

Relative Accuracy of Pricing Butcher Hogs on Foot and by Carcass Weight and Grade

Gerald Engelman, Austin A. Dowell, and Robert E. Olson
Department of Agricultural Economics



LIBRARY

SEP 1 1953

New Mexico College of Agriculture
and Mechanic Arts

University of Minnesota
Agricultural Experiment Station

In Cooperation with

BUREAU OF AGRICULTURAL ECONOMICS
U. S. DEPARTMENT OF AGRICULTURE

CONTENTS

	Page
Introduction	3
Objectives	4
Source and character of data	5
Analysis of pricing accuracy	7
Pricing by liveweight only	8
Priced according to average liveweight of lot	8
Priced according to individual liveweight	10
Pricing by carcass weight and grade	12
Pricing by liveweight and grade	17
Priced according to liveweight and estimated carcass grade and yield	17
Priced according to liveweight and grade only	21
An appraisal of pricing accuracy by lots	23
Some possible gains associated with the carcass method of marketing	27
Aid producers in supplying consumer demand	27
Payments distributed according to value	29
Bargaining, competition, and price determination	29
Sale by description	30
Reducing unnecessary fill before selling	31
Aid in reducing losses from bruising and disease	31
Make more effective the work in swine genetics	32
Sharpen the objectives in swine nutrition	32
Aid in the solution of the lard problem	33
Some possible problems associated with the carcass method of marketing	33
Identification	33
Weighing	34
Grading	35
By-product credit	35
Settlement	37
Costs	38
Time and location of slaughter	39
Maintaining grade identity to the retail counter	40
Acceptability	41
Improved carcass standards	43
Summary	44
Appendix A	46
The effect of weight and grade on carcass yield	46
Barrows and gilts combined	47
Barrows vs. gilts	48
Appendix B	50

Relative Accuracy of Pricing Butcher Hogs on Foot and by Carcass Weight and Grade

Gerald Engelman, Austin A. Dowell, and Robert E. Olson¹

THE TENDENCY to price hogs largely according to averages is a basic and fundamental problem in marketing slaughter hogs in this country. Hogs of the same weight group, except for gilts and sows advanced in pregnancy and those with obvious defects, tend to sell at about the same price per hundredweight. Hogs producing high value carcasses do not command the appropriate differential over less valuable animals. Individual producers of hogs, therefore, are not given adequate incentives to improve the quality of the products they bring to the market place. Farmers continue to produce hogs that yield excessive quantities of low-value lard. Appropriate price differentials for quality should lead to a larger total production of the more highly desired lean meat, such as top-quality hams, loins, picnics, and butts, and a relatively smaller output of lard.

In searching for a more equitable system of pricing hogs, several countries, including Canada, the United Kingdom, Denmark, Holland, and other countries of western Europe, have adopted the carcass weight and grade method of marketing. Under this system, settlement to farmers is based on the weight and grade of the carcass rather than by the head or by live-weight.

Carcasses are graded largely according to objective or quantitative criteria which include carcass weight, backfat thickness, and in some cases carcass

length. They are graded on the rail after the viscera are removed and the back split, but before they are moved from the killing floor to the chill room. In addition to the objective or quantitative measures, the grader may also make a subjective or qualitative evaluation of certain characteristics that may influence the grade into which the carcass is placed.

Until recent years satisfactory standards for grading hog carcasses were not available in this country. In an attempt to develop improved criteria of hog carcass merit, tentative objective car-

¹ Gerald Engelman was jointly employed by the University of Minnesota and the Bureau of Agricultural Economics during the early stages of this study, and since November 1950 by the Bureau of Agricultural Economics, United States Department of Agriculture; Austin A. Dowell is professor of agricultural economics; Robert E. Olson, former member of the Department of Agricultural Economics, is now employed by the Bureau of Agricultural Economics. The data upon which this study is based were obtained at the Geo. A. Hormel and Co. meat packing plant at Austin, Minnesota. The authors wish to acknowledge the cooperation received from officials and employees of the plant. This cooperation included the use of the plant facilities and personnel both in the receiving pens and in the plant.

The authors are greatly indebted to Richard R. Newberg, Arthur G. Wilson, and Glenn E. Maddy, research assistants, Department of Agricultural Economics, who made important contributions to certain phases of the study.

carcass standards based on average backfat thickness and carcass weight were developed at the Minnesota Agricultural Experiment Station.² Similar work was undertaken by six agricultural experiment stations, including Indiana, Iowa, Michigan, Minnesota, Missouri, and Ohio, under a cooperative regional project entitled "Marketing Slaughter Livestock by Carcass Weight and Grade," which was sponsored by North Central Livestock Marketing Research Committee. The work of the regional committee led to the development of another objective carcass grade standard based on carcass measurements.³

More recently, a hog carcass grade standard has been promulgated as the official United States standard by the Livestock Branch, Production and Marketing Administration, United States Department of Agriculture.⁴ This stand-

ard is based primarily on backfat thickness and either carcass length or carcass weight specifications. Some subjective factors also are considered in the determination of the carcass grade. Official U. S. live hog grades corresponding to the carcass grades were also promulgated at the same time.

These several objective grade standards differ in the details of grade specifications and in the terminology suggested for different grades. But they all depend on the same basic relationship, namely, the relationship between average backfat thickness and the proportion of the carcass that consists of some combination of the high value cuts. Each grade standard segregates hog carcasses into relatively homogeneous or similar groupings with respect to the physical characteristics affecting hog carcass value.

Objectives

THE DEVELOPMENT of these objective carcass standards was stimulated by a growing interest in the carcass method of marketing hogs. These standards make possible the sale of hogs on the basis of carcass weight and grade, but they do not, in themselves, make the method a desirable one in marketing hogs. One of the principal tests of the desirability of any method of marketing hogs is the relative accuracy of pricing in relation to the actual value of the hogs to the packer. Such a test is concerned with the degree to which preferences of consumers are reflected back to producers through the pricing mechanism.

The work on objective carcass standards created new interest in the possibility of making live hog grades the basis of sale. As live grades should be a reflection of the carcasses the live hogs are expected to yield, these newly developed carcass grade standards may provide a means of grading hogs or foot before slaughter. The pricing accuracy of a live grading system will depend upon the ability of buyers to estimate carcass grades and carcass yields.

Under the present liveweight system of marketing hogs, the estimated value of the carcass and all by-products forms the basis for determining the price to be offered per hundred pounds live-

² Engelman, Gerald, Dowell, Austin A., Ferrin, Evan F., and Anderson, Philip A. *Marketing slaughter hogs by carcass weight and grade*. Minn. Agr. Expt. Sta. Tech. Bul. 187. pp. 28, 69. 1950.

³ North Central Livestock Marketing Research Committee. *Objective carcass grade standards for slaughter hogs*. Minn. Agr. Expt. Sta. Bul. 414. North Central Reg. Pub. 30. 1952.

⁴ SRA-PMA 171 Official United States standards for grades of pork carcasses (barrow and gilt). September 1952.

SRA-PMA 172 Official United States standards for grades of slaughter swine (barrows and gilts). September 1952.

weight for hogs on any given day. Under the carcass method, the price to be offered per hundred pounds carcass weight will be based upon the actual weight and grade of the carcass, plus the estimated value of the various by-products. It may be that differential by-product credits should be allowed for different carcass weight and grade groups.

Although pricing accuracy may be the most important test of desirability, some other important gains may also be associated with particular marketing methods. Each marketing method also has its associated problems that affect its practicability. Increasing interest has grown out of discussions of the carcass method of marketing compared with marketing on the hoof, yet relatively little is known about it in the United States. In this report, therefore, the discussion of relative pricing

accuracy will be followed by a discussion of some possible gains and problems associated with the carcass method of marketing.

The specific objectives of the research upon which this report was based were:

1. To compare the pricing accuracy of the liveweight, the liveweight and grade, and the carcass weight and grade methods of marketing butcher hogs.

2. To examine the relationship between weight and grade and carcass yield.

3. To examine the variations in the yields of certain by-products and to determine the by-product credits to be made for the different weights and grades of carcasses when hogs are marketed by carcass weight and grade.

4. To make an appraisal of the possible gains and possible problems that might be associated with the carcass method of marketing.

Source and Character of Data

THE BASIC DATA underlying this study were collected at the Geo. A. Formel and Co. packing plant at Austin, Minnesota during the period from June 27 to July 13, 1949. Forty lots of butcher hogs with from 5 to 10 hogs per lot were randomly selected from those delivered to the plant by farmers from an area within 25 miles from Austin. Each lot was composed entirely of hogs delivered by one farmer. No more than one lot was selected from the hogs delivered by any farmer during this period. A total of 265 barrows and gilts was included in the original sample.

Individual data were obtained on each hog. Liveweight was recorded to the nearest one-half pound. An experienced hog buyer estimated the carcass yield to the nearest one-half per cent, average backfat thickness to the nearest one-tenth of an inch, and carcass

length. Individual identity was maintained by tattooing.

The hogs when slaughtered were dressed according to the usual "packer style." Scales used for weighing were read to the nearest ounce. Heads, leaf fat, kidneys, and ham facings were weighed separately after they had been removed from the carcass on the killing floor. Immediately after having been moved to the chill room the warm carcasses were weighed. After the carcasses had had a 24-hour chill they were weighed again, and carcass measurements were recorded. An average of three backfat measures was used in the analysis (figure 1). Backfat thickness was measured in millimeters to obtain the average, which was then converted to inches.

The carcasses were then moved to the cutting floor where they were disassembled into the component whole-

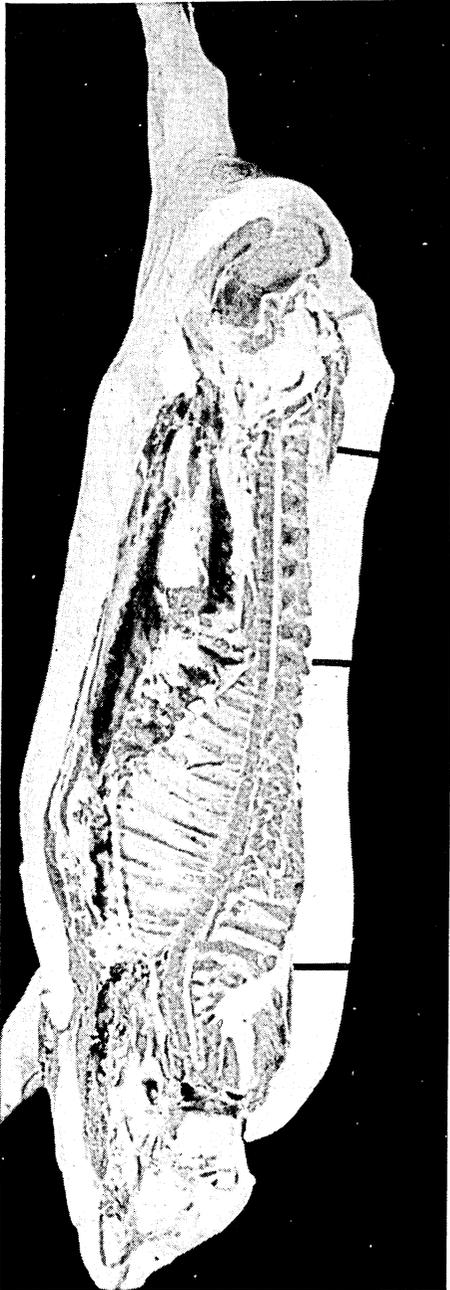


FIG. 1. Backfat thickness was measured at the three points shown above. Average backfat thickness of any given carcass is the average of those three measurements.

sale cuts and trimmings. A standardized cutting procedure was followed by highly skilled personnel selected from the regular cutting gang. The workmen were supervised by plant representatives to insure compliance with the standardized cutting procedure.⁵

A number of hogs were eliminated from the analysis because of condemned heads, bruising, etc., which substantially affect the carcass weight used to determine pricing accuracy. In cases where these losses brought the number of hogs in a lot below five the lot was rejected from the portion of the analysis relating to pricing accuracy. The usable sample comprised 32 lots including 219 individual butcher hogs. These lots were distributed according to numbers as follows:

- 7 lots with 5 hogs each
- 6 lots with 6 hogs each
- 9 lots with 7 hogs each
- 6 lots with 8 hogs each
- 3 lots with 9 hogs each
- 1 lot with 10 hogs

A study of hog marketing methods abroad was conducted during the period April to September 1950.⁶ Countries included the United Kingdom, Denmark, the Netherlands, Sweden, Norway, Western Germany, Belgium, and France. Information was obtained from hog producers, officials of farm organizations, packers, wholesale and retail meat dealers, government officials, college and experiment station workers, and consumers in the various countries. In most of these countries butcher hogs are sold by carcass weight and grade. The experience of these countries with the carcass method was drawn upon in developing the sections on possible gains and possible problems associated with the carcass weight and grade method of marketing.

⁵ For measuring and cutting procedures see Engelman, Dowell, Ferrin, and Anderson. *Op. cit.* pp. 54, 55.

⁶ This investigation was made by Austin A. Dowell in connection with a study of the export market for pork and lard.

Analysis of Pricing Accuracy

THE STANDARD against which the relative pricing accuracy of alternative marketing methods are measured and compared in this study is the cut-out value of the hog, the sum of all the values of the several wholesale cuts and trimmings yielded by the carcass. Cut-out values were calculated separately for each individual hog in the analysis in the manner illustrated in table 1. Weights of wholesale cuts and trimmings obtained on the cutting floor were valued according to Chicago wholesale prices on June 29, 1949. (See table 18, appendix B).

The hams, loins, picnics, and butts are all lean cuts of relatively high value per pound. Collectively, they contribute most of the value of the carcass. The belly, although not a lean cut, is nevertheless one of the relatively high value cuts and makes a substantial contribution to the carcass value. Fatbacks and fat trimmings usually are converted into low value lard. They are therefore low value items that contribute relatively little to carcass value.

For the particular hog carcass shown in table 1, the fatback and fat trimmings together contributed more to the weight of the carcass than did the hams alone. Yet they contributed less than one-fifth as much to total value.

Of the 219 carcasses, 21 had one or more wholesale cuts graded down for packing quality because of inadequate finish to move in the wholesale trade as No. 1 grade cuts. In these cases the following discounts were applied to the wholesale prices shown in table 1:

	Grade No. 2	Grade No. 3
Hams	\$1.00	\$1.00
Bellies		
6-10 pounds	1.50	3.00
Over 10 pounds	1.00	2.00

⁷ Of the 21 carcasses with discounted cuts, 11 had No. 2 bellies, 1 had No. 2 hams, and 1 had No. 2 hams and bellies. These were the 13 carcasses having some No. 2 cuts. The 8 carcasses having some No. 3 cuts included 6 with No. 3 bellies, 1 with No. 3 hams, and 1 with No. 3 hams and No. 2 bellies.

Table 1. Example of Calculating Cut-Out Value of an Individual Hog—Liveweight, 227 Pounds; Carcass Weight, 156.5 Pounds; Carcass Yield, 68.9 Per Cent

Wholesale cuts and trimmings	Weight		Per cent carcass weight	Price per cwt.	Amount
	lbs.	ozs.			
Skinned ham	29	4	18.68	\$50.25	\$9.39
Regular picnic	14	3	9.06	33.63	3.05
Boston butt	11	4	7.18	40.25	2.89
Regular loin	24	3	15.45	43.25	6.68
Regular trimmings	5	13	3.71	13.12	.49
Belly	23	3	14.82	30.50	4.52
Fatback	15	2	9.70	8.70	.84
Dry salt jowls	6		3.83	15.25	.58
Fat trimmings	16	3	10.34	8.70	.90
Spare ribs	3	14	2.48	39.25	.97
Neck bones	2	7	1.56	13.12	.20
Fore feet	1	15	1.24	4.25	.05
Hind feet	2	9	1.63	2.50	.04
Tail		8	.32	13.12	.04
Total weight	156	8	100.00		
Cut-out value per 100 pounds carcass weight					\$30.64
Total carcass cut-out value (30.64 x 156.5)					\$47.95
(100)					
Cut-out value per 100 pounds liveweight (47.95)					\$21.12
(227 x 100)					

These discounts did not affect greatly the value of the carcasses to which they were applied.⁷

The average cut-out value per hundred pounds liveweight for each lot was calculated by summing the individual hog cut-out values and dividing by the total liveweight of the lot. Cut-out values were thus obtained for 219 individual hogs and for 32 separate lots. Cut-out values per 100 pounds liveweight were used as the basic cri-

teria of pricing accuracy in evaluating alternative methods of marketing. A difference between cut-out value and the price paid under any marketing system is therefore called a pricing error.

The use of the term *pricing error* is not intended to imply a criticism of any particular marketing system. This study is aimed at measuring pricing accuracy. The most accurate pricing method is the one that has the minimum pricing errors associated with its use.

The cut-out values for each lot, the prices that would be paid for each lot under several alternative marketing methods, and the associated pricing errors are shown in table 3. Each pricing method compared in this table is discussed later in this bulletin. The relative pricing accuracy of all pricing systems discussed is compared in the section "Appraisal of Pricing Accuracy."

PRICING BY LIVWEIGHT ONLY

Priced According to Average Liveweight of Lot

Probably the most common pricing procedure used in marketing hogs throughout the United States is to base the price to be paid on the average weight of the lot. If the hogs that make up a lot average 210 pounds, the price quotation for the 200-220 pound weight group applies; if they average 230 pounds the 220-240 pound quotation determines the price. Packers make occasional cutting tests to determine the expected physical yields of the several wholesale cuts and trimmings from each of the weight groups in which they are conducting trading. Current wholesale prices are applied to these yields to arrive at the worth to the packer of hogs of each weight classification. This information is used in de-

termining what price would be offered for each weight group.

In order to determine the average cut-out value per hundred pounds live weight of different weight groups of hogs, the 219 individual hogs were sorted into their respective weight groups. The average cut-out value per 100 pounds liveweight was then determined for each weight group. The number of individual hogs in each weight group and the average cut-out value of each group are shown in table 2.

It is important to note that while 3 individual hogs were included in the 180-200 pound group, only one lot of hogs averaged in this weight group. These 9 hogs were priced as a lot at \$20.69, the average value for all individual hogs within this particular weight classification. There were 12 lots in the 200-220 pound weight group, 1 lot in the 220-240 weight group, 6 lots in the 240-270 weight group, and none in the 270-300 weight group. Each of these lots was priced at the average value for its particular weight group. This was done to approximate the present liveweight system of marketing in which prices are based on the average value of all hogs in each weight group.

The comparisons of cut-out values and prices paid under this pricing system are presented in columns 4 and 5 of table 3. The pricing error, the difference between price and cut-out value, is shown in column 6.

Table 2. Number of Hogs and Average Cut-Out Value per 100 Pounds Liveweight, by Weight Groups

Weight group	Number of individual hogs	Average cut-out value
pounds		
180-200	38	\$20.69
200-220	71	20.65
220-240	54	20.46
240-270	46	20.11
270-300	10	20.17
Total	219	



mn1000_agexpstn_tb_208

Technical Bulletin

Technical Bulletin

MN1000_AGEXPSTN_TB_208



Butcher Hogs, 32 Lots Including 219 Hogs

Lot number	Number of hogs in lot	Average weight of lot	Cut-out value of lot	Pricing method															
				Liveweight only				Carcass weight and grade				Liveweight and estimated carcass grade and yield				Liveweight and grade only			
				Average weight of lot		Individual weight		Carcass weight and grade		Actual estimates		Adjusted estimates (est. price-21 cents)		Estimated grades (adjusted)		Perfect grading assumed			
				Price	Pricing error	Price	Pricing error	Price	Pricing error	Price	Pricing error	Price	Pricing error	Price	Pricing error	Price	Pricing error		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)		
1	10	226.1	\$20.72	\$20.46	\$-.26	\$20.35	\$-.37	\$20.53	\$-.19	\$20.84	\$+1.12	\$20.63	\$-.09	\$20.58	\$-.14	\$20.52	\$-.20		
2	7	241.0	20.70	20.11	-.59	20.31	-.39	20.62	-.08	20.67	-.03	20.46	-.24	20.32	-.38	20.18	-.52		
3	5	255.3	19.80	20.11	+.31	20.19	+.39	19.96	+.16	20.16	+.36	19.95	+.15	20.11	+.31	20.12	+.32		
4	8	224.6	20.69	20.46	-.23	20.46	-.23	20.70	+.01	21.08	+.39	20.87	+.18	20.64	-.05	20.62	-.07		
5	5	212.4	20.88	20.65	-.23	20.61	-.27	20.88	.00	21.41	+.53	21.20	+.32	20.85	-.03	20.85	-.03		
6	9	215.2	21.52	20.65	-.87	20.59	-.93	21.09	-.43	21.47	-.05	21.26	-.26	20.77	-.75	20.78	-.74		
7	9	195.3	20.73	20.69	-.04	20.68	-.05	20.69	-.04	20.94	+.21	20.73	.00	20.63	-.10	20.65	-.08		
8	6	209.7	21.13	20.65	-.48	20.63	-.50	21.02	-.11	20.66	-.47	20.45	-.68	20.67	-.46	20.72	-.41		
9	7	207.8	20.52	20.65	+.13	20.57	+.05	20.54	+.02	20.75	+.23	20.54	+.02	20.60	+.08	20.49	-.03		
10	5	240.7	20.86	20.11	-.75	20.31	-.55	20.85	-.01	21.13	+.27	20.92	+.06	20.52	-.34	20.52	-.34		
11	5	228.6	19.36	20.46	+1.10	20.38	+1.02	19.34	-.02	19.52	+.16	19.31	-.05	19.98	+.62	19.67	+.31		
12	9	242.5	20.24	20.11	-.13	20.32	+.08	20.40	+.17	20.01	-.23	19.80	-.44	20.12	-.12	20.02	-.21		
13	6	233.8	20.53	20.46	-.07	20.32	-.21	20.40	-.13	20.72	+.19	20.51	-.02	20.53	.00	20.51	-.02		
14	8	225.4	20.47	20.46	-.01	20.51	+.04	20.27	-.20	19.97	-.50	19.76	-.71	20.25	-.22	20.53	+.06		
15	6	213.6	20.26	20.65	+.39	20.59	+.33	20.52	+.26	21.12	+.86	20.91	+.65	20.82	+.56	20.37	+.11		
16	8	219.7	20.50	20.65	+.15	20.49	-.01	20.65	+.15	20.68	+.18	20.47	-.03	20.67	+.17	20.49	-.01		
17	6	203.3	20.82	20.65	-.17	20.66	-.16	20.64	-.18	20.71	-.11	20.50	-.32	20.82	.00	20.93	+.11		
18	5	228.3	20.04	20.46	+.42	20.31	+.29	20.00	-.02	20.02	-.02	19.81	-.23	20.25	+.21	20.46	+.42		
19	6	215.2	19.77	20.65	+.88	20.56	+.79	19.94	+.17	20.42	+.65	20.21	+.44	20.42	+.65	20.35	+.58		
20	7	237.9	19.43	20.46	+1.03	20.29	+.86	19.91	+.48	20.38	+.95	20.17	+.74	19.96	+.53	19.96	+.53		
21	6	261.3	20.91	20.11	-.80	20.13	-.78	20.89	-.02	20.48	-.43	20.27	-.64	20.25	-.66	20.51	-.40		
22	7	235.3	19.91	20.46	+.55	20.40	+.49	19.87	-.04	19.88	-.03	19.67	-.24	20.11	+.20	20.45	+.54		
23	8	224.2	20.74	20.46	-.28	20.46	-.28	20.69	-.05	20.62	-.12	20.41	-.33	20.38	-.36	20.39	-.35		
24	7	233.0	20.30	20.46	+.16	20.34	+.04	20.53	+.23	20.81	+.51	20.60	+.30	20.47	+.17	20.45	+.15		
25	7	206.6	20.26	20.65	+.39	20.66	+.40	20.10	-.16	20.89	+.63	20.68	+.42	20.70	+.44	20.68	+.42		
26	7	216.0	20.41	20.65	+.24	20.54	+.13	19.96	-.45	21.04	+.63	20.83	+.42	20.66	+.25	20.31	-.10		
27	7	220.3	20.36	20.46	+.10	20.54	+.18	20.49	+.13	21.12	+.76	20.91	+.55	20.61	+.25	20.68	+.32		
28	5	250.5	20.04	20.11	+.07	20.19	+.15	19.94	-.10	20.44	+.40	20.23	+.19	20.50	+.46	20.37	+.33		
29	8	201.9	20.54	20.65	+.11	20.64	+.10	20.82	+.28	20.99	+.45	20.78	+.24	20.69	+.15	20.61	+.07		
30	8	234.3	20.13	20.46	+.33	20.40	+.27	20.04	-.09	20.25	+.12	20.04	-.09	20.15	+.02	20.34	+.21		
31	5	223.0	20.42	20.46	+.04	20.45	+.03	20.72	+.30	21.08	+.66	20.87	+.45	20.62	+.20	20.34	-.08		
32	7	202.3	21.00	20.65	-.35	20.67	-.33	21.24	+.24	21.02	+.02	20.81	-.19	20.66	-.34	20.66	-.34		

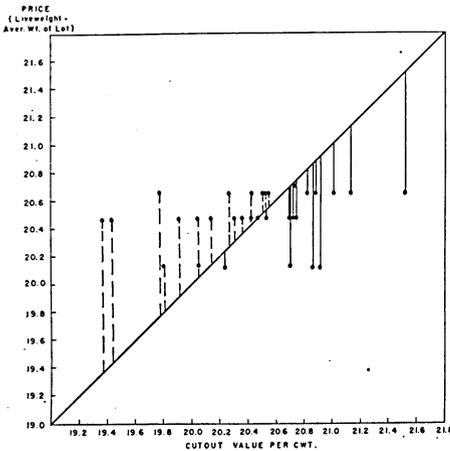


FIG. 2. Relationship between prices based on average liveweight of lots and cut-out values per 100 pounds liveweight, 32 lots of butcher hogs.

The relationship between price and cut-out value is illustrated graphically in figure 2. Each dot represents one lot of hogs. Liveweight prices of each lot can be read on the vertical scale in this diagram, while cut-out values can be read on the horizontal scale. The dots form three horizontal lines in the chart, one for each of three weight groups—the upper line for the 200-220 pound weight group, the middle line for the 220-240 pound weight group, and the lower line for the 240-270 pound weight group. The dot for the one lot in the 180-200 pound weight group is just above the highest of the three horizontal lines.

It is clear from this figure that the distribution or spread of actual cut-out values (the horizontal distribution in this chart) is considerably greater than the distribution of prices paid (the vertical distribution). The lot cut-out values vary from \$19.36 to \$21.52, a range of \$2.16, while lot prices vary from \$20.11 to \$20.69, a range of only 58 cents.

The diagonal line represents an "ideal relationship," in which the price paid

for the lot equals the cut-out value. If all of the prices had been equal to cut-out value, all of the dots would have fallen on the diagonal line. Where the pricing method is less than completely accurate, the dots lie either above or below the line. Dots above the line represent lots for which prices exceed cut-out values, lots which would be overpriced under the average liveweight pricing method. Dots below the line represent lots for which cut-out value exceeds price, lots which would be underpriced by the average liveweight method. The length of the line connecting the dot to the line of ideal relationship indicates the extent to which price departs from cut-out value for each of the 32 lots. The longer the line, the greater the difference between price and cut-out value, and the greater the pricing error.

The chart indicates some substantial pricing errors occur when hogs are sold at a flat price by weight groups. The two lots at the left of the chart represent errors of \$1.10 and \$1.03 per 100 pounds liveweight, respectively (lots 11 and 20 in table 3). Three more lots had prices which differed by more than 75 cents per 100 pounds liveweight from the cut-out value of the lot. Seventeen of the lot prices, more than half of all the lots, differed from lot cut-out value by more than 25 cents per 100 pounds liveweight. The comparative accuracy of this and other pricing methods is discussed in a later section.

Priced According to Individual Liveweight

All of the 32 lots of butcher hogs contained individuals that weighed either more than the upper limits, or less than the lower limits, of the weight group in which the lot was priced on the basis of its average weight. The distribution of the individual hogs in each lot among the various weight groups is shown in table 4. Eight of the lots had indi-

Table 4. Distribution of 219 Butcher Hogs Among Specified Weight Groups, 32 Farmers' Lots Varying from 5 to 10 Hogs Each

Lot number	Number of hogs in lot	Lot Average weight	Number of hogs in each weight group				
			180-200 pounds	200-220 pounds	220-240 pounds	240-270 pounds	270-300 pounds
1	10	226.1	3	1	1	5	0
2	7	241.0	0	2	1	3	1
3	5	255.3	0	0	1	3	1
4	8	224.6	2	2	2	2	0
5	5	212.4	0	4	1	0	0
6	9	215.2	1	5	3	0	0
7	9	195.3	6	3	0	0	0
8	6	209.7	2	3	1	0	0
9	7	207.8	3	2	2	0	0
10	5	240.7	0	0	3	2	0
11	5	228.6	0	2	1	2	0
12	9	242.5	0	3	1	3	2
13	6	233.8	0	2	1	3	0
14	8	225.4	1	3	3	0	1
15	6	213.6	1	3	2	0	0
16	8	219.7	2	1	4	1	0
17	6	203.3	2	4	0	0	0
18	5	228.3	1	1	0	3	0
19	6	215.2	1	2	3	0	0
20	7	237.9	0	2	1	4	0
21	6	261.3	0	0	0	4	2
22	7	235.3	0	2	3	1	1
23	8	224.2	0	2	5	1	0
24	7	233.0	1	1	2	3	0
25	7	206.6	2	5	0	0	0
26	7	216.0	2	1	4	0	0
27	7	220.3	0	3	4	0	0
28	5	250.5	0	0	1	3	1
29	8	201.9	4	3	1	0	0
30	8	234.3	1	3	1	2	1
31	5	223.0	1	1	2	1	0
32	7	202.3	3	4	0	0	0
Total	219		39	70	54	46	10

Individuals distributed among two weight groups, 14 lots had individuals distributed among three weight groups, 9 lots had individuals distributed among four weight groups, and the hogs in 1 lot were distributed among five weight groups.

Lot 16, for example, had hogs distributed among the 180-200, 200-220, 220-240, and 240-270 pound weight groups. The lot averaged 219.7 pounds per hog. In the preceding section this lot was priced at \$20.65, the price for 200-220 pound hogs.

In some markets the individual hogs within any given lot are sorted by ob-

servation into the weight groups in which they appear to belong prior to sale and are priced accordingly. In this section of the analysis the individual weight pricing method was tested by pricing each hog according to the average liveweight value for all hogs in its particular weight group (table 2). This pricing system is equivalent to sorting hogs by weight prior to sale.

The average value of the lot was determined by summing the individual values of all the hogs in the lot and dividing by the total lot liveweight. The resulting average values of the lots priced by this method were compared

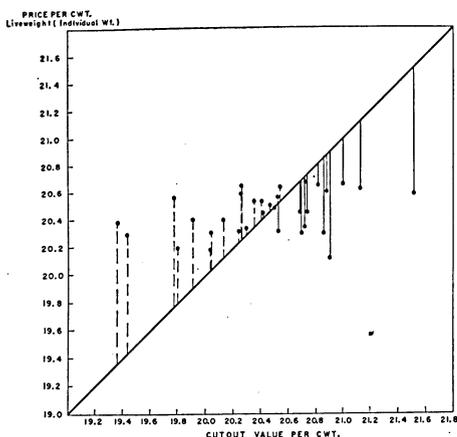


FIG. 3. Relationship between prices based on individual liveweight and cut-out values per 100 pounds liveweight, 32 lots of butcher hogs.

with the cut-out value to determine the difference, or pricing error, when lots of hogs are priced by pricing each hog separately on the basis of a schedule of liveweight prices. The average price and the pricing error associated with this pricing method are shown in columns 7 and 8 of table 3. The relationship between cut-out value and average lot price for the individual weight pricing method, as well as the pricing errors, are illustrated in figure 3.

Figure 3 for individual liveweight pricing is analogous to figure 2 for lot liveweight pricing. The most apparent difference between the two charts is that under the individual liveweight pricing the prices paid do not form horizontal lines on the chart as they do when based on average lot weight. The pricing errors—the differences between price and cut-out value indicated by the length of the line separating the dot from the ideal line of relationship—tended to be slightly less than under the average liveweight pricing method.

It is nevertheless evident on this chart that the cut-out values still vary

considerably more than do the average prices paid for the 32 lots of hogs. The prices are distributed within a relatively narrow band extending horizontally across the chart. The range in individual liveweight prices per 100 pounds was from \$20.13 to \$20.68 or 55 cents compared with a range of 58 cents under the average lot liveweight method.

As indicated in the preceding section, cut-out values vary along the line of ideal relationship, from \$19.36 to \$21.52 or a range of \$2.16. If prices equaled cut-out value, the dots would all fall along this line.

PRICING BY CARCASS WEIGHT AND GRADE

The recent development of objective hog carcass grade standards was stimulated largely by an interest in the carcass method of marketing hogs. Although Denmark, the United Kingdom, Canada, and a few other western European countries had previously developed standards for their own use, the adaptability of these standards to conditions in the United States, where pork products are handled differently from those in the other countries, was not known.

Until satisfactory standards were developed, interest in the carcass method of marketing in this country was largely academic. The first task was to develop satisfactory, practicable carcass grade standards, which may be used to sort carcasses of widely varying physical characteristics into relatively similar groupings.

Now that such standards have been developed, it is possible to price hogs by the carcass weight and grade method. The grade standard used for this purpose (table 5) was adapted from the material presented in the earlier Minnesota study.⁸ The standard is based

⁸ Engelman, Dowell, Ferrin, and Anderson. *Op. cit.* p. 27.

Table 5. Carcass Weight and Grade Standard, Backfat Thickness Limits for Each Weight and Grade Group, with Grade 10 Centered at Index of Lean* at 71.0

Carcass weight	Equivalent liveweights (approximate)	Carcass grade and index of lean*				
		8 65.0	9 68.0	10 71.0	11 74.0	12 77.0
		backfat inches				
100-120	153-182	1.84-2.14	1.54-1.84	1.25-1.54	.95-1.25	under .95
120-140	182-210	1.93-2.24	1.63-1.93	1.31-1.63	.99-1.31	under .99
140-160	210-237	2.00-2.32	1.68-2.00	1.35-1.68	1.03-1.35	under 1.03
160-180	237-263	2.07-2.40	1.73-2.07	1.40-1.73	1.07-1.40	under 1.07
180-200	263-288	2.13-2.47	1.78-2.13	1.44-1.78	1.10-1.44	under 1.10

* Percentage of the carcass dressed packer style which consists of hams, loins, picnics, butts, bellies, and lean trimmings.

on backfat thickness and carcass weight when carcasses are dressed packer style, which is the usual method in the United States.⁹

Carcass weight intervals are 20 pounds. The backfat specifications for each grade are those which are associated with a 3 per cent interval in the index of lean (the percentage of the carcass which consists of hams, loins, picnics, butts, bellies, and lean trimmings).

Grade 10 is centered at an index of lean of 71.0 per cent.¹⁰ Grade 8 carcasses are extremely fat as indicated by the backfat specifications. They yield a relatively higher percentage of low value lard and a lower percentage of the high value cuts than carcasses of the other grades. Grade 9 carcasses are also overfat, although not to the same extent as grade 8. The percentage of lean cuts is greater and the percentage of low value lard correspondingly less for grade 9 than for grade 8 carcasses. The same trend in the proportion of lean cuts to fat continues through the lean grades 10, 11, and 12. Because of the price relationship between lean cuts and fat, as one moves from extremely fat grade 8 carcasses through the leaner grades, the value per hundredweight increases up to the

point where sufficient numbers of wholesale cuts are discounted because they lack adequate finish.

The 219 hog carcasses were sorted according to the carcass weight and backfat specifications of this grade standard. The distribution of these carcasses by weight and grade groupings is presented in table 6. As shown in table 7, 17 of the 32 lots delivered from 32 different farms included hogs that produced carcasses of 2 grades and the remaining 15 lots contained hogs that produced carcasses of 3 grades. No lot contained hogs of only one grade.

The average cut-out values for each weight and grade group were then de-

Table 6. Distribution of 219 Butcher Hog Carcasses by Carcass Weight and Grade

Carcass weight	Carcass grade					Total
	8	9	10	11	12	
pounds						
100-120	0	1	3	0	0	4
120-140	1	19	29	12	0	61
140-160	6	40	34	6	0	46
160-180	7	27	12	0	0	46
180-200	8	9	5	0	0	22
Total	22	96	83	18	0	219

⁹ The packer style carcass is the entire body of the hog minus blood, hair, viscera, head, leaf fat, kidneys, and ham facings.

¹⁰ Some recently developed grade standards have backfat specifications associated with the percentage of four lean cuts—hams, loins, picnics, and butts. The index of lean figures shown at the top of table 5 can be converted to approximate percentages of these four lean cuts by subtracting 20. These figures would then read 45.0, 48.0, 51.0, 54.0, and 57.0.

Table 7. Distribution of the Hogs in Each of the 32 Lots According to Carcass Grade

Lot number	Number of hogs in lot	Lot average weight	Number of hogs in each grade group			
			Grade 8	Grade 9	Grade 10	Grade 11
		pounds				
1	10	226.1	.....	7	3	.....
2	7	241.0	2	4	1	.....
3	5	255.3	.....	1	4	.....
4	8	224.6	.....	3	4	1
5	5	212.4	.....	1	2	2
6	9	215.2	.....	2	4	3
7	9	195.3	.....	4	5	.....
8	6	209.7	.....	1	2	3
9	7	207.8	1	3	3	.....
10	5	240.7	.....	1	4	.....
11	5	228.6	4	1	.....	.....
12	9	242.5	4	4	1	.....
13	6	233.8	.....	2	4	.....
14	8	225.4	.....	4	4	.....
15	6	213.6	1	4	1	.....
16	8	219.7	.....	3	4	1
17	6	203.3	.....	.....	3	3
18	5	228.3	.....	4	1	.....
19	6	215.2	1	5	.....	.....
20	7	237.9	3	4	.....	.....
21	6	261.3	.....	3	3	.....
22	7	235.3	.....	5	1	1
23	8	224.2	1	6	1	.....
24	7	233.0	.....	1	5	1
25	7	206.6	.....	2	4	1
26	7	216.0	2	5	.....	.....
27	7	220.3	.....	2	5	.....
28	5	250.5	.....	.....	4	1
29	8	201.9	.....	5	2	1
30	8	234.3	2	2	4	.....
31	5	223.0	1	4	.....	.....
32	7	202.3	.....	3	4	.....
Total	219	.....	22	96	83	18

terminated. These are shown in table 8.¹¹ They are the prices that were applied to the carcass weights of each of the hog carcasses to determine their respective values when priced by the carcass weight and grade method. The total lot value was the summation of the values of the individual carcasses within the lot.

For comparison of the pricing accuracy of this method of marketing with the various liveweight and liveweight and grade methods, it was necessary to convert this value expression to live-

Table 8. Mean Carcass Weight and Grade Prices

Carcass weight	Carcass grade				
	8	9	10	11	12
pounds					
100-120	.....	\$30.67	\$31.37	\$32.00	.....
120-140	\$29.02	30.25	31.11	31.81	.....
140-160	28.96	30.01	31.11	31.97	.....
160-180	28.34	29.59	30.33	31.33	.....
180-200	27.78	28.86	29.86	.....	.....

weight terms. This was done by dividing the total lot value, as determined by the carcass method of pricing, by

¹¹ The number of discounted cuts among the 18 carcasses in grade 11 was not sufficient to have an appreciable effect on carcass value per hundredweight. As a result, the cut-out values for these particular grade 11 carcasses were consistently above values for grade 10.

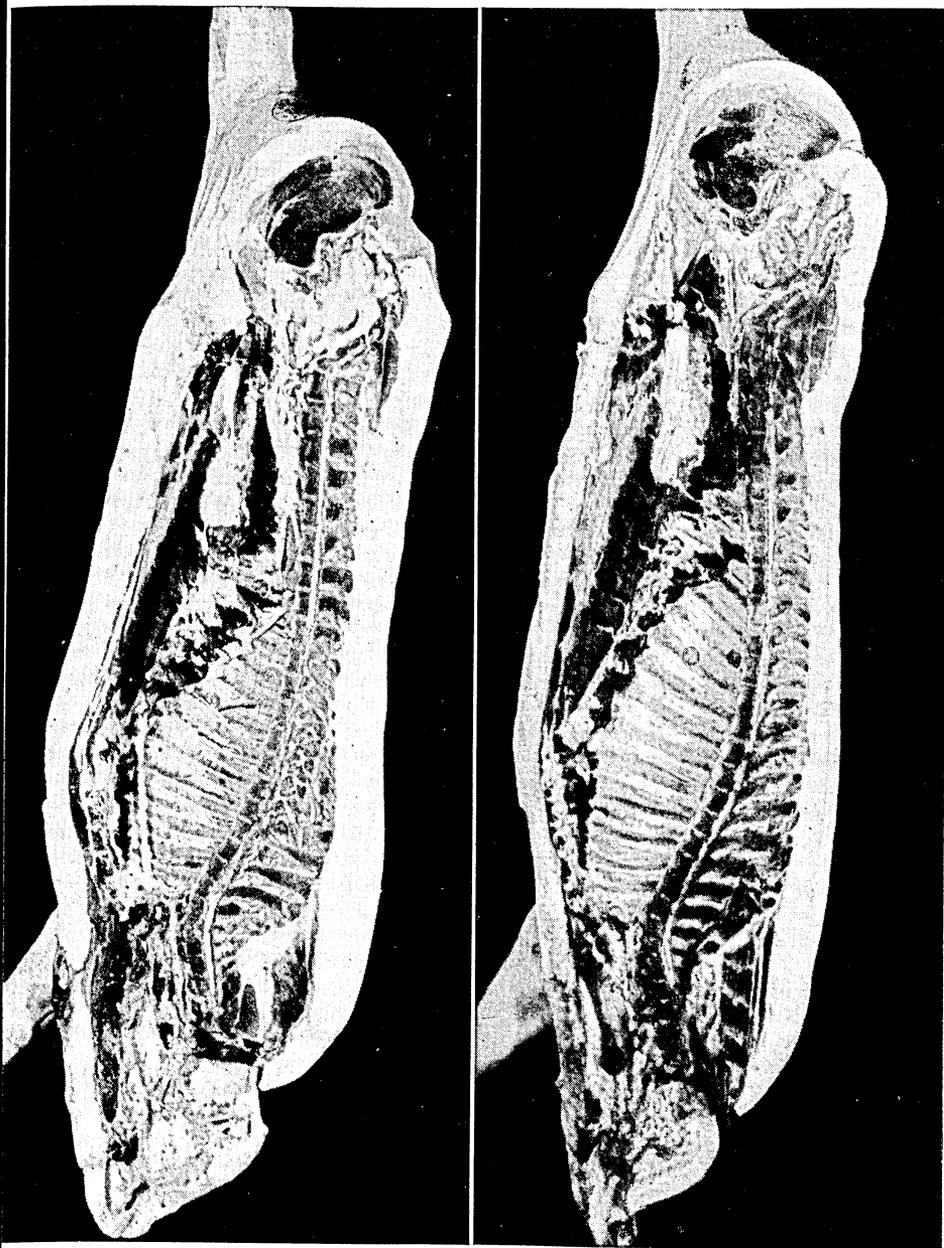


FIG. 4. The very fat grade 8 carcass on the left weighed 169 pounds, measured 2.30 inches of backfat, and would be expected to yield 44.4 per cent lean cuts (hams, loins, picnics, and Boston butts). The desirable grade 10 carcass on the right weighed 143 pounds, measured 1.53 inches of backfat, and would be expected to yield 51.0 per cent lean cuts.

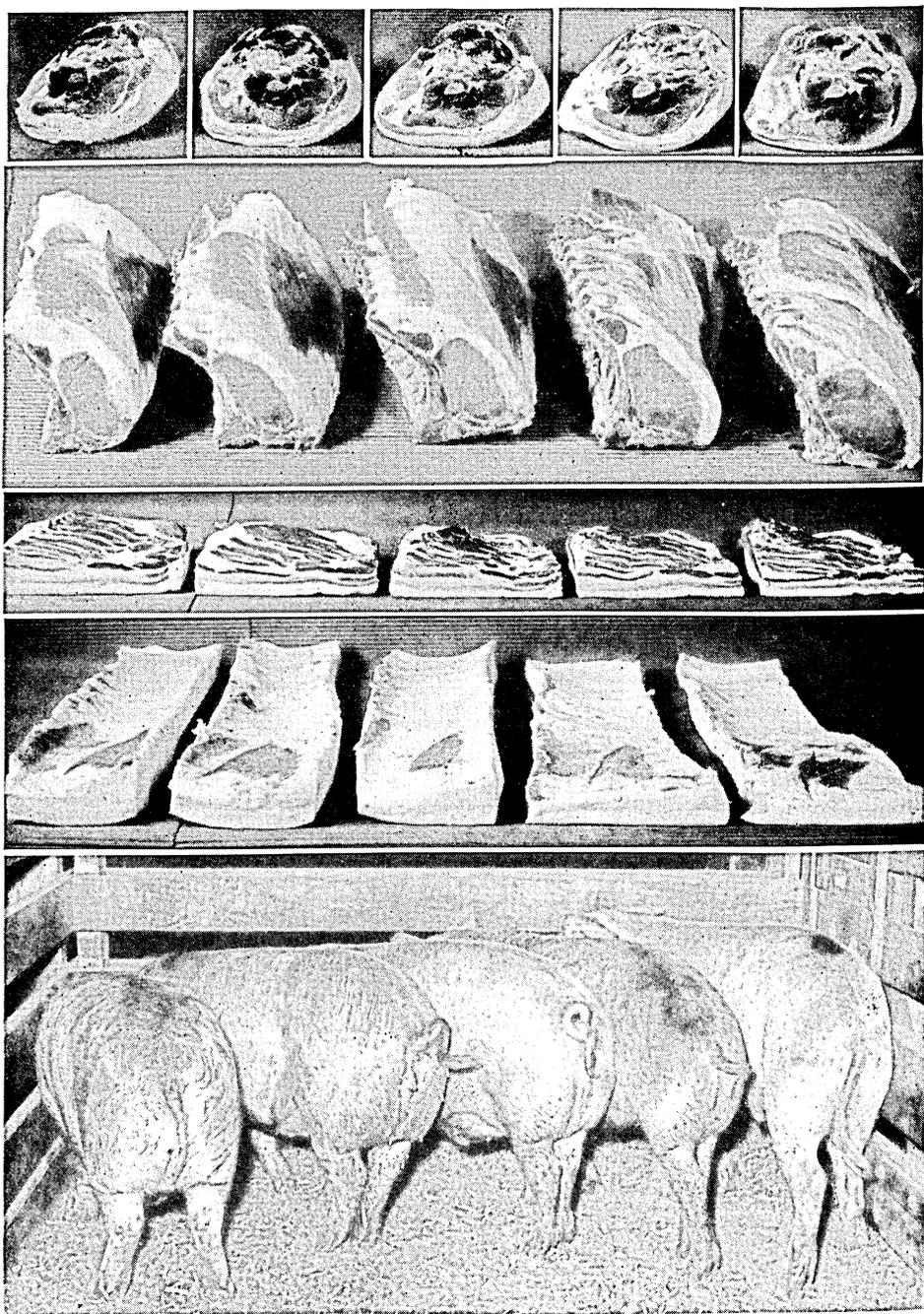


FIG. 5. Hams, loins, bellies, and fatbacks from hog carcasses in the same weight range. Shown at bottom are the hogs which produced these cuts. From left to right: grades 8, 9, 10, 11, and 12.

the total liveweight of the lot. The result of this calculation is a carcass weight and grade value expressed in liveweight terms which can be compared, therefore, with liveweight prices paid under other pricing methods.

The comparison of equivalent liveweight prices of lots priced by the carcass method with cut-out values is shown in columns 9 and 10 of table 3. The relationship between price and cut-out value for the carcass method of marketing is shown in figure 6.

The pattern of prices is clearly quite different under the carcass method from that under either of the liveweight methods shown previously. In the liveweight methods (figures 2 and 3) prices arranged themselves in rather narrow bands extending horizontally across the chart. Under the carcass method the prices for the 32 lots arrange themselves much more closely around cut-out values, the diagonal line of ideal relationship. Equivalent liveweight prices under the carcass method varied from \$19.34 to \$21.24, a range of \$1.90. This compares with a range of only 58 cents under the lot liveweight method.

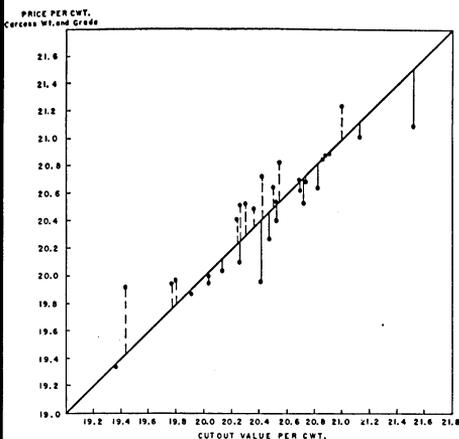


FIG. 6. Relationship between prices based on carcass weight and grade and cut-out value per 100 pounds liveweight, 32 lots of butcher hogs.

This diagram indicates that the pricing errors are substantially reduced under the carcass method of marketing. The largest single pricing error was + 48 cents per hundred pounds liveweight. Only six out of the 32 lots had pricing errors of more than 25 cents. Thirteen of the lots were priced within 10 cents of cut-out value, and eight within 5 cents.

PRICING BY LIVWEIGHT AND GRADE

Priced According to Liveweight and Estimated Grade and Yield

The recent development of objective carcass grade standards has also led to considerable interest in the possibility of selling hogs on a liveweight and live grade basis instead of liveweight only. Since a live grade is only an estimate or a reflection of the carcass grade the animal is expected to yield, live grade descriptions could be formulated on the basis of any carcass standard.

The official U. S. subjective grade standards for butcher hogs that became effective September 12, 1952 were developed from objective carcass grade standards. The greater pricing accuracy of the carcass method over the liveweight method results from (1) the fact that the carcass method gives consideration to the variation in backfat thickness and its relation to the physical composition of the carcass, and therefore to carcass value, and (2) the fact that variations in carcass yield, which normally have a major influence on the value of live hogs, are no longer a value factor, since the price is determined on the carcass weight. If the buyer could estimate both carcass yield and backfat thickness correctly, such estimates could be used to arrive at prices that would be equal in pricing accuracy to the prices paid under the carcass method of marketing.

In order to test the possible accuracy of such a liveweight and grade system of pricing, an experienced hog buyer was asked to make estimates of the carcass yield and backfat thickness on each of the 219 hogs. The buyer knew the origin of the hogs and the individual liveweight before he made his estimates of backfat thickness and carcass yield. Although most buyers may not be accustomed to estimating backfat thickness in conducting their buying operations, this buyer was familiar with

the concept of average backfat thickness, with its relation to carcass grade, and with the carcass weight and grade system of buying hogs. He had had some previous experience in making on-foot estimates of backfat thickness and carcass yield.

The relationships between estimated and actual carcass yields and between estimated and actual average backfat thickness are illustrated in figures 7 and 8. In these diagrams the lines of ideal relationship between the esti-

ESTIMATED AVERAGE BACKFAT
THICKNESS IN INCHES

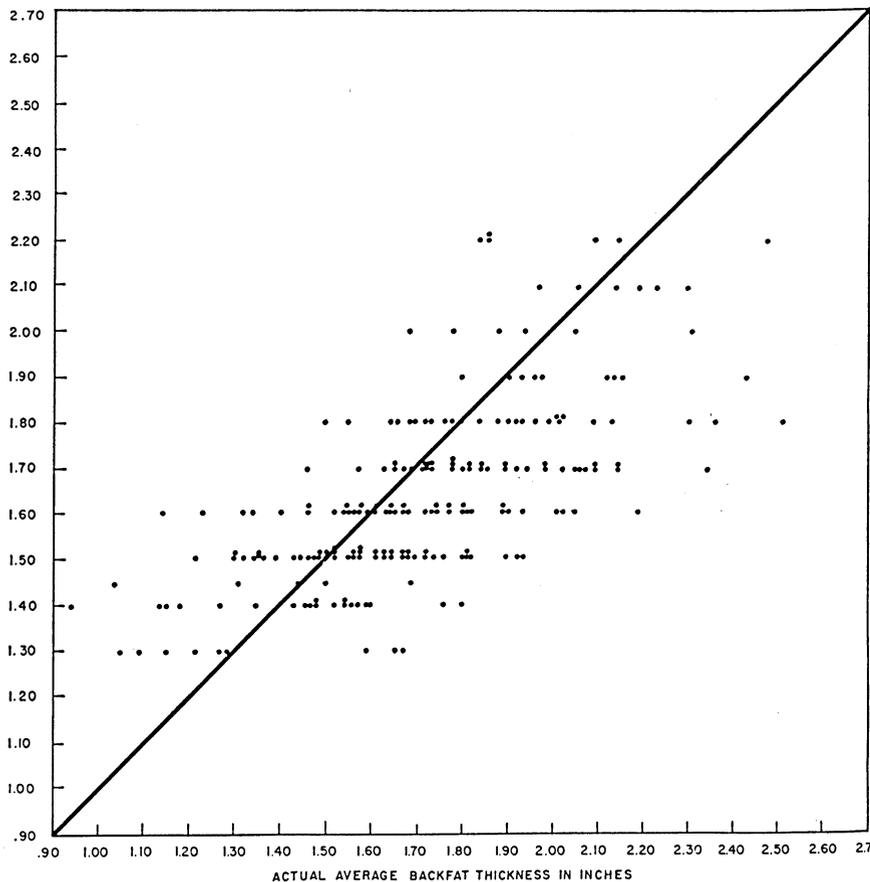


FIG. 7. Relationship between estimated and actual average backfat thickness, 219 hogs.

mated and actual carcass yields and backfat thicknesses have been drawn to indicate the positions of the dots if all the estimates had been made accurately. These lines run diagonally across the diagrams. The diagrams indicate that estimating yield and backfat thickness is a rather difficult assignment for a buyer to undertake. Some of the estimates differed widely from the actual yields and backfat thicknesses determined after the hogs were slaughtered.

The number and size of the errors of estimating yield and backfat thickness are indicated in table 9. When carcasses are worth \$30.00 per 100 pounds carcass weight (table 8) an error of 1 per cent in estimating carcass yield is equivalent to a 30 cent error in liveweight price per 100 pounds. When the price differential between each carcass grade is \$1.00, an error of 0.1 inch in backfat

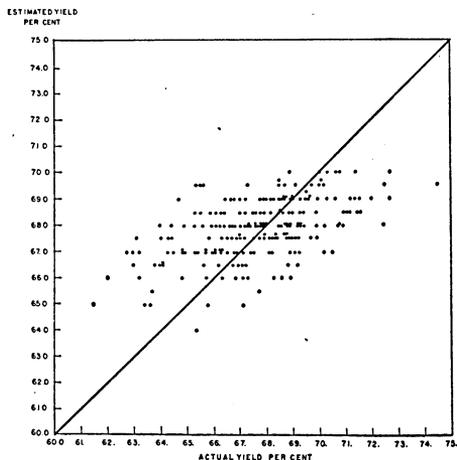


FIG. 8. Relationship between estimated and actual carcass yields, 219 butcher hogs.

thickness is approximately equivalent to a 23 cent error in liveweight price per 100 pounds. More than half of the yield estimates differed from actual

Table 9. Distribution of Errors in Estimating Carcass Yield and Average Backfat Thickness, 219 Butcher Hogs

Estimating errors					
Carcass yield			Average backfat thickness		
Error	Number	Per cent	Error	Number	Per cent
per cent			inches		
Overestimates					
Over 4.0	6	2.7	Over .40	4	1.8
3.1-4.0	12	5.5	.31-.40	4	1.8
2.1-3.0	22	10.0	.21-.30	10	4.6
1.1-2.0	25	11.4	.11-.20	24	11.0
0.1-1.0	48	22.0	.01-.10	31	14.1
0	7	3.2	0	5	2.3
Underestimates					
0.1-1.0	46	21.0	0.1-.10	44	20.1
1.1-2.0	23	10.5	.11-.20	40	18.3
2.1-3.0	23	10.5	.21-.30	26	11.9
3.1-4.0	5	2.3	.31-.40	18	8.2
Over 4.0	2	0.9	Over .40	13	5.9
Total	219	100.0		219	100.0
Overestimates and underestimates combined					
Over 4.0	8	3.6	Over .40	17	7.7
3.1-4.0	17	7.8	.31-.40	22	10.0
2.1-3.0	45	20.5	.21-.30	36	16.5
1.1-2.0	48	21.9	.11-.20	64	29.3
0.0-1.0	101	46.2	.00-.10	80	36.5
Total	219	100.0		219	100.0

yield by more than 1 per cent. Almost two-thirds of the backfat estimates differed from the actual average backfat thickness measurement by more than 0.1 inch.

The individual hogs were priced on the basis of the buyer's estimates of backfat thickness (converted to carcass grades) and carcass yields. Equivalent average liveweight prices were determined for each lot on the basis of these estimates.

The lot prices and the pricing errors which would be associated with this pricing system are shown in columns 11 and 12 in table 3. The lot prices, cut-out values, and pricing errors are illustrated in figure 9. Twenty-two of the 32 lots were overpriced, several by rather substantial amounts. This overpricing results from the fact that the buyer tended to overestimate carcass yield and underestimate backfat thickness (see figures 7 and 8).

Table 9 indicates that slightly more than half of the carcass yields were

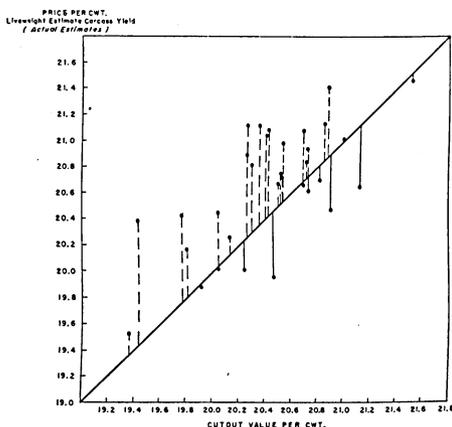


FIG. 9. Relationship between prices based on liveweight and actual estimates of carcass yield and carcass grade, and cut-out value per 100 pounds liveweight, 32 lots of butcher hogs.

overestimated, while two-thirds of the backfat thicknesses were underestimated. The average of estimated yields exceeded the average of actual yields by 0.16 per cent. The average of estimated backfat thicknesses, however,

¹² The statistics of the on-foot estimates and actual carcass yields and backfat thickness are as follows:

Statistics	Carcass yield	Average backfat thickness
	per cent	inches
Averages		
On-foot estimates	67.86	1.64
Actual	67.70	1.72
Differences	+ .16	-.08
Standard deviations		
On-foot estimates	1.13	.18
Actual	2.23	.28

The standard deviations indicate that these actual yields and backfat thicknesses varied much more than the estimates. Apparently the estimates were cautiously made on hogs which had yields or backfat thicknesses that differed considerably from the average. This was more true on estimates of yield than on estimates of backfat (see figures 7 and 8).

The estimating errors, both for carcass yield and for backfat thickness, were adjusted by the difference between the averages (above). The standard deviation of the adjusted errors in estimating yield was 1.88 per cent. The standard deviation of the adjusted errors in estimating backfat thickness was 0.16 inch. When the variances of these adjusted estimating errors were compared with the variances of the actual yields and backfat thicknesses, the estimates of yield accounted for 29 per cent of the variation in yield and the estimates of backfat thickness accounted for 44 per cent of the variability in backfat thickness.

Yield estimates were also analyzed on the basis of lots (see table 19 in appendix B). For the 32 lots of hogs the standard deviation of actual lot yields was 1.53 per cent. The standard deviation of the adjusted estimating errors was 1.21 per cent. The estimates of yield accounted for 42 per cent of the variability of actual lot yields.

Many other tests have shown considerable divergence between the estimated yields and the actual yields either on single animals or on lots. (See: Dowell, Austin A., and Bjorka, Knute. *Livestock Marketing*. McGraw-Hill Book Co., Inc., New York. pp. 437-447. 1941.)

For a recent example see Wiley, James R., Paarlberg, Don, and Jones, R. C. *Objective Carcass Factors Related to Slaughter Hog Value*. Purdue Agr. Expt. Sta. Bul. 567. December 1951. This bulletin reports on studies conducted in Indiana in which the dressing percentage (carcass yield) of 129 individual hogs was estimated by a Purdue representative and a packing company hog buyer (page 18) as follows:

"The over-all average of the estimates by each man was not far from the average of the actual dressing percentage of all the hogs. However, when the individual estimates were related to the actual dressing percentages, it was found that the estimates of each man accounted for only about 12 per cent of the actual variation in dressing percentage from one hog to another."

understated the average of actual backfat thickness by 0.08 inch.¹² Although these differences between the average on-foot estimates and the actual carcass yields and backfat thicknesses may appear to be rather small, they account for an average pricing error of 21 cents per 100 pounds liveweight, on each of the 32 lots.¹³

It is altogether probable that with continued experience a buyer could improve his estimating ability so that the average estimates of yield and backfat for his total purchase of hogs over a week or more would approach the actual average yield and average backfat thickness. On the assumption that this might be the case, 21 cents was subtracted from each of the lot prices per hundredweight. The adjusted lot prices and the pricing errors associated with them are shown in columns 13 and 14, table 3. The relationship between the adjusted lot prices and cut-out values and the pricing errors are illustrated in figure 10.

Under this adjusted on-foot estimated yield and grade method of pricing, the prices arranged themselves about the ideal line of relationship with cut-out values somewhat more like the carcass method than the two liveweight methods previously discussed. In other words the prices did not form a relatively narrow horizontal band as was the case under the liveweight methods in which liveweight was the only consideration affecting price (figures 2 and 3). The pricing accuracy for this method was superior to that of either liveweight method.

When compared with the carcass method, however, the errors in pricing for the adjusted estimated yield and grade method were relatively larger. Six of the lots had errors of more than 50 cents per 100 pounds liveweight compared with none for the carcass method. Sixteen of the 32 lots had

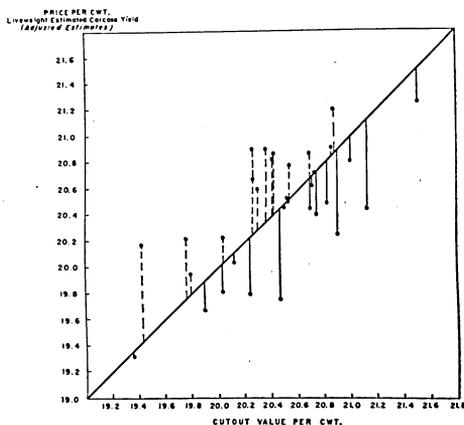


FIG. 10. Relationship between prices, based on liveweight and adjusted estimates of carcass yield and carcass grade, and cut-out values per 100 pounds liveweight, 32 lots of butcher hogs.

errors of more than 25 cents, compared with only 6 lots for the carcass method.

Priced According to Liveweight and Grade Only

Most of the recent interest in marketing hogs on the live grading basis has not been greatly concerned with the variations in carcass yields, either among individual hogs or among lots of hogs. Some packers at the present time estimate the backfat thicknesses of individual hogs and use these estimates to pick out premium hogs alive. In a few markets where hogs are graded alive, they are sorted into separate pens and the pens are priced separately, on the basis of their live grades. In others, an estimate is made of the average grade of the lot. The average yield of all hogs bought of any particular weight and grade may be a factor in arriving at the price to be offered for all hogs of this description. But variations in yields between hogs and between lots within the given

¹³ For an analysis of the influence that weight and grade have upon carcass yield, see appendix A.

weight and grade group are not considered by the buyer in arriving at the price to be paid for any particular lot, except that adjustments may be made on hogs that may have been hauled a long distance or obviously have been filled excessively.

The usual liveweight method of pricing gives some consideration to the influence of liveweight on value. The liveweight and live grade method would in addition give some consideration to the influence of grade as a factor affecting value, insofar as the grade of the ultimate carcass can be estimated on foot before the animals are slaughtered.

The 219 hogs in the study were distributed by liveweight groups and by carcass grades (which may be considered as the *correct* live grades) as indicated in table 10. The average cut-out value for each weight and grade group was determined (table 11) and these were used as the live grade prices for this method of pricing.

As indicated in the previous section the buyer had been asked to estimate the backfat thickness on each of the 219 hogs. These backfat estimates were increased by .08 inch to adjust for the buyer's tendency to underestimate backfat thickness.¹⁴ The adjusted backfat estimates and actual carcass weights were used as the buyer's estimate of grade based on the carcass standard (table 5). Each hog was priced on the basis of his liveweight and estimated carcass grade.

On the basis of adjusted backfat estimates, the buyer graded 122 of the 219 hogs, or about 56 per cent, correctly. He graded 53 hogs one grade too fat and one hog two grades fatter than the carcass actually measured. He

Table 10. Distribution of 219 Hogs by Liveweight and Carcass Grade

Liveweight	Grade				Total
	8	9	10	11	
pounds					
180-200	0	11	20	7	38
200-220	1	32	29	9	71
220-240	10	23	20	1	34
240-270	9	25	11	1	44
270-300	2	5	3	0	10
Total	22	96	83	18	219

Table 11. Average Prices per Hundredweight for Liveweight and Grade Groups

Liveweight	Grade			
	8	9	10	11
pounds				
180-200		\$20.59	\$20.77	\$20.61
200-220	\$19.11	20.39	20.87	21.04
220-240	19.98	20.38	20.77	21.11
240-270	19.46	20.40	19.97	20.18
270-300	19.58	19.96	20.93	

graded 41 hogs one grade too lean and two hogs two grades too lean.

Average lot prices for hogs bought on the liveweight and live grade method were calculated. These were compared with cut-out values to determine the pricing errors for each lot (columns 15 and 16, table 3). The relationship between cut-out value and the average lot price, based upon estimated live grades of individual hogs, is illustrated in figure 11.

The pricing errors for this particular method of pricing are substantially larger than the errors under the carcass method. They are in general considerably smaller, however, than pricing errors under the liveweight methods.¹⁵ This method of pricing appears to be more accurate than the other on-foot pricing methods.

¹⁴ This was the average estimating bias for 219 hogs. See footnote 12.

¹⁵ These results are not surprising. It is surprising, however, to find that the pricing errors when only grade is estimated are smaller than the pricing errors when both grade and carcass yield are estimated (compare figures 9 and 10). This would seem to suggest that unless the ability to estimate yield can be improved measurably, buyers can arrive at on-foot prices more accurately by estimating grade alone, ignoring the variations in carcass yield.

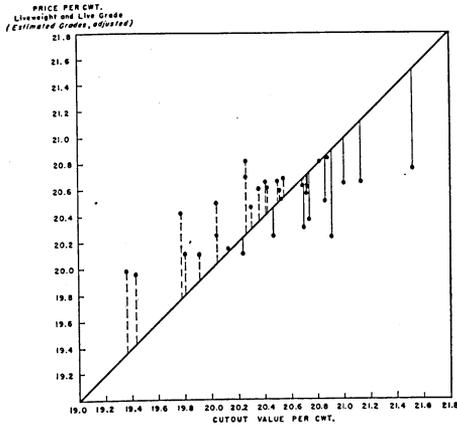


FIG. 11. Relationship between prices based on liveweight and adjusted carcass grade, and cut-out value per 100 pounds liveweight, 32 lots of butcher hogs.

It is possible that the buyer's ability to estimate grade might be improved with added experience. In other words, buyers might be expected to grade more than 56 per cent of the hogs correctly, the percentage graded correctly in this study. In order to test the maximum improvement in pricing accuracy that conceivably could be realized under the live grading method each of the hogs was graded by carcass weight and backfat measurements, and was valued accordingly.

The prices and pricing errors when it is assumed that live grading agrees exactly with carcass grading are shown in columns 17 and 18, table 3. They are

illustrated in figure 12. There is a slight improvement in pricing accuracy, barely perceptible in the diagram, over the live grading method with 56 per cent of the hogs graded correctly. (Compare with figure 11.)

This method of pricing is the equivalent of 100 per cent accuracy in live grading. It assumes that all of the hogs were placed in the correct grade by the buyer. It is not suggested that 100 per cent grading accuracy can be realized. This method simply represents the ultimate in pricing accuracy or the limits of improved pricing that could conceivably be achieved by the live grading method when variations in yield are not considered.

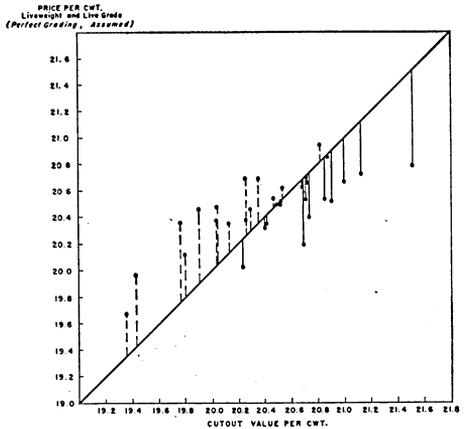


FIG. 12. Relationship between prices based on liveweight and assumed perfect grading on foot, 32 lots of butcher hogs.

An Appraisal of Pricing Accuracy by Lots

THE DIAGRAMS in the preceding sections show that each of the pricing methods has certain pricing errors associated with its use in marketing butcher hogs. Under each method some lots of hogs are priced above cut-out values while others are priced below. The diagrams in the preceding sections also indicated, however, that the varia-

tion of pricing errors differed considerably among the several alternative pricing methods. In pricing hogs according to their cut-out values, some methods appear to be more accurate than others.

A tabular picture of the extent of these pricing errors for alternative pricing systems is given in table 12. From

this table it appears that the two liveweight methods of pricing were probably the least accurate in pricing butcher hogs. These were the only marketing methods under which some lots were priced at \$1.00 or more per 100 pounds liveweight above their actual value.

The carcass method of pricing appears to be the most accurate of any of the pricing methods examined in this study. None of the lots under the carcass method was priced at 50 cents or more per 100 pounds liveweight above or below actual value, and 26 out of the 32 were priced within a range of 25 cents above and below actual cut-out value. The estimated carcass grade and yield and the live grading methods appear to occupy an intermediate position in pricing accuracy.

The relative pricing accuracy of each of the several pricing methods, measured statistically in terms of the variation of pricing errors, is shown in table 13.¹⁰ The usual method of marketing hogs on the basis of a single price for each lot, based on the average weight of the lot, results in a certain variation of cut-out values above and below prices paid.

This variation is a measure of pricing error. The larger the variability the less accurate the pricing system. The smaller the variability the more accurate the pricing system. If price had been equal to cut-out value for each lot, the pricing errors would have all been zero, and the variability of pricing errors would have been zero. The cut-out value was used as the criterion of pricing accuracy in this study and

is indicated for that purpose in the last column of table 13.

In this comparison of pricing accuracy, the variation of pricing errors associated with the usual liveweight marketing method is used as the base against which the other pricing methods are compared in their ability to improve pricing accuracy. The variation of pricing errors, a measure of the variation of values above and below prices paid, for each of the pricing systems is presented in the first line of the table. The relative size of the variability, as compared with the usual liveweight marketing method in column 1, is given in percentage terms in the second line of the table.

If the variation of the pricing errors associated with the usual liveweight method is known, the question logically follows as to what extent this variability could be reduced by any one of several alternative pricing methods. The third line gives this information for each of the alternative pricing methods. The greater the reduction of variability of prices above and below actual value, the greater the improvement in pricing accuracy.

The reduction in pricing error accomplished simply by pricing each hog according to his own weight group is shown in column 2. The variation of prices above and below cut-out value for the usual lot liveweight method was reduced by about one-sixth by the individual liveweight pricing system. This is a relatively small improvement in pricing accuracy.

When the buyer based the lot price on his estimates of carcass yield and carcass grade for each hog (column 3),

¹⁰ The measure of variation most useful for this type of analysis is the variance, the average of the squared deviations of price from cut-out value. This is because of the additive nature of variance which permits any remaining variation to be broken down into constituent elements measurable in percentage terms.

In this particular appraisal of pricing accuracy, the variation of pricing errors is treated in a manner analogous to the remaining unexplained variance of a two-variable correlation problem. In the correlation analysis a number of alternative third variables might be applied to the data to determine which would be associated with the greatest reduction in remaining variance. In this study a number of alternative pricing methods are used to determine which would be associated with the greatest reduction in the variance of the pricing errors under the usual liveweight method of sale.

Table 12. Distribution of Pricing Errors for Several Different Methods of Pricing Hogs, 32 Lots of Butcher Hogs

Pricing error	Pricing method							
	On-foot							
	Liveweight only		Liveweight, estimated yield and estimated grade		Liveweight and live grade		Carcass Carcass weight and grade	
	Average weight of lots	Individual weight of hogs	Actual estimates	Adjusted estimates	Estimated grades adjusted	Assumed perfect grading		
Dollars per 100 pounds liveweight	lots (1)	lots (2)	lots (3)	lots (4)	lots (5)	lots (6)	lots (7)	
Overpayments								
Over \$1.00	2	1	.....	.....	.....	.....	.....	.....
.76-\$1.00	1	2	3	.....	.....	.....	.....	.....
.51-.75	1	.....	6	3	4	3	.....	.....
.26-.50	5	6	5	6	3	6	4	.....
.01-.25	8	9	8	6	10	5	9	.....
0 .....	.....	.....	.....	1	2	.....	1	.....
Underpayments								
.01-.25	7	5	7	9	6	11	16	.....
.26-.50	4	6	3	4	5	5	2	.....
.51-.75	2	1	.....	3	2	2	.....	.....
.76-\$1.00	2	2	.....	.....	.....	.....	.....	.....
Over \$1.00 .....	.....	.....	.....	.....	.....	.....	.....	.....
	32	32	32	32	32	32	32	32
Overpayments and underpayments combined								
Over \$1.00	2	1	.....	.....	.....	.....	.....	.....
.76-\$1.00	3	4	3	.....	.....	.....	.....	.....
.51-.75	3	1	6	6	6	5	.....	.....
.26-.50	9	12	8	10	8	11	6	.....
.00-.25	15	14	15	16	18	16	26	.....
	32	32	32	32	32	32	32	32

Table 13. Relative Accuracy of Pricing Butcher Hogs by Several Alternative Pricing Methods, 219 Butcher Hogs in 32 Lots of 5 to 10 Each

	Pricing method							
	On-foot							
	Liveweight only		Liveweight, estimated yield and estimated grade		Liveweight and live grade		Carcass weight and grade	Cut-out Carcass cut-out value
	Average weight of lots	Individual weight of hogs	Actual estimates	Adjusted estimates	Estimated grades adjusted	Assumed perfect grading		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variation of pricing errors .....	.2234	.1880	.1903	.1387	.1266	.1057	.0401	.0000
Percentage of column 1	100.0	84.15	85.2	62.1	56.6	47.3	17.9	0.00
Percentage reduction in pricing error based on column 1 .....	.....	15.8	14.8	37.9	43.4	52.7	82.1	100.0
Rank in pricing accuracy	Seventh	Fifth	Sixth	Fourth	Third	Second	First	Optimum

the reduction in pricing error over the average weight of lot method (column 1) did not differ greatly from the reduction in error associated with the individual weight method (column 2) in which carcass yield and grade were not considered.

Under this method the buyer tended to overestimate yield and underestimate backfat thickness. The combined effect of these two estimating biases was to overprice the entire purchase of hogs by 21 cents per hundredweight. With additional experience in estimating yield and grade the buyer may be expected to make the average of his estimates agree more closely with the average value of a large number of hogs. When each lot price was adjusted downward 21 cents to compensate for the buyer's overpricing tendency (column 4), the pricing error was reduced by 38 per cent from the pricing error associated with the usual liveweight method.

In recent years there has been a considerable development of interest in the possibility of marketing hogs by live grade, a pricing system which gives no consideration to variations in carcass yield. When this method was tested the pricing error associated with the usual liveweight marketing method was reduced by about 43 per cent (column 5). This represents a greater improvement in pricing accuracy than was realized when both grade and yield were estimated. It suggests that unless the buyer's ability to estimate yield can be measurably improved, value can be determined more accurately by estimating grade alone.

In order to test the ultimate improvement possible under a live grade buying method it was assumed that all hogs were graded correctly by the buyer (column 6). Under this assumption of perfect grading the variability of pricing error was reduced by about 53 per cent from the variation for the usual liveweight method. This improvement is greater than could be expected from a live grading method of pricing, because perfect live grading is not likely to be achieved.¹⁷

This test of pricing accuracy indicated that the carcass method of marketing (column 7) is the most accurate system of pricing butcher hogs. Under this system the variations in carcass yield do not affect the returns to the farmer. The quality of the carcass can be determined more accurately when the carcass is hanging on the rail than on the live hog before it is slaughtered.

The carcass weight and grade marketing method eliminated 82 per cent of the variation of cut-out value above and below price paid that is associated with the usual liveweight method. This means that the residual pricing errors remaining under the carcass method were only about 18 per cent of the pricing errors of the usual liveweight method. These residual value variations are accounted for by the fact that the carcasses within any given weight and grade group are not all worth exactly the price assigned to that particular weight and grade group. Some variation of value above and below the grade price still remains, but this value variation is much less than that associated with any other pricing method.

¹⁷ In this analysis the live hog grades are essentially finish grades, reflecting differences in backfat thickness on the carcass. It is sometimes suggested that live hog grade standards could be improved by incorporating other than purely finish considerations (e.g. plump hams, freedom from wrinkles, etc.). In this case the ultimate improvement possible under the live grade method might be greater than that indicated above. It is also true, however, that any subjective characteristics affecting value are more easily observed on the carcass than on the live hog. If live grade standards can be improved by subjective considerations, carcass standards can also be improved by the same considerations. Any improvement in grade standards, live or carcass, will improve the pricing accuracy of the carcass method more than that of the live grade system. This is because variations in yield are the major source of pricing error for the live grade method, whereas yield variations have no influence whatsoever on the pricing errors remaining under the carcass method.

The value variation about the carcass prices could be removed completely only by cutting the carcasses from a single producer separately to arrive at the cut-out value of his entire lot (column 8). This would not be practicable, however, under the usual packing house conditions in this country.

Another approach to the measurement of relative pricing accuracy would be to compare the variation of pricing errors for the several on-foot methods with the variation of pricing errors for the carcass method. For the live grading method with perfect grading assumed, the variation of pricing errors was two and one-half times that of the carcass method. When live grades were based on the buyer's estimates of backfat thickness the variability of pricing errors was about three times that of the carcass method.

For the on-foot method using estimates of both carcass grade and carcass yield, the adjusted variation was about three and one-half times that of the carcass method, while the non-

adjusted was more than four and one-half times as large. The variation of errors for the individual pricing method was also four and one-half times as large as that of the carcass method. The variation of errors for the usual liveweight method was five and one-half times the variation of prices above and below cut-out value for the carcass method of marketing.

These several comparisons of pricing accuracy differ in the relative importance they attach to the improvement in pricing which appears to be inherent in the carcass method of marketing. By any standard of comparison, however, the carcass method would be substantially superior to any alternative on-foot method in paying farmers according to the value of product delivered.

Because of the greater pricing accuracy of the carcass method it is important that some of the possible gains as well as some of the possible problems associated with this method of marketing should be examined.

Some Possible Gains Associated with the Carcass Method of Marketing

AID PRODUCERS IN SATISFYING CONSUMER DEMAND

THE GENERAL OBJECTIVE of any grading system is to make the pricing mechanism a more effective means of communication through which consumers can indicate their preferences to producers. In the United States consumers have a higher order of preference for the high value wholesale cuts such as hams, loins, picnics, butts, and bacon than they do for lard. Without appropriate grade-price differentials farmers in the United States continue

producing hogs which yield excessive amounts of lard. This results in a substantial waste of corn and other feed resources, which could be allocated to the production of a larger output of the more highly desired meat cuts or other uses.

The most effective method by which producers can interpret the demand for different grades of hogs is through the pricing mechanism. If approximately the same price is paid for all hogs of the same weight regardless of quality, farmers have little incentive to alter production methods and market the

more desirable animals. On the other hand, if consumer preferences are fully reflected in prices paid for the product delivered, farmers will tend to produce and market the kind of product desired. Since the carcass method of marketing more accurately reflects consumer preferences back to producers than any of the liveweight methods, farmers would have a greater economic incentive to produce more highly desired types of carcasses.

It is important to remember that accuracy of pricing hogs by lots is not the only means by which the carcass method of marketing would encourage producers to change the carcasses they market to the more desirable types. The carcass method of marketing focuses attention on individuals. Under this system invoices showing the distribution of hogs by weight and grades would provide the farmer with additional information as to what could be done to improve the quality of the product he sends to market.

The seven hogs of lot 2 had a cut-out value of \$20.70 a hundred pounds liveweight. As a lot, they were underpriced only 8 cents a 100 pounds liveweight by the carcass method, 38 cents by the live grade method, and 55 cents by the lot average weight method of pricing. Even though the average carcass price for the lot was relatively accurate, the average price by itself tended to cover up the variation of individuals within the lot. The cut-out values per 100 pounds liveweight for the individual hogs within the lot were as follows: \$22.01, \$21.00, \$20.82, \$20.69, \$20.47, \$20.47, and \$19.78.

One of the carcasses from the lot was grade 10, 4 were grade 9, and 2 were

grade 8. They were distributed by carcass weight groups as follows:

Carcass weight	Grade 8	Grade 9	Grade 10
pounds			
140-160 .....	...	1	1
160-180 .....	...	3	...
180-200	2	...	...
.....	-	-	-
Total	2	4	1

With no identification other than for the lot as a whole the invoice under the carcass method would show the farmer the number of hogs in each grade and weight and the differential prices by grade and weight. It would tell him how many of his hogs were overfinished or overweight and would indicate the extent to which he would be required to change his breeding and management programs to get more hogs in the more desirable grade categories.¹⁸

For farmers who wish to compare carcasses of hogs from different sows or different boars, or from different breeds or crosses, it would be possible, under the carcass method, to maintain the identity of each hog in the lot. This could be accomplished by giving each hog a separate number along with the lot number when the hogs are tattooed for lot identity. Tattoo instruments with rotating heads are available for this purpose.

Maintaining the identity of the animals from the farm to the carcass rail would make it possible for the pricing mechanism to bring about an improvement in the general level of quality of market hogs. The productive resources in agriculture would be more effectively allocated to satisfy consumers wants.

It should not be inferred that consumer preferences are sufficiently well

¹⁸ In this illustration the two overfat grade 8 carcasses were in the heaviest carcass weight group. The cut-out values of these carcasses were \$19.78 and \$20.47 per 100 pounds liveweight. It would be obvious from the invoice that the two heavy carcasses were the lower value carcasses and the farmer probably would remember the two hogs from which those carcasses were obtained. He might not know the identity of the two hogs which produced the grade 9 and grade 10 carcasses in the 140-160 pound carcass weight group, or which of the four hogs that produced the grade 9 carcasses yielded the one in the 140-160 pound carcass weight group. Even so, a study of the invoice would be much more meaningful than an invoice covering sale on the hoof.

known at this time for the carcass method to do the most complete job of reflecting consumers' wants back to hog producers. Much research is needed to measure more precisely the consumer's response to pork cuts with varying proportions of fat to lean. As knowledge of this improves it will enable improved carcass grading and pricing. This in turn will make the carcass method more effective as a medium for informing producers of consumer preferences.

PAYMENTS DISTRIBUTED ACCORDING TO VALUE

One of the most significant results to be expected from the adoption of the carcass weight and grade method of marketing is that farmers would be paid more nearly the true market value of the hogs they bring to market than is possible when hogs are sold by liveweight.

Butcher hogs vary in value because of (1) the variation in dressing percentage or carcass yield, (2) the variation in weights of wholesale cuts from hogs of different weights, and (3) the variation in the relative proportions of high value and low value cuts from hogs of the same weight.

The present method of buying gives major consideration to liveweight groups. Selling on the basis of live grades would in addition give some consideration to value variations arising out of differences in carcasses of the same weight, insofar as the ultimate carcass value can be estimated in the live hog. By basing the price to be paid on the carcass grade, however, the carcass method would minimize the value variations due to differences in carcass type. By basing the price on the weight of the carcass, the carcass method would go one step further and completely remove all value variations that result from differences in carcass

yield. Thus, the carcass method would reflect more accurately value differences to producers than either the present liveweight method or a liveweight and grade method of marketing hogs.

It is probable that packers would pay around the same total amount of money for all hogs under the carcass weight and grade method as under the present liveweight method. Only to the extent that marketing efficiency is increased or the quality of hogs improved would total payments to farmers be increased. But, payments would be distributed differently. Under the carcass method farmers who market superior hogs would be more likely to receive higher returns than those whose hogs are marketed on foot, while farmers who market inferior animals would be more likely to receive less.

BARGAINING, COMPETITION, AND PRICE DETERMINATION

In marketing hogs by carcass weight and grade the producer or his selling agent would bargain with the buyer in terms of price per 100 pounds carcass weight rather than in terms of price per 100 pounds liveweight. The bargaining could take place at the farm, at the local market, or at the public stockyards market just as it does under the present liveweight method. There would be no necessary change in the time or place at which the price is agreed upon. The agreement would be reached before, not after, the animals pass out of the sellers' hands. In this respect the bargaining power of producers would not be affected.

It has sometimes been suggested, however, that under the carcass method free competitive bidding would be weakened, since the final price is not determined until the animals are hanging on the rail in the packer's coolers.

The fact that the final grade (and accordingly, final price) is not deter-

mined until the hogs have been delivered to the packer does not in itself mean that competition in bidding for hogs would be lessened in any way. In the marketing of grains, for example, bids are made by wire, card, or telephone to country elevators, either "on track" or "to arrive" by a certain date, without the grain having been seen by the buyer. In the case of wheat the final grade, moisture content, and protein content are determined after the car arrives. The important consideration is that prices for specific grades, discounts for moisture, and premiums for protein which govern the returns to the seller are based on the terms of sale which were agreed to before shipment.

Far from restricting competition, this system enhances the possibilities for competitive bidding. Buyers can make bids on more shipments than would be possible if it were necessary to travel through the country to inspect each carload of grain before bidding on it. Sellers accordingly can have a wider selection of bids to consider before accepting the most favorable offer.

Under the carcass method of marketing hogs, firm bids could be made on the basis of the ultimate carcass grades. There is reason to believe competition would be widened rather than restricted under this system. Assuming that the same carcass weight and grade classifications are used at all markets, farmers or their commission agents could compare the prices offered at alternative outlets over a wider area and select the one which offers the highest net price for the product actually delivered. The bargaining position of producers might well be strengthened, rather than weakened, under the carcass weight and grade method of marketing.

Under the carcass weight and grade method of marketing, however, the character of the bargaining would be

changed. The bargaining would no longer revolve around the degree of fill or the probable dressing yield of the animals. This would be accurately determined by the scales after the animals had been slaughtered. Nor would the bargaining center around the grade of the carcass, for this also would soon be determined on the carcass rail. The bargaining would quickly settle down to the basic issue of the level of values in the market for grades of carcasses delivered. Buyers could offer prices more in line with the true value of the animals because they would be more certain of obtaining the kind and amount of product actually paid for.

SALE BY DESCRIPTION

One of the reasons why hogs have been sold at a flat price within weight groups has been the difficulty of detecting differences in value by inspection of butcher hogs on foot. As the determination of value by inspection has been difficult, it has not been possible to sell hogs by description with any degree of confidence that price arrived at was an accurate reflection of the value of the product.

If hogs were sold on a carcass basis it would not be necessary for buyers to see the lots on which they were making bids. Instead, bids could be made for specific weights and grades of carcasses over the telephone. Buyers could make their bids with greater confidence, as some of the more important sources of value variations would have been removed and payment would be made on the basis of the product delivered. Sale on the basis of objective carcass standards would provide a more accurate language for price quotations. Sellers would have more information about the worth of their marketable product, and alternative outlets over a wider market area could be more readily compared.

REDUCING UNNECESSARY FILL BEFORE SELLING

Under the liveweight method of marketing, hogs are often fed and watered just before leaving the farm or at markets in order to increase the weight upon which the price is to be paid. This practice makes the problem of accurate price determination more complicated. Hogs vary in the amount of feed and water they will consume at markets before they are sold. As differences in carcass yield are difficult to detect accurately on foot, buyers tend to generalize their bids for hogs of approximately equal weight, offering the same price for hogs which may have considerable variation in fill. Under this system producers who sell hogs with more than average fill receive greater returns than those whose hogs are filled less than average. Producers therefore have an economic incentive to fill their hogs as much as the buyers will accept without discounts.

Sale on the carcass basis would remove the incentive to fill hogs simply to increase the liveweight of the animals. The sellers' interest in feeding would be limited to its effect upon the weight and quality of the carcass at the time of slaughter. Heavy feeding of hogs shortly before slaughter is an economic waste both to producers and to slaughterers. It has little effect on the weight or quality of the carcasses. Hogs with considerable fill are more difficult to dress in the plant than those with little fill, and the undigested feed must be disposed of. For hogs held over at markets or in the packers' pens and for those shipped considerable distances for slaughter, the cost of the feed should be weighed against the loss in carcass value due to tissue shrinkage and/or carcass quality if the hogs were not fed.

Under the carcass method of marketing, unnecessary feeding could be

avoided, marketing costs could be reduced, and net returns to producers could be increased.

AID IN REDUCING LOSSES FROM BRUISING AND DISEASE

Under the liveweight method of sale, losses from bruised and diseased animals are borne initially by the packer unless some defect is noted before purchase and the hogs are bought "subject to inspection." Over a period of time, however, a packer can predict what his average losses from condemnations and bruising will be and take these losses into account in arriving at the prices he will pay for hogs. Such losses are therefore generalized and are shared by all producers. In most cases the identity of the hogs is lost and the farmer seldom learns about the condition of his particular lot of hogs.

Under the carcass method of marketing it would be a relatively simple matter to identify the farmers who market bruised or diseased animals. Even though the losses might be shared by all farmers as at present or by a specified insurance charge or by some other means, the farmers could be advised of the condition of the animals so that steps could be taken to prevent such losses in the future.

If losses for which farmers were responsible were sustained by them, it would offer a strong incentive to clean up diseased herds and to avoid bruising at the farm. While this would be equitable, it would present such a marked change from past practice that it might not be desirable, at least during the initiation of the carcass method of marketing.

In some cases it would be difficult to determine whether the producer, the trucker, or market men were responsible for particular bruising losses. Nevertheless, the losses would be a matter of record under the carcass method of sale. Since the carcasses would be iden-

tified it would be easier to determine where and how the loss occurred than under a liveweight method of marketing.

If certain truckers consistently delivered bruised animals, steps could be taken to ascertain the practices responsible for the loss. If certain handling practices at the market or on the farm were responsible, this would be shown in the higher proportion of bruised animals consistently received from certain market men or from certain farmers.

In any case losses from bruising and disease would be brought out in the open under the carcass method. This would facilitate the determination of causal factors and would enable a loss prevention program to be carried out more effectively than under any liveweight method of marketing.

MAKE MORE EFFECTIVE THE WORK IN SWINE GENETICS

As long as all hogs in the same weight group are sold at about the same price per 100 pounds liveweight, farmers will continue to breed the types or strains of hogs that they think will go to market at the lowest possible cost per pound on the hoof. Farmers will accept the work of geneticists in swine breeding only insofar as it affects the size of litters, milk capacity and motherly qualities of the sows, and the rate and economy of gains of the growing and fattening pigs. They have little reason to be interested in breeding work which is directed towards changing the proportion of fat to lean in the hogs they send to market.

Under a liveweight and grade system, producers would be more interested in breeding work which leads to improvement in the type or conformation of market hogs than under the present liveweight system. This study, as well as experience in other coun-

tries, suggests that producers would be even more concerned over the proportions of lean and fat in their market hogs if they were sold by carcass weight and grade.

The more precise carcass method would give the work of the animal geneticists more meaning in the market place and make it more effective. Farmers could test the merits of different blood lines or strains in terms of the quality of the carcasses they market.

SHARPEN THE OBJECTIVES IN SWINE NUTRITION

Sale on the carcass basis also would sharpen the objectives in swine nutrition. Under the present liveweight method the producer's interest in the kind and amount of the various feeds used is limited almost entirely to their effects on the breeding herd and on the rate and economy of gains on growing and fattening pigs. Most producers have little interest in the proportions of fat and lean or in the quality of the fat or lean that will result from different rations. In certain areas where particular feeds, such as peanuts, are fed in substantial amounts, packers may discount hogs because they produce soft or oily carcasses. Since these discounts are applied generally within the local area, individual producers have little incentive to change feeding practices. In the main, producers are interested chiefly in quantity rather than quality in the hogs they send to market.

In Canada, the Scandinavian countries, and the lowlands of western Europe the situation is quite different. There producers are concerned with the proportion and quality of fat and lean because the price paid depends upon the grade as well as weight of the carcass. European hog producers, research men, and slaughterers believe that a top grade carcass cannot be pro-

duced on a ration made up largely of corn, self-fed free-choice up to the time of marketing.

In the United States, corn is produced in abundance, and it must necessarily make up a large proportion of the ration for market hogs. Nevertheless more information is needed about the influence of various feeds and combinations of feed on carcass quality. Sale on the basis of carcass weight and grade would sharpen the objectives of the swine nutritionist just as it would the work of the swine geneticist.

AID IN THE SOLUTION OF THE LARD PROBLEM

During recent years a serious problem has developed with respect to markets for lard. The combined domestic and foreign demand for this product has been such that it could be moved into consumption only at relatively low prices. The wholesale price for 100 pounds of lard often has been less than the price of 100 pounds of live hogs, occasionally as little as half.

The relatively low price of lard has resulted chiefly from increasing competition from vegetable oils, especially cottonseed oil and soybean oil. At times the price has been so low that some lard has been used in soap manufacture. This occurs when the price of lard approaches the price of inedible tallow, an important ingredient of soap.

Indications are that the price of the vegetable oils will serve as an effective ceiling to the price of lard in the future, while the price of inedible tallow will act as a floor.

In spite of the decline in the relative price of lard during the past several decades, large quantities continue to pour into the market. The supply of lard is not very sensitive to the price it brings on the market. Lard is produced jointly with pork. It is not possible to produce a first grade hog carcass without producing some lard.

But this does not mean that lard and pork are always produced in the same proportions. The amount of lard produced from a given number of hogs varies with the type of hog, kind of feed and method of feeding, weight at time of marketing, and proportion of fat that is rendered into lard.

Most of these factors are under the control of producers. They can be varied to alter the proportion of lard yielded from the hogs they market. One of the most important reasons American farmers continue to produce hogs yielding excess fat is that the hog market does not adequately reflect back to hog producers the different levels of consumer preferences for pork and lard. Sale by carcass weight and grade would offer farmers a strong incentive to grow and market hogs with a maximum of high value lean cuts and a minimum of low value lard.

Some Possible Problems Associated with the Carcass Method of Marketing

IDENTIFICATION

ONE OF THE additional requirements of a carcass method of marketing would be the maintenance of the identity of hogs until the car-

casses were weighed and graded and this information is recorded for calculating the proceeds of the sale to the producer.

In Canada, where all hogs are bought on the carcass basis, this problem ap-

pears to have been met satisfactorily by tattooing hogs on the shoulder at time of purchase. The tattoo method is gaining in popularity in several other countries where other methods have been used. The tattoo is clearly visible on the carcass and is recorded along with the carcass grade on the automatic scale ticket.

Maintaining the identity of hogs through slaughtering operations is not entirely new in the United States. A small number of packers now buy hogs by carcass weight and grade if farmers wish to sell on this basis. A somewhat larger number maintain the identity of the various lots of hogs from different markets, dealers, or farmers.

Most packers run yield tests on lots of hogs at more or less frequent intervals. Nevertheless, maintaining the identity of each farmer's lot of hogs, as would be necessary under the carcass method, would entail some additional cost over the usual liveweight method. However, based on the experience of other countries and on limited experience in this country, it does not appear that identification would prove to be a serious problem in the United States.

WEIGHING

When hogs are sold liveweight they are weighed either in the presence of the seller or his representative or by an impartial, disinterested weighmaster, usually on scales that are government tested for accuracy at regular intervals. Under the carcass method of marketing, liveweights would not be required. They might be desired, however, to permit subsequent calculation of yields or to approximate more closely the dressed weight of the carcasses if this information is needed to evaluate bids made by different buyers for carcasses of various weights.

Accurate carcass weights, however,

are essential to the carcass method of marketing. Since the seller would not be present in most cases when his carcasses were weighed, the services of an impartial weighmaster would certainly be desirable, if not indispensable, for the successful operation of the marketing method. In this case the official weighmaster would move to the killing floor and weigh carcasses instead of operating in the yards weighing live hogs as at present.

In countries where the carcass method is used, carcasses usually are weighed on the rail while they are on the killing floor before they are moved into the cooler. The scale usually is mounted on a section of the rail so that the carcass passes over it as it moves through the plant.

The scales used in Canada are electrically operated. They automatically record the weight in duplicate on a heavy, durable card, which is hung on the carcass after the tattoo number is recorded. Space is also available on the weight card for the carcass grade and other comments by the grader. Scales of this type are available which handle up to 600 or 700 carcasses per hour.

In packing plants that engage in interstate trade within the United States and have meat inspection (including all of the larger plants), carcasses are permitted to move on the rail past the inspectors up to the rate of 600 an hour. Packers who kill at a faster rate operate two separate chains on the killing floor.

Based on the experience in Canada, the United Kingdom, Denmark, the Netherlands, Sweden, and other western European countries, it appears that the weighing of carcasses within the plant would impose no mechanical or technological difficulty in packing operations in the United States. But it would require certain adjustments in the arrangement of operations on the killing floor.

GRADING

In the United States hog carcasses are not commonly graded as are beef, veal, and lamb carcasses. The carcass method of marketing would of course require that graders be placed inside the packing houses to grade carcasses, probably just after the killing and dressing operations have been completed and before the carcasses are moved into the coolers.

It has not been demonstrated how rapidly carcasses could be graded in this country. In Canada hogs can be graded at the rate of 500 to 600 an hour, but after an hour or two of continuous work the grader needs a few minutes rest.

In the United States, where carcasses in some plants move through the plant at speeds faster than 500 an hour, it may be necessary to have two graders working at the same time, each taking every other carcass. A third grader could be on hand to spell the other graders occasionally.

It would be essential that the carcasses be graded by impartial graders. Without absolutely impartial grading it would be more difficult to maintain the confidence of farmers in the carcass method over a wide area for any length of time. The use of uniform standards and uniform grading as the common denominator for hog carcass merit would also be needed to enable farmers to compare prices from different outlets over a wider area. Official graders are now available at many plants to grade beef, veal, and lamb carcasses. This service could be extended to include hog carcasses.

BY-PRODUCT CREDIT

In the usual packers' style of dressing hogs that is common in the United

States, the head, leaf fat, kidneys, and ham facings along with other valuable internal by-products are removed on the killing floor. Under current packing house practice these items do not comprise a part of the carcass and would not enter into the weight of the carcass on which the price and proceeds to the farmer would be based if the hogs were sold by carcass weight and grade.

Credit for the value of by-products is taken into account by the packer under the liveweight pricing system in the price he offers per 100 pounds liveweight. Under the carcass method, by-product credit would be considered in the price offered per 100 pounds carcass weight. As by-products are involved in both methods of sale, the principle would be the same under either system.

Most packers compute differential by-product credit for butcher hogs by weight groups. Under the carcass method additional by-product information would be needed for the different grades within weight groups. This additional information would also be required if hogs were to be sold on the liveweight and grade basis rather than by liveweight alone.

Data on the yields of heads, leaf fat, kidneys, and ham facings were obtained from 246 hogs included in the study. The analysis of these data indicated that the yields of these items varied somewhat with backfat thickness within weight groups.¹⁹ Table 14 shows the expected yields of these items at various backfat thicknesses for carcasses weighing from 145 to 155 pounds. Head weight tends to decline in relation to carcass weight as hogs become more highly finished. Leaf fat yields, as would be expected, increase with finish. Because leaf fat increases with fin-

¹⁹ The original analysis of the data on by-product credits was done by Arthur G. Wilson, research assistant, Department of Agricultural Economics.

Table 14. Relationship Between By-Product Weight and Percentage Yield* and Average Backfat Thickness, 57 Hogs, 145-155 Pound Packer Carcass Weight Group

By-product	Average backfat thickness in inches					
	1	1¼	1½	1¾	2	2½
	pounds					
Head	11.01	10.70	10.38	10.07	9.75	9.44
Leaf fat	3.18	3.83	4.47	5.12	5.76	6.41
Ham facings	1.16	1.16	1.16	1.16	1.16	1.17
Kidneys .....	.66	.63	.60	.57	.54	.51
Total	16.01	16.32	16.61	16.92	17.20	17.53
	per cent*					
Head	7.34	7.13	6.92	6.71	6.50	6.29
Leaf fat	2.12	2.55	2.98	3.41	3.84	4.27
Ham facings .....	.77	.77	.77	.77	.77	.77
Kidneys .....	.44	.42	.40	.38	.36	.34
Total	10.67	10.87	11.07	11.27	11.47	11.68

* Expressed as a percentage of packer carcass weight.

ish more rapidly than head weight decreases, the total weight of these by-products tends to be greater on more highly finished hogs than on less highly finished, leaner hogs. Ham facings and kidneys are minor items and make a relatively small contribution to the total weight of these four by-product items:

As would be expected, yields of these several by-products varied directly with carcass weight. But, on a percentage basis (which is equivalent to pounds of by-product per 100 pounds of carcass) by-product yields tended to decline with carcass weight. The percentage decline in head yields was most pronounced. Leaf fat yields increased, in percentage terms, with carcass

weight but not enough to offset the decreased percentage yield of heads.²⁰

Prices were applied to these items to ascertain the differential value contribution they made to the total value of the hog. Kidneys were priced at 18.4 cents a pound, leaf fat at 18.1 cents, ham facings at 14.5 cents, and heads at 12.7 cents.²¹ On the basis of these prices the average value contribution of by-product credits was \$1.64 per 100 pounds carcass weight. Within weight groups the by-product credit differential between grades was 5.7 cents per 100 pounds carcass weight. The more highly finished grades had larger by-product credits than the leaner under-finished grades.

²⁰ Regression coefficients in terms of percentage yields in relation to carcass weight were as follows:

Heads	-.021 per cent per pound carcass weight
Leaf fat	+.004 per cent per pound carcass weight
Ham facings .....	.000 per cent per pound carcass weight
Kidneys	-.001 per cent per pound carcass weight
Total	-.018 per cent per pound carcass weight

Only the regressions for heads and total by-products were significant at the 95 confidence level.

²¹ Prices used in this value determination were taken from *The National Provisioner*, September 23, 1950. Ham facings and leaf fat were priced on the basis of lard equivalents. Heads were valued on the basis of lard equivalents and meat yields from the several head components. Head component data were furnished by R. L. Fox, Farm Credit Administration, U. S. Department of Agriculture. A more complete discussion of pricing these by-product credits is available in *The Determination of By-Product Credits in the Marketing of Slaughter Hogs by Carcass Weight and Grade*, a thesis by Arthur G. Wilson, Department of Agricultural Economics, on file at the University of Minnesota Library, pp. 93-105, 1952.

By-product credit declined with added carcass weight, chiefly because of the decline in head yield. At 20-pound intervals in carcass weight, by-product credits declined at about the rate of 5 cents per 100 pounds carcass weight.

In all countries where the carcass method of marketing is used, payment is made to producers on the basis of the weight and grade of carcasses dressed shipper style. The shipper carcass is the entire body of the hog with blood, hair, and viscera removed. The packer style carcass, common in the United States, differs from the shipper carcass in that the head, leaf fat, kidneys, and ham facings are also removed. The relation of shipper carcass weight to packer carcass weight is shown in table 15.

This study has indicated that the percentage yields of head, leaf fat, kidneys, and ham facings varied according to grade within and between weight groups. In the case of each item, however, the proportion of variability which could not be accounted for by differences in backfat thickness or carcass weight was greater than the proportion of variability which was associated with differences in backfat and weight. Some of this variability may be associated with breed or type of

hog, sex, kind of feed, rate of growth, etc.

Observation of packing house operations suggests that some of the variability in yields of heads and ham facings may be the result of variation in cutting within the plant. The removal of these parts is subject to some cutting variations even if done by the same man on the same day. It might be more equitable to pay producers on the basis of shipper carcass weight as in Canada, the United Kingdom, Denmark, and other countries.

SETTLEMENT

When hogs are sold liveweight, settlement is usually made in full shortly after the animals are weighed. If sales are local or nearby shipments are consigned for sale through commission agents, the owner may deliver his hogs, see them weighed, and return home with the buyer's check in his pocket. If the owner does not accompany the shipment consigned to a commission agent, the check is mailed and may be received the next day.

Under the carcass method the hogs might be killed, the returns computed, and the check mailed on the day of delivery. The owner would receive his check in the mail the following day. If the hogs were killed on the day following delivery, or two days after delivery as would happen on Saturday deliveries, payment would be delayed an additional one or two days. And if the returns could not be computed on the day of slaughter, another day's delay would be involved.

Thus it appears that the payment might be delayed from one to four days depending on how quickly hogs can be slaughtered after delivery and the returns to the farmer computed by the packing company. Where hogs are purchased by order buyers for distant slaughtering plants 500, 1,000, or per-

Table 15. Relation of Packer Dressed Carcass Weight to Shipper Dressed Carcass Weight

Packer dressed carcass weight	By-product yield*		Shipper dressed carcass weight
	Per cent†	Pounds	
pounds			pounds
115	12.0	13.6	128.6
125	11.8	14.7	139.7
135	11.6	15.7	150.7
145	11.4	16.5	161.5
155	11.2	17.4	172.4
165	11.0	18.2	183.2
175	10.9	19.0	194.0
185	10.7	19.8	204.8

* Includes only head, leaf fat, kidneys, and ham facings.

† Expressed as percentage of packer dressed carcass weight, $Y = 14.07505 - .01836X$.

haps 1,500 miles away, payment would be delayed further by the time required to transport the hogs to the distant slaughtering plant.

Some farmers might object to the extra delay in payment involved in marketing hogs by carcass weight. In such cases, however, it might be possible to make an advance payment of from 75 to 90 per cent of the estimated value at time of delivery, and final payment of the remainder after slaughter. On the other hand many farmers are now members of dairy, poultry, grain, or wool cooperative marketing associations in which delayed payments of a few days to several weeks are not uncommon. In any event, it does not appear that the delay in payment would prevent the adoption of the carcass method if it were found to be otherwise desirable and practicable.

COSTS

Under the carcass method, some of the costs of marketing would be increased while others might be reduced. An additional operation would be tattooing the hogs. Weighing within the plant would require some changes by packers who do not now weigh hog carcasses. They would need to rearrange their lines on the killing floor and install scales capable of weighing carcasses at a rapid rate and automatically printing the weight on the scale tickets. Weighing would require one or two weighmasters, depending on whether single or double chains were operated.

If the carcass method replaced the liveweight method the weighmasters in the yards could be moved inside the plants. Additional weighmasters would probably be required under the carcass method. But net savings in labor might result for those packers who have

weighmasters operating in several shifts so that hogs can be received 24 hours a day.

The grading of carcasses, which is not required under the liveweight method, would be a necessary function under the carcass method. Regardless of whether it is performed at government expense or at the expense of the seller or of the buyer, grading is a cost that must be charged against the method of marketing by grade. It is probable that grading carcasses would involve less additional labor than grading live hogs. It would be relatively more simple to sort carcass tickets than to sort live animals and weigh them individually or by weight and grade groups in the yards.

The clerical work of maintaining records and calculating payments would be increased under the carcass method. The unit on which weight and price would be translated into returns to farmers would be the hog carcass, rather than a single scale draft of hogs as under the present method, or several drafts if sorted and sold in liveweight and grade groups.

The physical problem of maintaining identity and calculating and transmitting payments to farmers has been a manageable one in the Canadian experience. A number of packing plants in the United States are considerably larger than any in Canada. Keeping records on a large number of carcasses would pose a problem for them, yet solutions to new technological problems often follow the appearance of the needs.

Modern punch card computing methods are available which could take the grade and weight of each carcass, translate these into a price per hundred-weight and a total value for each carcass, sort out the cards belonging to each farmer and sum the various values, prepare an itemized statement of the number, weight, and value of

the carcasses in each weight group, and prepare the check for mailing to the farmer.

Once the information is transcribed from the scale card to the punch card and verified, the entire operation is either mechanical or electrical. Such machines are now in use by several large packers for the maintenance of personnel records and for payroll purposes and could be adapted to the task of calculating and preparing returns to farmers.

Some of the cost items of marketing hogs might be reduced under the carcass system. For one thing, the incentive to fill hogs excessively before sale would be removed. This would result in saving on feed costs, as feeding would be limited to an amount that would minimize losses from tissue shrinkage before slaughter.

The carcass method would facilitate the selling of hogs by description. It would not be necessary to inspect animals before they were sold in order to appraise their value. This should make it possible for packers to conduct their livestock procurement operations at less cost than under the present method. Sale by description would enlarge the market area over which bids could be obtained and tend to hold unnecessary transportation to a minimum.

If the carcass method would reduce marketing costs, it would be a clear gain. If marketing costs were increased, the added costs under the carcass method must be weighed against the gains that could be expected from the more effective allocation of resources as a result of the more accurate pricing inherent in the carcass method.

TIME AND LOCATION OF SLAUGHTER

Under the liveweight method of sale the producer retains title to the animals until they are sold and weighed

to the account of the buyer. Consequently, the producer is directly concerned with losses from death, bruising, crippling, and tissue shrinkage that may occur up to the time of weighing. The weighing may take place at a local market, at a public stockyards market, or upon arrival at a nearby or distant packing plant. The sooner the animals are weighed to the account of the buyer the less the risk of loss to the farmer, as the packer assumes the risk from the time the animals are weighed until they are slaughtered.

Under the liveweight system, losses that occur among hogs held over in packers' pens, or among hogs shipped from the corn belt markets to eastern packers or to west coast packers, usually are initially borne by the packers and are reflected in a lower price level to farmers. It is the packers' problem to determine the method of feeding and handling to minimize these losses.

Tissue shrinkage, bruising, death losses, high procurement costs, and other costs incurred in shipping hogs great distances for slaughter act as a force tending to pull livestock slaughter closer to the source of supply. The existing location of slaughtering plants and consumer preferences for freshly killed pork (much less now than several decades ago because of improvement in refrigeration, transportation, and methods of distribution) act as forces tending to pull slaughter closer to the more concentrated consumption areas.

But the overriding factor determining the location of slaughter is the freight rate structure, particularly the relation of rates on livestock to the rates on meat and meat products. If the freight charge per 100 pounds of live hog is less than the total charge on the meat and meat products processed from 100 pounds of live hogs, the freight rate structure tends to favor slaughter away from the source of

supply. Conversely, if the freight charge on live animals is higher than the charges for moving an equivalent amount of meat, slaughter closer to the source of supply is encouraged.

Under the carcass method, farmers would be paid according to the weight and grade of the carcasses. They would therefore be directly concerned with minimizing losses from death, bruising, crippling, and tissue shrinkage right up to the time of slaughter. The sooner the animals are slaughtered the less the loss. Consequently, the probable time of slaughter and methods of feeding and handling up to the time of slaughter would be taken into account by farmers or their agents in evaluating bids from different packers and from different areas.

The carcass method would be another force tending to pull slaughter somewhat closer to the sources of supply.²² This would tend to reduce the over-all losses from tissue shrinkage, death, and bruising. Any reduction in such losses would result in larger output of hog products for consumers.

MAINTAINING GRADE IDENTITY TO THE RETAIL COUNTER

One question that would arise under the carcass method of selling hogs would be that of the desirability and feasibility of maintaining the identity of the grade up to the retail counter. This has been accomplished quite successfully with beef carcasses. The official government grader stamps the

grade from end to end along the outer surface of the carcass by means of a roller. The grade is readily seen on most retail cuts. A consumer who wishes to buy a certain grade of beef, such as Good grade or Choice grade, can be sure that she is getting what she wants and pays for if it carries the official U. S. grade stamp.

The problem appears to be much more complicated in the case of hog carcasses. If the full carcass were stamped along the outer surface as is the case with beef carcasses, the stamp would be removed from most of the wholesale cuts when the carcasses were disassembled on the cutting floor or after curing. The skin is usually left only on the lower part of the hams and picnics and on the bacon sides. And much of the bacon now leaves the plant in sliced form with the skin removed.

If the cuts from all grades and weights of hog carcasses could be made equally acceptable to consumers simply by removing the excess exterior fat there would be little need for the grading to be carried beyond the carcass. But this does not appear to be the case. It is a relatively simple matter to remove the excess exterior fat from the ham of an overfat hog but it is not possible to remove the excess interior fat.

A housewife who pays a first grade price for a defatted ham from an overfat heavyweight hog naturally is keenly disappointed when the ham is opened on the kitchen table and found to contain an excessive amount of fat

²² A number of the west coast packers distributing meat to nearby, consuming centers have adequate local or nearby sources of supply for cattle and sheep, but not for hogs. In order to obtain the pork required to maintain the balanced line of meat products their clientele desires, they purchase hogs from the western corn belt for shipment to the west for slaughter. Sale on the carcass basis might tend to reduce this type of shipment. The pork they require could be slaughtered close to its origin, and purchased and shipped west in the form of dressed carcasses. Wholesale cuts would be processed from the carcass in the western plants. Hams and bellies would be cured. Sausages and pork products would be processed according to their own formula and merchandised under their own brand.

The expansion of what is now a relatively small trade in dressed pork carcasses at wholesale would reduce the tissue and bruising losses which are entailed in the shipment of substantial numbers of live hogs 1,800 to 2,000 miles to west coast slaughtering centers. When carcasses are graded, as they would be under the carcass method of sale, western processors will be able to specify the grade and quality of carcasses which yield the maximum of high quality pork cuts and minimum of surplus lard to a degree which is difficult to achieve in procuring live hogs through order buyers.

around the ham bone and among the muscle fibers. The problem is much the same with picnics, butts, and loins. Even less can be done to improve the condition of overfat bacon.

At the other extreme, some carcasses are so lean that they lack tenderness and flavor, although few hog carcasses presently produced in the United States are too lean.

Not enough is now known about consumer preferences to evaluate cuts from carcasses of the same weight but varying in the proportion of fat to lean. Sale of hogs on a carcass weight and grade basis would emphasize the need for research on consumer preferences. It is important that consumer preferences be known and properly reflected through the pricing system back to hog producers so that hog producers can more adequately supply consumer wants.

ACCEPTABILITY

Another important question associated with the carcass method of marketing hogs is that of its acceptability among hog producers and consumers of pork.

Farmers likely to be favorably disposed towards the carcass method would be those who produce superior rather than inferior animals. Under the present liveweight method farmers who offer superior animals for sale receive about the same price as those who offer inferior animals. Farmers with superior animals would receive more, farmers with inferior animals less, under the carcass method than under the present liveweight system.

If the carcass method made it possible for consumers to make their purchases of pork more wisely, and to reflect their preferences more effectively

back to hog producers than under the liveweight system, it would be a distinct gain. The increase in consumer demand for official U. S. graded beef suggests that they would also favor improved grading of pork.

Experience in other countries may throw some light on the question of acceptability of the carcass method in the United States. In Canada, the program of selling hogs by grade was initiated by the Dominion government in 1922. That year it required all slaughter hogs to be sold by liveweight and grade. Hogs were graded by government officials at specified points. When buying in the country, the dealers were required to grade the hogs and pay by grade.

A farmer who sold to a local dealer later received a grade report from the official grader so that he could compare the official grading with the grading on which he was paid. Arguments frequently arose over the accuracy of the live grading and could only be settled by examining the carcasses. In other words, the grade of the carcass was the criterion by which the accuracy of the live grading was measured.

In 1934 two packing plants in eastern Canada began to buy hogs by carcass weight and grade on an optional basis. This plan was soon made available at other plants, and an increasing number of farmers were attracted to it. In 1940, the Dominion government made the carcass weight and grade method the official method of marketing hogs throughout the country and this method has since been in operation.

British²³ experience with the carcass grade and weight method of marketing hogs began with the adoption of the Pigs Marketing Scheme in 1933. This was a sharp break with long established practice. Farmers had been ac-

²³ The following discussion of the acceptability of the carcass method of marketing hogs in the United Kingdom and in western Europe is based on conferences during the summer of 1950 between A. A. Dowell and hog producers, farm organization officials, college and experiment station workers, hog slaughterers, and others in the various countries.

customed to selling their slaughter hogs by the head to local dealers at the farm or at the many local auction markets scattered throughout the country. Relatively few hogs were sold by liveweight as in the United States. The new carcass system involved moving all at one time from the antiquated method of sale by the head to the more precise carcass weight and grade method.

Many farmers approved and vigorously supported the plan from the beginning because they thought it was in the farmers' interest to be paid for the actual weight and grade of product delivered. Other farmers objected at first. Practically all auction market operators were opposed to it and encouraged farmers to oppose it.

Slaughterers generally supported the plan because they believed it would lead to increased hog production and more uniform supplies of good quality bacon hogs. Most of the slaughtering plants in the United Kingdom are privately owned. There are few cooperatively owned plants in the country.

The farmers who opposed the plan did so chiefly because it involved such a sharp break with long established custom. This was especially true in areas remote from the slaughter houses and in areas where few hogs were raised. For example, farmers in North Ireland rather generally objected to payment on the carcass weight and grade basis. At first, they agreed to sell by live grade and weight but with a bonus for quality as determined on the rail.

Later they agreed to sell on the basis of carcass grade and liveweight, the liveweight being converted to a carcass basis by means of a uniform con-

version factor. There was much dissatisfaction with this hybrid method because of variations in the amount of fill of pigs from different farms and variations in the actual yield of hogs that had been fasted for the same length of time. It was not possible to estimate accurately the yield of hogs on the hoof.

In 1939, after 6 years' experience, first with the live grade and weight method, and then with the liveweight and carcass grade method, the farmers of North Ireland shifted over to the carcass weight and grade system.

In 1946 a vote was carried out among National Farmers' Union²⁴ members in England and Wales to determine whether they would prefer to market their hogs under the carcass system alone, or under the liveweight method alone, or have the privilege of marketing under either method on an optional basis. Farmers near the packing plants were distinctly in favor of the carcass method, those further away less favorably disposed. About 65 per cent of the country branches of the National Farmers' Union favored the carcass weight and grade method, and producers of a majority of the hogs favored it. A few farmers expressed the view that it might be desirable to make both the live and carcass methods available on an optional basis until all farmers were convinced of the merits of the carcass method.

The great majority of spokesmen for all segments of the swine industry in the United Kingdom say there is no expectation that the farmers of the United Kingdom will return to the sale of slaughter hogs on a live basis. They are almost unanimous in the view that

²⁴ According to the National Farmers' Union of England and Wales, there are only about 300,000 farms in England and Wales, and only about 227,000 of these are large enough to be considered commercial farms. The operators of 203,000 of these commercial farms were members of National Farmers' Union of England and Wales in 1950. The National Farmers' Union of England and Wales represents and speaks for the farmers of England and Wales in all matters with which the farmers and government need to reach an agreement. The same is true of the Scottish Farmers' Union and of the North Ireland Farmers' Union.

"As the ultimate value of a pig depends primarily on the weight and grade of the meat which it produces, it follows that the fairest basis on which to pay producers is by dead weight and carcass grading."²⁵

The Danes have had the longest experience of any people with the carcass method of marketing. In Denmark all references to the weight of a slaughter hog are in terms of the weight of the carcass rather than in terms of liveweight.

There were 81 slaughter plants in Denmark in 1950, and 62 of these were cooperatively owned. The cooperatives slaughtered 88 per cent of all hogs slaughtered in 1949. The slaughterers are strong supporters of the carcass method. They say it is clearly the fairest method of payment to producers.

To get first-hand information on hog marketing in Denmark and on the acceptability of the carcass method among Danish farmers, one of the authors of this bulletin accompanied a trucker on two of his regular pickup trips for a representative packing plant in the province of Zealand, Denmark. Stops were made at ten farms. Eight of the ten farmers said they preferred the carcass method of sale to the liveweight method. They thought it was the fairest for all because each farmer was paid according to the product actually delivered. One farmer expressed no opinion, while one said he would prefer to sell by liveweight.

None of these men objected to the delay of two to four days in settlement on the carcass basis. They said they were accustomed to some delay in payment for products marketed through other cooperative organizations. The attitude of these ten farmers was said to be quite representative of all Danish farmers.²⁶

The situation in the Netherlands, Sweden, and Norway is much the same as in Denmark. Hogs are sold by the carcass method, and most farmers prefer this method to selling their hogs by liveweight.

Every country that has made a serious effort to sell hogs according to the value of the meat and other products yielded has sooner or later shifted to the carcass method of sale. In some cases the shift has been made directly from sale by the head or by liveweight as in England and Denmark. In others it has followed an intermediate step involving sale by liveweight and grade or some hybrid between the on-foot and carcass methods as in North Ireland and in Canada. The carcass method was found acceptable by farmers who produce most of the hogs in these countries.

IMPROVED CARCASS STANDARDS

It is not to be inferred that the objective carcass grade standards referred to in this bulletin are the best that can be produced. They do make it possible to pay hog producers more nearly according to the actual value of the product delivered than can be done when hogs are marketed on foot. Nevertheless, the gap between estimated carcass value and the actual cut-out value has not been completely closed.

It is to be expected that additional research will make it possible to narrow this gap still more. It may be found that some objective measure or measures in addition to backfat thickness and carcass weight, or that a combination of objective and subjective factors, will provide a more accurate criterion of carcass merit.

²⁵ Pigs Marketing Board, *Policy for Pigs*. Penrhos College, Colwyn Bay, N. Wales. p. 3. December, 1945.

²⁶ This view was expressed by Dr. Hjalmar Clausen, Director of Progeny-Testing Swine for Denmark, by several packers, and by government officials.

Summary

A BASIC PROBLEM in marketing butcher hogs in the United States is that, within the same weight group, hogs usually sell at about the same price a hundredweight at given markets. Because little attention is given to quality in pricing hogs, producers have little incentive to improve the hogs they bring to the market place.

In searching for a more equitable system of pricing hogs, Canada and western European countries have adopted the carcass weight and grade method of marketing. Until recently, satisfactory hog carcass standards were not available in this country. Since World War II, however, several hog carcass standards, based largely on objective specifications of backfat thickness and carcass weight, have been developed which would make possible the marketing of hogs by carcass weight and grade in the United States. These carcass standards may also provide the basis for live butcher hog grade standards which might be used for marketing hogs by liveweight and live grade.

The primary objectives of this research are to compare the pricing accuracy of the present liveweight method, a possible improved liveweight and grade method, and the carcass weight and grade method of marketing hogs. Relationships between carcass yield and weight and grade are also explored. The influence of weight and grade on by-product credits is examined. Some of the possible gains and problems associated with the carcass method of marketing in this country are discussed.

Data were obtained on 32 lots of 5 to 10 hogs each at the Geo. A. Hormel and Co. plant at Austin, Minne-

sota, in July 1949. The lots were randomly selected from hogs delivered to the plant by farmers living within 25 miles of the plant. Detailed on-foot carcass, and cut-out information was obtained on each of the 219 hogs in the 32 lots. Each hog carcass was cut separately into its several wholesale cuts and trimmings and cut-out values were ascertained for each hog and for each lot on the basis of wholesale prices at Chicago for June 29, 1949.

Lot cut-out value was used as the criterion of pricing accuracy for the several methods of marketing hogs. The difference between cut-out value and price for any given lot under any marketing system was considered to be a pricing error.

The pricing accuracy of different marketing methods were compared when price was based on (1) the average liveweight of each lot, (2) individual liveweight of each hog in the lot, (3) liveweight and estimated yield and carcass grade of each hog, (4) liveweight and adjusted estimates of yield and carcass grade of each hog, (5) liveweight and live grade of each hog, (6) liveweight and live grade with perfect grading assumed, and (7) individual carcass weight and grade.

The usual method of selling hogs on the basis of a flat price according to the average weight of the lot (1)²⁷ results in a certain amount of variability of cut-out values above and below prices paid. This variability is a measure of the pricing error. The smaller the variability the more accurate the pricing method. The pricing accuracy of the other marketing methods were all compared with the accuracy of the average

²⁷ Numbers in parenthesis refer to marketing methods listed in the preceding paragraph. These methods are also shown in table 12.

weight method. This was the least accurate of all methods in pricing hogs according to cut-out value.

All of the lots in this study included hogs that weighed either more than the upper limit or less than the lower limit of the weight group in which they were sold. When each hog in the lot was priced according to its own weight (2) the variability of cut-out values above and below prices for the lots was reduced by about 16 per cent below that of the usual liveweight method. This represents a slight improvement in pricing accuracy.

Another method of pricing involved an estimate of the carcass yield and carcass grade, based on backfat thickness, of each hog in the lot (3). This method reduced the variability of pricing errors by 15 per cent, about the same as the individual liveweight method.

In estimating carcass yield and carcass grade the buyer overpriced the value of the entire sample of 219 hogs by 21 cents per 100 pounds liveweight. This overpricing resulted from a tendency to overestimate yield and underestimate backfat thickness. Inasmuch as it is probable that with more experience the buyer would be able to estimate the average value of a large number of hogs more closely, the prices were adjusted by 21 cents so that his estimated total value equaled the total cut-out value of the 219 hogs. When this was done the pricing error was reduced 38 per cent below that of the usual liveweight method.

In recent years considerable interest has developed in the possibility of marketing hogs by live grade (5), a pricing system that gives no consideration to variations in carcass yield. When this method was tested the buyer graded 56 per cent of the hogs correctly and the pricing error associated with the usual liveweight method was reduced by about 43 per cent. This represents

a greater improvement in accuracy than was realized when both grade and yield were estimated. In order to test the ultimate improvement conceivable under a live grade buying method, it was assumed that all hogs were graded correctly by the buyer (6). Under this assumption of perfect grading (according to the carcass standard) the variability of pricing error was reduced by about 53 per cent from that for the usual liveweight method based on average weight. This improvement is greater than could be expected from a live grading method of pricing, since perfect live grading is not likely to be achieved.

The carcass weight and grade method of pricing (7) was by far the most accurate of any system studied. Under this method the variations in carcass yields do not affect the returns to the farmer. And the quality of the carcass can be ascertained more accurately on the rail than on the live hog. The carcass weight and grade method eliminated 82 per cent of the variability of cut-out values above and below prices paid that is associated with the usual liveweight method of marketing.

The variability of cut-out values about prices paid under the carcass method, which was 18 per cent of the variability under the present liveweight method, is due to the remaining variation of values within carcass grades. This variability could be completely removed only by determining the cut-out value separately for each lot, which would not be practical under usual packing house operations.

The carcass method of marketing is a system of pricing hogs individually. This is important because most farmers' lots of hogs contain hogs of more than one grade. If the farmer knows how many hogs were sold in each grade, he will know the extent to which he will need to change his breeding and management practices to get

more hogs in the more desirable grade categories. Under the carcass method of marketing farmers could compare carcasses of hogs from different sows or different boars, or from different breeds or crosses.

Pricing errors would be greater for individual hogs than those shown for lots. Errors in estimating yields, grades, and values of individual hogs tend to cancel out to some extent in lots.

Returns to producers would be distributed differently under the more precise carcass method of pricing. Farmers marketing the more valuable hogs would receive more, and those selling less valuable animals would receive less than under the present system where hogs below average are carried along at the same price as hogs above average. Farmers would have a greater incentive to produce the kind of hogs and pork consumers desire. More of the high value pork cuts and less low value lard could be produced from the same amount of corn and other feed resources. The productive resources of agriculture would be more effectively allocated to satisfy consumers' wants.

Several other improvements would be associated with the carcass method. Sale by description would be facilitated since carcass prices by grades would provide a more accurate language for price quotations. Any incentive to fill

animals excessively before they were sold would be completely removed and the expense of such feed saved.

Bruising and disease loss prevention programs could be carried on more effectively because the carcasses would be identified. The more accurate pricing method would provide a more clearly defined objective for research in animal genetics, animal nutrition and consumer preferences.

Several practical problems involved in carcass selling must be considered. Hogs would have to be tattooed. The weighing and grading of carcasses would require some adjustments within the packing plant. The carcass method of payment would entail some delay in settlement. The clerical task of maintaining records and calculating payments would be increased. It is not likely, however, that many of these problems would be serious limitations if the carcass method were considered desirable for other reasons.

This study did not attempt to measure the net effect the carcass method would have on over-all marketing costs. If marketing costs were reduced, the shift to the carcass method would represent a clear gain. If marketing costs were increased, the added costs under the carcass method must be weighed against the gains that could be expected from the more accurate pricing in the carcass method.

Appendix A

THE EFFECT OF WEIGHT AND GRADE ON CARCASS YIELD²⁸

PREVIOUS SECTIONS of this study indicated that it is exceedingly difficult to estimate carcass yields with

sufficient accuracy to improve appreciably the pricing accuracy of on-foot methods of marketing butcher hogs. This raises the question as to some of the factors which might be associated with carcass yields.

²⁸ This section is based largely on an analysis of the original data by Richard R. Newberg, research assistant, Department of Agricultural Economics.

The carcass yields of butcher hogs increase with weight. Packers calculate their own so-called standard yields for each weight group of hogs in which they are conducting trading operations. These standard yields may change from season to season and may vary from region to region and market to market. But within any particular season or at any market, the standard yields for the heavier weight groups are always higher than those for the lighter weight groups.

Within weight groups it has been generally assumed that more highly finished, fat hogs have a higher carcass yield than the less well finished, leaner animals. Since grading live hogs according to finish categories has not been done extensively in this country, little information has been available as to the extent to which carcass yield varies with carcass grade. This section of the study is intended to provide some information on this problem.

Barrows and Gilts Combined

Data from 265 individual hogs gathered in connection with this study were analyzed to determine the influence of weight and grade on carcass yield. These data were collected at one packing plant during only one three-week period and should therefore be interpreted with caution. Although the yields might differ from season to season, region to region, and market to market, the relationships shown here between weight and grade and carcass yield should be indications of results which might be obtained elsewhere.

The expected carcass yields for different liveweight groups and live grades are presented in table 16.²⁰ With-

Table 16. Expected Carcass Yields of Butcher Hogs at Specified Live Weights and Live Grades

Live-weight group	Average weight	Live grade			
		8	9	10	11
pounds	pounds	per cent	per cent	per cent	per cent
180-200	190	67.96	67.08	66.20	65.32
200-220	210	68.63	67.74	66.85	65.96
220-240	230	69.31	68.41	67.51	66.61
240-270	255	70.18	69.27	68.36	67.45

in the same grade, carcass yields increased about 0.3 per cent with each 10 pounds of additional liveweight. Within the same weight range the fatter butcher hogs outyielded the leaner hogs by about 0.9 per cent per grade.

The relationships shown in this table have rather important implications in pricing hogs on a live grade basis. Leaner carcasses are more valuable (up to a certain point, at least) than the more highly finished, fat carcasses. In terms of liveweight price, however, the value advantage of the leaner carcasses is partially offset by the fact that the more highly finished hogs tend to have higher carcass yields. The following illustrates this point:

	Grade		Price differential
	9	10	
Carcass price per hundredweight	\$29.00	\$30.00	\$1.00
Average carcass yield	68.9%	68.0%	.....
Liveweight value per hundredweight	\$19.98	\$20.40	0.42

The \$1.00 price differential between grade 9 and 10 carcasses on the carcass weight and grade basis becomes a 42 cent differential when converted to liveweight and grade terms. If the grade 9 hogs would yield the same as the grade 10 hogs, the differential between live grades would have been 68

²⁰ These liveweight data were converted from a carcass weight table derived from multiple regression analyses. Carcass weight and the percentage of four lean cuts (a 3 per cent range is equivalent to one grade) were related to carcass yield. These two factors, carcass weight and percentage of four lean cuts, accounted for 41 per cent of the variability of carcass yield. On carcass weight data the linear regression of yield on carcass weight was .0445 while the linear regression of yield on per cent lean cuts was $-.2690$.

cents. The higher yield of the grade 9 carcasses partially compensates for the greater value of grade 10 carcasses.

Under the carcass method of pricing farmers would soon learn to make their production and marketing decisions in terms of carcass weights and grades and carcass prices as they now do in Canada and western European countries. The carcass method would offer more effective price incentives to farmers to change production methods and market more desirable animals than would be available under a live grade pricing system, because of the value-compensating role which carcass yield plays in live grade price determination.

Barrows vs. Gilts

Of the 265 individual butcher hogs on which data were analyzed in this section of the study, 119 were barrows and 147 were gilts. On the basis of over-all averages the 119 barrows out-yielded the 147 gilts by about 0.3 per cent. The higher yield of barrows was explained largely by the fact that the barrows in this sample tended to be somewhat fatter than the gilts. The barrow and gilt data were analyzed separately to determine if the relationship between weight and grade differed appreciably by sex. Table 17 presents the findings of the analysis of carcass yields of barrows and gilts by weight and grade.

The data in table 17 indicate that carcass weight seemed to have a more pronounced effect upon the carcass yields of gilts than of barrows. Within grade group, carcass yields of heavier hogs, both barrows and gilts, were

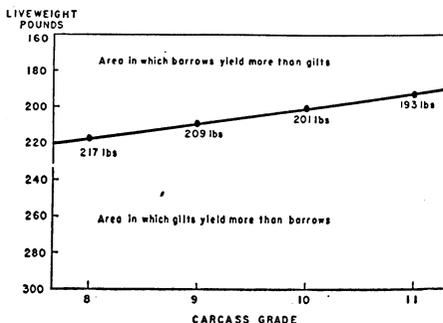


FIG. 13. The diagonal line indicates the weights and grades of hogs for which barrows and gilts would be expected to have identical carcass yields. Within the same grade, barrows tend to outyield gilts at lighter weights, while gilts tend to outweigh barrows at heavier weights.

greater than those of lighter hogs. But carcass yields for barrows increased, with increased weight, at a rate one-third less than that for gilt carcass yields. At heavier weights gilts out-yielded barrows. At lighter weights barrows outyielded gilts. These tendencies are illustrated in figure 13. The line running diagonally across the diagram indicates the weight and grades of hogs for which barrows and gilts would on the average have identical carcass yields.

To a somewhat lesser extent, added finish or condition within weight groups seemed to affect the carcass yield of barrows more than it did the yield of gilts. At the same weight the more highly finished hogs of both sexes out-yielded the less highly finished leaner hogs. With added finish, however, carcass yields of gilts increased at a rate about one-seventh less than did the yields of barrows.

Table 17. Expected Carcass Yields of Barrows and Gilts at Specified Carcass Weights and Grades

Carcass weight			Carcass grade											
			8			9			10			11		
Range	Average	Equivalent live-weight range (approximate)	Barrows	Gilts	Difference*	Barrows	Gilts	Difference*	Barrows	Gilts	Difference*	Barrows	Gilts	Difference*
pounds	pounds	pounds	per cent											
120-140	130	182-210	68.12	67.79	+.33	67.26	67.06	+.20	66.41	66.34	+.07	65.56	65.61	-.05
140-160	150	210-237	68.83	68.85	-.02	67.98	68.13	-.15	67.12	67.40	-.28	66.27	66.68	-.41
160-180	170	237-263	69.55	69.91	-.36	68.69	69.19	-.50	67.84	68.46	-.62	66.98	67.74	-.76
180-200	190	263-288	70.26	70.98	-.72	69.41	70.25	-.84	68.55	69.53	-.98	67.70	68.80	-1.10

* A + sign indicates that barrows outyielded gilts; a - sign indicates that gilts outyielded barrows.

Appendix B

Table 18. Wholesale Prices of Pork Cuts at Chicago, June 29, 1949*

Wholesale cuts	Price per cwt.	Wholesale cuts	Price per cw
Skinned hams		Bellies	
10-12 lbs.	\$50.25	6- 8 lbs.	\$31.00
12-14 lbs.	50.25	8-10 lbs.	31.00
14-16 lbs.	50.25	10-12 lbs.	30.50
16-18 lbs.	50.12	12-14 lbs.	29.75
18-20 lbs.	49.50	14-16 lbs.	28.62
20-22 lbs.	47.00	16-18 lbs.	25.37
Loins		18-20 lbs.	24.50
8-12 lbs.	47.00	Regular trimmings	
12-16 lbs.	43.25	(50 per cent lean)	13.12
16-20 lbs.	35.25	Lard, loose	10.87
Picnics		Fat (lard x 80 per cent)	8.70
4- 6 lbs.	35.00	Jowl butts	15.25
6- 8 lbs.	33.63	Spare ribs	
8-10 lbs.	28.50	Under 3 lbs.	39.25
10-12 lbs.	27.00	3-5 lbs.	34.75
Boston butts		5 lbs. and over	25.25
4- 8 lbs.	40.25	Neck bones	13.12
8-12 lbs.	32.50	Front feet	4.25
		Hind feet	2.50
		Tail	13.12

* *The National Provisioner*, June 29, 1949.

Table 19. Comparison of Estimated and Actual Carcass Yields, 32 Lots Including 219 Butcher Hogs

Lot number	Estimated carcass yield	Actual carcass yield	Estimating error
		per cent	
1	68.6	68.4	+ .2
2	69.1	70.5	-1.4
3	68.0	66.2	+1.8
4	69.0	67.0	+2.0
5	68.8	66.9	+1.9
6	69.0	68.0	+1.0
7	67.5	67.3	+ .2
8	67.3	67.5	- .2
9	68.1	67.9	+ .2
10	69.1	69.0	+ .1
11	65.9	66.9	-1.0
12	68.5	70.4	-1.9
13	68.5	67.1	+1.4
14	66.6	66.7	- .1
15	67.9	68.9	-1.0
16	66.6	67.5	- .9
17	65.8	65.5	+ .3
18	67.4	66.5	+ .9
19	67.6	66.7	+ .9
20	68.6	68.8	- .2
21	69.4	71.0	-1.6
22	67.3	66.1	+1.2
23	67.7	69.1	-1.4
24	68.1	67.0	+1.1
25	67.0	65.0	+2.0
26	67.8	67.4	+ .4
27	68.2	66.5	+1.7
28	67.6	65.0	+2.6
29	67.6	68.2	- .6
30	67.9	67.4	+ .5
31	68.5	69.8	-1.3
32	67.5	69.3	-1.7