VARIATION IN LABOR EFFICIENCY AND SELECTED COSTS AMONG VIRGINIA MEAT PACKING FIRMS

by

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INTRODUCTION

There were 46 firms in the Virginia meat packing and processing industry in 1955, each slaughtering over 300,000 pounds of liveweight annually. There was no change in the number of firms from 1955 to 1958 when, collectively, these firms employed 3,572 individuals with a payroll of approximately 14.5 million dollars. In 1960 labor costs made up approximately 51 percent of operating (this excludes animal purchases) expenses in the meat packing industry. 1/

In 1960 there were only 42 Virginia packing and processing plants slaughtering over 300,000 pounds of liveweight annually. 2/ Twelve of these were under Federal inspection. Of the non-Federally inspected plants, 11 slaughtered over two million pounds. Twelve of the plants slaughtered all species of animals and 16 slaughtered cattle, calves, and hogs only. There were two that slaughtered cattle and calves only, and four that slaughtered only cattle, calves, sheep, and lambs. Eight plants slaughtered hogs only. 3/

In 1960 Virginia packers slaughtered approximately four times as many hogs as were marketed in Virginia (Table 1). This slaughter represented an estimated 95 percent of pork consumption in the state. 4/

1/ Financial Facts About the Meat Packing Industry, The Department of Marketing, American Meat Institute, Chicago, Illinois, 1960, page 3.
2/ Ibid., page 27.
3/ Number of Livestock Slaughter Plants, United States Department of Agriculture, Agricultural Marketing Service, August 1960, page 7.
4/ Percentages estimated from data in Stout, R., et.al., Marketings, Slaughter, and Consumption in the South, Southern Cooperative Series Bulletin No. 66, (processed); and Livestock and Meat Statistics, United States Department of Agriculture, Agricultural Marketing Service, June 1961.

In 1960 cattle slaughter in Virginia was approximately 55 percent of cattle marketings, and calf slaughter approximately 85 percent of marketings (Table 1). The cattle slaughter represented an estimated one-third of the beef consumed in Virginia. 1/ Calf slaughter represented an estimated 300 percent of calf consumption. 1/

Although there was a decrease in the number of packing plants from 1955 to 1960, total volume increased. The increase during the five-year period was confined to hog slaughter which increased by approximately 700,000 head. Cattle and calf slaughter decreased during the same period after a large increase from 1950 to 1955 (Table 1).

Table 1. Number of Hogs, Cattle, and Calves Slaughtered and Marketed, Virginia, 1950-55-60. a/

Year	Hogs		Cattle		Calves	
	Marketings	Slaughter	Marketings	Slaughter	Marketings	Slaughter
	Number of head (in thousands)					
1950	518	1084	127	94	261	150
1955	479	1473	260	175	327	241
1960	587	2101	290	160	256	221

a/ Livestock and Meat Statistics, United States Department of Agriculture, Agricultural Marketing Service, Washington, D.C., 1960 and earlier.

1/ Ibid.

Table 2. Number and Percentage Changes of Meat Packing Plants by Type, United States, 1950-55-60. a/

Type of plant	Meat packing plants			Percentage change	
	1950	1955	1960	1955-60	1950-60
	--------Number---------			-------Percent-------	
Federally Inspected	441	455	530	+ 16.5	+ 20.2
Wholesale b/	725	952	902	- 5.3	+ 24.4
Local c/	2,072	1,810	1,712	- 5.4	- 17.4
Total	3,238	3,217	3,144	- 2.3	- 2.9

a/ Number of Livestock Slaughter Plants, United States Department of Agriculture, Agricultural Marketing Service, August 1960 and earlier.
b/ Non-Federally inspected plants slaughtering over two million pounds liveweight annually.
c/ Non-Federally inspected plants slaughtering less than two million pounds but more than 300,000 pounds liveweight annually.

Table 3. Number of Meat Packing Plants by Type and Percentage Changes, Virginia, 1950-55-60. a/

Type of plant	Meat packing plants			Percentage change	
	1950	1955	1960	1950-55	1955-60
	--------Number---------			-------Percent-------	
Federally Inspected	9	9	12	0	+ 33.33
Wholesale b/	12	12	11	0	- 8.33
Local c/	25	25	19	0	- 24.00
Total	46	46	42	0	- 8.70

a/ Number of Livestock Slaughter Plants, United States Department of Agriculture, Agricultural Marketing Service, August 1960 and earlier.
b/ Non-Federally inspected plants slaughtering over two million pounds liveweight annually.
c/ Non-Federally inspected plants slaughtering less than two million pounds but more than 300,000 pounds liveweight annually.

Because of changing economic forces, the number of packing and processing firms decreased during recent years in both the United States and Virginia. This decrease was in plants not under Federal inspection. The number of firms under Federal inspection increased in both the United States and Virginia (Tables 2 and 3). This increase means a wider area of competitive influence since Federally inspected firms can sell outside state boundaries.

Virginia packers are in direct competition with national and other Federally inspected packing firms. Virginia packers buy livestock (expecially hogs and fed cattle) from other areas in competition with firms in these areas. Virginia packers also sell in competition with Federally inspected plants located in other states. These out-of-state packers sell at least two-thirds of the beef consumed in Virginia and a substantial portion of the pork.

Virginia packers have vast resources at their command. These resources must be efficiently employed if Virginia packers are to compete with Federally inspected plants selling in Virginia. The reason is that Virginia packers, except for differentiated products, can sell their products only at a price equal to or less than that price at which competing packers are willing to sell. They must, then, operate on the margin between the cost of livestock and the selling price as set by competition. It is, thus, absolutely essential that Virginia plants be as efficient as their competitors if Virginia firms are to maintain their relative position in the meat packing

industry. They must become more efficient relative to their competitors if they are to improve upon their relative position.

Increasing the efficiency 1/ with which resources at the command of Virginia packers are employed is important to the entire Virginia livestock economy; because in a competitive industry such as meat packing and processing, consumers and producers (farmers) eventually reap part of the benefits from an increase in efficiency. These benefits come in the form of price changes and/or improved services.

In a perfectly competitive industry, a reduction in marketing margins 2/ permits either lower prices to consumers and/or higher prices to producers; improved service to consumers and/or producers; or a combination of both. The value of the change will equal the original decrease in marketing margins. The price and/or service changes tend to increase production and consumption, both of which affect Virginia's livestock economy.

Assuming a perfectly competitive equilibrium, a reduction in marketing margins will be divided between producers and consumers according to the relative elasticities of their supply and demand

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1/ Efficiency is defined as the ratio of the output of meat and meat products to the cost of inputs of productive resources employed by a packing firm.

2/ Marketing margin is the difference between the price per pound the consumer pays and the price the farmer receives for an equivalent quantity of live animal.

curves. 1/ If the consumers' demand curve is more elastic than the producers' supply curve, the producers will profit more from a reduction in the marketing margin. (The consumers would profit more from a margin reduction if the producers' supply curve were more elastic than the consumers' demand curve.) Packers also will receive relative benefits by maintaining their relative position within the industry.

The immediate benefit of an increase in the efficiency with which resources are employed in the Virginia meat packing industry will, however, be received by the packers; thus improving their relative position. This is true because of the time it takes for a large number of packers to adopt increases in efficiency and thereby apply competitive pressure to force savings back to producers and forward to consumers. Virginia packers will derive full benefits from an increase in efficiency until other Federally inspected plants change their operation or until Virginia packers expand considerably in hog and/or beef slaughter.

How the benefit from an increase in efficiency is shared is of minor importance to the productivity of the nation. 2/ What is most

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1/ The assumption of perfect competition is made only to illustrate the direction of benefit flow. It is realized that the meat packing industry is not perfectly competitive and that packers will maintain part of the benefit depending upon the amount of product differentiation they are able to accomplish.

2/ It is recognized that welfare considerations may be involved in a reallocation of resources, but these will not be considered here.

important from the firm's standpoint is that margins be reduced, where possible, in order that it may realize returns from a more efficient employment of its resources. Saving one unit of a resource permits the employment of this resource to increase production in the plant where saved, or releases the resource for use in another plant. Either results in an increase in national output equal to the productivity of the unit in its new use.

Problem and Hypothesis

In 1960 operating expenses in the national meat packing industry advanced to a record total of approximately 3.4 billion dollars. 1/ Raw material costs were down slightly due primarily to low livestock prices. Wages and salaries, which have doubled since 1947, accounted for 51 percent of operating expenses. With increasing costs occurring in the industry, firms are finding it necessary to reallocate resources in response to changing resource price ratios. Some of the larger organizations have made physical and personnel changes or additions to improve their efficiency; thus increasing the competitive pressure on inefficient, high-cost firms.

The effect of a reduction in cost by a firm, or group of firms, on other firm(s) and the long run implication of such action is discussed in subsequent paragraphs and is illustrated in Figure 1.

1/ Financial Facts about the Meat Packing Industry, op. cit., inside front cover page.
This was also a high for the 14 year period, 1947-1960, when actual dollars were deflated by the wholesale price index (1947-1949 = 100).

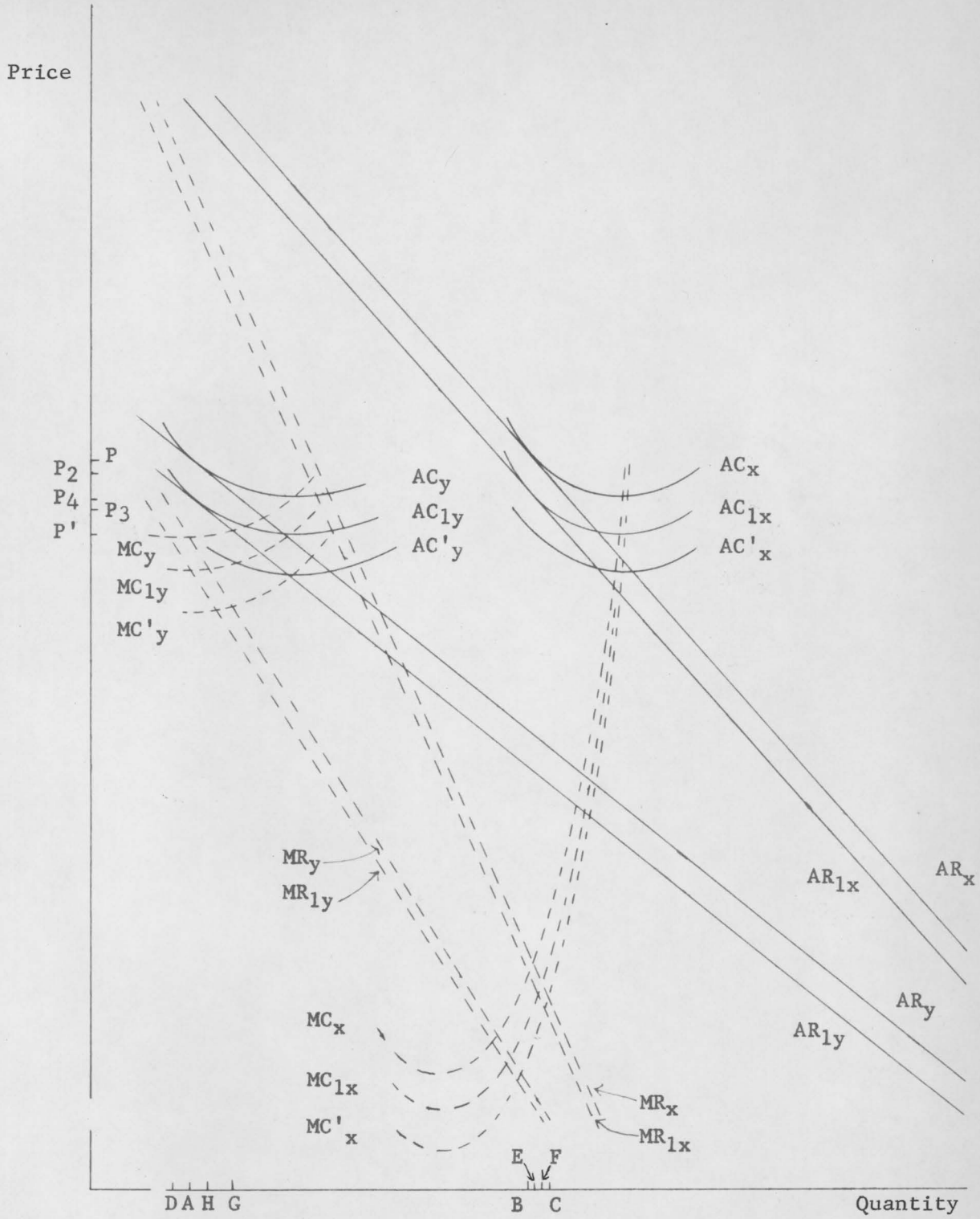
Price
P2
P
P4
P3
P'
ACy
AC1y
AC'y
ACx
AC1x
AC'x
MCy
MC1y
MC'y
MRy
MR1y
AR1x
ARx
ARy
AR1y
MCx
MC1x
MC'x
MRx
MR1x
E
F
D A H G
B C
Quantity

Figure 1

Given two firms, x and y, in industry equilibrium where x represents a larger packer than y, one can show the effect that a reduction in cost by one packer will have on the other. The demand curves for the two firms are AR_x and AR_y respectively.

It is by no means suggested that the demand and cost curves of the two packers actually have the elasticity so indicated. The slopes of the curves are for convenience of illustration. The type of competition assumed in the discussion is monopolistic competition with free entry. No one meat packing firm is thought to be large enough to have much of an effect upon the market for most of its product for a prolonged period of time. In addition it is considered very difficult to differentiate fresh meat which is a major portion of the output of nearly all meat packing firms. It is suggested, however, that the larger packer has a more inelastic demand curve because it sells a more fully identified product. The marginal revenue curves are MR_x and MR_y for the larger and smaller packer respectively. The marginal and average cost curves are labeled in a similar manner.

It is not suggested that the cost curves are identical throughout their range for different sized plants; but rather that they will, of necessity, be very similar within the relevant range of operation. The reason is that if the cost curves differed greatly, the high cost firms would not be able to remain in business. This is consistent with the theory of monopolistic competition where firms with free entry in equilibrium operate where the average cost curves are

tangent to their demand curves, and where the demand curves are very elastic. The high elasticity limits the success which inefficient firms may have by increasing price to maintain returns to the firm. For these reasons the similar cost curves are used in the illustration. With the above cost and revenue curves, the two firms are in equilibrium with firm x producing quantity OB and firm y producing quantity OA. The equilibrium price is OP.

Assuming that firm x lowers its cost curves to AC'_x and MC'_x, the following adjustments will take place. At the moment firm x lowers its cost, it will be making pure profits of P'P per unit of output. At this time, firm x is not equating marginal revenue and marginal cost, thus, not maximizing profits. In order to equate marginal revenue and marginal cost, firm x will attempt to increase output to quantity OC. Since it is impossible to make any significant increase in hog production in the short run, firm x will try to obtain a part of firm y's supply equal to quantity BC = AD. The market price for pork products will not change since the total quantity supplied has not changed.

As firm x tries to increase hog purchases, he has to increase buying costs. If this takes the form of increased prices in an informed market, it will force the cost curves of both firms upward. If firm x is successful in acquiring more hogs, firm y will be in an extremely difficult position because he will have to operate at a

more costly point on his average cost curve. Even if firm y increases price sufficiently to maintain output, he will still be operating at a loss because his AC curve has been shifted upward by the price increase.

Firm y is now faced with two alternatives: (1) lower its cost so it can compete with firm x or, (2) drop out of the industry. Assume that firm y lowers its cost to compete with firm x. Assume further that firm y lowers its cost by the same amount that firm x did originally. In order to maximize profits under the new cost structure, firm y will attempt to increase production to quantity OG. Since the supply of animals is fixed for any short period and neither firm can obtain the supply desired without bidding them away from the other, firms x and y will bid up the price of animals and thus increase cost. This passes savings from the cost reducing technique to the producer.

Assume now that the cost curves of the two firms rise by equal amounts to AC_{1x} and AC_{1y} as they bid up the price of animals, and that the supply of animals has had time to increase in response to price. Firm x will now produce quantity OF and firm y will produce quantity OH. Market price is now P_2, and both firms are making pure profits of P_2P_3 per unit of output.

If the two firms were originally so competitive as to be operating at zero pure profits, they may be expected to continue to force each other towards zero pure profits even if entry were not free. Final equilibrium without pure profits would be at increased production by both, and determined by the elasticity of supply of hogs as it

affects the AC curves. This would be at lower prices to consumers and at higher prices paid to producers.

Now if we allow free entry into the industry before pure profits are exhausted, another type of adjustment may take place. Seeing that the two firms are making pure profits, other firms may come into the industry and shift the demand curves of x and y to the left. At the same time, the new firm, in bidding for hogs, will tend to increase the rate at which the average costs of x and y will increase. Both of these effects will tend to reduce the time required to reach equilibrium.

For the graphic analysis we shall assume that other firms will come into the industry before average costs increase to AC_{1x} and AC_{1y}, but this entry will force x and y to AC_{1x} and AC_{1y}. The firms shift the demand curves of the original two firms to the left. The marginal revenue curves of the two firms will also be shifted to the left in proportion to the shift in the average revenue curves. Equilibrium will now be reached at lower individual plant volumes than would be the case without free entry.

This may be illustrated in the figure by assuming that the curves were shifted to AR_{1x}, AR_{1y}, MR_{1y}, and MR_{1x}. Equilibrium under these assumptions will be reached with x producing OE and y producing OA. Price will be OP_4 and there will be no pure profits.

Firms that first reduce their costs profit most from the reduction. As more and more firms reduce costs, the lure of pure profits increases the competition for resources used in production and forces

cost curves to rise until a new equilibrium is reached. The last firm to reduce cost gains nothing from the reduction except an ability to stay in the industry.

Virginia packers must be efficient to survive in the competitive industry of meat packing and processing. Many packers have realized that they have cost and efficiency problems and that research is needed to provide them with information they can use in allocating their resources more efficiently. The purpose of this study was to provide packers with such information.

It is hypothesized that a meaningful variation exists in cost and labor efficiency among departments in individual firms in the Virginia meat packing industry. It is also hypothesized that firms handling larger volumes are more efficient than smaller firms in the utilization of the resources studied.

Objectives

The principal objective was to study cost of production and labor efficiency by a uniform plant breakdown in a sample of Virginia meat packing plants to uncover hypothesized inefficient or problem areas in individual firms by departmental comparisons of production costs and labor efficiency.

Specific objectives were:

1. To determine selected costs by department and by plant.
2. To determine labor requirements by departments within firms.
3. To make interfirm cost and labor comparisons.
4. To investigate, where possible, causes for differences.

Review of Literature

No evidence was found of any research having been done on the efficiency of meat packing and processing firms. 1/ At the time of this writing, there was a study of the efficiency of meat packing and processing firms underway in Indiana. The forms used in the Indiana study and the Accounting Manual published by the National Independent Meat Packers Association were helpful in preparing forms for this study.

Selection of Firms and Characteristics of the Sample

All Virginia packing firms slaughtering over two million pounds of liveweight annually were invited to participate in the study. Ten firms voluntarily supplied data for the study. The sample included both firms slaughtering all common slaughter species and those slaughtering only one specie. The firms were located in all geographical areas of the state, and all but one of the firms purchased animals from outside Virginia.

Nature and Source of Data

The data collected consisted of departmental labor records, quantity of product moved through each department, and departmental supply costs. Utility, depreciation, maintenance, and

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1/ The Agricultural Index, The H. W. Wilson Company, Volumes 12, 13, 14, & 15; and Bibliography of Agriculture, U.S. Government Printing Office, Volumes 18, 19, 20, 21, and 22.

insurance costs were obtained for the total operation in each plant.

Each firm kept current departmental labor and tonnage records for the four months--February through May, 1961. Cost data for the same period were obtained from individual firm records.

Procedure and Method of Analysis

Advice was sought from many members of the Virginia Meat Packers Association during the planning stages of the project. A joint meeting of some of the members of the Virginia Meat Packers Association and three members of the Department of Agricultural Economics was held to determine what should be included in the study to make the results most meaningful subject to the types of data available from the packers.

Forms for keeping the required records were designed by the researchers and sent to the packers for constructive criticism. Adjustments were made on the forms, and the forms sent to the packers to keep current records for the study. 1/ Departmental definitions were included on the forms as a precaution against improper resource allocation.

Departmental records were kept for the following departments: acquisition, hog kill, cattle kill, calf kill, hog cut-up, beef

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1/ Sample forms for hog kill, sausage kitchen, and assembling and loading are in the Appendix.

boning, sausage kitchen, bacon slicing, cure and smoke, beef fabricating, assembling and loading, sales, and office. Because of the difficulties of accurately allocating the costs to individual departments and the questionable value of such costs if accurately allocated, utility, depreciation, maintenance, and insurance costs were analyzed from a total standpoint. Some firms were unable to supply departmental costs, but did furnish total costs and labor records.

Only the results of the analysis are presented because data for individual firms would reveal identities.

Graphic analysis was used to test for relationships between volume and both labor efficiency and production costs in the various departments. Where the graphs suggested any meaningful relationships, the coefficient of correlation was calculated to measure the degree of association between volume and labor efficiency or volume and production costs. These associations are noted in the departmental analyses with the coefficient of correlation. The graphs are not presented because firm identities would be revealed.

The range, mean, median, standard deviation, and coefficient of variation of the selected costs and labor efficiency were calculated by departments.

The range shows the high and low in the selected costs and labor efficiency.

The mean is the arithmetic average of all the observations. It is a representative value of the observations in the sample.

The median value is that value such that one-half of the observations in the sample is less and one-half is greater than the median value. This also is a representative value and is especially important where there are excessively large or small values in the sample which distort the mean value.

The standard deviation is a measure of variation in the sample. In a normal population two-thirds of the observations fall within plus or minus one standard deviation of the mean.

The coefficient of variation is the standard deviation expressed as a percentage of the mean. This makes possible a comparison of variation between values which differ absolutely.

The above statistical tools were used to indicate the range, representative values, and a measure of variation of cost and labor efficiency for the firms studied.

ANALYSIS AND DISCUSSION OF DEPARTMENTAL RESULTS

Four firms supplied departmental labor and cost data. Two other firms supplied only departmental labor records. Departmental cost data consisted of labor and supply costs in all departments other than office, acquisition, and sales. 1/ Costs included in these departments are specified in the discussion of the respective departments. Insurance, utility, and maintenance costs were also obtained from firms contributing cost data. Live-animal costs were not included in the analysis because of the differences in the make up of kind and type of animals slaughtered by each firm.

Supply costs were allocated to each month according to quantity slaughtered, because supplies are sometimes purchased in one month and used over several months. Adjustments unique to individual departments are explained in the discussion of these departments.

The mean, median, standard deviation, coefficient of variation, and the high and low observations of the related costs and labor efficiency in each department are presented in tabular form in the discussion of individual departments. 2/

1/ Labor costs included wages and fringe benefits.
2/ Labor efficiency is defined as the ratio of pounds of meat and meat products produced in each department to the number of man-hours used.

Hog Kill

Data included all labor used and selected costs incurred from the holding pen outside the kill room until the hog carcasses were spaced in the chill cooler. The weight used in computing the results was the dressed weight out-of-kill.

There was a considerable amount of variation among plants in labor costs, supply costs, total costs, and pounds per man-hour (Table 4). There was no meaningful relationship between either costs or labor efficiency and volume. The lower variation in total costs relative to supply and labor costs indicates that some firms high in labor cost were low in supply cost and vice versa. Total cost for the firm with the lowest total cost was, however, approximately one-half that of the firm with the highest total cost. The results also indicate that there was a firm which had a supply cost far greater than the other firms. This is indicated by the difference between the mean and median values. In this case, the median value gives a truer picture of supply cost for most of the firms than does the mean value which is distorted by the extremely high supply cost for one firm.

The variation in cost per hundredweight and pounds per man-hour could not be attributed to variation in hog weights among firms since the variation among firms in head per man-hour was close to the variation among firms in pounds per man-hour (Table 4).

Table 4. Results of Hog Kill Analysis

	Cost per hundredweight a/			Lbs. per man-hour b/	Head per man-hour b/
	Labor	Supply	Total		
High	$ .84	$ .36	$ .97	615	3.90
Low	.41	.01	.44	272	1.92
Mean	.60	.11	.71	445	2.97
Median	.58	.04	.71	426	2.82
Standard deviation	.15	.15	.16	98	.57
Coefficient of variation	25	137	23	22	19

a/ Data from four firms.
b/ Data from six firms.

Cattle Kill

Data included all labor used and selected costs incurred from the holding pen outside the kill room until the cattle carcasses were spaced in the chill cooler. The weight used in computing the results was the dressed weight out-of-kill.

There was a great deal of variation in costs and labor efficiency among firms (Table 5). There was no meaningful relationship between either costs or labor efficiency and volume. The closeness of the mean and median values for all costs and labor efficiency does not mean that there was little variation, but means that the values of the observations were fairly evenly distributed between the high and low values.

An analysis on a per head basis showed relationships among firms to be very similar to the per pound analysis (Table 5).

Table 5. Results of Cattle Kill Analysis

	Cost per hundredweight a/			Lbs. per man-hour b/	Head per man-hour b/
	Labor	Supply	Total		
High	$1.05	$ .12	$1.05	529	.81
Low	.39	.02	.47	206	.37
Mean	.80	.06	.86	358	.68
Median	.87	.06	.92	374	.74
Standard deviation	.24	.02	.22	80	.14
Coefficient of variation	30	33	26	22	21

a/ Data from four firms.
b/ Data from six firms.

Calf Kill

Data included labor used and selected costs incurred from the holding pen outside the kill room until the carcasses were spaced in the chill cooler. The weight used in computing the results was the dressed weight out-of-kill. An insufficient number of firms reported calf-kill costs to make any meaningful cost comparisons. For this reason, only labor efficiency is discussed for this department. The results of the analysis are given in Table 6.

Table 6. Results of Calf Kill Analysis a/

	Lbs. per man-hour	Head per man-hour
High	660	4.03
Low	103	1.02
Mean	298	2.23
Median	263	1.91
Standard deviation	180	1.17
Coefficient of variation	60	53

a/ Data from four firms.

The results of the analysis differed from those in hog and cattle kill in that a meaningful relationship existed between volume and labor efficiency. As volume increased, labor efficiency increased. The coefficient of correlation between pounds of calves killed and pounds per man-hour was .95. 1/ (This coefficient of correlation indicates the degree of association between pounds of calves killed and pounds per man-hour.)

The regression coefficient was .0003 and was significantly different from zero. 2/ The regression coefficient means that as

1/ The coefficient of correlation between number of calves killed and head per man-hour was not calculated because the same relationships held among firms in head per man-hour as in pounds per man-hour.
2/ The chosen level of significance was .95.

volume changed by one unit, pounds per man-hour changed by .0003 units in the same direction.

Although there was a positive and meaningful relationship between volume and pounds per man-hour, this does not mean that a firm killing calves should necessarily increase the number of calves slaughtered. Before attempting to increase efficiency in this department by increasing the number of calves killed, a firm must consider such factors as its market for veal and the effect such an increase would have on the efficiency of other departments.

Hog Cut

Data included labor used and selected costs incurred from the time workers went to the chill room for the carcasses until the carcasses were delivered to the sausage kitchen, cure, or sales cooler. The weight used in the analysis was the dressed weight out-of-kill. Because only two firms reported supply costs, only labor cost and labor efficiency were considered in the analysis.

The variation in labor cost was greater than the variation in labor efficiency (Table 7). This can be attributed to the variation in wage rates among firms. There was no meaningful relationship between either labor cost or labor efficiency and volume. Although the mean and median values were close, there was still considerable variation in labor cost and efficiency. The firm with the highest labor cost had a labor cost three and one-half times

that of the lowest cost firm. The most efficient firm was approximately one and three-fourths times as efficient as the least efficient firm in the employment of labor resources.

The same relationships held among firms in head per man-hour as in pounds per man-hour. The variation in head per man-hour, however, was slightly greater than the variation in pounds per man-hour (Table 7).

Table 7. Results of Hog-Cut Analysis

	Labor cost per hundredweight a/	Pounds per man-hour b/	Head per man-hour b/
High	$ .70	827	5.71
Low	.20	470	3.13
Mean	.38	618	4.16
Median	.30	625	4.15
Standard deviation	.18	108	.82
Coefficient of variation	47	17	20

a/ Data from four firms.
b/ Data from six firms.

Bacon Slicing

Data included labor used, selected costs incurred, and packaging done in the department. The weight used in computing the results was the weight of the product leaving the department. The analysis is presented in Table 8.

Table 8. Results of Bacon Slicing Analysis

	Cost per hundredweight a/			Pounds per man-hour b/
	Labor	Supply	Total	
High	$17.48	$5.42	$22.89	161
Low	2.43	2.39	5.40	10
Mean	6.37	4.26	10.64	84
Median	3.12	3.99	6.86	90
Standard deviation	5.97	.79	6.63	49
Coefficient of variation	94	17	62	58

a/ Data from four firms.
b/ Data from six firms.

The variation in labor cost and labor efficiency was greater than for any other department. The variation in total cost was also very great, since labor cost makes up such a large percentage of total cost. There was no meaningful relationship between either cost or labor efficiency and volume.

The most efficient firm was approximately sixteen times as efficient--when considering labor only--as the least efficient firm. The labor cost for the highest cost firm was approximately eight times that for the lowest cost firm.

Cure and Smoke

Data included labor used and selected costs incurred from the time the product was placed in the cure or smoke room until it was placed in the sales cooler. The weight used in computing the results was the weight out-of-cure. 1/

Table 9. Results of Cure and Smoke Analysis

	Cost per hundredweight a/			Pounds per man-hour b/
	Labor	Supply	Total	
High	$3.20	$1.29	$4.04	452
Low	.61	.49	1.10	91
Mean	1.54	.94	2.48	253
Median	1.43	1.06	.67	233
Standard deviation	.81	.32	.95	123
Coefficient of variation	53	34	38	49

a/ Data from four firms.
b/ Data from six firms.

The greatest variations in this department existed in labor cost and labor efficiency (Table 9). The most efficient firm was approximately five times as efficient as the least efficient firm. The

1/ It was necessary to adjust the weight of some firms since they reported weight going into cure. The adjustment value used was 110 percent of the weight going into cure. The adjustment value was obtained from Dr. R. F. Kelly of the Department of Animal Husbandry, Virginia Polytechnic Institute.

variation in supply cost may have been due to variation in the type of cure and ingredients used in cure. If this is true, the possibilities for savings depend largely upon the individual firm's ability to increase labor efficiency. There was no meaningful relationship between either costs or labor efficiency and volume.

Sausage Kitchen

Data included all labor used and selected costs incurred from the time the meat was placed in the sausage kitchen until it reached the sales cooler. This included smoking, cooking, frank skinning, and any packaging done in the sausage kitchen. The weight used was the weight of the products leaving the sausage kitchen. The results of the analysis are given in Table 10.

The greatest variation in this department was in supply cost (Table 10). This variation could be the result of a number of factors. One of these is the percentage of a firm's sausage products sold in bulk packages compared to the percentage sold in per unit packages. Supply costs are lower for bulk packaging than for packaging products in per unit packages. Another factor that may cause variation in supply cost for the sausage kitchen is a possible variation among firms in seasoning ingredients. No two firms produce identical sausage products, hence expected variation in seasoning costs. The extent to which a firm trys to identify its products through its packages may also contribute to variation in supply cost. The "fancier" a package, the more expensive it often becomes.

Table 10. Results of Sausage Kitchen Analysis

	Cost per hundredweight a/			Pounds per man-hour b/
	Labor	Supply	Total	
High	$4.42	$5.27	$8.73	90
Low	2.52	2.25	5.84	49
Mean	3.43	4.04	7.46	67
Median	3.51	4.32	7.80	68
Standard deviation	.61	1.14	.80	14
Coefficient of variation	18	28	11	21

a/ Data from four firms.
b/ Data from six firms.

Although the variation in labor cost and labor efficiency was not as great as the variation in supply cost, it may be more difficult to justify. Since it is improbable that firms will make major changes in their sausage products and in their supply costs, it is through lower labor costs that firms are most likely to achieve savings. This is not meant to suggest that savings were not possible in supply costs, because it is possible that there was some waste in the use of supplies or that there were opportunities for procurement from lower cost sources. The most efficient firm in the use of its labor resources was approximately twice as efficient as the least efficient firm, while the firm with the highest labor cost had a labor cost approximately one and three-fourths that of the lowest cost firm.

Boning

Data included all labor used and selected costs incurred from the time workers went to the cooler for carcasses until boned meat entered either the sausage kitchen cooler or the sales cooler, and included packaging done within the department. The weight used in computing the resultswas the weight of the boneless beef. 1/

The variation in both costs and labor efficiency is indicated in Table 11. The relative closeness of the mean and median values indicates that costs were fairly evenly distributed between the high and low values. The supply cost of the high cost firm was approximately 70 times that of the low cost firm. This variation may be explained by the fact that some firms packaged in the boning room and others did not. The lower variation in total cost was because some firms high in supply cost were low in labor cost and vice versa. The firm highest in labor efficiency was approximately nine times as efficient as the least efficient firm. There was no meaningful relationship between either costs or labor efficiency and volume.

1/ It was necessary to adjust the value of some of the firms because they reported the weight of the beef before it was boned. The adjustment value used was 80 percent of the beef before boning. The adjustment value was obtained from Dr. R. F. Kelly of the Department of Animal Husbandry, Virginia Polytechnic Institute.

Table 11. Results of Boning Analysis

	Cost per hundredweight a/			Pounds per man-hour b/
	Labor	Supply	Total	
High	$2.91	$2.63	$3.01	677
Low	.30	.04	.45	78
Mean	1.17	.99	1.93	249
Median	1.05	.31	2.01	172
Standard deviation	.85	1.22	.97	162
Coefficient of variation	73	123	50	65

a/ Data from four firms.
b/ Data from six firms.

Fabricating

An insufficient number of firms reported costs for fabricating to make any meaningful analysis of costs. For this reason only labor was included in this analysis. Labor included that used in the making of hamburger patties, cutting of minute steaks, etc.

As in calf kill, there was a meaningful relationship between volume and labor efficiency. The coefficient of correlation (.85) indicates the degree of association between volume and labor efficiency.

The regression coefficient obtained was .0017. This means that as volume changed by one unit, pounds per man-hour changed by .0017

units in the same direction. This regression coefficient was significantly different from zero. 1/

This relatively high degree of association between volume and labor efficiency does not mean that firms with smaller volumes should necessarily attempt to increase their volume. It may be impossible to increase volume because of the quantity of beef slaughtered or the firms' market for fabricated beef.

The variation indicated in Table 12 suggests that large savings may be possible in this department.

Table 12. Results of Fabricating Analysis

	Pounds per man-hour a/
High	227
Low	26
Mean	117
Median	128
Standard deviation	62
Coefficient of variation	53

a/ Data from four firms.

1/ The chosen level of significance was .95.

Assembling and Loading

Data included all labor used and selected costs incurred on assembling and loading orders. This included all packaging not performed in the individual departments and all assembling and wrapping in preparation for loading. Only two firms reported supply costs for this department. For this reason only labor cost and labor efficiency were included in the analysis.

The variation in labor cost and labor efficiency for this department is indicated in Table 13. The fact that the variation in labor cost was less than in labor efficiency can be explained by differences in wage rates among firms. There was no meaningful relationship between either labor cost or labor efficiency and volume.

Table 13. Results of Assembling and Loading Analysis

	Labor cost per hundredweight a/	Pounds per man-hour b/
High	$ .63	1511
Low	.24	372
Mean	.42	825
Median	.40	788
Standard deviation	.13	324
Coefficient of variation	31	39

a/ Data from four firms.
b/ Data from six firms.

ANALYSIS AND DISCUSSION OF TOTAL RESULTS

Of the eight firms that supplied cost data, only four were able to supply cost data by departments. In order to include all firms in an analysis, it was, therefore, necessary to analyze the firms on the total operation of the individual firms. It was possible to separate some of the firms' costs out for analysis. These were maintenance, insurance, office, sales, depreciation, rent, and utility costs. Labor and supply costs were also obtained from each firm. In addition to the eight firms that supplied cost data, two other firms supplied labor and production records.

An analysis of all ten firms revealed that composition of kill was an extremely important factor in labor efficiency and many of the costs. In general, the higher the ratio of beef to total liveweight slaughtered, the higher the labor productivity and the lower the various costs.

There were four firms which had a much higher or a much lower percentage of cattle in their kill than was true in the other six firms. Of the four, two were unable to supply costs. The two which did supply costs represented the extremes in the composition of kill.

Since these extremes would distract from the meaningfulness of the results, only the data from the six firms having a relatively homogeneous composition of kill were included in the analysis presented in this section.

The weight used in computing all results in this section was the total liveweight slaughtered by the individual firms. The analysis used was the same as used in the analysis of the departmental results. Supply cost was allocated to each month in the same manner as in the previous section.

Labor Efficiency

Pounds per man-hour were computed using the total liveweight slaughtered and the hours of all employees except administrative, office, sales, and maintenance personnel.

There was considerable variation in labor efficiency among firms. There was no meaningful relationship between volume and labor efficiency. The results of the analysis are as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Pounds per man-hour	172	77	123	120	29	24

1/ Coefficient of variation.

The variation was great enough to suggest that savings might be possible for many firms through increased labor efficiency.

Labor Cost

Labor cost for each firm consisted of wages and fringe benefits for all employees except those working in the office, sales, maintenance, and administration.

The following results indicate the variation in labor cost among firms:

	High	Low	Mean	Median	Standard deviation	CV 1/
Labor cost per cwt.	$2.54	$.79	$1.75	$1.98	$.55	31

1/ Coefficient of variation.

There was no meaningful relationship between volume and labor cost per hundredweight. The relative closeness of the mean and median values indicated that there was a fairly even distribution of labor costs between the high and low values. The lower variation in labor cost than in labor efficiency was explained by differences in wage rates among the firms.

Supply Cost

Supply cost included those expenses for all supplies other than those used in the office and sales.

The variation in supply cost among firms was as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Supply cost per cwt.	$2.95	$.67	$1.40	$1.24	$.79	56

1/ Coefficient of variation.

There was no meaningful relationship between volume and supply cost per hundredweight. The firm with the high supply cost had a supply cost approximately four and one-half times as great as the firm with the low supply cost. The relative closeness of the mean and median values indicated a fairly even distribution of supply costs between the high and low values.

It must be recognized that the high supply costs may be justified, particularly where packaging is used for product differentiation and/or a lot of packaging in small quantities is done in the plant. This may or may not be true among the firms in this study. It is known that some variation of this type existed among the firms, but the data collected for this study were not detailed enough to determine the reason(s) for the variation.

Labor and Supply Cost

This is the total of the labor and supply cost just discussed. Since these two costs represented a major portion of total costs, it was deemed advisable to compare firms on this basis.

Labor and supply cost variation among firms was as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Labor and supply cost per cwt.	$5.08	$1.70	$3.15	$3.33	$1.07	34

1/ Coefficient of variation.

There was no meaningful relationship between volume and the total of labor and supply cost per hundredweight. The cost for the high cost firm was approximately three times greater than that for the low cost firm. These results indicate that large savings may be possible in labor and supply costs with any type of operation.

The distribution between the high and low values was fairly even as indicated by the relative closeness of the mean and median values.

Office Cost

The following expenses were included in office cost: salaries of personnel working in the office, office equipment rental, professional services, postage, dues and subscriptions, bank service fees, office travel and auto expense, and office equipment maintenance. Administrative salaries were not included. Variation in office cost was as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Office cost per cwt.	$.68	$.20	$.41	$.42	$.14	34

1/ Coefficient of variation.

The variation could not be explained by volume. The mean and median values indicate a fairly even distribution between the high and low values.

Sales Cost

The following costs made up sales cost for this study: salesmen's salaries, delivery wages, expense accounts, broker fees, sales supplies, advertising expenses, and transportation expenses. Transportation expenses include depreciation, insurance, maintenance, operation, licenses, and tax costs for owned trucks and/or expenses for hired or rented transportation.

The variation in sales cost per hundredweight among firms was as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Sales cost per cwt.	$1.73	$.30	$.94	$.95	$.39	41

1/ Coefficient of variation.

There was no meaningful relationship between volume and sales cost per hundredweight. Opportunities for large savings seem to exist. The firm with the highest sales cost had a sales cost approximately six times that of the firm with the lowest sales cost.

It should be realized that large sales costs may be justified if they are a result of advertising and/or other promotional efforts which yield returns to the firm greater than the additional cost associated with such activities.

Utility Cost

Utility cost included expenses for electricity, water, fuel, telephone, and telegraph.

The variation in utility cost per hundredweight is given in the following results:

	High	Low	Mean	Median	Standard deviation	CV 1/
Utility cost per cwt.	$.39	$.10	$.28	$.29	$.07	25

1/ Coefficient of variation.

This variation was not as great as the variation in the other costs considered. The variation did not appear to be due to geographical location of the firm or volume.

Maintenance Cost

Maintenance cost included those expenses for labor and materials used in the maintenance of buildings and equipment.

The following results indicate the variation in maintenance cost per hundredweight:

	High	Low	Mean	Median	Standard deviation	CV 1/
Maintenance cost per cwt.	$.42	$.04	$.24	$.18	$.13	62

1/ Coefficient of variation.

The variation could not be explained by either volume or age of plant.

Rent and Depreciation Cost

Rent and depreciation cost included rent and depreciation on buildings and equipment. These costs were combined because the amount of buildings and equipment rented reduces depreciation by the amount of depreciation on the rented buildings and equipment.

Rent and depreciation cost varied considerably among firms. It was as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Rent and depreciation cost per cwt.	$.57	$.04	$.23	$.22	$.15	65

1/ Coefficient of variation.

This variation could not be explained by either age of plant or volume.

Since depreciation cost is fixed for each individual firm, it is not as meaningful to management as the variable costs considered in the study.

Insurance Cost

Insurance cost included all insurance expenses incurred by the firms except those for transportation equipment. Insurance records were not available for one firm.

The variation in insurance cost among firms was as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Insurance cost per cwt.	$.07	$.01	$.03	$.02	$.02	66

1/ Coefficient of variation.

There was no meaningful relationship between insurance cost per hundredweight and volume. It should be noted that insurance cost per hundredweight for the firm with the highest insurance cost per hundredweight was seven times that of the firm with the lowest insurance cost per hundredweight. It should also be realized that the data collected for this study did not provide any means for comparing coverage among firms, thus limiting the value of this cost comparison to management.

Total Cost

Total cost for each firm was made up of the following costs: labor, supply, maintenance, insurance, office, sales, depreciation, rent, and utility.

The variation was as follows:

	High	Low	Mean	Median	Standard deviation	CV 1/
Total cost per cwt.	$7.13	$2.69	$5.19	$5.43	$1.34	26

1/ Coefficient of variation.

There was no meaningful relationship between volume and total cost per hundredweight. The fact that the variation in total cost was less than for most costs can be explained by the fact that firms with low costs in one cost category had high costs in another. The results indicate possibilities for large savings as the firm with the highest total cost had a total cost approximately two and one-half times as large as the lowest cost firm. When slaughtering two million pounds annually, a four dollar difference in total cost per hundredweight means $80,000.

CONCLUSIONS

The results support the hypothesis that there existed a significant variation in selected costs and labor efficiency between similar departments in Virginia meat packing firms.

Considerable variation existed in all departments in costs and labor efficiency (Table 14). There was also a considerable variation in costs and labor efficiency when the firms were analyzed on a total basis (Table 15). The variation was not so great, however, as interdepartmental variation.

The reason for a greater variation in individual costs than for total cost on a departmental basis is that a firm high in one cost may be low in another. The same relationship was true in the total analysis.

The hypothesis that efficiency increases as volume increases cannot be accepted. Only in fabricating and calf kill was there a meaningful relationship between volume and labor efficiency in the departmental results. Variation in other departments where there was no meaningful relationship between volume and labor efficiency suggests that savings might be possible through means other than an increase in volume.

It is entirely possible that firms have reached a size such that they are realizing all efficiencies in division of labor in all departments except calf kill and fabricating.

Table 14. Percent Variation Among Departments in Individual Firms a/

	Labor cost	Supply cost	Total cost	Labor efficiency
Hog Kill	25	137	23	20
Cattle Kill	30	40	26	22
Calf Kill				60
Hog Cut	47			17
Bacon Slicing	94	17	62	58
Cure and Smoke	53	34	38	49
Sausage Kitchen	18	28	11	21
Boning	73	123	50	65
Fabricating				50
Assembling and Loading	30			40

a/ Where no variation is given, there was no analysis of that particular cost.

Table 15. Percent Variation in Total Analysis Among Firms

	CV a/
Pounds per Man-hour	24
Labor Cost per Cwt.	31
Supply Cost per Cwt.	56
Labor and Supply Cost per Cwt.	34
Office Cost per Cwt.	34
Sales Cost per Cwt.	41
Utility Cost per Cwt.	25
Maintenance Cost per Cwt.	62
Rent and Depreciation Cost per Cwt.	65
Insurance Cost per Cwt.	66
Total Cost per Cwt.	26

a/ Coefficient of variation.

There was no meaningful relationship in any of the departments between costs and volume. The total analysis revealed no meaningful relationship between either labor efficiency or costs and volume.

The data were not sufficiently detailed to determine the causes for the variation exhibited. If one assumes similar plant equipment and plant layout, the variation in labor efficiency may be attributed to either wage rates or the use of labor. If the assumption of similar wage rates is added, then the variation can be attributed solely to the use of labor.

Possible reasons for variation in supply and sales costs are suggested, but it is not known whether or not they are the proper explanation. This, however, does not reduce the significance of the research. The principal objective of the study was to study costs of production and labor efficiency by a uniform plant breakdown in a sample of Virginia meat packing plants to uncover inefficient or problem areas that may exist in individual firms by departmental comparisons of production costs and labor efficiency. To the extent that data were available, this objective was accomplished. Where departmental data were not available, total comparisons were made. Although total comparisons are not as meaningful as departmental comparisons, they do give packers an indication of their relative position in production costs and labor efficiency among packing firms in Virginia.

It can be concluded, however, that all firms who participated in the study have areas of inefficiency in their plants; and that the Virginia meat packing industry can realize large returns from further research to more fully explain the reasons for the wide variation uncovered in this exploratory project. This will provide more precise management tools with which the industry can more effectively allocate the resources at its command.

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APPENDIX

Kill*
Hogs

Firm Code Number_____ Month_____

Date	Killed		Condemned	Labor Record2/	
	Number	Pounds1/	Pounds1/	Number working	Hours worked3/

* Kill includes labor from holding pen to chill cooler

1/ Dressed weight

2/ More than one entry can be made for each day. If any labor is used from another department, record the number of persons used and the hours they worked in your department.

3/ Include break time, clothes changing time, and janitor time in the department.

PROCESSING RECORD

Firm Code Number_____ Month_____

Sausage Kitchen 1/

Labor*

Date	Pounds processed		Number working	Hours worked2/
	in wt.	out wt.		

1/ Include labor on meat from the time the meat is placed in the sausage kitchen, including smoking, cooking, frank skinning, and any packaging that is done in the sausage kitchen.

2/ Include breaktime, clothes changing time and janitor's time.

* More than one entry can be made on one day. If labor is used from another department, record the number of persons used and the hours they work in your department.

PROCESSING RECORD

Firm Code Number_____ Month_____

Assembling and Loading1/

Labor*

Date	Pounds processed		Number working	Hours worked2/
	in wt.	out wt.		

1/ Include all labor on assembling and loading the orders. This includes all packaging not performed in the separate departments and all packaging done in order assembly and wrapping in preparation for loading.

2/ Include breaktime, clothes changing time and janitor's time.

* More than one entry can be made on one day. If labor is used from another department, record the number of persons used and the hours they work in your department.

ABSTRACT

Costs and production records from six 1/ Virginia meat packers and processors were analyzed by departments to obtain the interfirm variation in man-hours required and in the costs of labor and other selected resources.

In addition, four firms that were unable to supply departmental data supplied total plant labor records and selected other costs. These four firms were combined with the other six and analyzed for interfirm variation of the selected resources for the total operation. The total analysis included the following costs in addition to labor efficiency: labor, supply, maintenance, office, insurance, sales, depreciation, rent, and utility.

Graphic analysis was used to investigate relationships between volume and labor efficiency and volume and costs. The standard deviation and coefficient of variation were calculated to measure the variation that existed among firms.

Considerable interfirm and interdepartmental variation was found. In most instances the coefficient of variation exceeded 30. In the departmental analysis there was a relationship between volume and labor efficiency only in calf kill and fabricating. There was no meaningful relationship between volume and costs in the departmental

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1/ Two of these firms supplied departmental labor records only.

analysis. In the total analysis there was neither a meaningful relationship between volume and labor efficiency nor volume and costs.

All firms were inefficient in some areas of operation. The norms and measures of variation as discovered should prove to be valuable management tools when used with individual plant records to delineate problem areas within a firm.