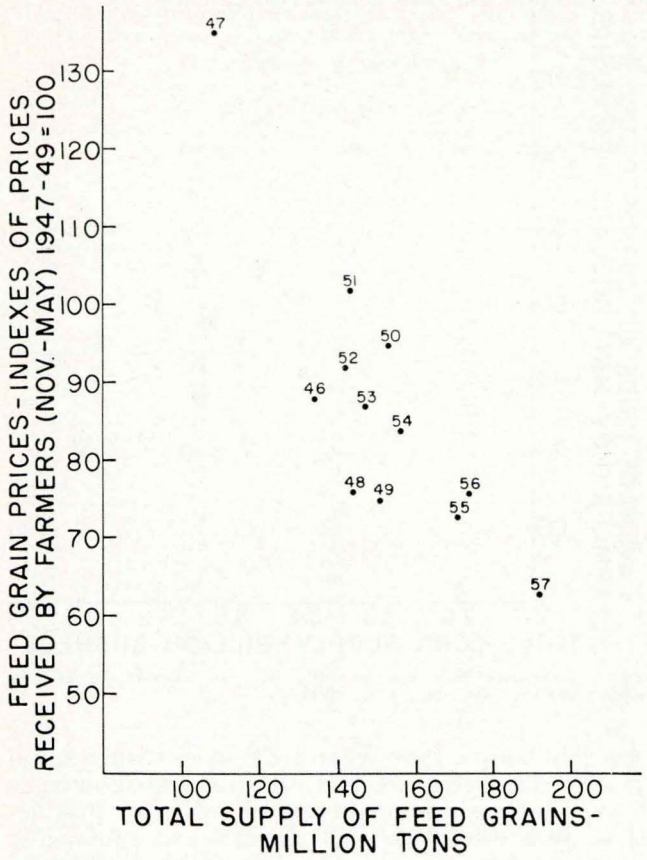

Fig. 8. November-May average index of feed grains prices received by farmers plotted against total feed grains supply, 1946-57.

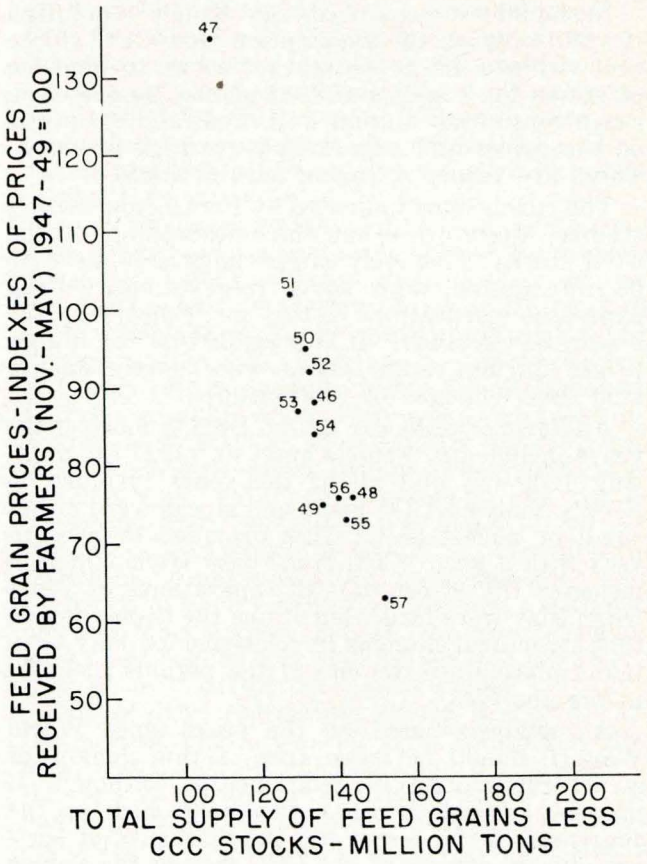

Fig. 9. November-May average index of feed grains prices received by farmers plotted against total feed grains supply less CCC stocks, 1946-57.

along on a single line, as shown in fig. 7. There is some tendency for most of the dots since 1954 to fall below and to the left of the line. This would indicate that the CCC stocks of corn had no depressing effect on corn prices until the last few years, when some depressing effect begins to appear.

Figure 8 shows the relation between the total supply of the four *feed grains* and the index of prices received by farmers for the four feed grains. Figure 9 shows that when the CCC stocks are subtracted from the total supply, the dots for the years when the CCC stocks were large fall right along with the dots when the CCC stocks were small. The correlation is —0.96. This would indicate that the CCC stocks of feed grains as a whole had very little depressing effect on feed grain prices as a whole.

In this case, however, the dots for 1949 and 1953 are low, and the dot for 1957 is not low. This is different from the situation for corn, where the dots for 1949 and 1953 are not low but the dot for 1957 is low.

The most recent conclusion on this subject published by the USDA is: "When large quantities of corn and other feed grains are placed under price support and later delivered to CCC, the Government becomes another outlet for corn and other feed grains. The effect on prices, however, is probably somewhat less than if the corn were consumed and taken entirely out of the market. Corn moving into government storage is still on hand and is available for sale in domestic markets or for export at a future date."[10]

Our own over-all conclusion, based on the USDA studies and on our own analysis, is that in most years the withholding of the CCC stocks of corn from the market had a substantial supporting effect on corn prices, but that the effect in recent years was not as great as if the corn had been consumed and removed entirely from the market. For feed grains as a whole, however, the effect of the withholding of the CCC stocks of feed grains appears to be as great as if the CCC stocks were removed entirely from the market.

EFFECTS OF THE CCC CORN LOAN PROGRAM ON THE CORN PRICE SURFACE[11]

The purpose of this section is to determine the effects of the CCC corn price stabilization program on the corn price surface over the Corn Belt; that is, on the prices of corn at different points over the area in relation to each other.

Corn prices over the area are not uniform. The

10/ U. S. Dept. Agr., Agricultural Marketing Service. The feed situation. Jan. 1958. p. 22.

11/ The preliminary work in this section was done by Richard Day.

corn price surface is not flat; it is uneven. Furthermore, the relations among the prices of corn in the different parts of the area are not fixed. The corn price surface is not like the topography of an area of land, with hills and valleys in fixed locations, but rather like the surface of the ocean, swept by tides, swells, waves and ripples, and continually changing with the passage of time.

When the corn loan program was put into effect in 1933, the question was raised whether a flat loan rate, or a system of differential loan rates, should be adopted. The decision was reached to adopt the simple flat loan rate and see how it worked out.

The flat loan rate was simple, but it did not conform with the uneven price surface that existed under the open market, which facilitated shipments of corn from surplus to deficit areas. Accordingly, beginning with 1941, the flat loan rate was replaced by a system of differential loan rates.

The question then was, should the differentials be fixed, or should they vary from year to year in line with variation in relative corn production and perhaps also with variations in relative numbers of livestock fed?

The decision was made to adopt fixed differentials. Originally, these differentials were based on 10-year and 3-year moving averages of prices by crop reporting districts and states. These differentials, therefore, changed slightly from year to year as the moving average prices advanced another year; they did not, however, change drastically and inversely with each year's changes

TABLE 9. DECEMBER-MAY SIMPLE AVERAGE OHIO, NEBRASKA AND IOWA FARM PRICES OF CORN, 1909-56. (1909 MEANS DECEMBER 1909-MAY 1910.) CENTS PER BUSHEL.

Year	Ohio	Nebraska	Iowa	Ohio minus Iowa	Nebraska minus Iowa
1909	60	51	61	—1	—10
1910	47	37	38	9	—1
1911	66	61	59	7	2
1912	49	43	40	9	3
1913	64	63	58	6	5
1914	71	62	64	7	—2
1915	67	55	62	5	—7
1916	114	100	104	10	—4
1917	140	133	129	11	4
1918	148	138	136	12	2
1919	149	134	136	13	—2
1920	61	38	46	16	—8
1921	53	36	41	12	—5
1922	76	62	62	14	0
1923	74	58	65	9	—7
1924	118	100	102	16	—2
1925	62	58	56	6	2
1926	62	68	60	2	8
1927	91	74	81	10	—7
1928	89	75	74	15	1
1929	75	64	68	7	—4
1930	67	44	52	15	—6
1931	29	31	29	0	2
1932	27	17	17	10	0
1933	44	34	36	8	—2
1934	80	94	84	—4	10
1935	49	52	48	1	4
1936	103	120	113	—10	7
1937	51	52	44	7	8
1938	46	38	37	9	1
1939	56	56	49	7	7
1940	65	54	51	14	3
1941	78	65	71	7	—6
1942	90	83	85	5	—2
1943	111	103	100	11	3
1944	112	93	95	17	—2
1945	117	107	104	13	3
1946	141	129	130	11	—1
1947	218	217	225	—7	—8
1948	118	117	114	4	3
1949	125	114	116	9	—2
1950	166	147	154	12	—7
1951	176	152	159	17	—7
1952	148	142	138	10	4
1953	146	139	140	6	—1
1954	134	138	135	—1	3
1955	123	134	126	—3	8
1956	125	128	118	7	11

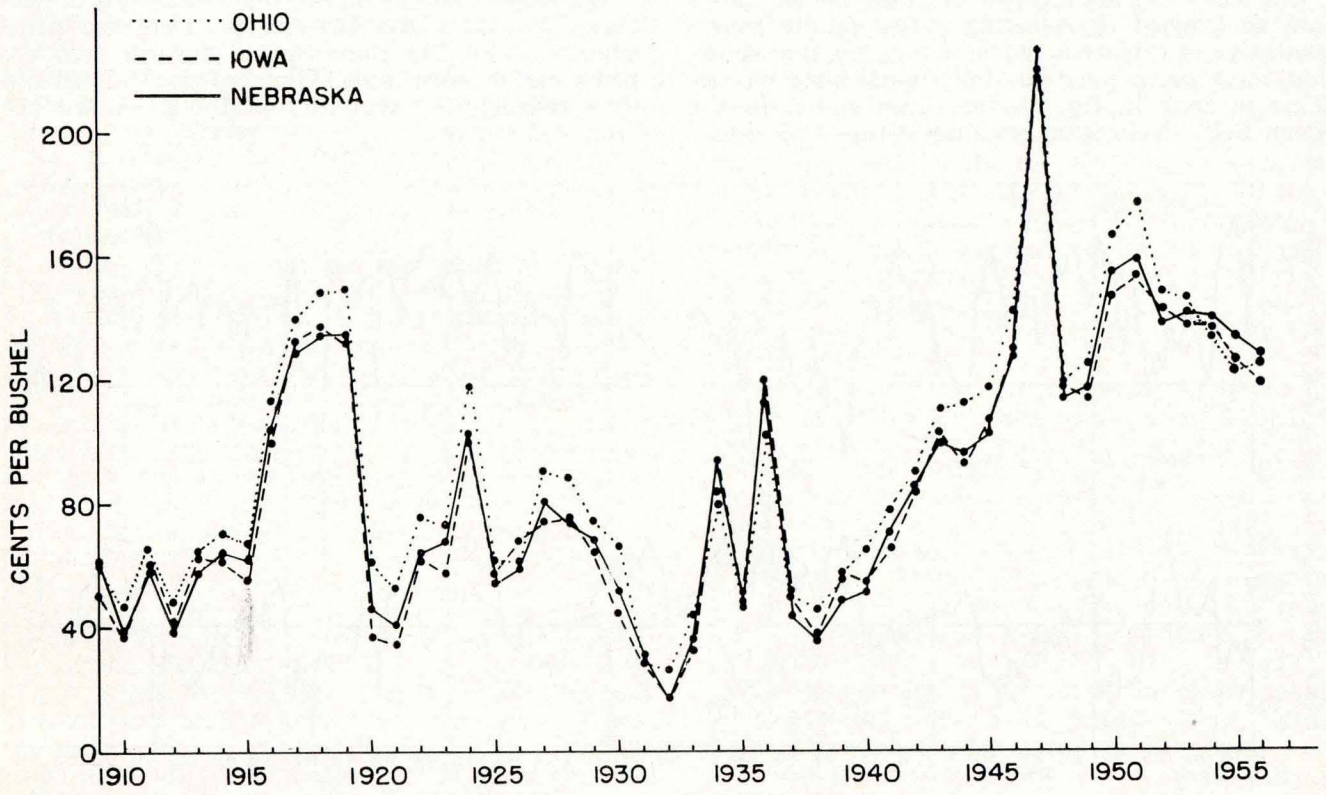

Fig. 10 December-May simple average, Ohio, Iowa and Nebraska farm price of corn, annually, 1909-56.

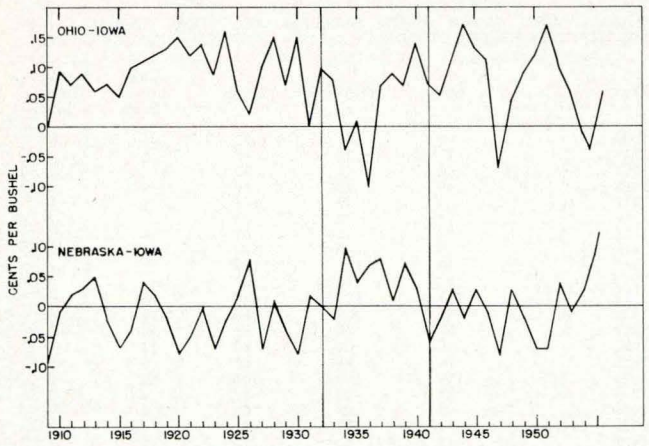

Fig. 11. December-May simple average corn price differentials, Ohio minus Iowa, and Nebraska minus Iowa, annually, 1909-56.

in relative production as open-market prices do. Geographical differentials in loan rates of this nature have been in effect since 1941.

Effects of Flat and Differential Loan Rates

We will attempt to measure the effects of the flat and differential loan rates on the corn price surface over the periods of time when they were in effect.

The variations in the corn price surface could be represented by a series of three-dimensional models, one model for each point of time. It would be difficult, however, for the reader to grasp the nature of the variations over a period of years from study of photographs of these models. More can be learned by selecting a few points representative of different parts of the area and showing their prices on two-dimensional time charts. This is done in fig. 10 for three points in the Corn Belt—Nebraska, Iowa and Ohio—representing the western, central and eastern parts of the Belt. The data for each year are the simple averages from December to May of the monthly farm prices of corn for each state. These data are given in table 9.

Figure 10 shows how the prices of corn in the three states changed over the years from 1909 to 1953, in absolute terms and in relation to each other. The figure shows that the prices in the three states generally varied in the same direction from one year to another, but frequently changed relative to each other.

The nature of these relative changes in prices is shown more clearly in fig. 11. In this figure, the Iowa price is taken as the base line. The differences between the Iowa price and the Nebraska price are plotted above and below the Iowa price in the upper part of the figure; the Ohio prices are shown in a similar manner in the lower part of the figure.

Figure 11 is based on annual (December-May) data from 1909 to 1955. Figure 12 is based on monthly data from 1924 to 1954.

The space to the left of the two vertical lines on these charts represents the open-market period before 1933, when the CCC program went into effect. The space between the two vertical lines represents the 8-year period from 1933 to 1941 when the loans were made at a flat rate over the area (45 cents in 1933, for example). The area *to the right* of the two lines in figs. 11 and 12 represents the period after 1941 when these geographical differentials in loan rates were in effect.

Did these systems of flat loan rates and differential loan rates have any effects on the corn price surface? (1) Did they flatten out the average price surface over a period of years? And (2) did they reduce the variability of the price surface from year to year?

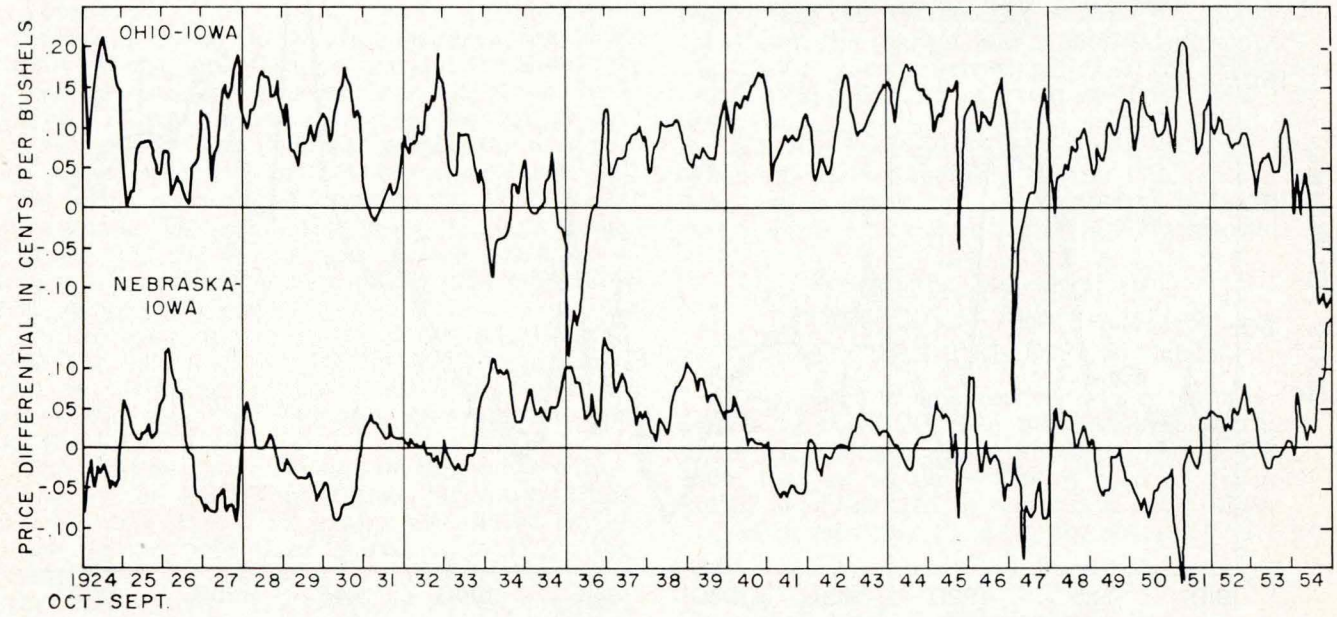

Fig. 12. Corn price differentials, Ohio minus Iowa and Nebraska minus Iowa, monthly, 1924-54.

It is natural to turn to figs. 11 and 12 for the answer to these two questions. A flattening effect would show up in a lowering of the Ohio price line, for example, relative to Iowa; and a reduction in variability would show up in a smoothing out of both the Nebraska and Ohio lines, relative to Iowa.

During the flat loan rate period, shown between the two vertical lines in figs. 11 and 12, the Nebraska price line runs higher (relative to Iowa) than before or after the period. In contrast, the Ohio price line runs lower. It would be easy to conclude from this that the flat loan rates had a flattening effect on the corn price surface and that the differential loan rates restored the surface to about the same unevenness as before the program went into effect.

It would be easy to reach these conclusions, but the conclusions would be unreliable. Many things were happening during the period from 1933 to 1941, and the institution of flat loan rates was only one of them. It would be fallacious reasoning to attribute changes in the corn price surface to any one of these factors without recognition of the effects of the others.

As a matter of fact, the flat loan rates could not have had any flattening effect on the corn price surface from 1934 to 1937 inclusive, because during all of these years the November-May price of corn averaged higher than the loan rate as shown in table 1, and only insignificant quantities of corn were put under loan.

One of the most important changes that took place after World War II was a doubling of the price level. Under these conditions, differentials after the war would be expected to run only about half as great in proportions as in cents. The price surface after World War II in cents was about as uneven as before the war, but fig. 13 shows that in proportional terms, with the differential each year divided by the United States average farm price of corn that year, the price surface was only about half as uneven. That is, it was about half flattened out.

Before we reach another easy conclusion, based on study of this figure, that the corn loan program half flattened out the corn price surface in proportional terms after World War II, we need to remember again that many other things were happening, as well as the coming of the corn loan program. Close inspection of figs. 11, 12 and 13 shows that the most marked decline in the levels of the Nebraska and Ohio price lines took place in the early part of the 1933-41 period. The Ohio price line in fact is depressed only from 1934 to 1936. Now 1934 and 1936 were years of extreme drouth and short crop in the western part of the Corn Belt. This suggests that it was this severe decrease in relative corn production in the western Corn Belt that raised Iowa prices relative to Ohio prices during the flat loan rate period, rather than the flat loan rate. Perhaps also it was this same factor, changes in relative corn production in the different states, that affected the level of relative corn prices after World War II.

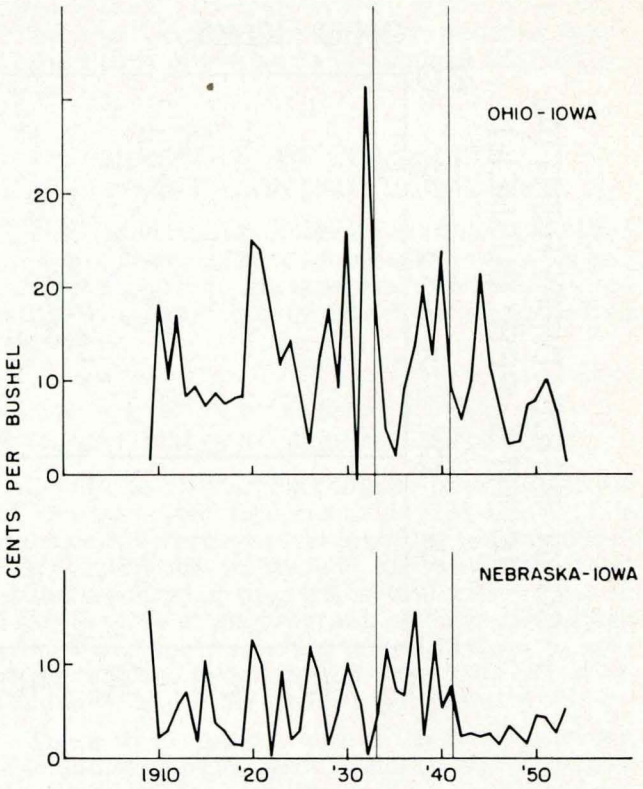

Fig. 13. December-May simple average corn price differential divided each year by the corresponding United States average farm price of corn, Ohio minus Iowa and Nebraska minus Iowa, annually, 1909-54.

As a test of this hypothesis, the annual (December-May) differentials between corn prices in different states are plotted against the relative corn production in those states (that is, against Ohio corn production divided by Iowa corn production, and against Nebraska corn production divided by Iowa corn production) each year from 1909 to date in fig. 14. The upper part of the chart shows the data for Ohio and Iowa; the lower part shows the data for Nebraska and Iowa.

This chart shows a negative correlation of —0.66 for Ohio-Iowa, and —0.69 for Nebraska-Iowa. A relatively large crop in Ohio or Nebraska depresses the price in Ohio or Nebraska relative to the price in Iowa. This effect is in line with price theory.

The slopes of the two regression lines for the two states fitted mathematically in fig. 14 differ. The regression coefficients are —0.54 for Ohio-Iowa and only —0.25 for Nebraska-Iowa. This shows that the relative price responds more than twice as much to a given change in relative production in Ohio as it does in Nebraska. Nebraska is adjacent to Iowa, and shipments of corn from one state to the other evidently put a brake on the responsiveness of prices to changes in relative production.

The dots in fig. 14 do not all lie closely about the regression lines. This indicates that factors other than relative production also have some influence on relative prices.

The corn loan program does not appear to have

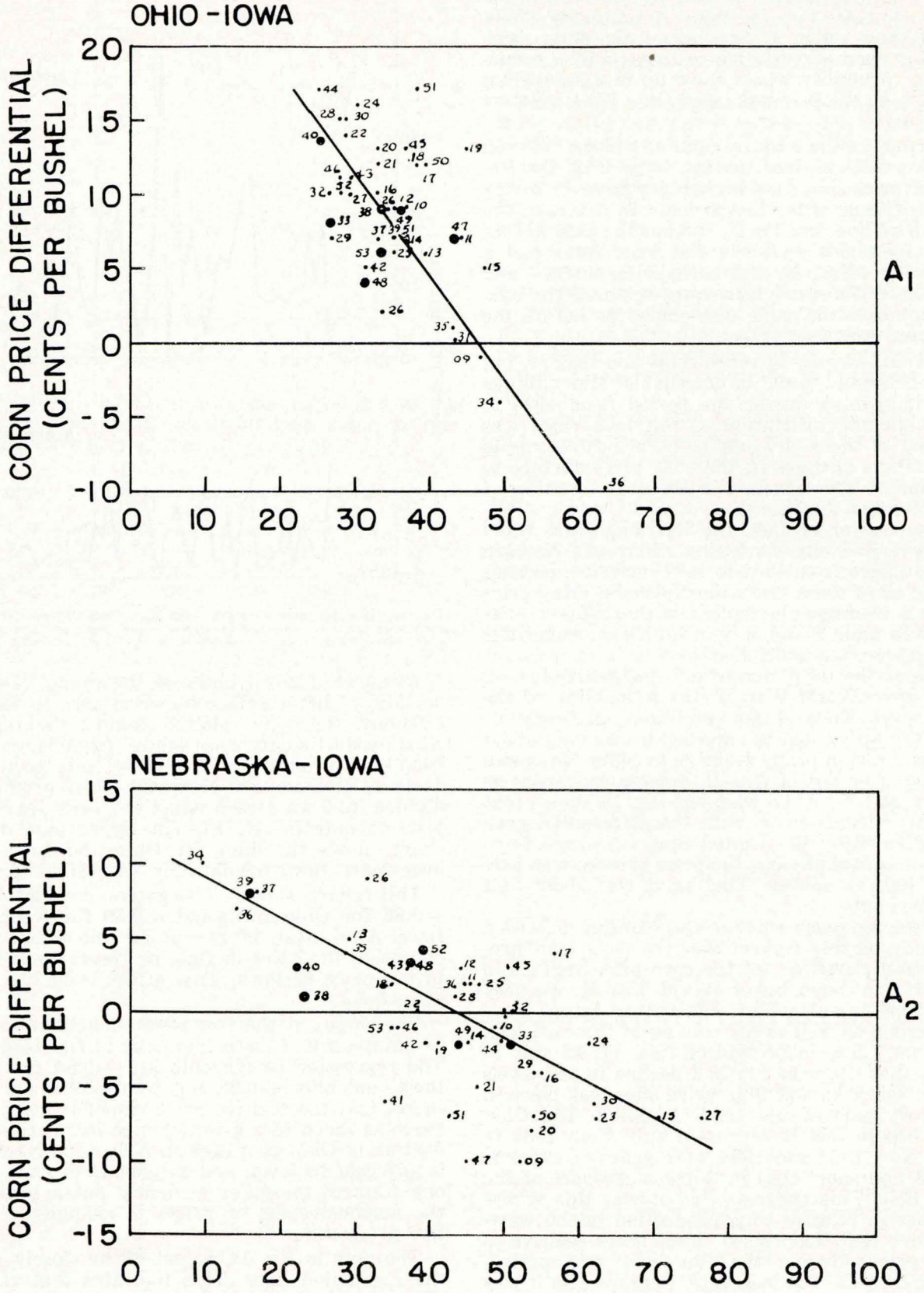

Fig. 14. Upper section: December-May simple average corn price differential, Ohio minus Iowa, plotted against the relative corn production in Ohio and Iowa (Iowa production divided by Ohio production) each year, annually, 1909-53. Lower section: Same as upper section, but for Nebraska and Iowa.

been one of these other factors. The 7 years when substantial quantities of corn were put under loan are shown as larger dots in fig. 14. There is no evidence that these years lie consistently above, or below, or closer to or farther from the lines of average relationship than the other dots, taken as a group. The regression coefficient for the 7 years for Ohio-Iowa is —0.87 and for Nebraska-Iowa is —0.19. These coefficients are not significantly different from the coefficients for the whole period 1909-53 given above, and furthermore, the small differences that do exist lie in opposite directions.

The nature of any shifts in the position of the regression lines can be revealed to some extent by connecting the dots in chronological order. The number of dots in the present case is large, and the nature of the connecting lines is confused by a good deal of overlapping and crossing. A careful study of the data, broken down into six time periods and plotted separately in different charts —too detailed to be shown here—reveals only a downward shift in the regression line for Nebraska after the severe drouths of 1934-36 reduced the number of animal units fed in the state by nearly half.[12] It reveals no stabilizing or other effects of the corn loan program on the corn price surface.

Apparently, the corn loan program did not appreciably affect the configuration of the corn price surface. The price surface continued to vary in response to relative changes in corn production and in animal units, much the same during the flat loan rate period and the differential loan rate period as it did before the program was instituted.

Application of Results

This leads to a conclusion of considerable practical importance.

During the first 8 years of the CCC corn loan program, from 1933 to 1940, geographically flat loan rates were used. From 1941 on, relatively stable geographical loan rate differentials were put into effect. Have these relatively stable differentials been working out all right, or do they need to be replaced by variable differentials, varying each year inversely with relative variations in corn production in different parts of the commercial corn area that year?

The evidence from the present study is that the present relatively stable differentials are working satisfactorily. They are not imposing any rigidity on the flexible corn price surface. The corn price surface remains about as responsive to variations in relative corn production and numbers of livestock fed as before. This implies that, as before, corn is as free to move about in response to relative price changes. There appears to be no need to change the existing system of relatively fixed loan rate differentials to a system that would vary from year to year in response to relative variations in corn production and numbers of livestock fed.

12/ The details are given in: Measuring and appraising the impact of the corn price and acreage control program upon producers, distributors and consumers. NCM-11 Subproject No. 3, Corn Progress Report No. 2. Oct. 4, 1955. N-836.

EFFECTS OF THE USDA ACREAGE CONTROL PROGRAMS

The USDA acreage control programs since 1953 apparently have had different effects on corn and other feed grains acreage and production compared with the effects of earlier programs during the 1930's.

Effects on Corn and Other Feed Grains Acreage and Production

Schultz and Brownlee compared the production of corn and other feed grains in 1938-40 after the AAA corn acreage control program was instituted with production in 1928-30 and also with their estimates of what production would have been in 1938-40 without the program.[13] Table 10 is taken from their analysis. This table led them to conclude that the program had very little effect on total corn and other feeds production.

There were changes within the total, however, attributable to the AAA. Schultz and Brownlee estimated that under the control program corn acreage was reduced about 10 percent below what it would have been without a program. However, they attributed one-third of the average increase in corn yields between 1928-30 and 1938-40 to the acreage control program. Therefore, the higher estimated acreage without a program was offset by estimated lower yields than those that were actually attained under the acreage program. Thus, the total corn production remained about the same with a control program as it would have been without a program. They also concluded that the acreage control program did promote a some-

13/ T. W. Schultz and O. H. Brownlee. Effects of crop acreage control features of AAA on feed production in 11 midwest states. Iowa Agr. Exp. Sta. Res. Bul. 298. April 1952. See also: T. W. Schultz. Agriculture in an unstable economy. McGraw-Hill, New York. 1945. p. 172; and G. Shepherd. Agricultural price policy. Iowa State College Press, Ames, Iowa. 1947. pp. 61-64.

TABLE 10. PRODUCTION OF FEED CONCENTRATES IN 11 MIDWEST STATES.*

Crop	1928-30		1938-40		1938-40 without crop control	
	Average annual acreage (000)	Av. annual production (millions of feed units)	Average annual acreage (000)	Av. annual production (millions of feed units)	Average annual acreage (000)	Av. annual production (millions of feed units)
Corn	62,660	1,826.4	49,962	1,811.2	54,607	1,852.5
Oats	30,138	501.5	25,073	415.9	26,192	435.6
Barley	7,497	141.0	7,170	125.0	7,243	126.6
Rye	1,542	18.5	2,225	25.8	2,225	25.8
Soybeans	712	11.9	3,656	86.8	2,662	63.0
Total	102,549	2,499.3	88,086	2,464.7	92,929	2,503.5
Wheat	27,763	488.6	28,182	476.1	28,764	465.1
Total	130,312	2,987.9	116,268	2,940.8	121,693	2,968.6

* The states included are: Iowa, Illinois, Indiana and Ohio; Minnesota, Wisconsin and Michigan; and South Dakota, Nebraska, Kansas and Missouri. This table was taken from Schultz and Brownlee, op. cit., p. 688.

what smaller production of corn and oats and a larger production of soybeans than would have been attained without the program. The change, however, was not sufficient to disturb feeding operations.

Effects After World War II

The 1954 and 1955 corn acreage programs apparently had very little effect on total acreage in crops. They also had very little effect on corn acreage; but they did affect total feed grain production.

Table 11 shows that the total United States acreage of corn decreased only 1 percent from 1953 to 1955. The chief reason why the decrease in corn acreage was so small was the lack of compliance by many corn farmers. Only 42 percent of the Iowa farmers interviewed in a USDA study[14] complied with corn allotments. Most of the corn farmers interviewed who did not comply with corn allotments intended to feed their corn and therefore were not interested in complying for eligibility in the price support program. Reductions in corn acres made by those who complied with the program were just about offset by increases in corn acres made by farmers who did not comply.

Table 11 also shows that the corn program had little or no effect on corn production. But the programs for wheat and cotton had substantial effects on *total feed grains* production.

Compliance in the wheat and cotton programs was high. All wheat farmers interviewed by the USDA in North Dakota and Washington complied with the allotments. All but 4 percent of the wheat farmers interviewed in Kansas and 14 percent interviewed in Montana complied. Most of the acres diverted from wheat, cotton and corn went into feed grain production. Iowa corn farmers who complied with corn allotments grew more soybeans and oats. Wheat acres were reduced by 30 percent (see table 11). These acres were mainly diverted to grain sorghum in Kansas and to barley in other major wheat-producing regions. The acres which were taken out of cotton production were shifted mainly to the production of soybeans, corn, grain sorghum and barley. The diversion of acres from allotment crops to feed grains other than corn resulted in a 10-percent increase in the total production of feed grains.[15] This increase in feed grains production was not necessarily a net addition to the total quantity of grain fed because some of the wheat would have been fed anyway. But the increase had some depressing effect on feed grain prices.

Thus the wheat and cotton producers transferred a substantial part of their surplus problem to the producers of the nonbasic crops, chiefly the feed grains other than corn, for which price supports were provided without restrictions on production.

"The expansion in production of feed grains and the lower prices of these grains tended to encourage an expansion in production of grain-consuming livestock. However, much of the 6-percent increase in this type of livestock that occurred between 1953 and 1955 probably would have occurred without the allotment programs. There was no increase in these years in roughage-consuming types of livestock; it would take much longer than 2 years for acreage-allotment programs to bring about a significant increase in these types."[16]

14/ U. S. Dept. Agr., Agricultural Research Service. Effects of acreage allotment programs. Prod. Res. Rpt. 3. June 1956. See also: North Central Farm Management Research Committee. Farmers reaction to acreage allotments. Kentucky Agr. Exp. Sta. December 1955.

TABLE 11. CHANGES IN PRODUCTION, HARVESTED ACREAGE AND YIELDS FOR VARIOUS CROPS IN THE UNITED STATES BETWEEN 1953 AND 1955.

Crop	Harvested acreage (percent)	Total production (percent)	Yield per acre (percent)
Wheat	— 30	— 20	+15
Cotton	— 31	— 11	+28
Corn	— 1	no change	+ 1
Rice (1954-55)	— 28	— 17	+16
Oats	+ 4	+ 30	+25
Barley	+ 66	+ 61	— 3
Grain sorghum	+105	+113	+ 4
Soybeans for beans	+ 26	+ 38	+ 9
Flaxseed	+ 10	+ 11	+ 1
Rye	+ 49	+ 61	+ 8
All tame hay	+ 3	+ 7	+ 3

Source: U. S. Dept. Agr., Agricultural Research Service. Effects of acreage allotment programs. U. S. Dept. Agr. Prod. Res. Rpt. 3. June 1956. p. 6.

Effects on the Location of Corn Production

Some observers believe that the corn program increased corn production outside of the Corn Belt—that is, outside of the original commercial corn area.

A recent article on this subject [17] starts out "The Corn Belt is not what it used to be." The article included a chart, similar to fig. 15, entitled "Big Increase in U. S. Corn Growing Areas," showing the increase in the number of counties attaining the status of "commercial corn counties"[18] in recent years. Most of these new commercial corn counties are located on the fringe of the Corn Belt and in scattered areas in the South. The chart appears to show that corn production is being expanded outside the Corn Belt.

It is true that the number of commercial corn counties has increased more than 50 percent. When the commercial area was first set up in 1938, it was composed of 566 counties. The only counties outside the Midwest were four Mississippi and Ohio riverbottom counties of Kentucky. By 1950, the area had expanded to 837 counties, including 55 in Kentucky, 12 in Tennessee and 5 in Arkansas.

Further increases in the production of corn led to enlargement of the area to 932 counties for 1958. There are 17 new corn counties in Alabama,

15/ U. S. Dept. Agr., Agricultural Research Service, op. cit., pp. 1 and 2.

16/ U. S. Dept. Agr., Agricultural Research Service, op. cit., p. 2.

17/ Des Moines Sunday Register. Nov. 10, 1957. p. 21-G.

18/ Commercial corn counties are defined by law as those whose farms produced an average of 450 bushels of corn per farm or 4 bushels or more per acre of farmland in the county.

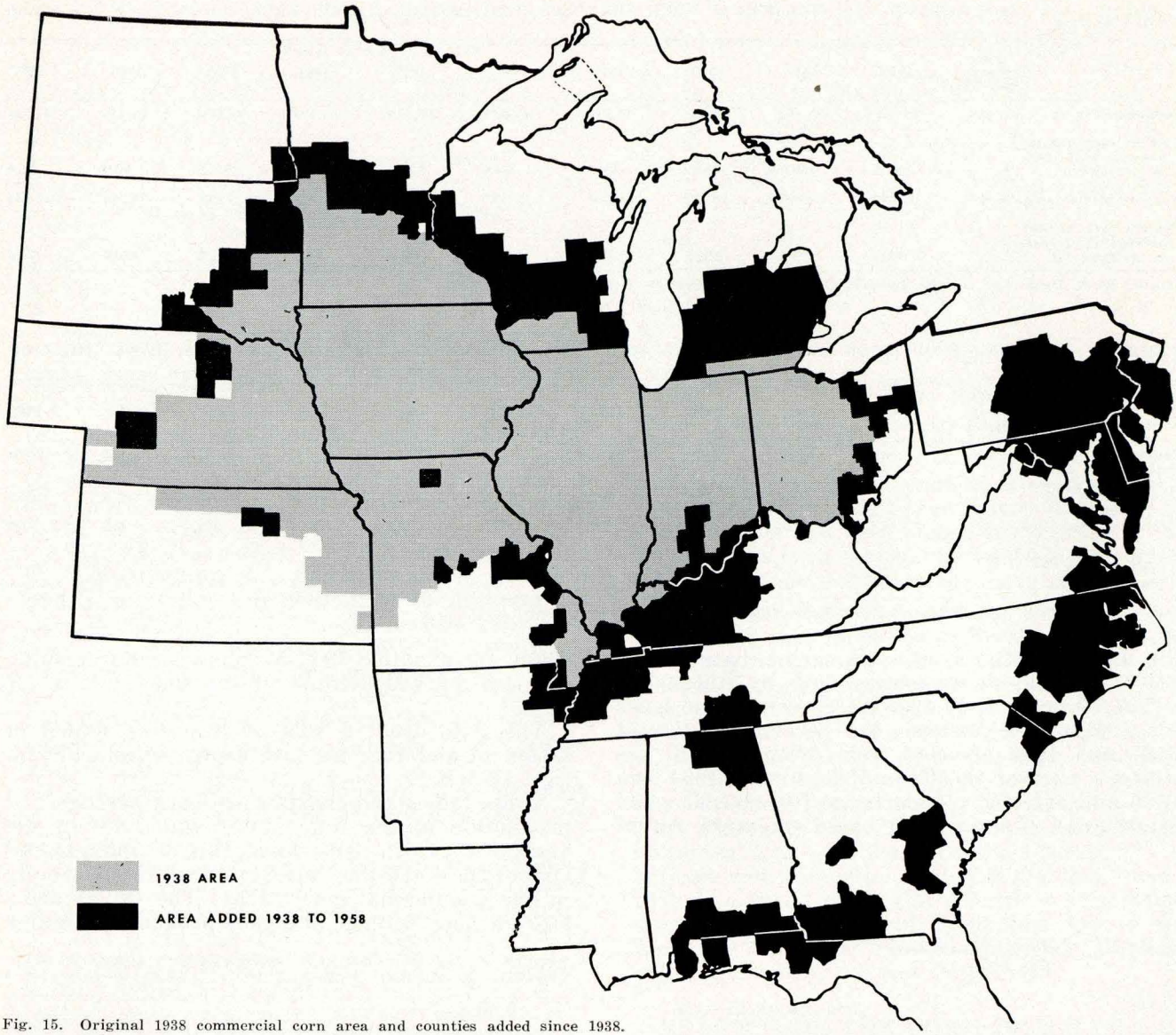

Fig. 15. Original 1938 commercial corn area and counties added since 1938.

5 in Florida, 28 in Georgia, 32 in North Carolina, 2 in South Carolina, 25 in Tennessee and 17 in the Virginias. The East, too, has greater representation, including 11 counties in New Jersey, 31 in Pennsylvania and 16 in Maryland.

Does this increase in the size of the commercial corn area mean that corn production is being driven out of the Corn Belt?

Many observers believe that it does. They believe that acreage controls on corn, the denying of corn loans to noncompliers, and the substitution of corn for controlled crops like wheat and cotton in other areas are driving corn production out of the traditional Corn Belt area.

What do the corn acreage and production data show? Analysis of the corn acreage and production data, however, shows that this is not true.

The data, compiled by the Grain Division of the Commodity Stabilization Service, USDA, are given by years since 1948 in tables 12 and 13. They are shown graphically in figs. 16 and 17.

The data show the corn acreage and production in the 1958 commercial corn area and outside the commercial corn area (that is, in the noncommercial corn area) each year since 1948. The data are shown as percentages of the 1948-50 average.

The table and chart show that the acreage of corn in the commercial corn area has declined 8.5 percent in recent years below the 1948-50 level, but that the acreage of corn outside the area has declined further, 23.5 percent below the 1948-50 level.

The table and chart show also that corn *production* in the commercial corn area has risen 5 percent since 1948-50, but that outside the area, it has declined 7 percent.

Thus, corn acreage and production is not being driven out of the commercial corn area. On the contrary, it is moving into the commercial corn area.

Analysis by states. Another analysis, made by

TABLE 12. ALL CORN ACREAGE, 1958 COMMERCIAL CORN AREA AND NONCOMMERCIAL CORN AREA, 1948-57 (PLANTED ACRES —THOUSANDS).

	3-year average 1948-50	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Commercial area	59,242	59,859	61,446	56,422	59,043	59,094	60,319	60,194	60,030	57,435	54,237
Percent each annual acreage is of 1948-50 average		101.0	103.7	95.2	99.7	99.8	101.8	101.6	101.3	96.9	91.6
Noncommercial area	25,797	25,663	25,292	26,437	24,232	23,136	21,255	21,991	21,067	20,784	19,748
Percent each annual acreage is of 1948-50 average		99.5	98.0	102.5	93.9	89.7	82.4	85.2	81.7	80.6	76.6

Source: U. S. Dept. Agr., Grain Division, Commodity Stabilization Service. April 18, 1958.

TABLE 13. ALL CORN PRODUCTION, 1958 COMMERCIAL CORN AREA AND NONCOMMERCIAL CORN AREA, 1948-57 (MILLION BUSHELS).

	3-year average 1948-50	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Commercial area	2,662	2,963	2,617	2,405	2,349	2,815	2,699	2,614	2,608	2,850	2,804
Percent each annual production is of 1948-50 average		111.3	98.3	90.3	88.2	105.7	101.4	98.2	98.0	107.1	105.3
Noncommercial area	644	642	621	670	577	477	511	444	622	605	599
Percent each annual production is of 1948-50 average		99.7	96.4	104.0	89.6	74.1	79.3	68.9	96.6	93.9	93.0

Source: U. S. Dept. Agr., Grain Division, Commodity Stabilization Service. April 18, 1958.

the present authors, uses an earlier base period (1940-49) and shows more details by states.

The 10 years 1940-49 were chosen as the basis for comparison because the severe drouths of 1934 and 1936 affected corn production in the western part of the Corn Belt during 1934 and 1936 and affected corn acreage for several years afterwards. Comparisons based on more recent years, for example 1944-53, show similar results, but less marked because of the shorter lapse of time.

The data used in this analysis are shown in tables 14 and 15. They are shown graphically in figs. 18 and 19.

These tables and charts show corn acreage and production in the four states which lie in the heart of the Corn Belt—Iowa, Illinois, Indiana and Ohio (these are the only states which lie wholly in the commercial corn area). The tables show also the corn acreage and corn production figures

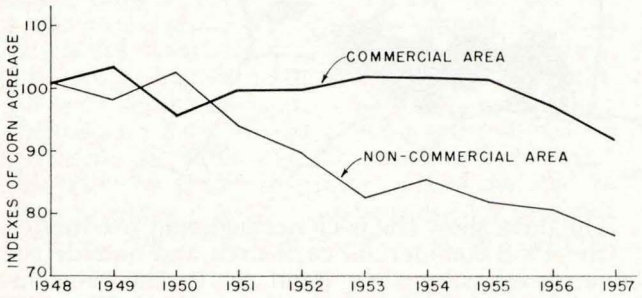

Fig. 16. Annual indexes of corn acreage in the commercial corn area and in the noncommercial corn area, 1948-57 (base 1948–50=100).

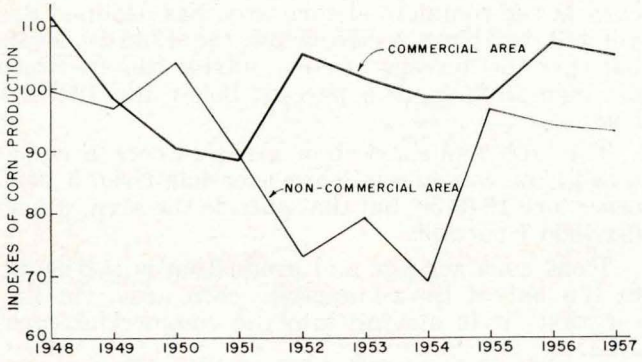

Fig. 17. Annual indexes of corn production in the commercial corn area and in the noncommercial corn area, 1948-57 (base 1948–50=100).

TABLE 14. CORN: ANNUAL INDEXES OF ACREAGE HARVESTED, 1951-57, AND AVERAGE 1950-57 (BASE 1940—49=100).*

	1940-49 average	1950	1951	1952	1953	1954	1955	1956	1957	1950-57 average
Seven southern states	100	91.8	87.4	86.4	81.3	82.2	79.1	76.4	71.7	82.0
Four Corn Belt states	100	96.6	103.0	104.5	107.6	105.8	107.1	101.4	98.2	103.0
Remainder of United States	100	91.5	88.1	87.1	86.0	85.8	84.7	80.4	77.3	85.1
Total for United States	100	93.1	92.5	93.2	91.7	91.2	90.5	86.1	82.7	90.0

*/ This table was compiled by R. D. Krenz.

TABLE 15. CORN: ANNUAL INDEXES OF PRODUCTION, 1951-57, AND AVERAGE 1950-57 (BASE 1940—49=100).*

	1940-49 average	1950	1951	1952	1953	1954	1955	1956	1957	1950-57 average
Seven southern states	100	112.9	103.9	75.1	98.1	71.3	118.5	114.6	102.7	99.9
Four Corn Belt states	100	95.6	102.2	119.9	114.1	113.9	114.0	121.6	118.1	112.4
Remainder of United States	100	107.2	93.7	108.5	102.2	98.3	100.0	110.4	113.0	104.2
Total for United States	100	102.6	98.7	110.0	107.1	102.6	108.4	115.9	114.2	107.4

*/ This table was compiled by R. D. Krenz.

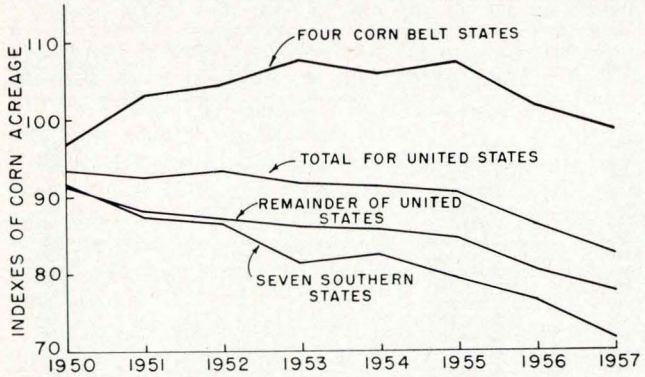

Fig. 18. Annual indexes of corn acreage harvested, 1951-57 and average 1950-57 (base 1940–49=100).

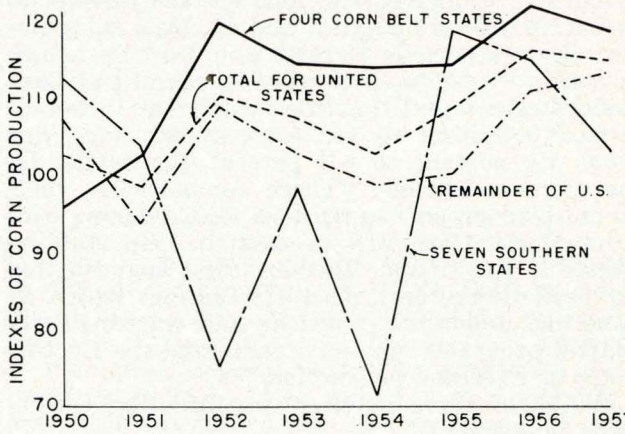

Fig. 19. Annual indexes of corn production, 1951-57 and average 1950-57 (base 1940-49=100).

for the seven southeastern states (Kentucky, Tennessee, Alabama, Georgia, Florida, North Carolina and South Carolina) and for the rest of the states (37 states). Figures for the United States as a whole also are shown.

Table 14 shows that by 1957, corn acreage in the United States as a whole decreased 17.3 percent below its level in 1940-49. In the four central Corn Belt states, however, corn acreage decreased only 1.8 percent, whereas in the seven southeastern states it decreased 28.3 percent. In the rest of the states (the 37 states outside of the four Corn Belt states and seven southern states) corn acreage decreased 22.7 percent. The situation is shown graphically in fig. 18.

Thus corn acreage is becoming relatively more concentrated in the heart of the Corn Belt, not less.

The same sort of relative concentration of corn acreage in the Corn Belt is shown by the 1950-57 average acreage data shown in the last column of table 14. In this case, corn acreage in the four Corn Belt states is up 3 percent, whereas it is down substantially in the rest of the country.

Corn *production* varies considerably from year to year, due chiefly to changes in the weather, but in most years it also is increasing more in the four Corn Belt states than in the southern states or the rest of the country. Table 15 shows that the corn production percentages for the four Corn Belt states exceeded the percentages for all the other areas in 1957 and in most of the earlier years. The percentages for the seven southern states rose slightly above the percentages for the four Corn Belt states and for the other areas too in 1955, but ended up well below the percentages for all the other areas in the most recent year, 1957 (see fig. 19).

The same sort of situation is shown by the average data for 1950-57. Total corn production for the United States was up 9.4 percent. For the four Corn Belt states it was up 12.4 percent, while in the seven southern states, it was actually down a trifle. In the rest of the country it was up only 4.2 percent.

In only one respect are the seven southern states advancing more rapidly than the four Corn Belt states; that is in relative yield per acre, in percentage terms (but not in absolute terms). This increase in yield per acre may be one of the main reasons why the number of commercial corn counties has been increasing creating the impression that corn production has been increasing.

These data show the combined influence of all the factors that have been affecting the location of corn acreage and production—changes in technology, changes in population, etc.—as well as the corn programs. The direct effect of the corn programs alone may have reinforced the influence of these other factors, or it may have completely or partially offset them. The data do not measure the effect of the corn programs alone. The corn programs may have had a decentralizing—or centralizing—influence on the location of corn acreage and production. All that the data show is that as a result of all the influences acting upon them, corn acreage and production are in fact becoming somewhat more centralized in the heart of the Corn Belt, not less centralized.

EFFECTS OF THE CORN PROGRAM ON LIVESTOCK PRODUCTION

The corn storage program was originally set up in the belief that stabilizing the flow of corn into consumption would stabilize corn prices and that this would stabilize livestock production and prices, too.

Has this belief been confirmed? Has the corn and other feed grain storage program stabilized livestock production and prices?

A Senate Document prepared by the USDA in 1952 used statistical measures which "suggest that the price support and storage programs in force during the past 12 to 15 years may have reduced the earlier variability of corn consumption by livestock by as much as 50 percent."[19] This could be expected to reduce the variations in livestock production.

Elmer Working, however, in the study referred

19/ Reserve levels for storable farm products. Senate Document No. 130. U. S. Govt. Print. Off., Washington, D. C., 1952. p. 41.

to earlier, compared the average coefficients of variation of hog slaughter and of cattle slaughter for the two periods 1909-33 and 1937-52, which he referred to as the pre-loan and post-loan periods. He found that the coefficient increased from 8.0 percent to 14.9 percent for hogs, and from 4.1 percent to 6.3 percent for cattle. He therefore concluded: "These comparisons, then, do not lend support to the idea that reducing corn price fluctuations will necessarily help stabilize livestock production. Rather, they suggest that the reduction of corn price fluctuations which we have had under the corn loan and wartime price control programs may have increased the fluctuations in livestock production."[20]

Which of these apparently conflicting conclusions is correct?

In answering this question, the first thing is to recognize that the corn loan program was only a small factor after 1933 compared with the other events that took place: the most severe drouths in history, which reduced corn production 40 percent in those years; all-out production of hogs as a war measure in 1943; price ceilings and rationing during World War II; a doubling of the price level after the war; a drop in total feed concentrate production of 25 percent from 1946 to 1947 and a rise of 40 percent from 1947 to 1948; and war in Korea in 1950.

Any single mathematical figure for each period (before and after the corn program was started in 1933) such as the USDA and Working used, reflects the influence of all these other factors as well as of the corn program. It does not measure the influence of the corn program alone. Here, as with the study of the effect of the corn program on corn prices, it is necessary to compare the variations in livestock production after the programs were begun, not with the variation before the programs but with what the variation would have been if the programs had not been instituted. If this can be done, it will provide a basis for determining whether the corn program had a stabilizing effect on corn consumption by livestock (and thus presumably on livestock production) as the Senate Document suggests, or whether it unstabilized livestock production, as Working's study suggests. Several more years of data are available now than in 1952 and 1953 when these other studies were published. We can see how the conclusions have stood the test of time.

Effects on Corn Consumption

To stabilize corn consumption, the CCC would need to withhold stocks when corn crops were large and return them to the market when crops were small. The correlation between corn production and the change in CCC stocks at the end of the crop year would be positive.

The data to show what the nature of the correlation actually is are given in table 16. The table shows corn production each year since 1933 when the corn loan program began and the quantities of corn under loan or owned by the CCC at the end of the crop year.

TABLE 16. CORN PRODUCTION AND CORN UNDER LOAN OR OWNED BY CCC AT THE END OF THE CROP YEAR, 1933-56.

Year	Corn production for all purposes	CCC corn stocks at end of crop year	Change in corn stocks from previous year
	(1,000 bu.)	(million bu.)	
1933	2,397,593	82	+ 82
1934	1,448,920	.....	— 82
1935	2,299,363	.....	0
1936	1,505,689	.....	0
1937	2,642,978	45	+ 45
1938	2,548,753	258	+213
1939	2,580,985	471	+213
1940	2,457,146	403	— 68
1941	2,651,889	197	—206
1942	3,068,562	8	—189
1943	2,965,980	6	— 2
1944	3,087,982	9	+ 3
1945	2,868,495	.....	— 9
1946	3,217,076	9	+ 9
1947	2,354,739	.....	— 9
1948	3,605,078	493	+484
1949	3,237,749	650	+157
1950	3,074,914	488	—162
1951	2,925,758	306	—182
1952	3,291,994	580	+274
1953	3,209,896	736	+156
1954	3,057,891	870	+134
1955	3,229,743	1,060	+190
1956	3,451,292	1,295	+235

The table shows that the corn program had very little effect during the early 1930's. The CCC was just getting started in 1933. It carried over only 82 million bushels at the end of the 1933 season, and most of that amount was in process of being redeemed. The CCC therefore was not able to fill out the short crops of the next few years to any significant extent.

From 1937 to 1939, the CCC stocks were built up from the moderately large crops of those 3 years to nearly half a billion bushels. Then came World War II in 1941. In 1942 and 1943, the CCC stocks were used, not to fill in short crops, but to add to large crops. Along with the feeding of large quantities of normally nonfeed grains, the stocks helped to produce a tremendous expansion in hog production in 1942 and 1943, far in excess of anything before or since.

This expansion in hog production is the chief reason why the "post-loan" (post 1933) variation in hog slaughter is greater than the "pre-loan" (pre 1933) variation. It cannot properly be regarded as an unstabilizing effect of the corn loan and other programs, in the sense in which the term unstabilizing is generally used in peacetime, as an undesirable thing. Rather it was a planned expansion, desired and necessary to the war effort, not an unintended and undesired result of the corn stabilization program.

For these reasons, conclusions concerning the effects of the corn loan program need to be based chiefly on the period, not since 1933 but since World War II, when the demand for meat was relatively stable and stability in livestock production was desired.

Post-war period. Study of the period since the war gives some support to the USDA conclusion that the corn stabilization program had a stabilizing effect on corn consumption.

20/ E. J. Working, op. cit., p. 790.

The CCC stocks were too small in 1946 to have much effect in filling out the short corn crop of 1947; but the CCC reduced the impact of the large crop of corn in 1948 by absorbing nearly half a billion bushels of corn at the end of the 1948 crop year—a record up to that time.

Stocks were built up further from the average size crop of 1950 and then drawn down to increase supplies from the short crop of 1951. During the next several years, nearly all of the crops were above average size, and stocks increased to record heights.

Figure 20 shows the corn production and stocks data in graphic form, the one series plotted against the other. The figure shows that the correlation between size of crop and change in CCC stocks at the end of the crop marketing year is positive. Furthermore, if 1946 and 1947 are ignored, because stocks in those years were still low because of the war effort, the slope of the line of relationship (the regression line) is about 4 to 5. That is, on the average the CCC corn loan program removed about 80 percent of the excess over average corn production in large crop years and returned it in small crop years. Thus, on the average the CCC corn loan program had a substantial stabilizing effect on corn consumption.

The scatter about the line of relationship between corn production and CCC stocks is fairly wide. That is, the correlation is not high. This means that the CCC program did not do a very accurate job of stabilization, year by year. Some years, it withheld more than the excess over average production; other years, it withheld less.

With this qualification, the over-all conclusion can be reached that after 1947, when the effects of the war-time programs had subsided, the CCC corn loan program had a considerable stabilizing effect on corn consumption.

The stabilizing effect of the corn program on corn consumption presumably had a stabilizing effect on livestock production. The same kind of conclusion could also be presumed with respect to total feed grains, if the feed grains programs as a group had a stabilizing effect on total feed grains consumption. Let us see what the facts of the matter are.

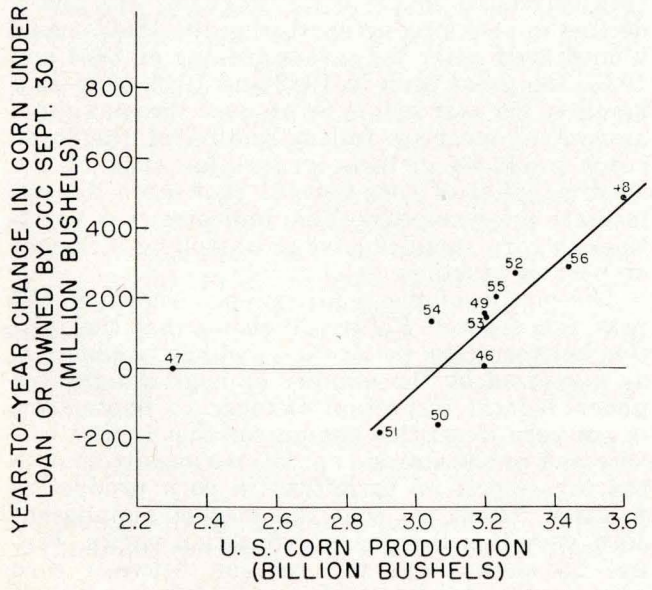

Fig. 20. Year-to-year change in corn under loan or owned by CCC Sept. 30 plotted against U. S. corn production.

Effects on Livestock Production

Hogs. The bulk of the hogs in the United States are produced in the Corn Belt, on corn-producing farms, and corn constitutes about 80 percent of their feed.[21] The relation between corn supplies and hog production, therefore, could be expected to be close, and a corn storage program that smoothed out the variations in corn supplies could be expected to smooth out the variations in hog production, too.

Table 17 and fig. 21 shows pork production annually since 1926.[22] The chart shows clearly that the variation in pork production increased substantially after 1933 when the corn program began. On the face of it, this could be regarded as evidence that the corn program unstabilized pork production rather than stabilized it.

21/ R. D. Jennings. Consumption of feed by livestock, 1909-47. U. S. Dept. Agr. Circ. 836. December 1949. p. 87.

22/ Pork production is used here rather than hog slaughter, because it shows the total weight produced, whereas hog slaughter shows only the total number of hogs, ignoring changes in their weights.

TABLE 17. HOG SLAUGHTER, PORK PRODUCTION, CORN PRODUCTION, CORN FED AND TOTAL CONCENTRATES FED, 1926-56.

Year	F. I. hog slaughter Oct. 1-Sept. 30*	Total hog slaughter Jan.-Dec.	Pork production (excluding lard)	Corn production	Corn fed Oct. 1-Sept. 30	Total conc. fed Oct. 1-Sept. 30
	(thous.)	(thous.)	(mil. lb.)	(m.l. tons)	(mil. tons)	(mil. tons)
1926	41,150	62,585	7,966	71.3	67.2	103.4
1927	43,090	66,195	8,430	73.3	70.4	107.7
1928	47,370	72,889	9,041	74.6	66.0	107.2
1929	48,957	71,012	8,833	70.5	64.8	104.9
1930	45,542	67,272	8,482	58.2	52.5	95.6
1931	43,559	69,233	8,739	72.1	64.3	103.7
1932	46,656	71,425	8,923	82.0	73.5	111.1
1933	47,104	73,270	9,234	67.1	63.1	91.9
1934	43,910	68,760	8,397	40.6	44.1	71.4
1935	30,680	46,011	5,919	64.4	55.7	94.1
1936	31,022	58,730	7,474	42.2	42.5	75.5
1937	34,144	53,715	6,951	74.0	56.5	97.0
1938	34,580	58,927	7,680	71.4	58.8	99.0
1939	39,719	66,561	8,660	72.3	62.5	102.2
1940	47,650	77,610	10,044	68.8	63.2	108.0
1941	48,000	71,397	9,528	74.3	70.0	118.7
1942	52,363	78,547	10,876	85.9	81.5	142.1
1943	59,981	95,226	13,640	83.0	80.2	139.0
1944	73,342	98,068	13,304	86.5	76.1	128.9
1945	43,887	71,891	10,697	80.3	76.9	132.5
1946	42,929	76,115	11,150	80.1	74.8	122.7
1947	47,062	74,001	10,502	65.9	63.4	110.6
1948	47,736	71,869	10,055	100.9	71.5	120.1
1949	51,205	75,997	10,286	90.7	79.4	126.4
1950	56,379	79,263	10,714	86.1	78.1	130.3
1951	60,984	85,560	11,481	81.9	79.7	132.3
1952	63,029	86,572	11,527	92.2	73.4	122.1
1953	56,600	74,368	10,006	89.9	76.0	126.0
1954	51,483	71,495	9,870	85.6	72.6	126.1
1955	58,182	81,058	10,991	90.4	76.4	131.5
1956	67,469	85,216	11,221	96.6†	79.2†	133.0†

*/ F. I. hog slaughter, Oct. 1-Sept. 30, 1956, for example, means Oct. 1955-Sept. 1956.

†/ Preliminary.

Source: Hog and pork data: U. S. Dept. Agr., Agricultural Marketing Service. Livestock market news statistics and related data, 1956. pp. 25, 67. Feed data: U. S. Dept. Agr., Agricultural Marketing Service. Grain and feed statistics through 1956. pp. 2-3; and Feed situation. Oct. 1957. p. 6.

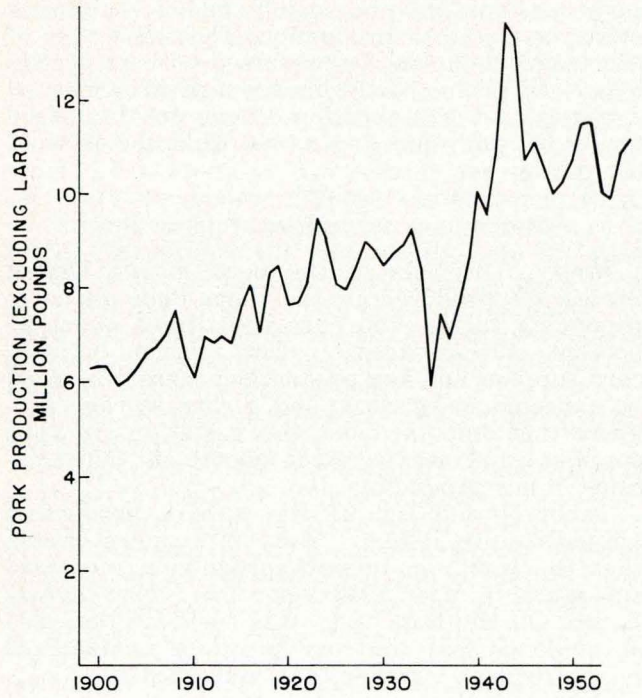

Fig. 21. United States pork production excluding lard, annually, 1900-56.

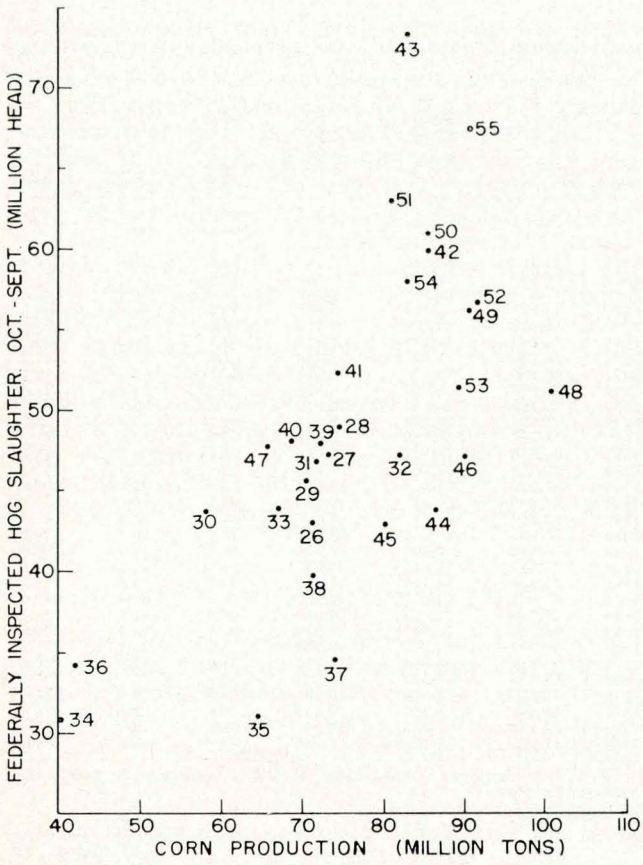

Fig. 22. United States federally inspected hog slaughter plotted against corn production, 1926-56.

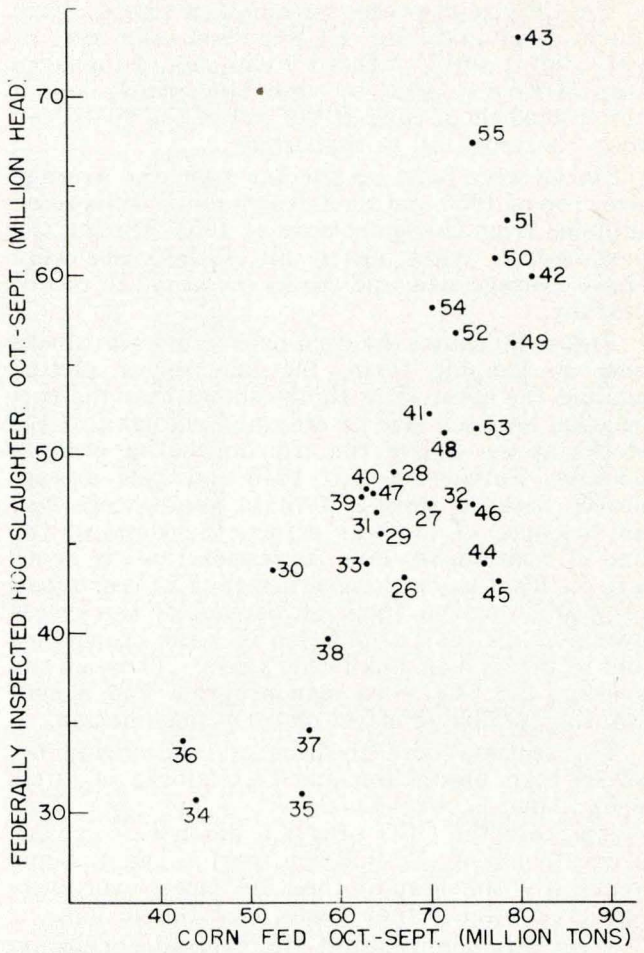

Fig. 23. United States federally inspected hog slaughter plotted against corn fed, 1926-56.

Study of fig. 21, however, suggests that the increase in the variation in pork production after 1933 resulted chiefly from two unique events, both unrelated to the corn program. The sharp decline in pork production during the 1930's came immediately after the severe drouths of 1934 and 1936; the great peak in 1942 and 1943 came as a result of the war effort to produce the maximum amount of meat by full utilization of the large crops produced in those years plus most of the large supplies of corn carried over from the immediate pre-war years. This indicates that variations in corn supplies have a controlling influence on pork production.

The nature of the relationship is shown in the next few figures. Figure 22 shows that the relation between corn *production* and hog production, as measured by the number of hogs slaughtered under federal inspection October to September, is not very close. One reason for that is that private and public storage operations usually smooth out the effects of variations in corn production to some extent, so that the market supplies of corn vary less than corn production varies. Figure 23 shows that the relation between corn *consumption* by livestock (corn fed October to September) and federally inspected hog slaughter

is closer than the relation between corn *production* and federally inspected hog slaughter.

Federally inspected slaughter is only a part of total hog slaughter; it is a major part, averaging about two-thirds, but the proportion varies from year to year. Estimates of the total number of hogs slaughtered are available, although only on a calendar year (January to December) basis. When these total hog slaughter data for the calendar year are plotted against corn fed from October of the preceding year to September of the given year, as in fig. 24, the relation is still closer than in the preceding figures.

The hog slaughter data, however, show only the number of hogs, ignoring variations in their weights. If the data showing total pork production (excluding lard) in pounds are plotted against corn fed, the relation between the two series is still closer than in fig. 24; the coefficient of correlation is 0.87. If the pork production data are plotted against total concentrates fed (corn, oats, barley and sorghum grains, wheat and rye, oilseed cake and meal, animal protein feeds and other by-product feeds) as in fig. 25, the relation is closer yet; the coefficient is 0.94.

These high correlations provide some basis for the expectation that the CCC corn loan program would stabilize corn production to about the same extent that it stabilizes corn and total concentrates consumption.

Examination of the period 1948-56, however, when corn crops and CCC storage stocks were large and the program should have been most effective, shows that the correlations between corn and other feed supplies and pork production were lower than for the period as a whole. For the period 1948-56 alone, the correlation with corn fed was only 0.55; the correlation with total concentrates fed was 0.80. This was partly due to the small range of variation in supplies during those years, and partly due to the fact that hog production responds to other things as well as to feed supplies. Apparently, during this period, the CCC corn loan program could have had only a partial stabilizing effect on pork production.

Beef cattle. Figure 26 shows that the number of cattle on farms varies in cycles, with an average length of about 15 years. These cyclic variations are particularly marked in the case of beef cattle, as shown by the data since 1920.

The annual production of cattle, as measured by the number of calves born, is shown in fig. 27. This figure shows that the number of calves born annually is more stable than the inventory of total cattle numbers shown in fig. 26. Beef production, as measured by the quantity of beef consumed, is shown in fig. 28.

It is difficult to find much evidence of the influence of variations in corn and other feed grains production in any one of these three charts. Corn and other feed grains constitute less than a third of the total feed used in beef cattle production;[23]

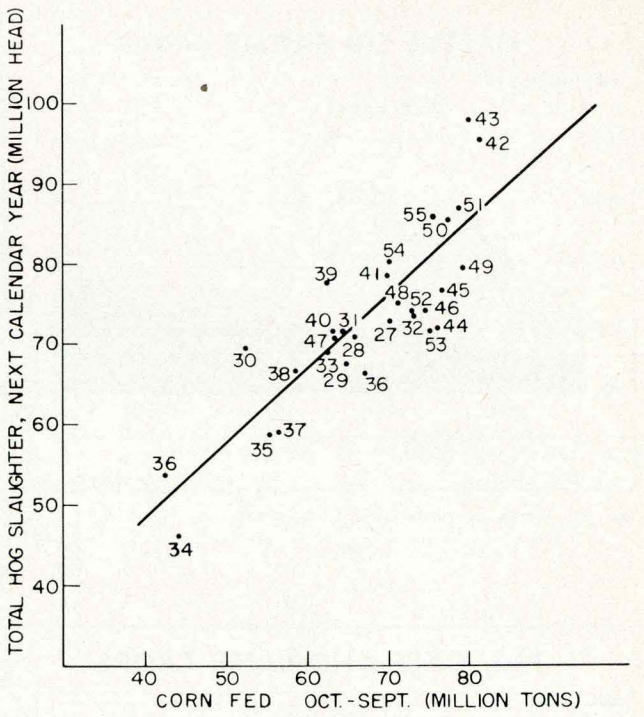

Fig. 24. United States total hog slaughter next calendar year plotted against corn fed, 1926-56.

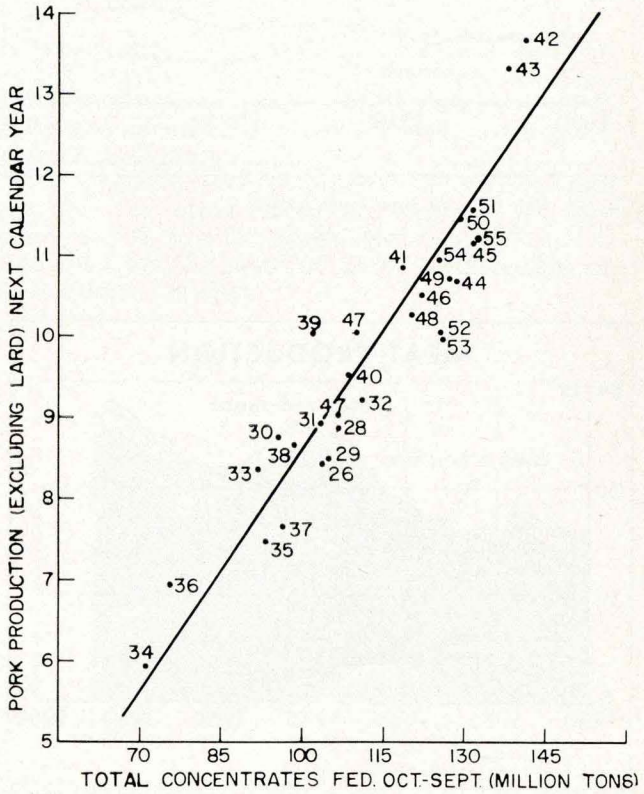

Fig. 25. United States pork production next calendar year plotted against total concentrates fed, 1926-56.

23/ R. D. Jennings. Animal units of livestock fed annually, 1909 to 1956. U. S. Dept. Agr. Stat. Bul. 215. July 1957. p. 7.

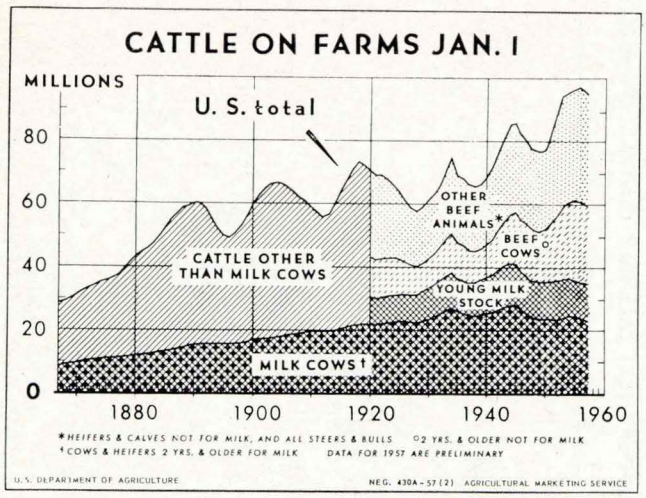

Fig. 26. Cattle on farms Jan. 1, 1865-1957.

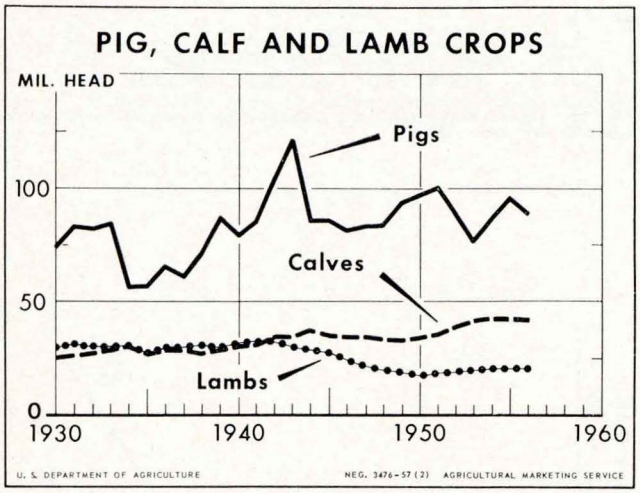

Fig. 27. Pig, calf and lamb crops, 1930-56.

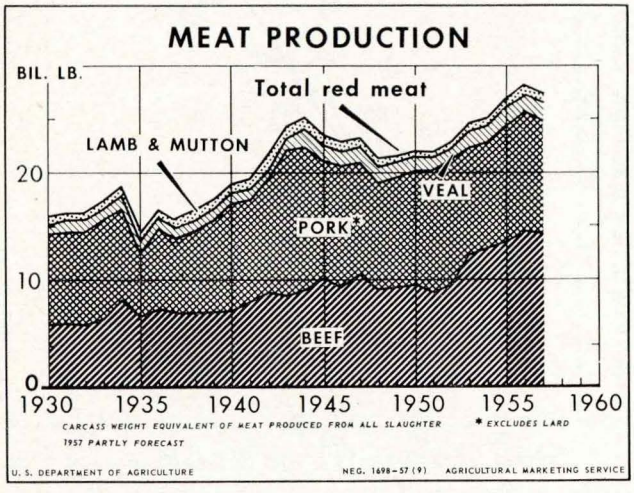

Fig. 28. Meat production, 1930-57.

roughage (hay, pasture and other forage) is the big input. Grain consumption by beef cattle is only from one-fifth to one-third as large as grain consumption by hogs.[24] Other factors, such as weather which affects roughage production in the range country and in other areas, may be as important as grain. Still other factors are the cyclic changes in beef cattle on farms, changes in the rate of slaughter of the stock and steers, changes in the per capita demand for beef, etc.

When so many factors are at work, it is difficult to isolate the effect of corn and other feed grains alone. The beef consumption chart shows a small rise in 1934, reflecting some liquidation of beef herds in response to the very small corn crop and the beef buying program in 1934, and a small decline the next year. The same sort of thing happened again in 1936, when the corn crop was again very small. There was a small rise in beef consumption again in 1945, when the corn crop was about 5 percent below previous levels, and another in 1947, when the corn crop was about 25 percent short. But the throwing off of OPA ceilings and other restrictions when World War II ended may have been the chief reason for these changes in beef consumption; it may have had more effect than the changes in corn production.

About the only other big change in beef consumption was the sharp rise that took place from 1951 to 1953, which was then extended in the form of a more gradual but steady rise after that time. It is difficult to see any close connection between these recent increases in beef production and the size of the corn crop and other feed crops; these crops, in the years after 1951, were only a little larger than the crops in the preceding several years.

Evidently, variations in the size of the corn and other feeds crops are only one of the several factors that affect beef production and consumption. It is difficult, therefore, to measure the influence of the corn and feed grain stabilization programs which were designed to smooth out these variations.

Beef production is plotted against corn fed to livestock and against total concentrates fed, in figs. 29 and 30, in the same way that pork production is plotted against these factors in figs. 24 and 25. The correlations are positive, but they are low, and most of the relationship that does exist results from the long-run upward trend in both series rather than from irregular variations from year to year. Apparently, the corn program could have had only a much smaller stabilizing effect on beef production than it had on hog production.

PROSPECTIVE EFFECTS ON LIVESTOCK IN THE FUTURE

The prospective effects of the corn and other programs on livestock production and prices in

24/ Photostat of table from R. D. Jennings.

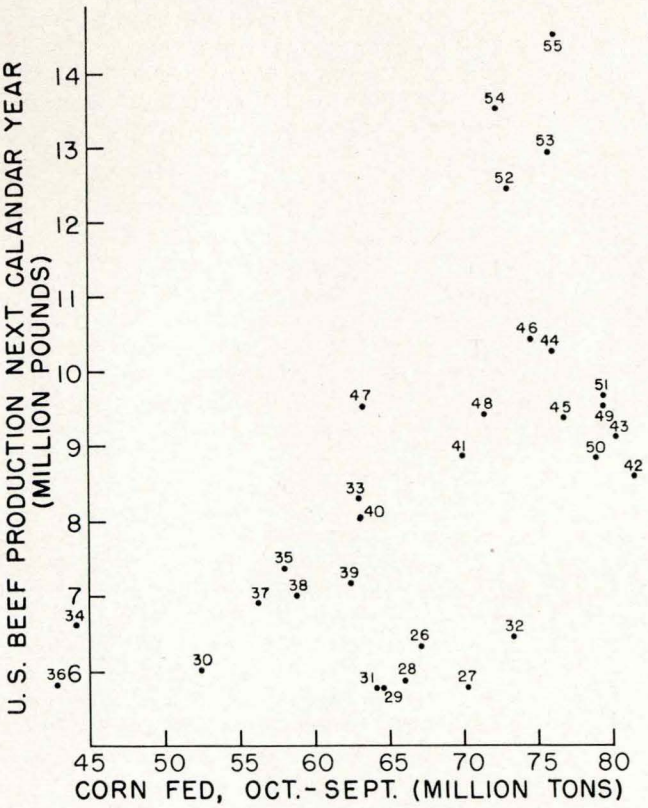

Fig. 29. United States beef production next calendar year plotted against corn fed, October-September.

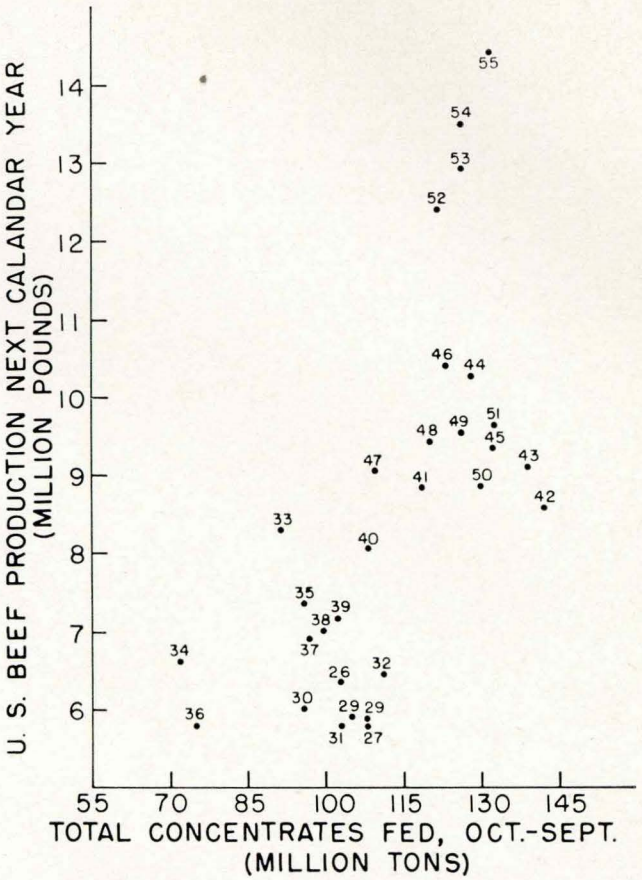

Fig. 30. United States beef production next calendar year plotted against total concentrates fed, October-September.

the future are of course even more difficult to estimate than the effects in the past. And one or two new factors are looming up which may have quite disturbing effects.

One new factor is the very large size of the stocks of corn and other feed grains which have accumulated in CCC hands. This factor is complicated by another—the evident ability of programs for other crops to shift a substantial part of their surplus problems to the nonbasic feed crops. This poses a real threat to the corn stabilization program in the next few years.

It poses a real threat to the livestock industry too. If the size of the stocks of feed grains becomes virtually unmanageable, the manner in which stocks are disposed of could seriously disturb the livestock industry.

This problem involves the whole agricultural program, for other crops as well as for feed grains, and it calls for consideration of that whole program from the point of view of its impact on the livestock industry.