LIVESTOCK-FEED GRAIN RELATIONSHIPS AFFECTING ECONOMIC ADJUSTMENT IN OREGON AGRICULTURE

by

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INTRODUCTION

Agriculture is one of the most important industries in Oregon, ranking second only to forestry. Because of the interrelationships existing between feed and livestock industries, the two are sometimes referred to within agriculture as the feed-livestock economy. The feed-livestock economy is the most important part of Oregon's agriculture, accounting for more than 60 percent of farm income in 1958.

Production of livestock is tied to the production of feed, both roughages and concentrates. To an increasing extent, this production is influenced by feed grain supplies and prices; although livestock continue to utilize millions of acres of pasture and hay lands where they convert roughages into high quality foods for human consumption. Because production of livestock is based upon feed supplies, in the long run adjustments in livestock production should follow adjustments in feed supplies. However, in some instances these adjustments are slow in taking place. This is particularly true under conditions of rapid technological developments and changing Government programs. Such has been the situation in Oregon as well as other western states in recent years.

Improved varieties of feed grains along with increased use of fertilizer and improved cultural practices have made it possible to increase feed grain production. At the same time, the Federal Government allotment program for wheat has encouraged greater production of feed grains.

During this period that feed grain production has been increasing, demand for meat on the west coast has expanded rapidly as a result of a rapidly increasing population and increasing consumer incomes.

With an increase in feed grain supplies in Oregon along with increased demand for livestock and poultry products on the west coast, the question frequently is raised as to whether increased production of livestock and livestock products should be encouraged. Continued production of feed grain at a higher rate than in the past and favorable livestock and livestock products to feed grain price ratios should indicate the feasibility of expanding livestock numbers in Oregon.

Failure of Oregon farmers to expand output of livestock and livestock products in proportion to increased supplies of feed grain available at lower prices and to a rapidly expanding market for these products indicates need for a study of forces that encourage or discourage adjustment of livestock production to feed grain production.

This study was undertaken as a preliminary analysis to a more detailed study to follow.

Objectives and Problem Statement

The objectives of this study were: (1) to examine adjustments occurring within Oregon's livestock-feed grain economy since 1935; (2) to describe factors that have influenced these adjustments; (3) to determine historical livestock-feed grain relationships that have existed in Oregon; and (4) to project future relationships from the historical relationships that have been present.

National livestock-feed relationships are well known (Figure 2, p.89). Since these relationships are significant, they are used by the Agricultural Research Service and others to project national livestock-feed relationships. Aggregate relationships such as these have also been used to project at the state level. The specific problem is to prove or disprove the validity of using such aggregate relationships for predictive purposes at the state level.

Source of Data

Data pertaining to Oregon's livestock-feed grain economy were derived from several sources. Oregon production data were taken from Agricultural Marketing Service commodity reports and from reports issued by the Oregon

Crop and Livestock Reporting Service. Data from Agricultural Statistics (24) were utilized. Shipments of feed grains into and out of Oregon were estimated from data published by the Interstate Commerce Commission and an Arizona study entitled Hay And Feed Grains In The West (7). Information on animal units and livestock-production units was obtained from the Agricultural Research Service. The Oregon State College Extension Service was helpful in providing estimates of various unrecorded data. Various bulletins and other reports issued by Agricultural Marketing Service, Agricultural Research Service, and state experiment stations provided information on such items as feeding rates and use of specific feeds. Calendar year data were obtained except when otherwise stated.

Methodology

This study is concerned with aggregate livestock-feed grain relationships that have existed in Oregon's feed-livestock economy. The scope of this study is to bring together data relating to the livestock-feed grain sector of this economy, to describe changes occurring within this economy, and to utilize this data in determining the various aggregate relationships that have been present.

Adjustments occurring in Oregon's livestock-feed grain economy were described in the first three sections of this

study. Production and disposition of feed grain was the subject of the first section. The second section was concerned with production of livestock and livestock products. Feed grain and other concentrates needed for livestock production was the topic of the third section.

In the second and third sections of the study it is important to distinguish between "grain-consuming animal units" and "livestock-production units from feed grain and other concentrates." The former refers to the "quantity" of livestock consuming the same amount of feed grain and other concentrates as the average United States dairy cow consumed annually in the 1940-45 period while producing 4,390 pounds of milk. This was 1,342 pounds of concentrates. The latter refers to "quantity" of livestock and livestock products produced from 1,342 pounds of feed grains and other concentrates by various classes of livestock. Grain-consuming animal units are utilized in estimating feed grain and other concentrates needed by various classes of livestock during the coming feeding year. Livestock-production units are used to measure how much feed grain and other concentrates were actually fed during the feeding year.

In some cases it was necessary to convert calendar year data to feeding year data. This was done by assuming

three fourths of the current year and one fourth of the past year equaled the feeding year.

Aggregate livestock-feed grain relationships present in Oregon since 1948 were developed in the fourth section of this study. A model was developed showing hypothetical aggregate livestock-feed grain relationships believed to exist in Oregon. Multiple correlations were used to show the relationships existing within this model. Correlations were limited to the years 1948-58 because information on feed grain inshipments and outshipments was not available prior to 1948. All variables were converted to logarithms before running the analyses because it was thought that the relationships were of a multiplicative nature. The Crout method was used in obtaining the regression coefficients. Regression coefficients were tested for significance with the t-test. Snedecor's Table 7.6.1. of "Correlation Coefficients At The Five Percent And One Percent Levels Of Significance" was used to test the significance of multiple and simple correlation coefficients.

PRODUCTION AND DISPOSITION OF FEED GRAINS IN OREGON

Production by Class and Total

There are five major feed grains produced in Oregon. These are, in order of importance for 1958: (1) wheat; (2) barley; (3) oats; (4) corn; and (5) rye. Volume of production for each of these feed grains and total feed grain production in bushels are shown in Table 1 for selected years from 1935 to 1958. It will be noted, with the exception of rye and oats, production of feed grains increased substantially in the 24-year period. Total feed grain production increased nearly 85 percent--from 33.6 million bushels average during the 1935-39 period to almost 62 million bushels in 1958. Barley was by far the most important feed grain making up this increase. Production of barley increased particularly fast when stricter acreage allotments were imposed on wheat in 1953.

Wheat is the most important feed grain produced in Oregon. This has been the case throughout the period of analysis. It must be remembered, however, that wheat is considered a food grain more than a feed grain. Production increased steadily from 1935-39 until a record of 34.3 million bushels was produced in 1953. Wheat production decreased in 1954 and again in 1955, but has increased since. A total of 28 million bushels was produced in 1958.

Table 1

Production of Grains in Oregon, Average 1935-39, 1940-44, 1945-49, Annual 1950-58(18)[1]

Crop of	Barley	Corn[2]	Oats	Wheat	Rye(24)	Total
			(1,000 bushels)			
Average						
1935-39	5,133[3]	2,020	9,856[3]	18,298	453	33,655
1940-44	8,325	1,700	10,246	20,981	542	41,794
1945-49	9,714	1,094	9,080	24,372	482	44,623
1950	10,784	1,025	8,996	23,683	242	44,730
1951	10,447	1,242	7,728	29,972	276	49,665
1952	10,488	1,150	10,183	32,016	315	54,152
1953	11,438	1,104	8,186	34,298	304	55,330
1954	19,499	1,595	11,970	26,196	207	59,467
1955	17,888	2,440	9,391	21,899	218	51,836
1956	21,375	2,400	11,752	25,607	290	61,424
1957	21,868	2,520	10,764	26,788	420	62,360
1958	19,890	3,150	10,574	28,000	348	61,962

[1]Except rye
[2]Includes corn in silage
[3]For year 1939 only

Barley is the second most important grain produced in the State. It was not until the period following World War II that barley became more important than oats. Production of barley increased steadily from 1940 to the early 1950's and then leveled off at approximately twice that of prewar years. In 1954, an increase of more than eight million bushels was recorded. Since then, barley production has remained at a relatively high level. Nearly 20 million bushels were reported produced in 1958.

The third most important feed grain produced in Oregon is oats. Until the period following World War II, oats ranked second behind wheat. Oat production varied less between the beginning and the ending of the period than any other feed grain. Reductions occurred following World War II, but then production increased to previous levels. The peak was reached in 1954, with a crop of about 11.7 million bushels. Production in 1958 was nearly 10.6 million bushels.

Corn is the fourth most important feed grain produced in Oregon. During the past five years production of corn increased steadily, until a record of 3.15 million bushels was produced in 1958. Prior to 1954, production decreased from slightly over two million bushels average during the 1935-39 period to a low of near one million bushels in 1950.

This relatively low level was maintained until the increase was noted in 1954.

Rye is the least important of the grains produced in the State. Rye production decreased from slightly more than one-half million bushels during the War to less than one-third million bushels in 1958. Production varied throughout the period, ranging from the high reported during the War years to a low of slightly more than one-fifth million bushels in 1955.

Factors Influencing Production Changes

Several factors have caused changes in production of feed grains in Oregon. These factors are reflected in increased yields per planted acre and changes in acreage planted (Table 2).

Increased yields per acre can be attributed in part to improved varieties, more fertilizer, better cultivation methods, and in general, improved management. Varieties have been developed which are resistant to rust, certain insects, and other natural factors which plague feed grains, including drought. Hybrid seed corn has been particularly effective in increasing corn yields per acre. Nationally, since 1948, use of nitrogen on corn, oats, and barley has increased by 208 percent, use of available phosphorous has increased by 55 percent, and use of potash has increased by

Table 2

Yield per Planted Acre and Total Acres Planted, Five Grains Produced in Oregon, Average 1935-39, 1940-44, 1945-49, Annual 1950-58[16]

Feed Grain	1935-39	1940-44	1945-49	1950	1951	1952	1953	1954	1955	1956	1957	1958
					(Yield per acre - bushels)							
Wheat	17.3	24.3	22.7	23.8	25.9	26.4	27.0	28.2	25.0	27.9	34.1	30.2
Barley	22.8	27.5	30.4	29.8	28.9	34.5	34.9	34.9	29.1	34.5	33.6	32.2
Oats	18.6	21.2	17.7	18.2	19.2	25.9	23.5	27.8	24.1	29.7	29.3	28.3
Corn	30.0	33.1	37.9	41.0	46.0	46.0	48.0	55.0	61.0	60.0	70.0	70.0
Rye	3.8	4.1	3.3	2.0	2.2	2.6	2.5	2.2	2.2	2.9	3.8	3.2
					(1,000 acres planted)[16]							
Wheat	1,097	866	1,079	997	1,159	1,215	1,270	928	876	919	786	861
Barley	172	300	318	362	362	304	328	558	614	620	651	618
Oats	480	485	514	493	402	393	348	430	389	394	368	373
Corn	67	52	29	25	27	25	23	29	40	40	36	45
Rye	119	131	147	121	123	122	122	95	100	100	110	110

148 percent (10, p.2). Similar increases have been noted in Oregon.

Another factor tending to influence yield per acre has been a shift in land use which has, in some instances, moved feed grain production to better land. Federal Government programs have influenced this shift as well as changes in acreages. For example, reductions in acres planted to wheat can be directly attributed to decreases in wheat acreage allotments. This in turn led to increased acreages of barley and oats and to heavier fertilization of wheat. Some of these plantings of barley and oats were on the better wheat land.

Prior to 1954, oat acreage decreased because of decreased use of oats in crop rotations and as a nurse crop. Also, a sharp increase in the use of tractors reduced the demand for oats as horse feed.

Changes in acreages are more important throughout the period for wheat than for other feed grains. This is because wheat has been influenced more directly than other feed grains by Federal farm programs. From Table 2, it is apparent that since 1954, year to year fluctuations in feed grain production are due to changing yields more than changing acreages. This is particularly so in the case of barley, oats, corn, and rye.

Acreage changes are partially due to changes in prices received for feed grains. When feed grain prices are high relative to prices of alternative crops, more acres are usually planted in the following year. This usually leads to increased production and decreased prices. And so the cycle continues, unless prices are supported and some controls placed on acreages.

Average prices received by Oregon farmers for feed grains are presented in Table 3. These prices were relatively low prior to World War II, increased during and following the War, but have decreased since 1953. Commodity Credit Corporation loan programs have limited the extent of this price decrease, and have in effect been a major factor in keeping production of barley at relatively high levels. Aggregate feed grain prices are presented in index number form, and represent total sales value of all feed grains except wheat.

Inshipments of Feed Grains

A knowledge of shipments of feed grain into the State is necessary to determine total quantities of feed grain available as livestock feed. Oregon is a deficit state for some feed grains, particularly corn and milo. Quantities of these feed grains shipped into Oregon cannot be easily determined; and in some cases cannot be determined to a great degree of accuracy.

Table 3

Average Prices Received by Oregon Farmers for Feed Grains, 1935-58(8)

Year	Wheat	Barley	Oats	Corn	Rye	Index of Aggregate Prices[1]
			(Dollars per bushel)			
1935	.72	.47	.34	.79	.60	88
1936	.90	.73	.44	.97	.71	91
1937	.77	.59	.38	.65	.67	103
1938	.53	.45	.38	.61	.44	87
1939	.71	.50	.35	.72	.59	84
1940	.61	.50	.35	.76	.58	80
1941	.92	.66	.50	.70	.70	87
1942	1.07	.71	.54	.74	.74	114
1943	1.29	1.00	.75	1.04	1.04	167
1944	1.38	1.06	.73	1.13	1.13	179
1945	1.45	1.06	.75	1.22	1.22	173
1946	1.77	1.32	.94	1.67	1.67	196
1947	2.19	1.68	1.11	2.03	2.03	234
1948	2.01	1.19	.97	1.63	1.35	260
1949	1.98	1.16	.80	1.59	1.27	220
1950	2.05	1.25	.88	1.93	1.37	225
1951	2.17	1.39	1.04	2.13	1.47	238
1952	2.16	1.56	.98	1.90	1.63	279
1953	2.12	1.19	.87	1.85	1.27	222
1954	2.17	1.17	.78	1.84	1.35	195
1955	2.03	.99	.70	1.68	1.39	205
1956	2.05	1.03	.73	1.75	1.25	207
1957	2.04	.98	.67	1.52	1.23	169
1958	1.81	1.01	.67	1.43	1.14	165

[1]Based on total sales - 1910-14 = 100

Shipments of feed grain by rail are reported by the Interstate Commerce Commission on a one percent sampling basis. Data collected by the Interstate Commerce Commission were extended to arrive at an estimate of total feed grain shipments to Oregon. This was done by multiplying the sample by one hundred. If there were no sampling error, actual product flows could be determined in this manner. Since there probably were sampling errors, these data are best used as a basis for an estimate rather than the exact measurement of the flows.[1]

Movements of feed grain by truck into the State are not reported. However, there is evidence truck movements are of major importance. An Arizona study reporting on hay and grain movements in the west reported an estimated 91,000 tons of feed grain shipped to Oregon by truck in 1954 (7, p.28). Since California inshipments of feed grain are accurately reported, the Arizona estimate for Oregon was based on the assumption nearly the same percentage of feed grain would enter Oregon by truck as was the case in California. This was approximately 33 percent of the rail movements. In this study a similar assumption was made: that estimated

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[1]The Interstate Commerce Commission indicates that for a given entry, an estimate of total tons will be within x percent of the true value of the population, where x is the reciprocal of the square root of the number of cars represented by the sample.

shipments of feed grain into the State by truck would approximate one third of the estimated rail shipments in any year.

Estimated inshipments of feed grain and other concentrates into Oregon are reported in Tables 4, 5, and 6 for rail shipments, truck shipments, and total shipments, respectively. It should be recognized that these quantities are estimates only, and should be used to show general trends rather than exact quantities. Although considerable quantities of wheat were shipped into Oregon, these are not included in the tabulations as wheat is regarded as a food grain rather than a feed grain.

Historically, only two feed grains have been shipped into Oregon in large quantities. These are corn and barley. Oats and grain sorghums were inshipped in smaller quantities until 1958. Inshipments of oil meals were included because they are concentrates and are fed quite extensively in Oregon.

Most corn is shipped to Oregon from the midwest, originating largely in northern and western corn belt states. In 1957 and 1958, small quantities of corn were shipped into the State from Washington (25). Estimated corn inshipments have varied considerably. However, only in 1955 was an unusually large quantity of nearly 300 thousand tons reported to have been shipped into the State.

Table 4

Estimated Shipments of Feed Grains and Other Concentrates Into Oregon by Rail, 1948-58[25]

Year	Corn	Barley	Sorghum Grain (Tons)	Oats	Oil Meals	Total
1948	33,000	40,000	6,000	15,000	25,000	119,000
1949	116,000	52,000		17,000	26,000	211,000
1950	95,000	39,000		4,000	32,000	170,000
1951	76,000	155,000	57,000	18,000	74,000	380,000
1952	83,000	47,000	5,000	14,000	52,000	201,000
1953	73,000	38,000	16,000	9,000	40,000	176,000
1954	85,000	55,000		5,000	25,000	170,000
1955	224,000	118,000	11,000	8,000	33,000	383,000
1956	72,000	224,000	11,000	5,000	36,000	348,000
1957	49,000	208,000	10,000	4,000	58,000	329,000
1958	62,000	323,000	321,000	10,000	27,000	743,000

Table 5

Estimated Shipments of Feed Grains and Other Concentrates Into Oregon by Truck, 1948-58[1]

Year	Corn	Barley	Sorghum Grain (Tons)	Oats	Oil Meals	Total
1948	11,000	13,000	2,000	5,000	8,000	39,000
1949	39,000	17,000		6,000	9,000	71,000
1950	31,000	13,000		1,000	11,000	56,000
1951	25,000	52,000	19,000	6,000	25,000	127,000
1952	28,000	16,000	2,000	5,000	17,000	68,000
1953	24,000	13,000	5,000	3,000	13,000	58,000
1954	28,000	18,000		2,000	8,000	56,000
1955	75,000	39,000	4,000	3,000	11,000	132,000
1956	24,000	75,000	4,000	2,000	12,000	117,000
1957	16,000	69,000	3,000	1,000	19,000	108,000
1958	21,000	108,000	107,000	3,000	9,000	248,000

[1]Developed from estimations by McGlothlin(7)

Table 6

Estimated Total Shipments of Feed Grains and Other Concentrates Into Oregon, 1948-58

Year	Corn	Barley	Sorghum Grain (Tons)	Oats	Oil Meals	Total
1948	44,000	53,000	8,000	20,000	33,000	158,000
1949	155,000	69,000		23,000	35,000	282,000
1950	126,000	52,000		5,000	43,000	226,000
1951	101,000	207,000	76,000	24,000	99,000	507,000
1952	111,000	63,000	7,000	19,000	69,000	269,000
1953	97,000	51,000	21,000	12,000	53,000	234,000
1954	113,000	73,000		7,000	33,000	226,000
1955	299,000	157,000	15,000	11,000	44,000	515,000
1956	96,000	299,000	15,000	7,000	48,000	465,000
1957	65,000	277,000	13,000	5,000	77,000	437,000
1958	93,000	431,000	428,000	13,000	36,000	991,000

With the exception of 1951 when an unusually large 1950 crop in Montana and Idaho was being disposed of, estimated barley shipments into Oregon remained relatively constant until 1955. Starting in 1955, large quantities of barley have been moving to Oregon from Montana, Idaho, and eastern Washington (25). Once in the State, this barley is either placed under loan at the terminal market or exported. Little is fed to livestock (7, p.24).

Oats are shipped to Oregon from the neighboring states of Washington, Idaho, and California (25). Estimated inshipments of oats have varied from five to 25 thousand tons annually. A slight reduction has been noted since 1954 when oat production increased slightly in Oregon.

The most recent development in shipment of feed grains into Oregon was the estimated more than 400 thousand tons of grain sorghum so reported in 1958. Prior to this time, with the possible exception of 1951, much smaller quantities were inshipped. In some years no inshipments of this grain were reported. The 1958 inshipments of grain sorghum originated in Kansas and Colorado where record harvests were recorded (25).

Quantities of oil meals shipped into the State have remained relatively stable. Soybean oil meal makes up the bulk of these shipments. Prior to 1955, most soybean oil originated in the midwest; since then, shipments from

California have increased. Most cottonseed oil meal originates in California (25).

Except for barley and wheat, most feed grains inshipped are used in commercial feed mixes, and are fed chiefly to poultry. The primary factor influencing these inshipments has been demand by Oregon poultry producers and hog producers for corn or milo.

Before 1955, inshipments approximated one fourth of all feed grains fed (Table 25). Since 1955, considerable barley inshipments have been noted. As previously stated, these are probably not fed, but are shipped to the coast for storage and export. Since other inshipments have also increased, it would appear more than one fourth of all concentrates utilized by Oregon livestock are inshipped.

Disposition of Feed Grains

Feed grain in Oregon is disposed of in several ways. A certain proportion of production is reserved for seed. Some feed grain is used for human consumption, while other quantities are stored or exported. However, the most important use of feed grain is as livestock feed, some of which is fed where produced; the rest is sold for use by other farmers and commercial feeders.

Feed Grains Used for Seed

Estimated quantities of feed grains used for seed are presented in Table 7. Wheat and corn are not included. Wheat was omitted because it is primarily a food grain, and the quantity used for seed has relatively little influence on the quantity fed to livestock. Corn was omitted because relatively little corn produced is used for seed. Hybrid seed corn is used, and as such, it is not included as a feed grain, but as a specialty crop.

In the case of rye, total quantities used for seed were obtained from Agricultural Statistics. For oats and barley this was not the case; quantities used for seed had to be estimated. In this study it was assumed that all seed for oats and barley was grown where used. This made it possible to break down the Agricultural Marketing Service heading of "feed grain used where produced" into "seed" and "feed". "Seed" use was determined by applying Oregon seeding rates to acreages planted. It is realized that in some years this may be unrealistic because of reseeding. Generally, this does not occur.

Use of barley for seed has more than doubled since the prewar period, even though less seed is being planted per acre. This further emphasizes the acreage changes that have been taking place. Largest increases of barley for seed occurred during the War, and between 1952 and 1954.

Table 7

Estimated Use of Selected Feed Grains as Seed in Oregon, Average 1935-39, 1940-44, 1945-49, Annual 1950-58

Crop of	Barley(18)	Oats(18) (Bushels)	Rye(24)
Average			
1939	399,000[1]	946,000[1]	
1940-44	633,000	881,000	152,000
1945-49	709,000	708,000	157,000
1950	636,000	693,000	135,000
1951	616,000	634,000	135,000
1952	724,000	896,000	128,000
1953	1,098,000	835,000	167,000
1954	1,345,000	1,017,000	147,000
1955	1,055,000	704,000	142,000
1956	1,475,000	1,116,000	110,000
1957	1,268,000	915,000	121,000
1958	1,333,000	899,000	121,000

[1]Year 1939 only

Little change is apparent in the use of oats for seed. Rye used for seed has remained stable at a high percentage of production because rye is used extensively as a pasture crop in Oregon, and relatively little grain harvest takes place.

Feed Grains Fed Where Produced

Feed grains fed where produced in Oregon are estimated in Table 8. No adjustments were necessary to determine quantities of wheat, rye, and corn fed where produced, as they were presented in this form in the original data. With oats and barley, it was necessary to subtract "seed" from "total used where produced" to estimate quantities fed where produced.

Wheat fed where produced decreased steadily after the War. In 1958, use of wheat as livestock feed where produced approximated 3.25 percent of total production. Relatively low use of wheat for feed is attributable to the Federal Government's policy of considering wheat as a food grain rather than a feed grain and pricing it accordingly. Most feed wheat is used by smaller enterprises such as farm chickens and turkeys. However, large quantities of wheat were fed to hogs extensively in eastern Oregon during the War. Little of this wheat was fed where produced, as it

Table 8

Estimated Quantities of Feed Grains Fed Where Produced in Oregon, Average 1935-39, 1940-44, 1945-49, Annual 1950-58

Crop of	Wheat(13)	Barley(18)	Oats(18)	Corn(18)	Rye(24)	Total
			(Tons)			
Average						
1935-39	60,990	43,392[1]	76,320[1]	51,268	[2]	231,970
1940-44	65,190	74,616	87,696	43,596	6,120	277,218
1945-49	53,670	56,712	68,816	27,524	4,050	210,772
1950	49,830	62,376	66,640	25,368	2,190	206,404
1951	45,030	65,448	54,160	28,224	2,310	195,172
1952	48,090	63,168	63,872	26,040	2,160	203,330
1953	41,220	45,024	56,064	24,752	1,650	168,710
1954	31,440	70,680	58,416	33,656	1,500	195,692
1955	27,150	73,416	45,776	47,320	1,500	195,162
1956	26,760	77,472	74,272	50,484	2,880	231,868
1957	25,860	74,544	45,920	47,656	4,170	196,150
1958	27,390	73,032	63,440	59,612	2,190	225,664

[1]For year 1939 only
[2]Not available prior to 1940

had been stored by the Commodity Credit Corporation before use, and was only released to encourage production of meat.

Since 1951, more barley has been fed where produced than any other feed grain. Prior to this time, barley was less important than oats. Quantities of barley fed to livestock where produced increased sharply during the War years to a level of near 75,000 tons annually. This level of feeding has been maintained since, with the exception of 1953 when considerable less barley was fed because of low cattle prices. Only slight changes in quantities of barley being fed where produced were recorded when barley production jumped eight million bushels in 1954. In 1958, approximately 15 percent of Oregon's barley production was fed where produced.

An increase was noted in oats fed where produced during the War years. Quantities of oats fed where produced decreased following the War until 1951. Since 1951, considerable variation in oats fed where produced has been noted. In 1958, approximately 38 percent of total oat production in Oregon was disposed of in this manner.

Quantities of corn fed where produced surpassed prewar years in 1958. Until 1953, a steady decrease in corn used in this manner was noted. Since 1953, the quantity of corn fed where produced has been increasing. It appears this quantity will continue to increase as production increases.

Nearly two thirds of Oregon's corn crop was fed where produced in 1958.

The quantity of rye fed where produced in Oregon is insignificant when compared to other feed grains. Only slightly more than one percent of the total feed grain fed where produced is rye. Rye fed where produced decreased after the War years and now averages about 3,000 tons annually. In 1958, 21 percent of the total rye production was fed where produced.

Total quantities of feed grain fed where produced remained quite stable throughout the period of analysis, averaging near the 200,000 ton level annually. The low use was in 1953 when cattle prices declined rapidly, and the high use occurred during the War years. As will be shown later, the 200 thousand ton level approximates one fourth of feed grain and concentrates necessary to produce all livestock production in Oregon (Table 25).

Much of these feed grains fed where produced are fed to small, inefficient enterprises maintained for home consumption and small sales. This has tended to keep quantities of feed grain fed where produced relatively stable.

Feed Grains Sold From Farms

Feed grains sold from farms in Oregon are presented in Table 9. It is apparent there have been increases in

Table 9

Grains Sold From Oregon Farms, Average 1935-39, 1940-44, 1945-49, Annual 1950-58

Crop of	Wheat(13)	Barley(18)	Oats(18)	Corn(18)	Rye(24)	Total
			(1,000 bushels)			
Average						
1935-39	15,628	2,926[1]	4,140[1]	189	267	22,790
1940-44	17,811	4,583	3,884	143	278	26,699
1945-49	21,518	6,640	4,071	111	296	32,636
1950	21,161	7,549	4,138	119	134	33,101
1951	27,503	7,104	3,709	234	164	38,714
1952	29,391	7,132	5,295	220	210	42,248
1953	32,143	8,464	3,847	220	211	44,885
1954	24,492	15,209	7,302	393	115	47,511
1955	20,464	13,774	5,816	750	147	40,951
1956	24,191	16,672	5,994	597	174	47,628
1957	25,399	17,494	7,104	818	295	51,110
1958	26,552	15,514	5,710	1,021	247	49,044

[1]Year 1939 only

quantities entering market channels in all cases except rye; and that total marketings are more than double prewar levels. In all cases there has been an increase in percentage of production sold from farms.

Wheat always has been the most important feed grain marketed in Oregon. The quantity of wheat sold from farms increased steadily between the prewar period and 1953. In 1953, Congress passed a new wheat law cutting acreage wheat allotments considerably. Consequently, marketings reduced nearly eight million bushels in 1954 and nearly four million bushels in 1955. Since then, quantities of wheat sold from farms in Oregon have increased slightly each year, the result of slightly more planted acres and heavier fertilization. In 1958, nearly 95 percent of the wheat produced in Oregon was sold from farms; this compared to nearly 83 percent in the prewar period.

Barley sold from farms in Oregon increased at a steady rate between prewar years and 1953. In 1954, an increase in marketings of nearly seven million bushels was recorded. Since then, these relatively high levels have been maintained, or nearly so. The percentage of barley marketed increased from 57 percent in 1939 to 80 percent in the 1950's.

Oats sold from Oregon farms has increased nearly 50 percent over prewar levels. Particularly large marketings

were reported in 1954 and 1957. Otherwise, marketings of oats would appear to have stabilized between five and six million bushels annually at roughly 60 percent of production. Prewar marketings of oats were near 40 percent of production. Increased yields and decreased numbers of horses are the primary reason for an increased percentage of oat production being marketed.

An increase in marketings of Oregon corn is noted, particularly since 1954. Marketings in the prewar years were less than 10 percent of corn production. In 1958, nearly one third of corn production was marketed. Field corn appears to be increasing in popularity in Oregon, particularly in the Willamette Valley. With the advent of mechanical pickers and driers and adaptable varieties of corn, it is possible to raise good corn in Oregon. These are the primary reasons corn marketings have been increasing in Oregon.

Quantities of rye sold from farms in Oregon have decreased slightly from prewar and War years. However, the percentage of rye marketed has increased slightly from less than 60 to more than 70 percent of production during the 24-year period.

Total quantities of feed grain marketed have increased quite steadily throughout the period of analysis and averaged near the 50,000 bushel level in 1957 and 1958. It is

significant to note total feed grain sold from farms in Oregon increased in 1954 by more than three million bushels even though wheat production decreased by nearly eight million bushels. A sharp reduction in total feed grain marketings of nearly seven million bushels occurred in 1955, the result of more acreage reductions for wheat, lower prices for oats and barley in 1954, and the Soil Bank program. Marketings of feed grain increased following 1955 because of higher yields. In the prewar years, approximately two thirds of total feed grain production was sold from the farm. This increased to nearly 80 percent by 1958.

For Human Use

Three Oregon feed grains are used as food. These are wheat, barley, and rye, in order of importance. Wheat is used as flour from which various foods are produced. Barley is necessary to produce beer and ale. Rye is used in making spirits and also as flour. Estimated quantities of these grains used for human consumption are shown in Table 10.

Most wheat sold from farms is stored, exported, or used as human food. It has been the policy of the Federal Government to consider wheat as a food grain, and to support its price as such. Therefore, even though this wheat is not used by humans, it is stored for that purpose.

Table 10

Estimated Quantities of Feed Grains Sold From Oregon Farms For Human Consumption, Average 1935-39, 1940-44, 1945-49, Annual, 1950-58

Crop of	Wheat(13)	Barley[1]	Rye(24)	Total
		(1,000 bushels)		
Average				
1935-39	11,352	585[2]		11,937
1940-44	8,739	917	186	9,842
1945-49	17,120	1,328	190	18,638
1950	19,240	1,510	34	20,784
1951	25,687	1,421	64	27,172
1952	27,657	1,426	115	29,198
1953	30,827	1,693	82	32,602
1954	23,613	3,042	10	26,665
1955	19,644	2,755	26	22,425
1956	23,466	3,334	84	26,884
1957	24,810	3,499	160	28,469
1958	26,021	3,103	154	29,278

[1]Estimate given by Ray Teal, Seed Marketing Specialist, Oregon State College Extension Service

[2]1939 only

During the War years, less wheat was stored for human consumption than was the case in previous years. Most of this wheat was released as livestock feed. Following the War, production increased rapidly until 1953, when acreage allotments were reduced. Since then, quantities of wheat sold for food, including Government Commodity Credit Corporation loan purchases, gradually increased to 26 million bushels in 1958.

Some barley is sold for malting purposes. Malt barley is one of the principal enterprises in the Klamath Falls area; and for many years farmers in the Willamette Valley have been attempting to raise malt barley as it commanded a higher price than feed barley. Unfortunately, there have been no studies made to determine to what extent Oregon barley is sold for this purpose. It has been estimated by the Oregon State College Extension Service that up to 1954, approximately 20 percent of the barley sold from farms in Oregon was used for malting.

In the last few years, production of barley in the midwest has decreased substantially because of a disease problem. This has helped increase Oregon barley marketings to midwest breweries. As shown in Table 10, estimated quantities of barley sold for malting have increased throughout the period of analysis. Since 1953, the volume of barley

sold as malt barley has been about double that of former years.

Use of rye for flour and spirits in 1958 was slightly less than during the War years, but considerably above low levels reported in 1950 and 1956.

In total, estimated quantities of feed grain sold for human consumption have followed very closely patterns shown by wheat. Increases occurred, with the exception of the War years, until 1953. A decrease of six million bushels was noted in 1954 followed by a four million bushel decrease in 1955. Since then, slight increases have occurred.

As Livestock Feed

Four feed grains are sold from Oregon farms as feed for livestock. These are, in order of importance in 1958, barley, oats, corn, and wheat. These estimated quantities are presented in Table 11. It is evident quantities of wheat sold as livestock feed have decreased, quantities of barley and corn sold as livestock feed have increased, and quantities of oats sold as livestock feed have remained relatively stable during the period of analysis. Total feed grain marketings for feed use have almost doubled. Relatively little rye is sold as livestock feed because there is so little of it produced.

Table 11

Estimated Quantities of Feed Grains Sold From Farms in Oregon as Livestock Feed, Average 1935-39, 1940-44, 1945-49, Annual 1950-58[1]

Crop of	Wheat(13)	Barley(18)	Oats(18)	Corn(18)	Total
			(1,000 bushels)		
Average					
1935-39	4,276	2,341[1]	4,140[1]	189	10,946
1940-44	9,072	3,666	3,884	143	16,765
1945-49	4,398	5,312	4,071	111	13,892
1950	1,921	6,039	4,138	119	12,217
1951	1,816	5,683	3,709	234	11,442
1952	1,734	5,706	5,295	220	12,955
1953	1,316	6,771	3,847	220	12,154
1954	879	12,167	7,302	393	20,741
1955	820	11,019	5,816	750	18,405
1956	725	13,338	5,994	597	20,654
1957	589	13,995	7,104	818	22,506
1958	531	12,411	5,710	1,021	19,673

[1]Year 1939 only

Barley hasn't always been the most important feed grain sold from Oregon farms as livestock feed. Before 1945, both wheat and oats were more important. Since 1945, however, barley has been the most important feed grain sold from farms in Oregon as livestock feed.

Barley sold from Oregon farms as livestock feed increased quite steadily through the War years. Following the War, sales of nearly six million bushels annually were maintained until 1954. In 1954, a near doubling occurred, when more than 12 million bushels of barley were sold as livestock feed. Since then, these relatively high levels of sales of barley as livestock feed have been maintained.

Quantities of wheat sold from farms as livestock feed were obtained from data released by the Oregon Wheat Commission. These quantities have continued to decline. In the period through the War years, wheat was the most important grain used as livestock feed. In the prewar period, feeding of wheat approximated one third of production. During the War years, feeding of wheat was at a level nearly two thirds of production. In these years, the Federal Government subsidized feeding wheat to livestock in order to reduce mounting inventories of grain and to promote increased production of meat, milk, and eggs. Since then, decreases in sales of wheat as livestock feed have occurred

each year until only slightly more than 500 thousand bushels were sold as livestock feed in 1958.

Marketings of corn and oats as livestock feed have been discussed previously under the heading of "feed grain sold from the farm."

Estimated total marketings of feed grain as livestock feed were double prewar levels in 1957. These quantities decreased following World War II, and maintained a level of near 12 million bushels until 1954. During this period, decreases in wheat marketed as livestock feed were offset by increased marketings of barley and oats for these purposes. In 1954, a more than eight million bushel increase in total grain sold from the farm as livestock feed was noted. This was due to increases in marketings of both barley and oats. Since 1954, little change has occurred in total feed grain marketed as livestock feed.

It must be recognized all seed grain sold as livestock feed has not been fed to livestock. Some was actually placed in Commodity Credit Corporation loans and exported when the demand by livestock feeders did not clear the market at the supported price level. Other quantities were outshipped.

Outshipments by Rail and Truck

Only two feed grains are shipped from Oregon by rail and truck to any extent. These are barley and oats. More barley is outshipped than oats. The barley is principally malting barley, and the oats is livestock feed. Estimated quantities of these outshipments are presented in Table 12. Estimated outshipments by rail are based on the one percent sample taken by the Interstate Commerce Commission. Outshipments by truck to California have approximated 80 percent of estimated rail shipments to California (7, p.30). Obviously, other truck shipments occur to Idaho and Washington, but since there is not a means of estimating these movements, they have to be ignored.

Estimated outshipments of barley increased quite substantially in 1956, to a level of 225,000 tons. Prior to this, with the exception of 1952, outshipments of barley were near the 125,000 ton level. A large increase in barley outshipments was noted in 1952 because of heavier feeding and a dry year in California. The large increase in 1956 was due to increased shipments to Washington for storage or exportation (25). Barley shipped to the midwest is primarily malting barley. Outshipments of barley to the midwest have varied considerably during the 11-year period of analysis with a high of 102,000 tons reported in 1956 (25). This compares favorably with the estimate of the

Table 12

Estimated Shipments of Feed Grains From Oregon by Rail and Truck, 1948-58

Year	Rail to All Points[25]			Truck to California[1]			Total Outshipments		
	Barley	Oats	Total	Barley	Oats (Tons)	Total	Barley	Oats	Total
1948	108,500	3,800	112,300	4,200	3,000	7,200	112,700	6,800	119,500
1949	90,900	2,500	93,400		2,000	2,000	90,900	4,500	95,400
1950	107,400	67,900	175,300	12,200	26,200	38,400	119,600	94,100	213,700
1951	90,600	9,700	100,300	4,200	7,800	12,000	94,800	17,500	112,300
1952	158,800	21,100	179,900	18,100	16,800	34,900	176,900	37,900	214,800
1953	109,500	15,500	125,000	16,900	12,400	29,300	126,400	27,900	154,300
1954	113,800	10,600	124,400	13,500	8,500	22,000	127,300	19,100	146,400
1955	119,900	16,000	135,900	9,000	12,800	21,800	128,900	28,800	157,700
1956	215,700	4,000	219,700	9,300	3,200	12,500	225,000	7,200	232,200
1957	169,900		169,900	12,600		12,600	182,500		182,500
1958	218,500	15,600	234,100	9,000	8,200	17,200	227,500	23,800	251,300

[1]Developed from estimations by McGlothlin[7]

amount of malt barley sold from farms in Oregon. As estimated, this quantity would approximate 80,000 tons in 1956 (Table 10). Other years give similar comparisons. According to Interstate Commerce Commission data, approximately 25,000 tons of barley are shipped to California annually, most of which is malting barley (25).

With the exception of 1950 and 1957, oat outshipments have been relatively stable. In 1950, large quantities of oats were shipped to both California and Washington (25). In 1957, no oats was reported shipped out of the State.

Outshipments of wheat were not included in the analysis because they have no effect upon actual quantities of feed grain that will be fed.

Totally, outshipments of feed grain remained relatively stable at a level between 100 thousand and 150 thousand tons annually until 1956, with the exception of 1950 and 1952. In 1950, an unusually large quantity of oats was outshipped, and in 1952 an unusually large quantity of barley was outshipped. A large increase in total outshipments was noted in 1956 because of the corresponding large increase in barley outshipments.

Estimated Feed Grain Available for Feeding Other Than Fed Where Produced

Estimated quantities of feed grain available for feeding during the feeding year other than that fed where produced are tabulated in Table 13. This total is arrived at by subtracting outshipments (Table 12) and adding inshipments (Table 6) to the quantity of feed grain sold from farms as livestock feed (Table 11) and adjusting to a feeding year basis. (To adjust to a feeding year basis, one fourth of the estimated feed grain inshipments and outshipments during the calendar year were assumed to be disposed of after October 1 and three fourths of them were assumed to be disposed of between January 1 and October 1.) Feed grain sold from farms as livestock feed is available at the beginning of the feeding year. Outshipments of barley prior to 1955 were considered as food grain. As such, they were not subtracted in the above process. Since 1955, only outshipments of barley to the midwest and California were considered as malting barley. Thus, the large barley shipments to Washington since 1955 were subtracted as outshipments of feed grain. Only quantities of wheat actually sold as livestock feed are included as available for feeding.

It is apparent estimated feed grain available as livestock feed during the feeding year has varied tremendously

Table 13

Estimated Feed Grain Available for Feeding During the Feeding Year Other Than That Fed Where Produced, 1948-58[1]

Feeding Year Beginning October 1	Estimated Feed Grain Sold From Farm as Livestock Feed[2]	Estimated Out-shipments of Feed Grain[3]	Estimated In-shipments of Feed Grain[2]	Estimated Feed Grain Available for Feeding Other Than Fed Where Produced
		(Tons)		
1948	279,386	5,075	216,500	490,811
1949	274,334	71,700	199,000	401,634
1950	272,106	36,650	331,750	567,206
1951	256,768	34,800	252,000	473,968
1952	279,844	30,400	185,750	435,194
1953	269,696	21,300	190,000	438,396
1954	446,214	86,300	409,750	769,664
1955	403,112	111,325	433,250	725,037
1956	454,482	113,550	474,250	815,182
1957	490,118	182,400	805,500	1,113,518
1958	433,742			

[1]Developed from data in Tables 6, 11, and 12

[2]Includes quantities which are ultimately placed under loan to the Commodity Credit Corporation or exported

[3]Outshipments of barley prior to 1955 were considered as malting barley. Since 1955, only outshipments to California and the midwest were considered malting barley.

throughout the period of analysis; and that a substantial increase in these quantities has occurred since 1954. Prior to 1954, these variations could be explained in the most part by the nature of the inshipments. The large increase in 1954 was due to increases in production of barley and oats in the State. Nearly 300 thousand tons of corn inshipped in 1955 were responsible for another increase. Estimated feed grain available for feeding other than that fed where produced reached an all time high in 1958 when more than 400 thousand tons of grain sorghum were reportedly shipped into the State.

It will be shown later that it would have been impossible for livestock to have used all this feed grain available for feeding since 1955. As previously stated, some feed grain has been stored and other quantities have been exported. The estimated feed grain available for feeding other than that fed where produced includes these quantities stored and exported.

Estimated Quantities of Feed Grain
Available as Livestock Feed
Including That Fed Where Produced

Estimated feed grain available for feeding during the feeding year is tabulated in Table 14. This total is obtained by adding feed grain fed where produced (Table 8) to feed grain available during the feeding year other than

Table 14

Estimated Feed Grain Available as Livestock Feed Including That Fed Where Produced, Feeding Year 1948-58[1]

Feeding Year Beginning October 1	Estimated Feed Grain Available for Feeding Other Than Where Produced	Estimated Feed Grain Fed Where Produced	Estimated Feed Grain Available for Feeding Including That Fed Where Produced
		(Tons)	
1948	490,811	205,068	695,879
1949	401,634	197,302	598,936
1950	567,206	206,404	773,710
1951	473,968	195,172	669,140
1952	435,194	203,330	638,524
1953	438,396	168,710	607,106
1954	769,664	195,692	965,356
1955	725,037	195,162	920,199
1956	815,182	231,868	1,047,050
1957	1,113,518	196,150	1,309,668
1958		225,664	

[1]Developed from data presented in Tables 8 and 13

that fed where produced (Table 13) and includes feed grain which is ultimately stored or exported. Except for the War years and 1953, quantities fed where produced have averaged near 200,000 tons annually. Thus, variation in all feed grain available for feeding during the feeding year closely follows the variation in feed grain available for feeding other than where produced. Large increases in feed grain available for feeding during the feeding year were noted in 1950, 1954, and 1958.

LIVESTOCK AND LIVESTOCK PRODUCTS - NUMBERS ON FARMS, ANIMAL UNITS FED, AND TOTAL PRODUCTION, 1935-1958

Numbers on Farms

Seven classes of livestock are grown extensively on Oregon farms and ranches. These are: (1) dairy cattle; (2) other cattle; (3) sheep and lambs; (4) swine; (5) horses and mules; (6) chickens; and (7) turkeys. Table 15 summarizes annual January 1 inventories of these livestock for the years 1935-1958.

Cattle kept for milking purposes declined during the 24-year period of analysis. These include cows two years old and older, heifers one to two years of age, and heifer calves. The reduction of nearly 100 thousand head occurred after 1946, as prior to that time slight increases were noted. The largest portion of the decline came shortly after the War.

In 1958, other cattle numbers were 1,100 thousand head, approximately twice that of prewar levels. These include beef cows two years old and older, beef heifers, and all steers and bulls. The largest increase in this class of livestock occurred between 1951 and 1953 when beef cattle numbers increased almost 300,000 head. Another large increase was noted during the War years.

Table 15

Livestock on Farms January 1 in Oregon, Average 1935-39, 1940-44, 1945-49, Annual 1950-58(19)

Year	Number on Farms January 1						
	Cattle Kept for Milk	Other Cattle	Sheep and Lambs	Hogs and Pigs	Horses and Mules	Chickens[1]	Turkeys
	(1,000 head)						
Average							
1935-39	390	529	2,064	234	160	3,460	261
1940-44	421	647	1,538	313	135	3,922	496
1945-49	385	704	843	185	96	3,645	503
1950	366	719	689	166	75	3,798	356
1951	362	734	672	141	66	3,389	320
1952	362	876	743	180	60	3,794	352
1953	361	1,013	763	135	57	3,755	264
1954	363	1,080	811	94	52	3,631	296
1955	366	1,123	847	127	50	3,679	278
1956	346	1,110	846	157	48	3,760	289
1957	343	1,055	861	135	47	3,762	298
1958	349	1,063	881	135	46	3,714	271

[1]Broilers omitted

Sheep and lambs have decreased greatly in importance in Oregon since the prewar years. In 1951, numbers on farms and ranches January 1 were approximately one third prewar levels. Since the low of about 672 thousand head was recorded in 1951, increases of more than 200 thousand head have been noted. There were nearly 900 thousand head of sheep and lambs on Oregon farms and ranches January 1, 1958.

Hogs and pigs on inventory reached all-time highs during the War years. Numbers of these livestock decreased rapidly following the War and have since fluctuated considerably, ranging from a high of 184 thousand head in 1949 to a low of 94 thousand head in 1954. In 1958, the number of hogs and pigs on inventory was approximating 135 thousand head.

Horses and mules on Oregon farms decreased continually throughout the period of analysis to less than one third of prewar levels. This decline is becoming smaller each year.

Chicken numbers on Oregon farms and ranches January 1 remained quite stable through the 24-year period. These do not include broilers, and are principally laying hens. Slight increases were noted during the War years, and a relatively small decrease in chicken numbers followed the War. Inventory on January 1, 1958, was 3,714 thousand

head, only slightly more than the 3,460 thousand head reported in 1935.

Turkeys on farms January 1 fluctuated tremendously during the period of analysis. These are mostly breeder hens, and as such are maintained for egg production. A steady increase over prewar levels was noted until on January 1, 1946, 763 thousand head were inventoried. Large decreases followed, and the inventory of 1948 revealed only 222 thousand head of turkeys on Oregon farms and ranches. An increased inventory was noted through 1952. In 1953, turkeys again declined, nearly 100 thousand head. Since then, turkey numbers on farms January 1 have ranged between 270 and 300 thousand head. Large reductions following the War were the result of increased rate of lay, improved fertility, and competition from other areas.

Animal Units Fed Annually

Animal units fed annually between 1935 and 1958 in Oregon are summarized in Table 16. These were derived directly from United States Department of Agriculture, Agricultural Research Service publications. Three series of animal units are presented. These are: (1) grain-consuming; (2) roughage-consuming; and (3) grain-and-roughage-consuming. One animal unit is defined as the "quantity" of livestock consuming the same amount of feed

Table 16

Animal Units to be Fed Annually in Oregon, Average 1935-39, 1940-44, 1945-49, Annual 1950-58 (23)

Feeding Year	Type of Animal Units		
	Grain-consuming	Grain-roughage-consuming (1,000 units)	Roughage-consuming
Average			
1935-39	1,109	1,333	1,449
1940-44	1,279	1,413	1,507
1945-49	1,045	1,200	1,292
1950	1,074	1,196	1,276
1951	1,086	1,299	1,421
1952	992	1,374	1,548
1953	971	1,422	1,618
1954	1,015	1,461	1,660
1955	1,039	1,447	1,634
1956	1,009	1,400	1,582
1957	1,034	1,420	1,594
1958	1,084	1,494	1,682

as utilized by an average dairy cow annually in the United States in the period 1940-45. This amounts to 1,342 pounds of feed grains and other concentrates or a total of 4,981 feed units, including roughage.

Computation of Animal Units

Animal units were computed for the State by the Agricultural Research Service by multiplying numbers of cattle, sheep, horses and mules, and hens and pullets on farms January 1 by factors representing their expected feed consumption as a percentage of that utilized annually by the average dairy cow in the 1940-45 period. These factors are designed to account for turnover of beef and lambs fed during the year but not inventoried. Estimated numbers of pigs to be raised, broilers to be raised, turkeys to be raised, chickens to be raised, and goats to be clipped were also multiplied by appropriate factors. The sum of these multiplications is the number of animal units to be fed annually (23, p.2).

Factors for Computation

Factors used in determining the number of animal units fed in Oregon and the United States were obtained from Earl F. Hodges, Agricultural Economist, Agricultural Research Service, and are presented in Table 17.

Table 17

Animal Unit Factors for Three Types of Animal Units, United States and Oregon[1]

Item	Grain-consuming		Grain-roughage-consuming		Roughage-consuming	
	Ore.	U. S.	Ore.	U. S.	Ore.	U. S.
Cattle on farms Jan. 1						
Milk cows and heifers, 2 yrs. old and older	1.10	1.02	1.10	1.02	1.10	1.00
Heifers and heifer calves kept for milk	.20	.344	.64	.63	.80	.79
Beef cows 2 yrs. old and older	.10	.167	.80	.79	1.05	1.00
Cattle on feed[2]	.70	2.0	.70	.85	.70	.40
All other cattle	.06	.154	.64	.61	.90	.70
Stock sheep on farms Jan. 1	.015	.022	.15	.15	.20	.20
Sheep and lambs on feed Jan. 1[2]	.12	.12	.074	.074	.058	.058
Horses and mules on farms Jan. 1						
2 yrs. old and older	.30	1.34	.80	.90	.90	.80
Colts		.15	.60	.60	1.00	1.00
Hogs fed during the year	.70	.712	.17	.19	.01	.01
Hens and pullets on farms Jan. 1	.06	.0577	.016	.017	.0012	.0012
Chickens raised during the year	.015	.018	.0035	.0045	.0012	.0012
Turkeys raised during the year	.08	.07	.02	.02	.0024	.0024
Commercial broilers	.008	.008	.002	.002		
Goats clipped			.15	.15	.20	.20

[1]Obtained from Earl F. Hodges, Agricultural Economics, Agricultural Research Service

[2]Includes adjustment for turnover

In the case of grain-consuming animal units, several significant differences can be seen between national factors and Oregon factors. Largest differences occur for cattle on feed and horses. A factor of .7 is used for cattle on feed in Oregon, comparing with a factor of 2.0 nationally. This indicates Oregon cattle on feed are fed grains and other concentrates in considerably less quantity than is the case nationally. For horses, the national factor of 1.34 compares with an Oregon factor of .30, indicating horses in Oregon receive considerably less feed grain than the national average.

No large differences exist between Oregon and national factors for computing roughage-consuming and grain-and-roughage-consuming animal units, though it is apparent Oregon cattle and horses receive more roughage than is the case nationally. This is because more roughage is available in range form. Oregon chickens, cattle on feed, and horses receive slightly less feed units than is the case nationally.

Numbers of Animal Units Fed Annually

Numbers of grain-consuming animal units to be fed annually in Oregon have not changed drastically throughout the period of analysis. An increase occurred during World War II, but was followed by a decrease. A low of 971

thousand grain-consuming animal units was recorded in 1953. Since then, an increase of more than 100 units has been noted, half of which occurred in 1958.

Numbers of grain-and-roughage-consuming animal units increased to slightly above a level of 1,400 thousand units during the War years, and decreased immediately thereafter until a low of slightly less than 1,200 thousand units was reached in 1950. Steady increases occurred until 1954. Numbers decreased in 1955 and again in 1956, but increased in 1957 and 1958. Slightly less than 1,500 thousand grain-and-roughage-consuming animal units were present on Oregon farms in 1958.

Numbers of roughage-consuming animal units increased during the War years and then decreased to a low of near 1,275 thousand units in 1950. Since 1951, increases have occurred in all but two years, 1955 and 1956. A level of nearly 1,700 thousand units was recorded in 1958.

Concentrates Necessary to Feed Estimated Grain-consuming Animal Units

Grain-consuming animal units provide a means of estimating in advance of the feeding year quantities of feed grains and other concentrates necessary to feed animal numbers on farms and estimated numbers to be raised. By multiplying the computed animal units by the 1,342 pounds

of concentrates utilized by the average dairy cow annually in the United States during the period 1940-45, an estimate of feed grain needed for the livestock production expected to occur during the feeding year is obtained.

Concentrates necessary to feed estimated grain-consuming animal units are shown in Table 18. These quantities are considerably less than concentrates necessary for actual production, as will be pointed out later. This is due to errors in estimations of numbers of livestock on farms, numbers to be raised during the year, feeding for heavier production, and delayed feeding.

Production of Livestock and Livestock Products

Production of livestock and livestock products in Oregon includes poundage of meat animals and poultry, number of eggs, pounds of milk, and pounds of wool produced during the calendar year. Poundage of meat animals and poultry is pounds added by birth and growth but does not include weights of all livestock on farms and ranches. In ascertaining livestock production for the State, weights of livestock shipped into Oregon are deducted from total pounds of marketings and farm slaughter. Also, differences in inventory poundage between the beginning and close of the year are added or subtracted as the case may be.

Table 18

Concentrates Necessary to Feed Estimated Grain-consuming **Animal Units**, Average 1935-39, 1940-44, 1945-49, Annual 1950-58

Year	Grain-consuming Animal to be Fed During the Feeder Year (1,000 units)	Estimated Concentrates Necessary to Feed Them[1] (Tons)
Average		
1935-39	1,109	744,139
1940-44	1,279	858,209
1945-49	1,045	701,195
1950	1,074	720,654
1951	1,086	728,706
1952	992	665,632
1953	971	651,541
1954	1,015	681,065
1955	1,039	697,169
1956	1,009	677,039
1957	1,034	693,814
1958	1,084	727,364

[1] One unit equivalent to 1,342 pounds feed grains and other concentrates

Production of livestock and livestock products for the State for the years 1935-58 are summarized in Table 19. These data were obtained from United States Department of Agriculture publications. Nine items are included: (1) cattle and calves; (2) sheep and lambs; (3) hogs; (4) broilers; (5) farm chickens; (6) turkeys; (7) milk; (8) eggs; and (9) wool.

Production of cattle and calves increased quite steadily through the period of analysis from slightly more than 200 million pounds to slightly more than 400 million pounds, a near doubling. The largest single increase occurred between 1952 and 1953, when an increase of more than 50 million pounds was noted. Production has remained near a level of 400 million pounds since.

Sheep and lamb production declined steadily from levels above 80 million pounds in the prewar period to slightly above 37 million pounds in 1950. Since then, increased production has been noted each year, with the exception of 1956. More than 55 million pounds of sheep and lambs were produced in 1958.

As sheep and lamb production declined, so did wool production. Oregon wool production for the year 1950 was at a level one third that of prewar years. Since 1950, increased wool production has been noted every year except

Table 19

Production of Livestock and Livestock Products in Oregon, Average 1935-39, 1940-44, 1945-49, Annual 1950-58

Year	Cattle and Calves(21)	Sheep and Lambs(21)	Hogs(21)	Broilers(15)	Farm Chickens(14)	Turkeys(22)
			(1,000 pounds)			
Average						
1935-39	212,798	82,837	70,149	572	15,767	20,613
1940-44	259,609	65,450	90,660	2,113	21,476	35,567
1945-49	275,074	40,829	62,979	6,904	21,373	38,944
1950	300,900	37,090	51,248	13,875	21,207	38,494
1951	328,870	37,909	52,451	17,562	21,728	43,355
1952	357,355	44,779	52,511	15,788	18,475	41,109
1953	412,325	46,018	37,920	14,178	18,805	35,558
1954	408,570	50,942	41,912	16,575	17,444	29,196
1955	421,690	52,851	54,139	19,012	16,766	27,816
1956	396,305	49,091	51,393	26,822	15,922	26,826
1957	379,190	50,551	50,080	24,630	15,982	28,159
1958	414,370	55,187	56,701	26,688	14,938	30,528

Table 19 (cont.)

Year	Milk(17) (Million pounds)	Eggs(14) (Millions)	Wool(24) (1,000 pounds)
Average			
1935-39	1,342	410	16,279
1940-44	1,417	483	12,245
1945-49	1,283	485	6,522
1950	1,253	550	5,366
1951	1,196	570	5,682
1952	1,176	588	6,120
1953	1,214	599	6,029
1954	1,238	620	6,525
1955	1,208	616	6,723
1956	1,156	640	6,845
1957	1,135	624	6,932
1958	1,125	621	7,145

1953. Production was slightly more than seven million pounds in 1958.

Production of hogs varied more than any other livestock product through the period of analysis. Nearly 91 million pounds were produced during the War years. Following the War years, a rapid decrease occurred until a low of slightly less than 38 million pounds was recorded in 1953. Increases have occurred since then, and production was nearly 57 million pounds in 1958.

A phenomenal increase in broiler production occurred in the period under consideration. Production increased quite steadily from near one-half million pounds in the prewar period to 27 million pounds in 1956. This level has since been maintained.

Farm chicken production increased from 16 million pounds in the prewar period to above 21 million during World War II. This level was maintained until 1951. Since 1952, a decrease has taken place every year. In 1958, slightly less than 15 million pounds were produced.

Turkey production increased quite steadily to a high of near 57 million pounds in 1945. After the War, production declined quite rapidly to a level of near 38 million pounds in 1950. An increase of some five million pounds was noted in 1951. This was followed by successive decreases until 1956 production was slightly below 27

million pounds. In 1958, turkey production in Oregon was nearly 30.5 million pounds.

Milk production increased to slightly above 1,417 million pounds during the War years. An almost steady reduction, with the exception of 1953-55, has occurred since. Production in these three years increased slightly. In 1958, Oregon milk production was 1,125 million pounds.

Numbers of eggs produced in Oregon increased quite steadily from 410 million in the 1935-39 period to 640 million in 1956. Decreases occurred in both 1957 and 1958. About 621 million eggs were produced in 1958.

Prices of Livestock and Livestock Products

Mention has been made about the effect of livestock and livestock prices on the production of livestock. Prices of these products that have prevailed during the 24 years of analysis are presented in Table 20. These prices are simply yearly averages, but illustrate many of the changes that have taken place.

Prices of livestock and livestock products were relatively low prior to World War II. They increased during the War because of increased demand. Increases were limited, however, by Government price settings. Prices generally increased following the War for a short period,

Table 20

Prices Received for Livestock and Livestock Products by Oregon Farmers, 1935-49[9]

Year	Cattle	Calves	Hogs	Sheep	Lambs	Farm Chickens	Broilers	Turkeys
				(Dollers per pound)				
1935	.06	.07	.09	.03	.06	.18	.20	.19
1936	.06	.07	.10	.04	.07	.18	.19	.16
1937	.07	.08	.10	.04	.08	.18	.21	.17
1938	.06	.08	.08	.03	.06	.18	.18	.18
1939	.07	.08	.07	.04	.07	.16	.16	.15
1940	.07	.09	.06	.04	.08	.16	.18	.15
1941	.08	.11	.10	.05	.09	.19	.18	.20
1942	.10	.12	.13	.05	.11	.23	.26	.29
1943	.11	.13	.14	.06	.12	.23	.30	.33
1944	.11	.13	.13	.06	.11	.27	.30	.33
1945	.12	.13	.15	.06	.12	.27	.30	.35
1946	.14	.16	.18	.07	.15	.26	.35	.32
1947	.18	.21	.26	.08	.20	.27	.37	.35
1948	.20	.25	.25	.09	.23	.32	.39	.44
1949	.17	.21	.20	.08	.20	.27	.30	.31
1950	.22	.26	.20	.10	.23	.23	.30	.28
1951	.27	.33	.23	.14	.30	.26	.30	.34
1952	.22	.27	.20	.09	.24	.20	.30	.30
1953	.15	.17	.23	.06	.18	.21	.29	.30
1954	.15	.17	.24	.05	.17	.17	.25	.25
1955	.14	.17	.18	.06	.17	.19	.26	.28
1956	.13	.15	.16	.05	.18	.17	.23	.27
1957	.17	.21	.20	.05	.19	.14	.22	.22
1958	.21	.26	.22	.07	.20	.15	.20	.22

Table 20 (cont.)

Year	Milk (Dollars per cwt.)	Eggs (Cents per dozen)	Wool (Dollars per pound)	Index of Aggregate Prices[1]
1935	1.73	.23		106
1936	1.91	.20		113
1937	1.95	.20		119
1938	1.64	.21		105
1939	1.62	.19		105
1940	1.83	.18		110
1941	2.23	.25	.34	136
1942	2.71	.32	.39	168
1943	3.23	.41	.40	194
1944	3.34	.35	.40	190
1945	3.48	.44	.40	205
1946	4.38	.45	.41	233
1947	4.80	.55	.42	275
1948	5.26	.58	.48	309
1949	4.57	.53	.46	268
1950	4.58	.45	.58	280
1951	5.40	.56	1.07	345
1952	5.60	.51	.54	312
1953	5.20	.56	.55	265
1954	4.64	.43	.53	243
1955	4.39	.47	.46	232
1956	4.61	.45	.46	228
1957	4.71	.40	.58	244
1958	4.58	.42	.39	268

[1]Based on value of sales - 1910-14 = 100

then dropped down. They increased again at the outbreak of the Korean War, but have gradually decreased since then.

Aggregate livestock and livestock products prices are presented in index number form. These represent total sales value of all livestock and livestock products sold from Oregon farms and ranches.

LIVESTOCK-PRODUCTION UNITS AS A MEASURE OF CONCENTRATE CONSUMPTION

In the previous section, livestock on farms January 1 and estimated numbers of livestock to be raised during a selected series of years in Oregon were converted to grain-consuming animal units. These were computed by multiplying animal numbers by weights representing consumption of concentrates by them in terms of the annual concentrate consumption of an average United States dairy cow during the period 1940-45. From this, an estimate was obtained of feed grain and other concentrates needed to feed these animals. This estimate of concentrate consumption did not take into account improvements in feed efficiency, substitutions of feeds, delayed feeding, feeding to heavier weights, and unanticipated changes in numbers of livestock raised during the year.

In accounting for these inadequacies of grain-consuming animal units, it was necessary to convert livestock and livestock products to livestock-production units produced from feed grain and other concentrates.

A livestock production unit produced from feed grains and other concentrates only is equivalent to the production of various livestock and livestock products resulting from 1,342 pounds of feed grains and other concentrates, the quantity utilized annually by an average milk cow in the

United States during the period 1940-45 in producing 4,390 pounds of milk. Since livestock-production units are based on livestock production rather than animal numbers, most of the inadequacies of grain-consuming animal units are accounted for. That is, substitutions of feeds, delayed feeding, feeding for heavier production, and unanticipated changes in the numbers of livestock raised during the year are accounted for. Only increases in feed efficiency are not accounted for.

Computation of these livestock-production units is necessary to determine more accurately the quantities of feed grains and other concentrates fed grain-consuming animal units. Livestock production units are also an aid in viewing more accurately the consumption of feed grains and other concentrates by the various classes of livestock.

Conversion Factors

In order to convert livestock production to livestock-production units from grains and other concentrates, appropriate conversion factors had to be developed. United States factors were available from the Agricultural Research Service. Oregon factors were developed from these United States factors according to feed grain and other concentrate consumption by various classes of livestock reported in Feed Consumed by Livestock by States (5).

Chief adjustments were: (1) Oregon dairy cattle were fed at rates heavier than the national average; (2) grain-fattened cattle and sheep received less concentrates than the national average; and (3) horses were fed feed grain at rates less than the national average (5, p.28-44).

Conversion factors represent amounts of feed grain and other concentrates used to produce 100 pounds liveweight of meat animals and poultry, 1,000 pounds of milk, and 1,000 eggs in terms of a percentage of the feed grain used by the average United States dairy cow in producing 4,390 pounds of milk annually in the 1940-45 period. Since horses and mules are also utilizing concentrates, factors are given for them also. For example, 477 pounds of feed grains and other concentrates are needed to produce 100 pounds liveweight of hogs. The factor for hogs is 477 pounds divided by 1,342 pounds, or 36 percent. Both United States and Oregon conversion factors are presented in Table 21.

Calculation of Livestock-production Units

Only one adjustment is necessary to convert livestock production into livestock production from feed grain and other concentrates. Cattle production has to be divided into two categories: (1) grain-fattened; and (2) other. To estimate numbers of grain-fattened cattle in Oregon, the numbers of cattle and calves on feed January 1 were

Table 21

Factors for Computing Livestock-production Units from Grain, United States and Oregon

Item	Unit	United States[6]		Oregon[5]	
		Concentrates Fed per Unit (Pounds)	Factor	Concentrates Fed per Unit (Pounds)	Factor
On farms January 1					
Milk cows	head	1,342	1.0	1,610	1.2
Horses and mules 2 yrs. old and older	head	1,707	1.27	483	.36
Colts	head	345	.26	345	.26
Liveweight produced					
Grain-fattened cattle	cwt.	567	.42	456	.34
Other cattle	cwt.	33	.025	33	.025
Sheep and lambs	cwt.	113	.08	40	.03
Hogs	cwt.	477	.36	477	.36
Farm chickens	cwt.	519	.39	519	.39
Broilers	cwt.	316	.23	316	.23
Turkeys	cwt.	579	.43	579	.43
Milk	1,000 lbs.	306	.23	306	.23
Eggs	1,000 eggs	601	.45	601	.45

multiplied by the turnover in numbers. This turnover was assumed to be 1.8 in 1935 and to have increased to 2.0 by 1958. Numbers of estimated cattle and calves fed were multiplied by the gain per head, which was assumed to increase by five-pound intervals from 350 pounds in 1935 to 445 pounds.[1] The sums of these multiplications are the production from grain-fattened cattle. Other cattle production is obtained by subtracting grain-fattened cattle production from total cattle production. Production data utilized in computing livestock-production units from feed grains and other concentrates between 1935 and 1958 is presented in Table 22.

This production is multiplied by the conversion factors in Table 21 to give the number of livestock-production units produced from feed grains and other concentrates annually during this period. These production units are presented in Table 23.

Justification of the Base Period

A question may arise as to the legitimacy of using the 1940-45 period as a base because of increased feed efficiency. Feed efficiency has increased during this period

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[1]Estimates received from Earl F. Hodges, Agricultural Economist, Agricultural Research Service.

Table 22

Data for Computing Annual Livestock-production Units From Grain and Other Concentrates in Oregon, Annual 1935-58

Year	Liveweight Production							
		Cattle				Poultry		
	Hogs(21)	Grain-fattened	Other	Total(21)	Sheep(21)	Farm (14) Chickens	Broil-ers(15)	Tur-keys(22)
				(1,000 pounds)				
1935	47,450	4,410	208,280	212,690	91,294	15,660	390	13,814
1936	65,340	15,336	195,514	210,850	84,218	16,014	520	17,430
1937	75,225	14,904	197,626	212,530	72,540	14,717	585	19,128
1938	76,800	13,140	202,650	215,790	84,950	14,393	675	23,717
1939	85,930	15,318	196,812	212,130	81,181	18,050	688	28,974
1940	84,015	16,200	206,565	222,765	77,564	16,524	1,010	28,900
1941	83,535	17,784	230,416	248,200	82,973	19,773	1,656	31,286
1942	87,448	19,404	251,636	271,040	65,549	22,700	1,987	34,855
1943	111,545	18,252	247,343	265,595	50,428	26,960	2,782	40,786
1944	86,758	17,064	273,381	290,445	50,738	21,425	3,129	42,007
1945	63,899	21,280	255,340	276,620	47,327	24,820	5,679	56,672
1946	64,418	21,532	242,508	264,040	42,472	17,223	4,957	39,324
1947	61,045	22,591	253,404	275,995	41,051	20,385	5,453	31,889
1948	61,155	18,924	245,591	264,515	39,609	21,142	8,154	29,851
1949	64,376	25,536	268,664	294,200	33,686	23,293	10,278	36,985
1950	51,248	25,500	275,400	300,900	37,090	21,207	13,875	38,494
1951	52,451	22,360	306,510	328,870	37,909	21,728	17,562	43,355
1952	52,511	22,620	334,735	357,355	44,779	18,475	15,788	41,109
1953	37,920	26,400	385,925	412,325	46,018	18,805	14,178	35,558
1954	41,912	28,160	380,410	408,570	50,942	17,444	16,575	29,196
1955	54,139	31,680	390,010	421,690	52,851	16,766	19,012	27,816
1956	51,593	33,440	362,865	396,305	49,091	15,922	26,822	26,828
1957	50,080	30,260	348,930	379,190	50,551	15,982	24,630	28,159
1958	56,701	30,260	384,110	414,370	55,187	14,938	26,688	30,528

Table 22 (cont.)

Year	Other Production		Horses and Mules[19]	
	Milk[17] (1,000 pounds)	Eggs[14] 1,000	2 yrs. old and older (Head)	Colts (Head)
1935	1,329,000	357,000	171,000	
1936	1,333,000	398,000	165,000	
1937	1,336,000	446,000	161,000	
1938	1,350,000	425,000	153,000	
1939	1,364,000	423,000	148,000	
1940	1,394,000	444,000	145,000	
1941	1,428,000	456,000	142,000	
1942	1,446,000	480,000	137,000	
1943	1,411,000	506,000	132,000	
1944	1,408,000	530,000	121,000	
1945	1,354,000	497,000	115,000	
1946	1,284,000	491,000	95,000	8,000
1947	1,295,000	482,000	87,000	8,000
1948	1,233,000	477,000	79,000	8,000
1949	1,247,000	479,000	74,000	8,000
1950	1,253,000	550,000	68,000	7,000
1951	1,196,000	570,000	60,000	6,000
1952	1,176,000	588,000	55,000	5,000
1953	1,214,000	599,000	53,000	4,000
1954	1,238,000	620,000	48,000	4,000
1955	1,208,000	616,000	46,000	4,000
1956	1,156,000	640,000	44,000	4,000
1957	1,135,000	624,000	43,000	4,000
1958	1,125,000	621,000	42,000	4,000

Table 23

Livestock-production Units from Grain and Other Concentrates in Oregon, Annual 1935-58

Year	Milk	Grain-fattened Cattle	Other Cattle	Sheep and Lambs	Hogs
			(1,000 units)		
1935	305.67	14.99	52.07	27.39	170.82
1936	306.59	52.14	48.88	25.27	235.22
1937	307.28	50.67	49.41	21.76	270.81
1938	310.50	44.68	50.66	25.49	276.48
1939	313.72	52.08	49.20	24.35	309.35
1940	320.62	55.08	51.64	23.27	302.45
1941	328.44	60.47	57.60	24.89	300.73
1942	332.58	65.97	62.91	19.66	314.81
1943	324.53	62.06	61.84	15.13	401.56
1944	323.84	58.02	68.35	15.22	312.33
1945	311.42	72.35	63.84	14.20	230.04
1946	295.32	73.21	60.62	12.74	231.91
1947	297.85	76.81	63.35	12.32	219.76
1948	283.59	64.34	61.40	11.88	220.16
1949	286.81	86.82	66.85	10.11	231.75
1950	288.19	86.70	68.85	11.13	184.49
1951	275.08	76.02	76.63	11.37	188.82
1952	270.48	76.91	83.68	13.43	189.04
1953	279.22	89.76	96.48	13.81	136.51
1954	284.74	95.74	95.10	15.28	150.88
1955	277.84	107.71	97.50	15.86	194.90
1956	265.88	113.70	90.72	14.73	185.74
1957	261.05	102.88	87.23	15.17	180.29
1958	258.75	102.88	96.03	16.56	204.12

Table 23 (cont.)

Year	Eggs	Farm Chickens	Broilers	Turkeys	Horses and Mules[1]	Total Units
			(1,000 units)			
1935	160.65	61.07	.90	59.40	61.56	914.52
1936	179.10	62.46	1.20	74.95	59.40	1,045.21
1937	200.70	57.40	1.35	82.25	57.96	1,099.59
1938	191.25	56.13	1.55	101.98	55.08	1,113.80
1939	190.35	70.40	1.58	124.59	53.28	1,188.90
1940	199.80	64.44	2.32	124.27	52.20	1,196.09
1941	205.20	77.12	3.81	134.53	51.12	1,243.91
1942	216.00	88.53	4.57	149.88	49.32	1,304.23
1943	227.70	105.14	6.40	175.38	47.52	1,427.26
1944	238.50	83.56	7.20	180.63	43.56	1,331.21
1945	223.65	96.80	13.06	243.69	41.40	1,310.55
1946	220.95	67.17	11.40	169.09	36.23	1,178.69
1947	216.90	79.50	12.54	137.12	33.40	1,149.55
1948	214.65	82.45	18.75	128.36	30.52	1,116.10
1949	215.55	90.84	23.64	159.04	28.72	1,200.13
1950	247.50	82.71	31.91	165.52	26.30	1,193.30
1951	256.50	84.74	40.39	186.43	23.16	1,219.14
1952	264.60	72.05	36.31	176.77	21.10	1,204.37
1953	269.55	73.34	32.61	152.90	20.12	1,164.30
1954	279.00	68.03	38.12	125.54	18.32	1,170.75
1955	277.20	65.39	43.73	119.61	17.60	1,217.34
1956	288.00	62.10	61.83	115.36	16.88	1,214.94
1957	280.80	62.33	56.65	121.08	16.52	1,218.36
1958	279.45	58.26	61.38	131.27	16.16	1,224.86

[1]Includes colts after 1945

if efficiency is defined as output per unit of input. However, much of this is due to less forage being used per unit, or to feeding younger livestock (6, p.12). Only in the case of broilers has there been a significant increase in feed grain efficiency. For broilers, a base of 1950-53 has been used by the Agricultural Research Service. In the United States, concentrates fed per livestock-production unit during the period varied from a low of .59 tons in the drought year of 1936 to a high of .79 tons during the War. In 1958, .77 tons were fed per livestock-production unit. Feed grain and other concentrates fed per unit during this period have not changed significantly because most livestock are being fed at heavier rates. Therefore, there is justification in using the 1940-45 period as a base.

Quantities of Various Livestock and Livestock Products Equivalent to One Livestock-production Unit From Feed Grains and Other Concentrates

The reader may wish to know how much of the various livestock production is the equivalent of one livestock-production unit from feed grain and other concentrates. This can be obtained by dividing the 1,542 pounds of concentrates necessary for producing one livestock-production unit by the concentrates fed per 100 pounds liveweight of meat animals and poultry, 1,000 pounds of milk, 1,000 eggs, or head of horses, mules, and colts. In the case of hogs,

for instance, one livestock-production unit from feed grain would be equal to 1,342 pounds divided by 477 pounds, or 2.81 hundredweight of hogs. Other quantities of livestock and livestock products equal to one livestock-production unit from feed grains and other concentrates are summarized in Table 24.

Feed Grain Fed by Class of Livestock

Livestock-production units obtained from feed grain and other concentrates are summarized in Table 23. Since one livestock-production unit is obtained from 1,342 pounds of feed grain and other concentrates, importance of feed grain and other concentrates as feed for the various classes of livestock is evident from this table. However, the reader may wish to know estimated quantities of feed grains and other concentrates utilized by each class of livestock. These are obtained by multiplying calculated numbers of livestock-production units by the 1,342 pounds of feed grain and other concentrates necessary for this production. For instance, in 1958, 204.12 thousand livestock-production units from feed grains and other concentrates were produced from hogs. Hogs thus consumed 1,342 pounds of feed grain and other concentrates per production unit, or 136,965 tons. Quantities of concentrates

Table 24

Quantities of Livestock and Livestock Products Equivalent to One Livestock-production Unit from Grains and Other Concentrates in Oregon

Livestock or Livestock Product	Quantity Equivalent to One Livestock-production Unit from Grains and Other Concentrates	
	Unit	Quantity
Hogs	cwt. produced	2.81
Grain-fattened cattle	cwt. produced	2.94
Other cattle	cwt. produced	40.67
Sheep and lambs	cwt. produced	33.55
Farm chickens	cwt. produced	2.59
Broilers	cwt. produced	4.25
Turkeys	cwt. produced	2.32
Milk	1,000 lbs. produced	4.39
Eggs	1,000	2.23
Horses	Head	2.78
Colts	Head	3.89

utilized by other classes of livestock are presented in Table 25 and in Figure 1.

In 1958, more feed grain and other concentrates were used in producing eggs than any other livestock product. Milk ranked second and was followed by hogs, turkeys, grain-fattened cattle, other cattle, broilers, farm chickens, sheep and lambs, and horses, in that order.

This ranking has not always been maintained. The four most important users of feed grains and concentrates throughout the period have been milk-producing dairy cows, hogs, layers, and turkeys. Hogs ranked first as a consumer of feed grains during the War year of 1943 when surplus wheat was released as livestock feed. Other than that year, milk-producing dairy cattle were the most important users of concentrates until 1956. Since 1956, laying hens and pullets have used more feed grains and other concentrates than any other class of livestock. Both hogs and turkeys hit high peaks of concentrate utilization during the War years and have since declined to lower levels. Prior to 1947, broilers were the least important users of feed grains. Between 1947 and 1957, sheep utilized less feed grains and other concentrates than any other class of livestock. In 1958, sheep used slightly more feed grains than did horses.

Several important trends in consumption of feed grain and other concentrates by various classes of livestock are

Table 25

Tons of Concentrates Utilized in Producing Calculated Livestock-production Units From Grain by Class of Production in Oregon, Annual 1935-58[1]

Year	Milk	Grain-fattened Cattle	Other Cattle (Tons)	Sheep and Lambs	Hogs
1935	205,105	10,058	34,939	18,379	114,620
1936	205,722	34,986	32,798	16,956	157,833
1937	206,185	34,000	33,154	14,601	181,714
1938	208,346	29,980	33,993	17,104	185,518
1939	210,506	34,946	33,013	16,339	207,574
1940	215,136	36,959	34,650	15,614	202,944
1941	220,383	40,575	38,650	16,701	201,790
1942	223,161	44,266	42,213	13,192	211,238
1943	217,760	41,642	41,495	10,152	269,447
1944	217,297	38,931	45,863	10,213	209,573
1945	208,963	48,547	42,837	9,528	154,357
1946	198,160	49,124	40,676	8,549	155,612
1947	199,857	51,540	42,508	8,267	147,459
1948	190,289	43,172	41,199	7,971	147,727
1949	192,450	58,256	44,856	6,784	155,504
1950	193,375	58,176	46,198	7,468	123,793
1951	184,579	51,009	51,419	7,629	126,698
1952	181,492	51,607	56,149	9,012	126,846
1953	187,357	60,229	64,738	9,267	91,598
1954	191,061	64,242	63,812	10,253	101,240
1955	186,431	72,273	65,423	10,642	130,778
1956	178,405	76,293	60,873	9,884	124,632
1957	175,165	69,032	58,531	10,179	120,975
1958	173,621	69,032	64,436	11,112	136,965

[1]One livestock-production unit equivalent to 1,342 pounds of concentrates

Table 25 (cont.)

Year	Eggs	Farm Chickens	Broilers	Turkeys	Horses and Mules	Total
			(Tons)			
1935	107,796	40,978	604	39,857	41,307	613,643
1936	120,176	41,911	805	50,291	39,857	701,334
1937	134,670	38,515	906	55,190	38,891	737,825
1938	128,329	37,663	1,040	68,429	36,959	747,360
1939	127,725	47,238	1,060	83,600	35,751	797,752
1940	134,066	43,239	1,557	83,385	35,026	802,576
1941	137,689	51,748	2,557	90,270	34,302	834,664
1942	144,936	59,404	3,067	100,569	33,094	875,138
1943	152,787	70,549	4,294	117,680	31,886	957,691
1944	160,034	56,069	4,831	121,203	29,229	893,242
1945	150,069	64,953	8,763	163,516	27,779	879,379
1946	148,257	45,071	7,649	113,459	24,344	790,901
1947	145,540	53,345	8,414	92,008	22,411	771,348
1948	144,030	55,324	12,581	86,130	20,479	748,903
1949	144,634	60,954	15,862	106,716	19,271	805,287
1950	166,073	55,498	21,412	111,064	17,647	800,704
1951	172,112	56,861	27,102	125,095	15,540	818,043
1952	177,547	48,346	24,364	118,613	14,158	808,132
1953	180,868	49,211	21,881	102,596	13,501	781,245
1954	187,209	45,648	25,579	84,237	12,293	785,573
1955	186,001	43,877	29,343	80,258	11,810	816,835
1956	193,248	41,669	41,488	77,407	11,326	815,225
1957	188,417	41,823	38,012	81,245	11,085	817,520
1958	187,511	39,092	41,186	88,082	10,843	821,881

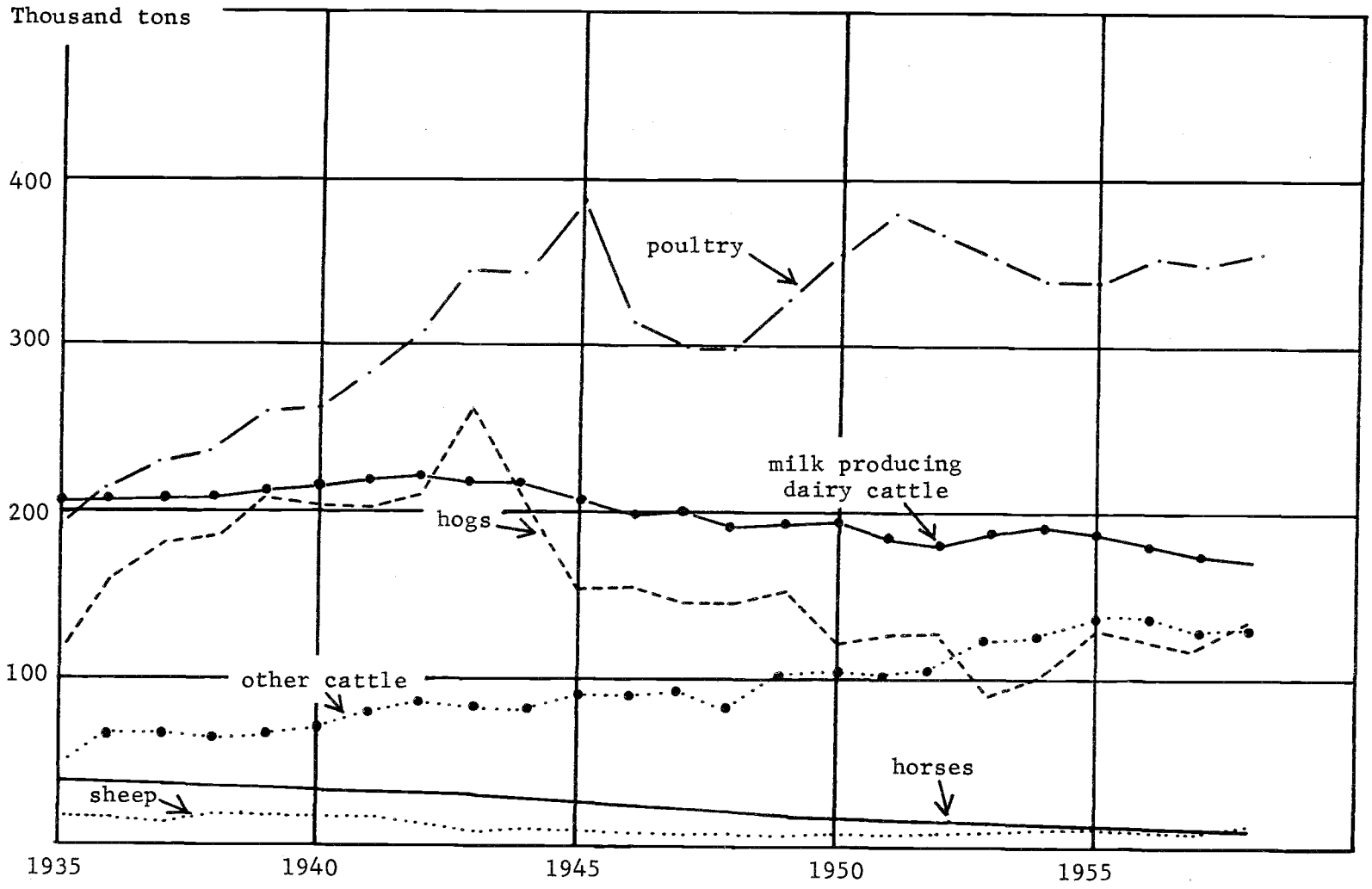

FIGURE 1. CONCENTRATES UTILIZED BY VARIOUS CLASSES OF LIVESTOCK IN OREGON

apparent. The two most important are: (1) decreasing quantities utilized by lactating dairy cattle; and (2) increasing quantities utilized by laying hens and pullets. Both grain-fattened and other cattle are using more feed grains. There has been a substantial increase in use of feed grains and other concentrates by broilers. Use of these concentrates by farm chickens has declined in recent years. Horses continue to utilize less concentrates each year. Since 1949, sheep have been utilizing more feed grains and other concentrates.

More fluctuation in use of concentrates occurred for hogs and turkeys than for any other class of livestock. Both reached high levels of utilization during the War years and have fluctuated considerably since. Presently, it appears that both turkeys and hogs will continue to utilize feed grains and other concentrates in considerable quantities. These fluctuations occur in part because it is easier for producers to enter and leave this sort of enterprise than one which requires more capital and the livestock have longer reproductive cycles.

Concentrates Necessary to Produce Calculated Livestock-production Units

Feed grains and other concentrates necessary to produce calculated livestock-production units are found by multiplying the feed grain utilized by one production unit,

1,342 pounds, by the number of calculated units. Table 25 summarizes this information for the years 1935-58.

This quantity of concentrates has not varied tremendously during the period of analysis. Less was fed in 1935 because of the drought and depression. Highest calculated use occurred during the War years when wheat was available as livestock feed. Since the War years, the quantity of feed grain and other concentrates needed for livestock production has varied around the 800,000 ton level. Approximately one fourth of these concentrates are fed where produced (Table 8), and slightly more than one fourth are inshipped (Table 6).

Comparison Between Feed Grain Available for Feeding and Total Concentrates Necessary for Production

Comparison must be made between feed grain available for feeding and total concentrates needed for production in order to be certain conversion factors used in computing total concentrates needed are not overestimated. This is done in Table 26 by subtracting total concentrates needed for production from feed grain available for feeding.

Prior to 1954, it is apparent there would not have been enough feed grain available to produce the calculated livestock-production units. However, concentrates other than feed grains have not been accounted for. Several of these are relatively important.

Table 26

Comparison Between Estimated Feed Grain Available for Feeding and Concentrates Needed to Produce Calculated Livestock-production Units From All Concentrates, 1948-57[1]

Feeding Year Beginning October 1	Total Concentrates Needed to Produce Calculated Livestock-production Units[1]	Total Estimated Feed Grain Available for Feeding[2]	Surplus or Deficit
		(Tons)	
1948	819,373	695,879	-123,494
1949	801,850	598,936	-202,914
1950	796,369	773,710	-22,659
1951	820,521	669,140	-151,381
1952	814,854	638,524	-176,330
1953	780,163	607,106	-173,057
1954	777,757	965,356	187,599
1955	817,238	920,199	102,961
1956	814,593	1,047,050	232,457
1957	816,488	1,309,668	493,180

[1]From Table 25

[2]From Table 14

Formula feeds are the most important of these. Ingredients in formula feeds in the feeding year of 1949-50 were estimated to be 44 percent feed grains, 28 percent millfeeds and other by-products, and 28 percent high protein feeds (5, p.19). These formula feeds were fed in considerable extent in Oregon in the 1949-50 feeding season. An estimated 324,000 tons of the total estimated 766,000 tons of concentrates fed in Oregon during this period were formula feeds (5, p.68).

Both cottonseed and soybean oil meals are fed in Oregon. Considerable quantities of these are reported inshipped by rail and truck (Table 6). An estimated 18,000 tons were fed in Oregon in the 1949-50 feeding season (5, p.68).

The other important concentrate fed in considerable quantities is beet pulp, a by-product of beet sugar manufacturing. During the 1949-50 feeding season, a reported 25,000 tons of this concentrate was fed (5, p.68).

Other concentrates reported fed to livestock in Oregon during the 1949-50 feeding season were millfeed and hominy, milk, and linseed oil meal (5, p.68). Others are undoubtedly fed in lesser amounts.

In the 1949 feeding season, total feed grain available for feeding lacked 203 thousand tons of meeting the requirements necessary to produce calculated livestock-

production units from feed grains and other concentrates. If 324,000 tons of formula feeds were fed, and these formula feeds contained only 44 percent feed grains, other ingredients of these feeds would be nearly enough to offset the 203 thousand ton deficit. These quantities of formula feeds plus the quantities of beet pulp produced and the quantities of oil meals shipped in should be more than enough to offset the deficit.

Estimated Concentrates Fed per Grain-consuming Animal Unit

As previously stated, one of the reasons for developing livestock-production units was to obtain a more accurate estimate of feed grain and other concentrates fed grain-consuming animal units. Concentrates fed per animal unit were developed from total concentrates needed to produce calculated livestock-production units from feed grain and other concentrates during the feeding year (Table 26). Concentrates needed to produce this livestock production were divided by the numbers of grain-consuming animal units fed to arrive at concentrates fed per grain-consuming animal unit. Table 27 summarizes this information.

Concentrates fed per grain-consuming animal unit increased in Oregon from .60 tons in 1935 to .82 tons in 1952. Since 1952, this level of feeding has fallen off slightly.

Table 27

Feed Grain and Other Concentrates Fed per Grain-consuming Animal Units in Oregon and United States, 1935-58

Feeding Year Beginning October 1	Concentrates Needed for Production[1]	Grain-consuming Animal Units Fed[2]	Concentrates Fed per Grain-consuming Animal Unit	
			Oregon	U. S.(23)
	(Tons)	(1,000 units)	(Tons)	
1935	613,643	1,018	.60	.68
1936	679,411	1,086	.63	.55
1937	728,703	1,104	.66	.70
1938	744,981	1,150	.65	.66
1939	786,406	1,188	.66	.65
1940	800,120	1,176	.68	.69
1941	826,642	1,244	.66	.71
1942	865,019	1,357	.64	.74
1943	937,053	1,355	.69	.72
1944	909.354	1,263	.67	.75
1945	882,845	1,100	.80	.79
1946	813,021	1,011	.80	.77
1947	776,236	1,001	.78	.72
1948	819,373	1,049	.78	.76
1949	801,850	1,063	.75	.77
1950	796,369	1,074	.74	.78
1951	820,521	1,086	.76	.79
1952	814,854	992	.82	.77
1953	780,163	971	.80	.80
1954	777,757	1,015	.77	.78
1955	817,238	1,039	.79	.80
1956	814,593	1,009	.79	.81
1957	816,488	1,034	.79	.86
1958		1,084		.86

[1]From Table 25

[2]From Table 16

Surprisingly, concentrates fed per grain-consuming animal unit did not increase greatly during the War years, though an increase did occur. During the War, farmers had a large degree of price uncertainty removed by Government price setting. Since farmers knew in advance favorable livestock-feed grain price ratios would prevail, they increased the number of animal units on feed rather than feed at much heavier rates.

Concentrates fed per grain-consuming animal unit in Oregon have not differed much from United States average. During the 24-year period in Oregon, an average of .73 tons was fed as compared to .74 tons fed per grain-consuming animal unit nationally.

LIVESTOCK-FEED GRAIN RELATIONSHIPS PRESENT IN OREGON

One of the objectives of this study was to determine historical livestock-feed grain relationships that have been present in Oregon. These relationships should be similar to national livestock-feed relationships (Figure 2). This section is presented with this in mind: that livestock-feed grain relationships in Oregon are similar to national relationships, and that these Oregon relationships are significant enough to be used in making predictions about future livestock production in Oregon.

National Relationships

Principal relationships existing in the national feed-livestock economy are illustrated in Figure 2. Rectangles represent forces that are essentially physical and circles those that are mainly economic. These relationships have been tested statistically by Foote (2) and others and found to be highly significant. As such, they are used in predicting future feed-livestock relationships by the Agricultural Research Service.

In any particular year, supplies of feed are determined by the acreage used for feed crops, yield per acre, and any stocks which may be on hand from previous years. As a rule, the acreage planted to feed crops does not vary

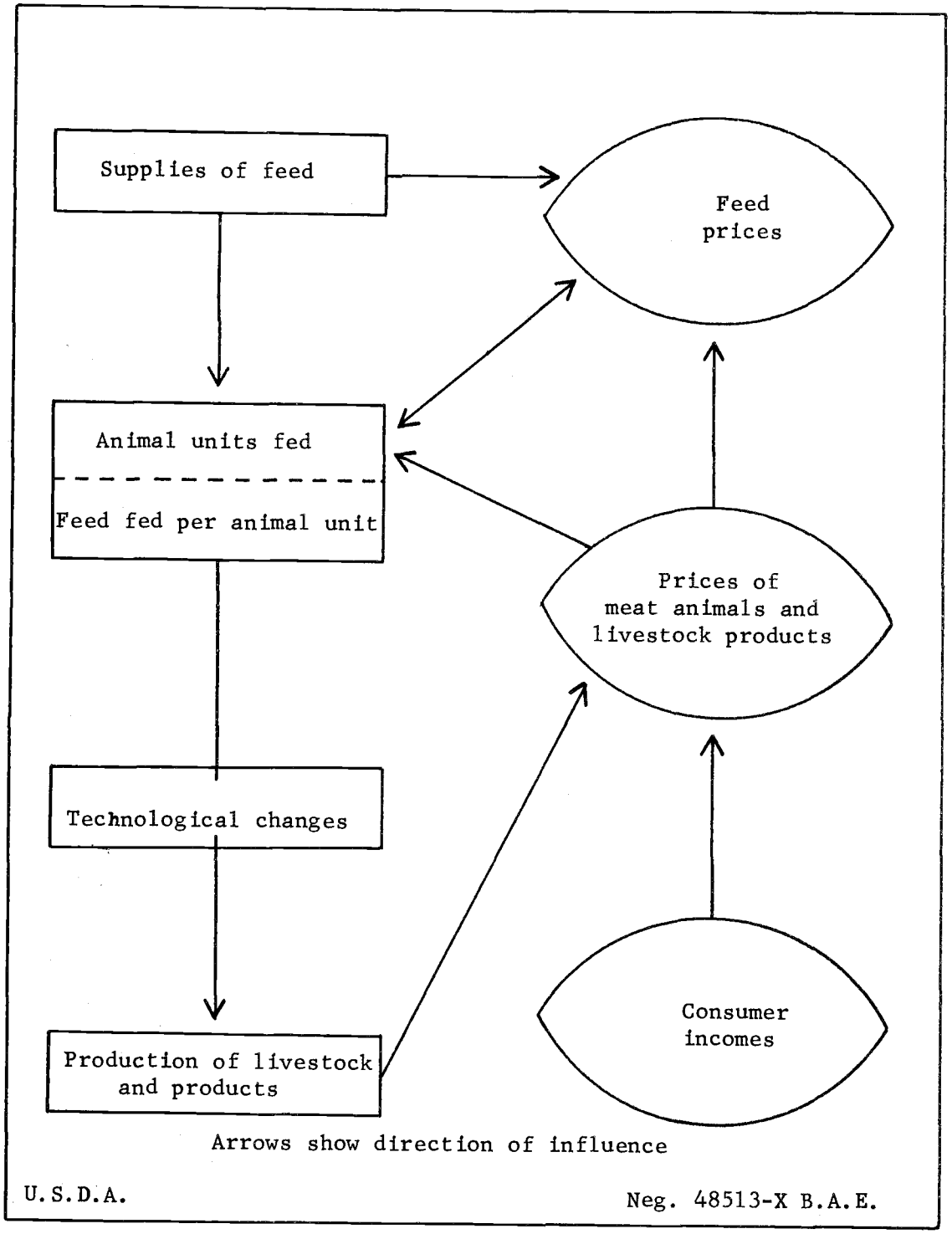

FIGURE 2. THE MAJOR ECONOMIC RELATIONSHIPS IN THE NATIONAL FEED-LIVESTOCK ECONOMY

much. Yield per acre is determined by the general level of cultural practices and the weather conditions that prevailed during the year.

Animal units fed and feed fed per animal unit are grouped together in this diagram. This is to emphasize that factors affecting number of animal units fed also influence quantities of feed fed per unit. Diminishing returns per unit of feed result when increasing quantities of feed are fed to a given number of animals. Because of these diminishing returns, changes in numbers of animal units cause changes in prices of feed and result from them as well.

Production of livestock and livestock products depends upon the number of animal units fed, feed fed per animal unit, and certain technological factors such as better feeding methods and improved animal breeding.

Prices of meat animals and livestock products are determined largely by current marketings of these products and by the level of consumer incomes. These prices influence producers' decisions to produce in the next production period. They also influence the present prices of feed, as the price of the last unit of feed fed tends to equal the value of the additional product resulting. Assuming no Government price supports, prices of feed result from the supply of feed, the number of animal units to be fed, the

feed fed per animal unit, and the prevailing level of livestock prices.

For a more detailed analysis of the national livestock-feed grain relationships, see Foote (2) and (3).

These national relationships are used by Agricultural Research Service economists in making predictions about the future livestock-feed economy. These relationships are also used by the Agricultural Research Service in making predictions at the state level.

Hypothesized Livestock-feed Grain Relationships in Oregon

The hypothesized livestock-feed grain relationships for Oregon are presented in Figure 3. Exogenous variables are feed grain available for feeding and personal income. All other variables, except technological change are endogenous.

Five hypothesized relationships are indicated. These are the relationships: (1) between numbers of grain-consuming animal units fed, feed grain available for feeding at the beginning of the feeding year, and the ratio of last year's aggregate livestock and livestock products prices to aggregate feed grain prices; (2) between concentrates fed grain-consuming animal units, feed grain available for feeding during the feeding year, and the current ratio of aggregate livestock and livestock products prices

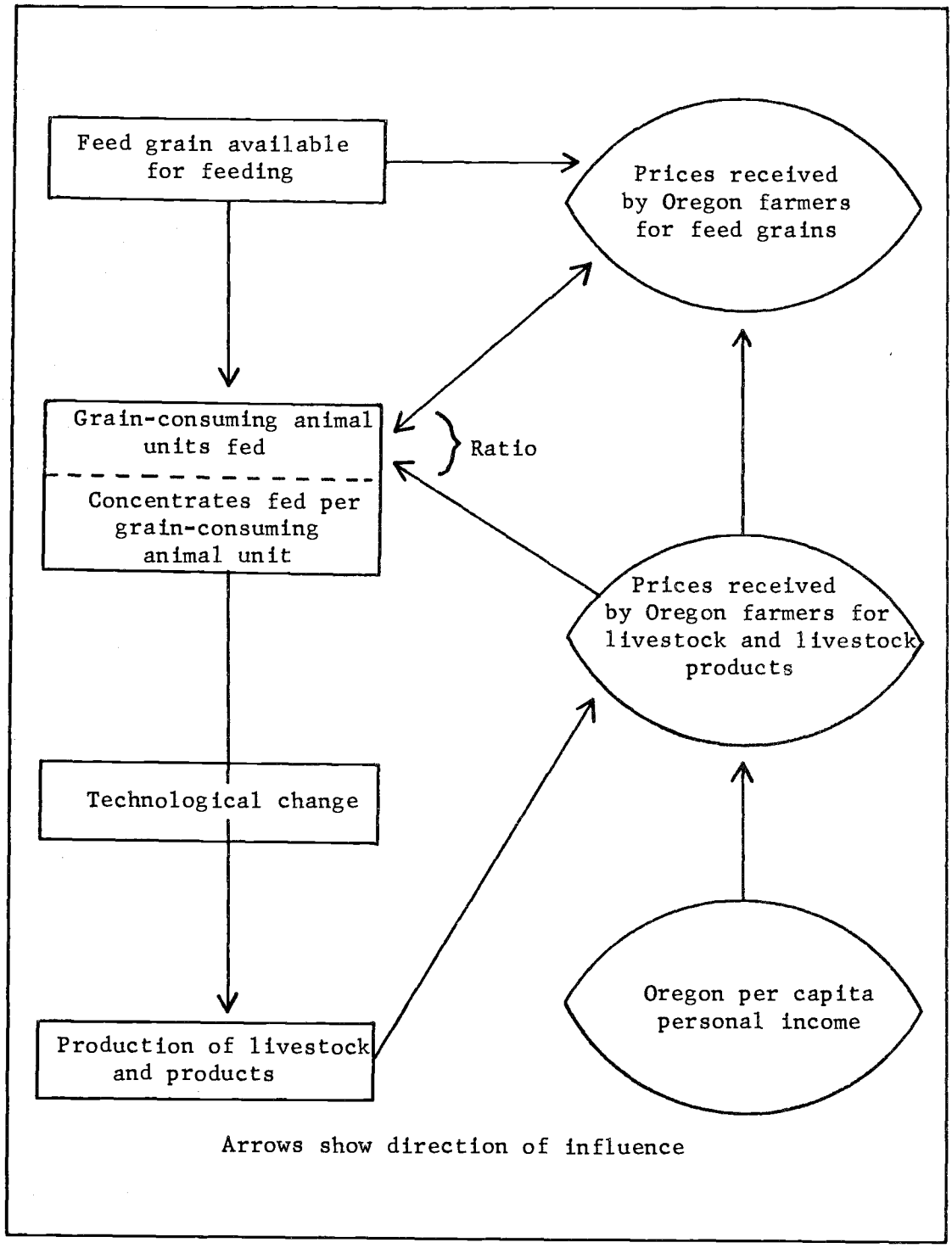

FIGURE 3. HYPOTHESIZED LIVESTOCK-FEED GRAIN RELATIONSHIPS IN OREGON

to aggregate feed grain prices; (3) between production of livestock and livestock products, numbers of grain-consuming animal units fed, feed grain and other concentrates fed grain-consuming animal units, and a technological factor; (4) between prices received by Oregon farmers for livestock and livestock products, production of livestock and livestock products, and per capita personal income in Oregon; and (5) between prices received by Oregon farmers for feed grain, numbers of grain-consuming animal units fed, concentrates fed grain-consuming animal units, the supply of feed grain available for feeding, and the prices of livestock and livestock products.

Three of these relationships are examined statistically to determine whether or not they can be used as a basis for predictions. The last two relationships in which prices are the dependent variables are not examined in detail because it was not a purpose of this study to predict prices, but rather to predict livestock production assuming various prices. In order to predict livestock production, it is necessary to predict numbers of animal units fed and the concentrates fed them. Therefore, only the first three relationships are tested statistically. No attempt is made to measure the influence of technology.

These relationships are not assumed to take place simultaneously, but instead to occur in sequence. Animal

units fed are hypothetically determined by the supply of feed grain available for feeding at the beginning of the feeding year and the previous year's livestock-feed grain price ratio. Concentrates fed grain-consuming animal units during the feeding year should depend upon the feed grain available for feeding during the feeding year and the ratio of livestock-feed grain prices that are prevailing. Livestock production should be determined by the number of animals fed during the feeding year and the concentrates fed them.

Hypothesized Influence of the Supply of Feed Grain

The supply of feed grain available as livestock feed during the feeding year, October 1 - September 30, consists of that portion of feed grain production sold from farms as livestock feed minus outshipments of feed grain, feed grain fed where produced, and any inshipments that occur. Stocks are assumed not available as livestock feed. Estimated feed grain available for feeding during the feeding year including that fed where produced is summarized in Table 14.

It is hypothesized that the number of grain-consuming animal units fed during the feeding year are significantly affected by the feed grain available for feeding at the beginning of the feeding year. Feed grain available at

the beginning of the feeding year would be that portion of the crop of the corresponding calendar year reported as "fed where produced" and "sold from the farm and available for feeding," assuming no carryover. These quantities are reported in Table 8 and Table 11, respectively.

Estimations as to the feed grain production that will result in any calendar year are usually available soon after the seed is in the ground. Livestock feeders thus have time to adjust to the anticipated supply of feed grain. Production estimates should reflect accurately the supply of feed grain that will be available for feeding in the fall. Therefore, feed grain available in the fall can be used as a base upon which livestock producers make decisions as to how many animal units to put on feed.

A change in the production of feed grain, and so a change in feed grain available for feeding should result in a change in the same direction in numbers of grain-consuming animal units fed. This change in numbers fed should occur because of anticipated reductions in feed grain prices. Also, new producers will consider the availability of feed grain when deciding whether or not to enter the livestock feeding business. A change in feed grain available for feeding usually results in a change in feed grain prices in the opposite direction. Therefore, an increase in the supply of feed grain available for feeding

should result in more feed grain being fed to more animal units because of the diminishing returns principle.

Feed grain available for feeding during the feeding year includes inshipments. It is thought this quantity of feed grain is a major factor in determining how much concentrates will be fed grain-consuming animal units. A change in the supply of feed grain available for feeding during the feeding year should result in a change in the same direction in the concentrates fed grain-consuming animal units. These changes in feed grain available during the feeding year are usually associated with changes in the opposite direction of feed grain prices. As such, these price changes should be more important than the supply of feed grain, as feed grain is easily inshipped from the midwest.

Hypothesized Influence of Livestock-feed Grain Price Ratio

It is commonly recognized that the primary factor regulating the volume of consumption of feed grain by the various classes of livestock in a given production period are the various livestock and livestock products to feed grain price ratios. For instance, the hog-corn ratio is a very useful and much observed guide as to the profitability of feeding corn to hogs. Similarly, the beef-barley ratio is an indicator of the profitability of feeding

barley to beef cattle. When these ratios are high, in the short run farmers typically feed livestock for longer periods than when they are low. In the long run farmers feed more livestock. Thus, it could be said that each of these ratios regulates the amounts of feed grains that will be used in the production of the various livestock products.

The ratio of index numbers of livestock and livestock products prices to index numbers of feed grain prices is used to indicate changes that occur in aggregate prices within the model. These indices are composed by the Oregon Crop and Livestock Reporting Service and represent total annual sales value of feed grains and livestock and livestock products sold by Oregon farmers. These indices are presented in Table 3 and Table 20. Wheat is not considered a feed grain. The ratio of these indices does not indicate relative profitability of feeding livestock at any one point, but is used to indicate changes that occur when aggregate weighted prices change relative to one another. It should be recognized that aggregate prices may not change when individual changes are recorded in opposite directions within the aggregate as is often the case.

It is hypothesized that the aggregate livestock-aggregate feed grain price ratio pertinent to determining the number of grain-consuming animal units fed is the ratio which prevailed during the previous feeding year. This

ratio is lagged one year in this case because it was thought that this would be the most likely average delay between the time producers' decisions were made and put into effect. Time lags for dairy and beef might be longer depending upon the circumstances. For sheep and hogs, an average lag should be about one year. For poultry, the lag should be less than a year. Therefore, an average lag for the aggregate would appear to be about one year.

Increases in this ratio should be associated with increased animal units on feed in the next feeding year and with increased concentrates fed per grain-consuming animal unit during the current feeding year. A sudden increase in the livestock-feed grain price ratio should result in heavier feeding to a given number of animal units in the short run. In the longer run, within the range of most feeding operations, greater returns can be obtained by feeding more animals for a given production than by feeding the same amount of concentrates to a smaller number of animals at heavier rates. This is because of the principle of diminishing returns. Because of this fact, farmers should tend to increase numbers of grain-consuming animal units as fast as possible when faced with favorable price ratios.

Increased numbers of grain-consuming animal units ultimately lead to relatively lower livestock prices and relatively higher feed grain prices. These lowered price

ratios should discourage increases in grain-consuming animal units and result in less concentrates fed per unit. Animal numbers should decrease and feed grain become more abundant. The stage is thus set for another response to more favorable price ratios.

Hypothesized Influence of Grain-consuming Animal Units and Concentrates Fed per Grain-consuming Animal Unit on Livestock Production

It is hypothesized that changes in grain-consuming animal units and concentrates fed grain-consuming animal units will be associated with changes in the same direction in livestock production. That is, if more animals are fed, or more feed grain is fed per animal unit, either should lead to more livestock being produced. Any production resulting from increased feeding of feed grain per animal unit is produced less efficiently than increased production resulting from increased numbers of animal units on feed. That is, more feed grain per pound of production is used in the first case than in the second case.

Statistical Analyses of Hypothesized Relationships

Three of the five hypothesized relationships were examined statistically. Dependent variables in these three cases were: (1) numbers of grain-consuming animal units fed annually; (2) concentrates fed grain-consuming animal

units; and (3) production of livestock and livestock products. Multiple correlations were run in all three cases to show the extent of the relationships. The Crout method was used in obtaining regression coefficients. The t-test was used to test significance of these regression coefficients. Coefficients of correlation were tested for significance using Snedecor's Table 7.6.1. of "Correlation Coefficients at the Five and One Percent Levels of Significance" (12, p. 174).

Relationship Between Grain-consuming Animal Units, Feed Grain Supply at the Beginning of the Feeding Year, and the Lagged Aggregate Livestock-feed Grain Price Ratio

Variables used in this analysis were as follows:

X_1 - Estimated grain-consuming animal units to be fed during the feeding year in Oregon in 1,000 units (dependent variable).

X_2 - Estimated supply of feed grain available for feeding at the beginning of the feeding year in Oregon in 1,000 tons (independent variable).

X_3 - Ratio of aggregate livestock and livestock products prices to aggregate feed grain prices in Oregon lagged one year (independent variable).

Table 28 shows the principal statistical coefficients obtained from this analysis. These values relate to the regression equation when all variables are expressed in logarithms.

Table 28

Principal Statistical Coefficients Relating the Number of Grain-consuming Animal Units Fed During the Feeding Year to the Supply of Feed Grain Available for Feeding and Last Year's Livestock and Livestock Products to Feed Grain Price Ratio

Coefficient	Value
$R^2_{1.23}$	.1580
$R_{1.23}$	.3976
$S_{1.23}$	.0135
$b_{12.3} \pm Sb_{12.3}$	.0689 $\pm$ .1212
$b_{13.2} \pm Sb_{13.2}$	.5393 $\pm$ .5209
$a_{1.23}$	2.2866
$r^2_{12.3}$	.0291
$r_{12.3}$	.1707
$r^2_{13.2}$	.0878
$r_{13.2}$	.2963

These values relate to the regression equation when all variables are expressed in logarithms

A coefficient of multiple determination of .16 was obtained, indicating 16 percent of the total variation in numbers of grain-consuming animal units fed, X_1, was "explained" by the interaction of the two independent variables. When taken alone, the lagged price ratio, X_3, was more important in accounting for variation in the number of animal units to be fed than was the supply of feed grain available at the beginning of the feeding year, X_2.

The coefficient of multiple correlation was not highly significant, indicating very little significance could be attached to a prediction of grain-consuming animal units based on past relationships between numbers of grain-consuming animal units to be fed, feed grain available for feeding at the beginning of the feeding year, and the lagged livestock-feed grain price ratio.

On the average, a one percent change in X_3, the ratio of aggregate livestock to aggregate feed grain prices, was associated with a .54 percent change in the same direction in the number of grain-consuming animal units fed. The probability of obtaining a t-value of 1.04 under these conditions (7 degrees of freedom) if there were no relationship present would be less than 0.35. Hereafter, this will be indicated by $P \leq 0.35$. Actually, when the sign of the regression coefficient is the same as would be expected from logical reasoning, a one-tail t-test can be justified.

The one-tail test would thereby be more sensitive in detecting significant relationships. However, unless otherwise specified, the probabilities will be stated in terms of the more conservative two-tailed test.

A one percent change in X_2, the feed grain available for feeding was associated with a .07 percent change in the same direction in the number of grain-consuming animal units fed. This regression coefficient was not highly significant ($P \leq .40$).

These regression coefficients indicate farmers have increased grain-consuming animal units somewhat when more favorable price ratios existed in the preceding feeding year, but have responded to increased supplies of feed grain at the beginning of the feeding year by increasing animal units on feed only slightly.

Relationship Between Concentrates Fed Grain-consuming Animal Units, Supply of Feed Grain Available for Feeding, and the Current Ratio of Aggregate Livestock Products Prices to Aggregate Feed Grain Prices

Variables used in this analysis were as follows:

X_1 - Estimated concentrates fed grain-consuming animal units during the feeding year in Oregon in 1,000 tons (dependent variable).

X_2 - Estimated supply of feed grain available for feeding during the feeding year in Oregon in 1,000 tons (independent variable).

X_3 - Ratio of aggregate livestock and livestock products prices to aggregate feed grain prices prevailing during the feeding year in Oregon (independent variable).

In this case, the aggregate livestock and livestock products to aggregate feed grain price ratio was not lagged.

Table 29 shows the principal statistical coefficients obtained from the analysis. These values relate to the regression equation when all variables are expressed in logarithms.

A coefficient of multiple determination of .19 was obtained, indicating 19 percent of the variation in the concentrates fed grain-consuming animal units, X_1, was "explained" by the interaction between the supply of feed grain and the ratio of aggregate livestock and livestock products prices to aggregate feed grain prices. The coefficient of multiple correlation was not highly significant, indicating relatively little significance could be attached to a prediction of concentrates fed grain-consuming animal units based on past relationships between concentrates fed grain-consuming animal units, feed grain available for feeding during the feeding year, and the ratio of aggregate livestock and livestock products prices to aggregate feed grain prices. When taken alone, there was a higher relationship between concentrates fed and the

Table 29

Principal Statistical Coefficients Relating Feed Grain and Other Concentrates Fed Grain-consuming Animal Units to the Supply of Feed Grain Available for Feeding and the Current Ratio of Aggregate Livestock and Livestock Product Prices to Aggregate Feed Grain Prices

Coefficient	Value
$R^2_{1.23}$	.1940
$R_{1.23}$	.4405
$S_{1.23}$	.0125
$b_{12.3} \pm Sb_{12.3}$	$-.0521 \pm .0529$
$b_{13.2} \pm Sb_{13.2}$	$.5147 \pm .3971$
$a_{1.23}$	2.3956
$r^2_{12.3}$	.0062
$r_{12.3}$	.0789
$r^2_{13.2}$	.0824
$r_{13.2}$	.2870

These values relate to the regression equation when all variables are expressed in logarithms

current price ratio than between concentrates fed and the supply of feed grain available for feeding.

During the period of analysis, on the average, a one percent change in the feed grain available for feeding was associated with a .05 percent change in the opposite direction in the concentrates fed grain-consuming animal units. This regression coefficient for X_2 was not highly significant ($P \leq 0.40$). A one percent change in the ratio of aggregate livestock and livestock products prices to aggregate feed grain prices was associated, on the average, with a .51 percent change in the same direction in the concentrates fed grain-consuming animal units. This regression coefficient for X_3 was not highly significant ($P \leq .24$). As was the case in the previous correlation, farmers have responded as predicted to the price ratio. However, they have shown little response to the supply of feed grain available for feeding during the feeding year.

Relationship Between the Production of Livestock and Livestock Products, Total Concentrates Fed Grain-consuming Animal Units, and Total Animal Units Fed Concentrates

Variables used in this analysis were as follows:

X_1 - Aggregate livestock production during the calendar year in Oregon (dependent variable).

X_2 - Concentrates fed grain-consuming animal units during the feeding year in Oregon in 1,000 tons (independent variable).

X_3 - Grain-consuming animal units fed during the feeding year in Oregon in 1,000 units (independent variable).

In order to run this correlation, it was necessary to aggregate production of livestock and livestock products. This was done by adding each 100 pounds of meat animal and poultry produced to each 1,000 eggs produced to each 1,000 pounds of milk produced. The sum of these additions was taken as aggregate livestock production. No units were attached to these aggregate figures. They were utilized in the same manner as index numbers are used. Any predictions that would be made as to total livestock production would have to be transformed into percentages of increase or decrease over 1958 levels. No predictions could be made as to the composition of the total production of livestock and livestock products.

Table 30 shows the principal statistical coefficients obtained from this analysis. These values relate to the regression equation when all variables are expressed in logarithms.

A coefficient of multiple determination of .50 was obtained, indicating one half of the variation in production of aggregate livestock and livestock products was "explained" by the interaction between the grain-consuming animal units fed and the concentrates fed these animal

Table 30

Principal Statistical Coefficients Relating the Production of Livestock and Livestock Products to the Number of Grain-consuming Animal Units Fed and the Concentrates Fed Them

Coefficient	Value
$R^2_{1.23}$	.5040
$R_{1.23}$	.7099
$S_{1.23}$	.0205
$b_{12.3} \pm Sb_{12.3}$	$-.9501 \pm .5610$
$b_{13.2} \pm Sb_{13.2}$	$-.8115 \pm .5931$
$a_{1.23}$	9.0776
$r^2_{12.3}$	.3713
$r_{12.3}$	.6094
$r^2_{13.2}$	.3008
$r_{13.2}$	.5484

These values relate to the regression equation when all variables are expressed in logarithms

units. Neither independent variable alone accounted for as much of this variation as the two together. The number of animal units fed "explained" more of the total variation than did the concentrates fed grain-consuming animal units.

The coefficient of multiple correlation is approaching significance at the five percent level. This indicates some significance could be attached to a prediction of aggregate livestock production based on past relationships between livestock production, numbers of grain-consuming animal units to be fed, and the concentrates fed grain-consuming animal units. Both coefficients of correlation are approaching significance at the five percent levels, which indicates that either of the independent variables could be used to predict aggregate livestock production, if they were known.

On the average, a one percent change in the number of grain-consuming animal units on feed was associated with a change of .95 percent in the production of livestock and livestock products. Similarly, a one percent change in the quantity of concentrates fed grain-consuming animal units was associated with a change of .81 percent in the production of livestock and livestock products. In both cases, these changes were in opposite directions. The regression coefficient between the numbers of grain-consuming animal units and the production of livestock and livestock

products is nearly significant at the 10 percent level ($P \leq 0.15$); while the regression coefficient between the concentrates fed grain-consuming animal units and the production of livestock is less significant ($P \leq 0.23$).

Possible Explanation of Results

Supply of Feed Grain

The supply of feed grain available for feeding at the beginning of the feeding year has had only slight effects upon the numbers of grain-consuming animal units fed in Oregon. As previously stated, a one percent increase in feed grain available for feeding at the beginning of the feed year was associated with a .07 percent increase in numbers of grain-consuming animal units fed. This was not as great an effect as was anticipated, though the change was in the hypothesized direction.

One explanation for a small change in numbers of animal units fed in the face of larger feed grain supplies available for feeding is the nature of the feeding operations using feed grains where produced. As previously stated, approximately one fourth of the feed grain utilized by livestock in Oregon is fed where produced. Much of this is fed to small, inefficient enterprises maintained for home consumption and small sales. Because of the nature of

these enterprises, the quantities of feed grain fed them have remained relatively stable. Farm chickens are a principal enterprise of this sort. Numbers of farm chickens have remained stable throughout the period of analysis (Table 15).

Except in the case of corn, increases in production of feed grains in Oregon have had very little effect upon quantities of feed grain fed where produced. Corn fed where produced has varied with production because so much is preserved in silage form. In 1954, when barley production increased, a substantial increase in barley fed where produced was noted (Table 8). However, this increase was due in part to lesser quantities being fed where produced the previous year because of drastically lower cattle prices. Lower quantities of oats were fed where produced in 1955 and 1957, but no corresponding decrease in total oat production was noted. When oat production declined in 1953 and 1955, only slight reductions were noted in the quantities of oats fed where produced.

Increases in grain-consuming animal units may have been limited by other factors not considered in the model. Livestock inventories are obviously significant in this respect. When breeding stock on hand is high, the number of animal units fed can be increased more rapidly than when the supply of breeding stock is low. Likewise, if

substantial numbers of young stock are available, a more rapid expansion in production can be brought about. Capital and labor needed for expansion may not be available when needed.

The supply of feed grain available for feeding during the feeding year has had relatively small effects upon quantities of feed grain and other concentrates fed. A one percent increase in the supply of feed grain available for feeding during the feeding year was associated with a decrease of .05 percent in total concentrates fed. It was expected that these two variables would change in the same direction.

Relatively large inshipments of barley since 1955 were probably a factor in accounting for this change. Some of this barley has been stored under loan or exported, and as such, it would not be fed to livestock (7, p.24). However, this barley would affect decisions of livestock feeders by being available at the loan price.

Both milk-producing dairy cows and laying hens are fed for continuous production. This may have had the effect of reducing the response to increased feed grain supplies in the short run. That is, laying hens were already being fed grains at heavy rates, and as such, they would not be able to consume more grains. In the case of dairy cattle,

forage may have been cheap relative to feed grains, so more forage was fed.

The aggregate livestock-aggregate feed grain price ratio probably accounts for some of this change. Even though feed grain was available in increased quantities, the prices of livestock and livestock products may have been such as to discourage heavier feeding. Or, the support price for feed grains may have, in effect, bid the grain away from livestock into storage.

Price Ratio

Farmers responded to the aggregate livestock and livestock products to feed grain price ratio more than they responded to the supply of feed grain. This change was anticipated. An increase in this ratio of one percent was associated with an increase of .51 percent in concentrates fed during the feeding year, and an increase of .54 percent in numbers of grain-consuming animal units fed during the year.

Prices of livestock have had a greater effect upon feed grain fed where produced than have the supply and prices of grain. This was particularly evident when cattle prices fell in 1952 and 1953. Use of barley as livestock feed where produced decreased almost one third in 1953. These livestock are usually fed in small lots.

Since the investment in lots and equipment is small, the feeder can afford not to feed livestock if prices are low.

Indications are that the response to these aggregate prices is not as great as could have been the case. Since 1954, there has not been a year in which the hog-barley or beef-barley price ratio in Oregon has not been favorable for expanding the number of hogs or grain-fattened cattle (1, p.33). Yet, producers have failed to expand numbers of these livestock greatly. It has been concluded by one analyst that slow expansion of cattle and hog feeding in the Northwest may be due to failure to recognize favorable livestock-feed grain price ratios and lack of processing facilities (11, p.29). Another analyst suggests that non-farm opportunities compete with the expansion of livestock feeding by offering higher returns to capital, management, and labor than the feeding of livestock would return. He believes that the comparative advantage of the western farmer has been in irrigated crops and extensive dryland farming and that the western farmer's next most profitable alternative is a non-farm enterprise rather than livestock (1, p.34). This problem is beyond the scope of this research, but suggests an area for further investigation. If more were known about individual farm enterprises and other alternatives, perhaps this question could be answered.

Factors other than prices of livestock and feed grains may adversely affect the feed grain and other concentrates fed per animal unit. The composition and the quality of rations varies with the price of roughage. In years when hay is in abundance and low in price, more hay will be fed in dairy and grain-fattened cattle rations than will be fed when hay is higher priced.

Quantities of feed grain to be fed in Oregon will be affected by the severity of the winter and the abundance and quality of pasturage available during the summer months. An unusually severe winter or a drought year will result in more concentrates being fed on the ranges of eastern Oregon.

Improved breeding has tended to reduce the amount of feed grain required per unit of production. But animals are being fed at heavier rates to get faster and more production, so overall feed efficiency has not changed much except in the case of broilers (6, p.12).

Livestock losses increase the total feed grain consumed per unit because production is decreased more by these losses than is the consumption of feed grain.

Production of Livestock and Livestock Products

It was anticipated production of livestock and livestock products would increase and decrease with the

concentrates fed grain-consuming animal units and the numbers of grain-consuming animal units fed. Such was not the case, however. On the average, a one percent decrease in numbers of grain-consuming animal units and concentrates fed grain-consuming animal units was associated with a .95 percent and an .81 percent increase in livestock production respectively, or vice versa.

A primary reason for this unanticipated result could be that much of this production is coming from increased utilization of roughage. While grain-consuming animal units have decreased, both grain-and-roughage and roughage-consuming animal units have increased (Table 16). Therefore, it has been possible for total livestock production to increase even though less grain-consuming animal units are being fed slightly less concentrates per unit.

Part of this increased production could be due to the technological factor. As previously stated, in a national analysis this amounted to approximately a .2 percent increase in production annually (3, p.28). This analysis covered only the years 1910-1940. Since that time, considerable technological advances in the field of animal science have been recorded. For instance, calving percentages in Oregon have increased from 72 percent of cows two years old and older in 1935 to 86 percent in 1958. Lambs saved have increased from 85 percent of ewes one year and older

in the prewar period to 100 percent in the 1950's. The number of pigs saved per litter has increased from slightly above six in 1935 to slightly below eight in 1958 (21). These increases are due to better breeding, better feeding, and in short, to improved management and management practices. Milk production per cow has been increased by using superior sires and artificial insemination. Pasture improvements have been possible through better varieties, fertilization, and reseeding. The replacement of horses with tractors has resulted in more pasture and other feeds being available for cattle, sheep, and other livestock.

Several Government programs have had specific effects upon the livestock industry in Oregon. The large increase in turkey and swine numbers during the War were primarily the result of subsidization of wheat as a livestock feed and the setting of favorable forward prices upon livestock and livestock products by the Federal Government. Farmers knew in advance what livestock prices were to be and that wheat would be available at lowered prices and planned accordingly. Poultry and hogs responded to these policies more than other livestock because of the relative ease of entry into production. Following the War, the policies of price setting and subsidization of wheat were dropped. As a result, prices of feed grains and livestock products began fluctuating, adding uncertainty.

Another Government program influencing the livestock industry has been the Soil Conservation program. Under this program, farmers have been encouraged to plant more pasture, and have been partially subsidized to do so. As more pasture was planted, numbers of livestock utilizing pasture increased.

Grazing permits on Government lands have been reduced in some areas.

Wool subsidies have been a factor in increasing sheep numbers.

Changes in demand have greatly influenced livestock production in Oregon. Decreased sheep numbers have resulted from decreased demand for lamb and mutton due partially to the manner in which this meat was served in the Armed Forces during World War II. Wool has met increased competition from synthetics. An increase in demand for beef has resulted in more beef being produced. Broiler numbers increased because they were in demand in this area, but stabilized when they met increasing competition from other areas of the nation.

Several other factors have influenced production of livestock and livestock products in Oregon. The reduction in sheep numbers during the War was due partially to a shortage of herders. Increases of sheep in the Willamette Valley since 1950 have occurred because these farmers have

found sheep to be particularly profitable users of aftermath from cash crops. Farm chicken numbers have remained relatively stable because the increase in flock size has offset decreases in the number of flocks. Total egg production increased 28 percent over the 1945-49 period chiefly as a result of an increased rate of lay. However, in dairying, decreases in total number of cows has resulted in a slight decline in milk production even though production per cow has increased along with average herd size.

Livestock-feed Grain Predictions

It was hoped the relationships existing in the hypothetical model would be significant enough to use in making predictions as to future numbers of grain-consuming animal units to be fed, concentrates to be fed them, and aggregate livestock production resulting. The plan was to assume various levels of aggregate livestock and livestock products to aggregate feed grain price ratios and observe the effect upon total livestock production. In doing this, the supply of feed grain available for feeding was to be computed by assuming the average 1954-58 acreages and straight line trend yields. It would have been possible to put these data into the computed regression equations and observe the effect upon animal units to be fed, feed grain and other concentrates to be fed per animal unit, and

aggregate livestock production. However, since the hypothesized relationships taken as an integrated system were not statistically significant, it would be hazardous to predict future livestock-feed grain relationships from the computed regression equations. Therefore, no projections were made.

SUMMARY AND CONCLUSIONS

This study was undertaken as preliminary background to a more specific and detailed study to follow. In order to conduct the more detailed study, it was thought necessary to: (1) examine changes that have occurred in Oregon's livestock-feed grain economy; and (2) make some predictions of future livestock-feed grain relationships from relationships that have existed previously, if it were possible to do so.

Changes occurring in Oregon's livestock-feed grain economy between 1935 and 1958 were described in the first three sections of the study. Several important aggregate changes in this economy were noted. Production of both feed grains and livestock and livestock products increased during World War II. This was followed by relatively little change in feed grain production, increased wheat production, and slight decreases in aggregate livestock production. Production of livestock and livestock products increased between 1948 and 1955. A large reduction in wheat production was noted in 1954, but feed grain production increased by more than the wheat reduction. Aggregate livestock production decreased in 1956 and has since regained the level that prevailed in 1955. Since 1954, feed grain production in Oregon has been at relatively high

levels. It was apparent that livestock production did not adjust to increased feed grain production in 1954.

Throughout the period, estimated feed grain fed where produced in Oregon has varied around the 200 thousand ton level. The high was in the War years, and the low was in 1953. In recent years, this approximates one fourth the feed grains and other concentrates necessary for livestock production.

Prior to 1955, it was apparent that approximately one fourth of the feed grains and other concentrates needed by Oregon livestock was inshipped. Since 1955, estimated inshipments of feed grains have increased. However, some of the barley is stored or exported. The increased quantities of corn and grain sorghum that have been inshipped are undoubtedly fed to livestock. Thus, since 1955, it appears that more than one fourth of the feed grain and other concentrates fed to livestock has been shipped into the State.

Livestock-production units from grain and other concentrates were used to measure feed grain consumption by livestock in Oregon. Throughout the period, the four classes of livestock utilizing the most feed grain and other concentrates were milk-producing dairy cattle, laying hens and pullets, hogs, and turkeys. It was apparent dairy cattle, farm chickens, and horses were using less concentrates annuelly, while layers and pullets, broilers,

grain-fattened cattle, and other cattle were using increasing quantities annually. Hogs and turkeys fluctuated considerably in the use of feed grains during the period. Sheep used relatively small amounts of concentrates throughout the period, but were using more in 1958 than in 1951. In 1958, poultry used an estimated 356 thousand tons of feed grains and other concentrates. This compares to an estimated 174 thousand tons used by milk-producing dairy cows, 137 thousand tons by hogs, 133 tons used by cattle other than milk-producing dairy cows, and 11 thousand tons used by both sheep and horses, for an estimated 822 thousand tons of feed grains and other concentrates fed in 1958.

A hypothetical model showing aggregate livestock-feed grain relationships believed to be significant in Oregon between 1948 and 1958 was developed. The supply of feed grain was assumed to be exogenous and included feed grain fed where produced, feed grain sold as livestock feed minus outshipments and inshipments. It was thought the numbers of grain-consuming animal units to be fed were a function of the supply of feed grain available for feeding at the beginning of the feeding year, and the ratio of aggregate livestock and livestock products prices to aggregate feed grain prices prevailing in the previous feeding year. Concentrates fed grain-consuming animal units were

hypothesized to be a function of the feed grain available for feeding during the feeding year and the current ratio of aggregate livestock and livestock products to aggregate feed grain prices. Livestock production was thought to be a function of the number of grain-consuming animal units fed and the concentrates fed per grain-consuming animal unit. Prices of livestock and livestock products were supposed determined by livestock production and the level of personal income prevailing in Oregon. Personal income was also an exogenous variable. Prices of feed grains were presumed determined by the supply available for feeding, numbers of animal units to be fed, feed grain fed per animal unit, and the prices of livestock and livestock products.

The first three relationships were analyzed statistically to determine if the relationships were highly significant. The analyses revealed that only the relationship between the aggregate production of livestock and livestock products, numbers of grain-consuming animal units fed, and concentrates fed per grain-consuming animal unit was significant enough to be useful in obtaining an accurate estimate of future relationships. In this correlation, the two independent variables explained half the variation in the production of livestock and livestock products.

On the average, a one percent increase in production of livestock and livestock products was associated with a decrease of .95 percent in the number of grain-consuming animal units fed and a decrease of .81 percent in concentrates fed grain-consuming animal units. These regression coefficients were unanticipated. However, they could be explained in part by the technological factor, and the influence of roughage feeds on livestock production, particularly on beef and dairy production.

It was apparent both numbers of grain-consuming animal units fed and the concentrates fed per animal unit were more responsive to price changes than to the supply of feed grain. On the average, a one percent increase in the aggregate livestock to aggregate feed grain price ratio was associated with an increase of .54 percent in numbers of grain-consuming animal units and an increase of .51 percent in concentrates fed grain-consuming animal units. These coefficients weren't highly significant, but did indicate farmers reacted as predicted to the aggregate price ratio.

No predictions as to future livestock-feed grain relationships to occur in Oregon were made because the relationships were not statistically significant and consistent enough to be used as a base for predictions. Therefore, it seems that predicting aggregate relationships at the state level, without first examining the makeup of the aggregate

and developing a more complex model in which the makeup of the aggregate is considered, is almost useless as far as providing an accurate prediction of aggregate relationships to be present in the future.

This study has brought to light several interesting problems which would be worth looking into in the future. Since malting barley is an important enterprise in Oregon, it would seem that a study could be initiated to determine its importance to the State's agricultural economy, and its potential as an enterprise on Oregon farms.

It was suggested by Bailey (1) that off-farm opportunities may be competing with livestock enterprises. A study to determine the extent of this competition would be interesting.

It would be of particular interest to the author to see a more complex model of Oregon's livestock-feed grain industry developed, and to compare the results of this model with the aggregate model.

Some of the data collected in this study are to be used in determining the profitability of hog production relative to other enterprises on Oregon farms. In this study, it is also planned to analyze the competitive position of Oregon as well as contingent states in the hog production industry.

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