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ALTERNATIVE RETAIL BEEF-HANDLING SYSTEMS

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Costs of seven methods of handling beef by retail firms are explored, considering number and size of stores per firm and distance from the packer. The least costly method is centralized cutting into retail cuts by retail firms. Larger store size reduced per unit costs significantly for all systems studied, while number of stores per firm affected costs only slightly.

Keywords: Beef fabrication, boxed beef, centralized beef cutting, retailer beef costs.

INTRODUCTION

In the traditional beef handling system, the packer delivers carcass beef to the local retail store where it is cut into retail cuts. Some disadvantages exist, such as the need to transport excess fat and bone, the lack of economies of size in cutting operations, and the need to merchandise the whole carcass; hence, the search for other alternatives.

The Search for New Systems

Several such systems have been proposed and tried by retailers to lower meat-handling costs. Here, we look at cost differences among seven systems for moving beef from packer to consumer. Our research demonstrates that "boxed beef" does not appear to provide the great savings frequently attributed to it. Boxed beef is so called because the packer breaks the carcass into smaller cuts, vacuum packs them, and ships them to the retailer in boxes.

Changes from the traditional system began 15 or more years ago and have been accelerating (7).¹ An estimated two-thirds of the beef entering supermarkets in 1974 was no longer arriving in carcass form (1). Some was being precut at the packing plant; the rest was cut in wholesale fabrication centers and retail chain warehouses. Boxed beef claims about one-fourth of the movement to retail stores, and perhaps a third of the beef is broken at retail warehouses. Only 2 to 4 percent of the beef now enters the retail store as fresh or frozen packaged retail cuts.

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Note: A Glossary appears at the end of this article.

¹Italicized numbers in parentheses refer to items in References at the end of this article.

Previous Studies

Analyses of alternative meat-handling systems began several years ago (9; 5; 10; 4, pp. 35-46; 6). All the authors suggest that cutting beef prior to receipt by the retail store has cost advantages, and some indicate that cutting and packaging to retail cuts at the retail warehouse is the least costly.

The Volz and Marsden report (9) has considerable detail on investment costs, as our study does, but the comparisons of cost per weekly dollar sales volume and per retail pound sold are difficult. Building shell cost of \$8 per square foot in the Volz and Marsden report, released in 1963, compares with \$25 to \$45 in this article, an increase due mostly to inflation. Wages per hour are two to three times higher in our study. In both studies, labor usage was reduced by about one-half when automatic wrapping machines rather than manual wrapping were compared.

The building shell cost in the Weatherly, Earle, and Brown study, released in 1967, was about \$12 per square foot (10). Labor was given in man-hours per year for different annual poundage volumes. Erickson and Lichty compared 11 alternative handling systems (4, pp. 35-46) while we examine 7. Results appear fairly consistent, although the total costs are less in their study. Inflation explains part of this difference. While Erickson and Lichty probably had to gather much of the detail needed, they do not include it, so we could not compare differences between their results and ours.

METHODOLOGY

In this article, we use economic engineering and capital budgeting to evaluate the potential impact of various beef-handling systems on meat distribution costs. An example of an economic engineering technique used in our research is a time and motion study wherein data were obtained by a time-paced movie camera operating at two frames per second.

A systems analysis was undertaken at the beginning to identify those functions which would change as the alternative systems were adopted. Incremental factors of physical coefficients, variable costs, capital requirements, capital costs, and other costs were measured for each system. The information was cast in a traditional budgeting framework. We examined variations among alternative systems, and differences for chains with

varying numbers and sizes of stores at varying distances from meat supply areas.

THE SYSTEMS

Data for the study were collected and developed for ERS by Case and Company, a private management consulting firm. Seven systems were analyzed from the retailer's viewpoint:

- Carcasses from packer, usually moving as quarters, fabricated to primals at the retailer's central warehouse with retail cuts prepared at retail stores;
- Carcasses from packer fabricated to subprimals at the retailer's warehouse with retail cuts prepared at retail stores;
- Carcasses from packer fabricated to fresh retail cuts at the retailer's warehouse before distribution to the stores;
- Carcasses fabricated to frozen retail cuts at the retailer's warehouse before distribution to the stores;
- Packer-cut primals (boxed beef) distributed through a retailer's warehouse to retail stores;
- Carcasses from packer delivered direct to the store, without going to the retailer's warehouse;
- Packer-cut primals (boxed beef) delivered direct to the retail store, without going to the retailer's warehouse.

These seven do not include all possible systems, such as combinations, but they do represent the main ones.

Some of the distribution systems include the ability to adjust the proportions of the various beef cuts purchased to fit the demands of customers. However, the same mix of cuts is assumed for all systems. To facilitate cost comparisons among systems, the costs of inflexibility were included in the cost of merchandising slow-moving cuts (see Glossary). This results in higher costs to the systems that have less flexibility, ranging from 4.3 cents per retail pound for direct carcass delivery to store—system 6, to 0 cents for centralized cutting and packaging to frozen retail cuts—system 4. All systems involve conversion of shanks and plates and most of the flank to ground beef.

DATA AND ASSUMPTIONS

The mix of cuts and the price data used were affected by the time when data were gathered, the summer and fall of 1975, which was not typical of the previous decade. The selloff period of the cattle cycle occurred in 1974-76, and relatively high grain prices reduced the number of cattle fed. A relatively large proportion of "nonfed" beef was marketed and a larger proportion of ground beef was sold. The peak in numbers in the cattle cycle was reached early in 1975. Increased slaughter of

nonfed or shorter fed steers and heifers meant lower-than-Choice table beef was sold at lower retail prices, or was used to increase the supply of ground beef. The mix used, reflecting summer and fall 1975 data for several chains contacted, was 3 hind quarters for every 2 fore-quarters and 50 pounds of additional lean beef purchases (for ground beef production) per quarter purchased.

The volume of beef moved for various store classes is presented in table 1. The volume of beef moving through each retail outlet of a particular size is assumed the same, regardless of distribution system. Two store sizes are examined: the smaller stores move about 2,500 retail pounds of beef a week and the larger stores, about 10,000 pounds. Chain warehouse volumes vary from 25,000 pounds weekly to over 2 million pounds.

The fore-to-hind purchase ratio affects the costs of all systems fairly equally, and it has little effect on system rankings. In the "Results" section, we outline effects of a decrease in the percentage of ground beef sold.

Several factors for which it is difficult to determine costs were not included in the analysis. These include: flexibility in sales plans, differences in handling inventories, labor relations problems, and management convenience. While the cost of a given level of inventories could be determined, the sales lost due to insufficient inventory could not be determined. An important assumption, especially for the frozen system, is that consumers were indifferent to the various systems. Existing labor agreements which may favor or require one alternative over another are also not considered.

COSTS CONSIDERED

Relevant costs in evaluating the best meat-handling system are those that would vary depending on the system used.

Cost Concepts

Some costs, such as checkout labor, trays and film, display cabinets, and various overhead costs, which are not affected by the choice of the system, were not studied. Estimates of these costs are introduced later. Only the portions of the meat-handling systems that involve the retailer are included. Internal costs of packers are not included.

About half to two-thirds of the total costs in the carcass to retail price spread for beef, which amounted to 41 cents per retail pound in 1975, are explicitly considered in the analysis. Cost components were examined and computed in considerable detail, but only the more relevant items will be discussed.

We considered three cost categories:

- 1) Investments, both for the central retail warehouse and the store,
- 2) Operations: labor at retailer's warehouse and at store, warehouse and store support, transportation from warehouse to store, price difference between buying

Table 1.—Situations analyzed by selected store size and number of stores per chain¹

Fresh beef movement per week	Small stores (Beef volume-2,505 lbs per week)			Large stores (Beef volume-10,020 lbs per week)		
	10	50	200	10	50	200
	<i>Number</i>					
Front quarters purchased	60	300	1,200	240	1,200	4,800
Rear quarters purchased	90	450	1,800	360	1,800	7,200
Retail packages excluding ground beef ²	6,000	30,000	120,000	24,000	120,000	480,000
Retail packages of ground beef ³	5,892	29,460	117,840	23,568	117,840	471,360
	<i>Pounds</i>					
Pounds of lean purchased ⁴	7,500	37,500	150,000	30,000	150,000	600,000
Pounds of ground ⁵	14,730	73,650	294,600	58,920	294,600	1,178,400
Total retail pounds ⁶	25,050	125,250	501,000	100,200	501,000	2,004,000
	<i>Dollars</i>					
Dollar volume at \$1.50 per retail pound:						
Per store	3,758	3,758	3,758	15,030	15,030	15,030
All stores	37,580	187,875	751,500	150,300	751,500	3,006,000
	<i>Miles</i>					
Average miles from retail warehouse to store	20	30	40	20	30	40

¹ All situations for both small and large store chains assume retail warehouse locations both 125 miles and 1,000 miles from packer. ² 31 packages from each front quarter plus 46 packages from each rear quarter. ³ Average 2.5 pounds per package. ⁴ 50 pounds for each quarter (from a sample of chains). ⁵ 65 pounds from each front quarter plus 37 pounds from each rear quarter plus 50 pounds of lean for each quarter. All usable trim converted to ground. ⁶ 129 pounds from each front quarter plus 109 pounds from each rear quarter plus pounds of lean beef purchased.

carcasses and boxed beef, shrinkage loss, and bone and fat salvage values,

3) Other factors: merchandising slow-moving cuts, labor coverage at stores (see Glossary); control of product, and control of accounting.

Investment Costs

Investment costs are for building and equipment of the retailer's central warehouse (where applicable) and of the stores. Retail warehouse investment comprises five cost categories: receiving and shipping dock; carcass holding cooler; processing area; selection area; and administrative and general items. Both warehouse and store investment costs were divided into a number of subcategories.²

² For example, under "selection area" in warehouse costs, the following were considered: share of building shell; rack slots; carts for tote boxes; tote boxes; forklifts; forklift batteries and chargers; and pallets.

Store investment cost components studied include: receiving scales, rails, and pallet jacks; cooler building shell and rails; cutting room building shell; slicers; tenderizers; saws; grinders;

The investment in each piece of equipment or in floor space was spread over the expected life and discounted at 10 percent per year. Costs are based on new stores and equipment. Annual costs were divided by pounds sold per year to estimate cost per pound. Investment items comprised about 15 to 20 percent of all costs considered. Note that our costs may not immediately apply if switching from one system to another occurs because some space and equipment can be converted when existing stores are being converted.

Operational Cost

Labor requirements for the retail store were determined from standards for each of several direct-labor categories, and for maintenance and sanitation (table 2). Estimates are based on typical hourly costs in 1975. Similar standards were established for central retail warehouses. Direct-labor costs were estimated from

tables; platters; platter carts; knives; wrapping area building shell and equipment; pricing equipment; display area building shell; and display cabinet.

Table 2.—Store labor standards in man-hours per unit and formulas used

Item ¹	Leaves packer as—						
	Carcass	Carcass	Primals	Carcass	Carcass	Carcass	
	Leaves retail warehouse as—						
	(6) ²	Primals (1)	Primals (5)	(7) ²	Sub-primals (2)	Fresh retail cuts (3)	Frozen retail cuts (4)
<i>Hours per unit</i>							
Receiving:							
Per quarter	0.014		NA			NA	
Per retail lb	NA		0.000024			0.000031	
Per lb lean beef	0.000021		NA			NA	
Cutting:							
Per front quarter	1.16		1.01		0.82		NA
Per rear quarter	1.15		0.99		0.75		
Steak tenderizing:							
Per front quarter			0.02				NA
Per rear quarter			0.15				
Grinding:							
Per lb			0.0023				NA
Wrapping: ³							
Per package ⁴							
Fully automatic			0.0015				NA
Manual			0.0032				
Pricing:							
Per package ⁴							
Fully automatic			0				NA
Semi-automatic			0.0015				
Display:							
Per package					0.0015		
Maintenance labor:							
Hours per week							0.042 x beef cutting, grinding, tenderizing, wrapping, and pricing labor hours per week
Sanitation labor:							
Hours per week							0.17 x beef cutting, grinding, tenderizing, wrapping, and pricing labor hours per week

Note: Numbers in parentheses refer to systems. NA means not applicable.

¹ Wages per hour used were \$9 per hour for receiving, cutting, steak tenderizing, and grinding; \$8 per hour for maintenance; and \$7 per hour for wrapping, pricing, display, and sanitation. ² Delivered direct to store; does not go through warehouse. ³ Case and Company calculates that the fully automatic wrapper is the least expensive to own and operate at greater than 5,100 packages per week. Below 5,100, the manual is the least expensive. (This assumes that for each beef package there is one nonbeef package wrapped.) ⁴ The fully automatic is used with the fully automatic wrapper, and the semi-automatic, with the manual wrapper.

recent time and motion studies conducted for ERS by Case and Company. Cooperating packers and retailers either supplied data or allowed Case and Company staff to perform economic engineering studies of operation. These standards allow for short rest breaks and delays: fatigue and delay of 20 percent at the central plant and 30 percent at the store. The greater amount of down-

time away from meat cutting at the stores is partly due to the need to respond directly to consumers and to fill the display case.

The data and methodology used for estimating product shrink are shown in table 3. A purchase shrink of 0.5 percent of the purchase weight is added when buying carcasses because it is common practice for the retailer

Table 3.—Product shrink cost at alternative purchase costs and retail sale prices¹

Cost per retail pound	Leaves packer as—						
	Carcass	Carcass	Carcass	Carcass	Primals	Carcass	Primals
	Leaves retail warehouse as—						
	Primals (1)	Sub- primals (2)	Fresh cuts (3)	Frozen cuts (4)	Primals (5)	(⁶) (6)	(⁶) (7)
	<i>Cents</i>						
\$1.10 purchase, \$1.50 retail price	² 3.10	² 3.10	³ 2.05	³ 2.05	⁴ 0.60	⁵ 2.05	⁴ 0.60
\$0.95 purchase, \$1.30 retail price	2.68	2.68	1.78	1.78	0.52	1.78	0.52
\$1.25 purchase, \$1.70 retail price	3.52	3.52	2.32	2.32	0.68	2.32	0.68

¹ Lean beef used in each system is assigned the same amount of shrink. A purchase price of \$1.10 and a retail price of \$1.50 are the base prices used throughout the study. ² (0.5 percent purchase shrink times \$1.10 purchase price per retail pound) plus (0.5 percent shrink per day nonvacuum wrapped in warehouse times 2 days) plus (0.35 percent shrink per day partially vacuum wrapped in warehouse and store times 2 days) times \$1.50 per pound at retail equals 3.10 cents per pound. ³ (0.5 percent purchase shrink times \$1.10 purchase price per retail pound) plus (0.5 percent shrink per day nonvacuum wrapped in warehouse times 2 days) times \$1.50 per pound at retail equals 2.05 cents per pound. ⁴ 0.4 percent total shrink times \$1.50 per retail pound equals 0.60 cents per pound. ⁵ (0.5 percent purchase shrink times \$1.10 purchase price per retail pound) plus (0.5 percent shrink per day nonvacuum wrapped in store times 2 days) times \$1.50 per pound at retail equals 2.05 cents per pound. ⁶ Direct delivered to the store, does not go through warehouse.

to pay for 100.5 percent of the weight received.

The rates of shrink by retail product weight sold are 0.5 percent per day for fresh nonvacuum wrapped meat; 0.4 percent for primals the packer vacuum wraps, until the package is opened; 0.35 percent per day for primals and subprimals the retailer centrally fabricates and partially vacuum wraps; and none for frozen meat. These rates are typical of rates in the meat industry (10). Average purchase cost of beef at the packer in carcass from during the study period was \$1.10 per retail pound.

The periods for which the meat is held at the retail central warehouse were standardized at 3 days for each of the distribution systems. When the meat is fabricated, it is held for 2 days before fabrication and 1 day after. The average holding time in the stores is standardized at 2 days when meat is cut at the stores, 1 day before cutting and 1 day after; and at 1 day when the stores receive retail cuts. For direct delivery of carcasses to the stores, holding time in the store is 3 days; 2 days before cutting and 1 day after. No shrinkage is applied after the cuts are retail packaged.

Two distances between the packer and retail chain warehouse were considered: 125 miles and 1,000 miles. A transportation cost differential of 5.04 cents per retail pound was used to adjust to the additional cost of the longer distance.

Transportation from warehouse to local store is a factor for five systems. As the number of stores per chain division increases, the average distances increase

(see table 1) and costs increase slightly. Firms with larger stores have about one-half cent lower costs than those with smaller stores, because each delivery is larger.

Other Costs

The higher price paid for primals than for carcasses per retail pound appears as a cost to the retailer. The transportation savings reduce costs; fewer pounds are shipped when beef is cut to primals at the packing plant. During 1975, the retailer apparently paid an average of about 5.77 cents more per retail pound for boxed beef. This difference would be the return to the packer for fabrication, vacuum packaging, and putting the primals in cartons. It is difficult and somewhat subjective to match equivalent products to accurately estimate the price difference between purchasing a carcass and buying the same quantity cut into primals and other cuts. Thus, instead of only using the 1975 estimate, we present a range of values in table 4 so that someone using the data can apply a schedule of price differences from 3 cents to 7 cents per pound.

Retailers usually buy beef per pound, and they tend to maintain their accounting records by purchase weight. However, to compare different systems, we converted all costs to the basis of a retail pound sold.

An estimate of the retail price is combined with the physical coefficients to estimate the cost due to product shrink and the cost of merchandising slow-moving cuts. Computations and results are based on a \$1.50 composi-

Table 4.—Comparison of beef-handling systems for supermarkets for all costs considered with the purchase price difference between carcass and packer primals at various levels in cents per retail pound¹

Number and size of stores per firm ⁴	125 miles from packer to supermarket							1,000 miles from packer to supermarket ²						
	Leaves packer as—													
	Carcass	Carcass	Carcass	Carcass	Primals	Carcass	Primals	Carcass	Carcass	Carcass	Carcass	Primals	Carcass	Primals
	Leaves retail warehouse as—													
Primals (1)	Sub-primals (2)	Fresh cuts (3)	Frozen cuts (4)	Primals (5)	(6) ³	(7) ³	Primals (1)	Sub-primals (2)	Fresh cuts (3)	Frozen cuts (4)	Primals (5)	(6) ³	(7) ³	
10 Small														
3 cents price difference . . .					(22.26)	(20.94)					(25.73)		(24.41)	
4 cents price difference . . .					(23.36)	(21.94)					(26.73)		(25.41)	
5 cents price difference . . .	23.37	22.96	17.82	20.60	(24.26)	(22.85)	28.41	28.00	22.86	25.64	(27.3)	27.89	(26.41)	
6 cents price difference . . .					(25.26)	(23.94)					(28.73)		(27.41)	
7 cents price difference . . .					(26.26)	(24.94)					(29.73)		(28.41)	
50 Small														
3 cents price difference . . .					(21.85)	(20.94)					(25.32)		(24.41)	
4 cents price difference . . .					(22.85)	(20.94)					(26.32)		(25.41)	
5 cents price difference . . .	22.83	22.40	17.03	19.20	(23.85)	(22.85)	27.87	27.44	22.07	24.24	(27.32)	27.89	(26.41)	
6 cents price difference . . .					(24.85)	(23.94)					(28.32)		(27.41)	
7 cents price difference . . .					(25.85)	(24.94)					(29.32)		(28.41)	
200 Small														
3 cents price difference . . .					(21.87)	(20.94)					(25.34)		(24.41)	
4 cents price difference . . .					(22.87)	(21.94)					(26.34)		(25.41)	
5 cents price difference . . .	22.84	22.44	16.86	18.94	(23.87)	(22.85)	27.88	27.48	21.90	23.98	(27.34)	27.89	(26.41)	
6 cents price difference . . .					(24.87)	(23.94)					(28.34)		(27.41)	
7 cents price difference . . .					(25.87)	(24.94)					(29.34)		(28.41)	
10 Large														
3 cents price difference . . .					(18.59)	(17.86)					(22.06)		(21.33)	
4 cents price difference . . .					(19.59)	(18.86)					(23.06)		(22.33)	
5 cents price difference . . .	19.58	19.09	15.30	17.45	(20.59)	(19.77)	24.62	24.13	20.34	22.49	(24.06)	24.81	(23.33)	
6 cents price difference . . .					(21.59)	(20.86)					(25.06)		(24.33)	
7 cents price difference . . .					(22.59)	(21.86)					(26.06)		(25.33)	
50 Large														
3 cents price difference . . .					(18.58)	(17.86)					(22.05)		(21.33)	
4 cents price difference . . .					(19.58)	(18.86)					(23.05)		(22.33)	
5 cents price difference . . .	19.55	19.09	15.03	17.05	(20.58)	(19.77)	24.59	24.13	20.07	22.09	(24.05)	24.81	(23.33)	
6 cents price difference . . .					(21.58)	(20.86)					(25.05)		(24.33)	
7 cents price difference . . .					(22.58)	(21.86)					(26.05)		(25.33)	
200 Large														
3 cents price difference . . .					(18.64)	(17.86)					(22.11)		(21.33)	
4 cents price difference . . .					(19.64)	(18.66)					(23.11)		(22.33)	
5 cents price difference . . .	19.59	19.14	14.98	16.97	(20.64)	(19.77)	24.63	24.18	20.02	22.01	(24.11)	24.83	(23.33)	
6 cents price difference . . .					(21.64)	(20.86)					(25.11)		(24.33)	
7 cents price difference . . .					(22.64)	(21.86)					(26.11)		(25.33)	

Note: Numbers in parentheses refer to systems.

¹ Costs that do not vary because of type of handling system are not included in most cases; see text for details. ² Firms 1,000 miles from the packer have an additional 5.04 cents per retail pound cost over those 125 miles from the packer to reflect the transportation differences for all systems except 5 and 7. Since fewer pounds of primals are transported, the cost per retail pound sold is lower (\$3.47) for the 5 and 7 systems. ³ Delivered direct to store, does not go through warehouse. ⁴ Each number and size of stores per firm category is computed at five different price levels for packer carcass price versus primal price (range used is 3 - 7 cents per retail pound).

retail price. The effect of higher and lower retail price assumptions on shrink estimates is shown in table 3. Retail prices significantly affect costs. The systems wherein the retailers buy carcasses involve more shrinkage loss than the systems wherein they buy vacuum-packaged primals. Thus, shrinkage costs of the boxed beef system are relatively lower at more distant points from the packer than those of the other systems.

Costs for the various systems are presented in table 4 and the figure. Costs for boxed beef in table 4 were computed using price differences varying from 3 to 7 cents per retail pound between boxed beef and carcass quarters. The figure is based on a price difference of 5 cents. Most of the discussion of results will be based on the 5-cent difference, apparently the current average for the industry.

RESULTS

Centralized cutting to fresh retail cuts (system 3) is by far the cheapest system, whether a firm has few or many stores or these are small or large. Distance from the packer does not affect this ranking. Lower costs come mainly from labor savings, lower store support costs, and a smaller cost of merchandising slow-moving cuts.

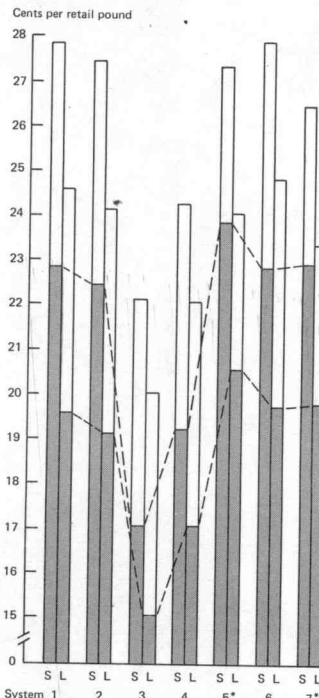
Central cutting to frozen cuts (system 4), however, has only slightly higher costs (about 2 cents per retail pound) than fresh cuts, and the products have a much longer shelf life. If consumers accept a switch to all frozen cuts, there could well be flexibility possible for management, not considered in this study, which would make the frozen system preferable over the fresh system. However, the 10-store small chain has significantly higher costs for the frozen cuts (system 4) because store volume is not large enough to make efficient use of the freezing equipment.

Number of stores per firm does not significantly affect the cost (except for the very smallest firms) of the systems studied, but the size does. Large stores (beef sales of about \$15,000 per week) enjoy a 2-4-cent advantage over small stores (beef sales of about \$3,760 per week), depending on the system. Small stores use equipment or building space less effectively. Large stores have about one-half cent less cost for plant to store transportation, as each delivery is larger. The figure indicates the difference in costs by store size and system, as well as the transportation cost differential (5.04 cents per retail pound for carcass).

Ranking the Systems

Depending on the price difference used for boxed beef over carcasses, boxed beef can rank either as the

FIGURE 1
Costs for selected meat-handling systems,
retailers with 50 stores per firm division, \$1.50
per retail pound



*Assumes a price difference of 5 cents between boxed beef and carcasses.

Note: Shaded portion of bar is cost when retail warehouse is 125 miles from packer; entire bar indicates costs at 1,000 miles.

S = small supermarkets. L = large supermarkets.

next lowest in cost (system 7) after the retail warehouse cutting to retail cuts (systems 3 and 4), or as the highest in cost (system 5). Assuming the 5-cent difference to buy primals, the third lowest cost system at 125 miles is the retail warehouse cutting to subprimals (system 2), while boxed beef delivered direct to the store (system 7) ranked third for firms 1,000 miles from the packer. The chart indicates all systems except the central cutting to retail cuts (systems 3 and 4), are very similar in costs. As the distance from the packer increases, the packer cut primal systems (5 and 7) become more attractive; transportation costs are lower because fewer pounds are moved.

Note that the boxed beef systems have the processing cost and profit included in the primal cost difference, whereas the retail warehouse breaking or cutting systems include processing costs but not profits.

For all store number and size classifications, it appears slightly more economical for retail warehouses to break carcasses to subprimals (system 2) rather than stopping at primals (system 1). The traditional carcass system (6) usually costs slightly more than if the retailer breaks to primals or subprimals (systems 1 or 2) at a warehouse. However, there does not appear to be a clear advantage; the traditional carcass system does not seem as inefficient as many persons have implied.

Chain warehouse receipt of vacuum-laminated, wrapped boxed beef delivered to the stores by the retailer (system 5) is more expensive than direct delivery to the stores by the packer of the same boxed beef (system 7). The first system requires extra handling in unloading and loading at the warehouse, and it ranks last in least cost for stores 125 miles from the packer. Its disadvantage is reduced relative to other systems with an increase in distance, ranking fourth at 1,000 miles from the packer.

Specific Cost Example

To provide a more complete breakdown of costs, we show a specific situation in table 5. Detailed cost budgets appear for each meat-handling system for a 50-store chain. Stores average \$3,760 in beef sales per week, and are about 1,000 miles from the packer. A 5-cent per pound packer primal price difference is used.

The base or zero value used in our study is carcass beef delivered to a retail warehouse 125 miles from the packer. Costs included are only those considered relative or additional to this base cost of the product. Table 4 uses this base. The additional transportation charge for delivery 1,000 miles from the packer to the retail chain warehouse is included in table 5. However, it is not the total transportation cost.

Table 5 provides subtotals for warehouse, store, and other costs. The data given for this specific example were completed for all situations examined and are available from the authors. Warehouse costs are the same regardless of distance, when the system, store size, and number of stores are compared. Store costs for a meat-

handling system differ based on store size, but not on number of stores per chain. Alternatively, warehouse cost variations occur both as a result of the number and size of stores.

Total costs included in table 4 vary from about 15 to 25 cents per retail pound, not including transportation to the chain warehouses for supermarkets 125 miles from the packer. A similar range exists, but with about 5 cents added for transportation, for firms 1,000 miles from the packer.

Costs Excluded. Costs we included are mostly those that vary only by type of handling system. Other costs not considered that retailers incur include about 0.5 cent per retail pound for checkout labor, 2 cents for trays and film, 1.5 cents for advertising, 0.5 cent for interest, and 0.13 cent for display equipment. In addition, there are division headquarters expenses for management, accounting, ordering, and so on. A portion of the store management, the parking lot, and various other overhead expenses have not been included. A final cost would be profits. USDA price spreads for carcass beef indicate an average spread of about 41 cents during 1975 for total costs after the beef arrives in the city where it is consumed. Only a small portion of this spread is profits.

Ground Beef Percentage. The results presented are based on an abnormally high proportion of ground beef in the mix of products sold (59 percent of the total retail weight). This unusual share was a result of the market situation existing in 1975. When results were evaluated at a more normal hamburger percentage (29 percent), the ranking of the seven systems was found relatively insensitive to a change in mix of this magnitude (see table 6). Cost of all systems increases absolutely with a lower ground beef sales mix, and boxed beef cost (systems 5 and 7) rises at a slightly greater rate than in the other systems. Major changes occurred in the product purchase and labor cost areas.

IMPLICATIONS

Based on results of our study, boxed beef is not necessarily as great a cost saver as many persons have assumed. The breaking to primals or subprimals at the packing plant has extra costs which counter the savings in labor and transportation. These include the cost of the vacuum bag and box. If the carcass is broken to retail cuts and packaged for the consumer, the meat need not be packaged twice. However, going to retail cuts right away means that fresh beef has only a few days shelf life; thus breaking would probably need to be done at a retail warehouse rather than at the packer. If the meat is frozen, it could be broken down either by the packer or the retail warehouse. A big question is whether the consumer can be convinced to buy mostly meat that is frozen. Central cutting by packers to retail

Table 5.—Detailed cost breakdown for chain of 50 small stores 1,000 miles from packer using \$1.50 retail price per pound and packer primal price 5 cents more than carcass price¹

Costs considered	Leaves packer as—						
	Carcass	Carcass	Carcass	Carcass	Primals	Carcass	Primals
	Leaves retail warehouse as—						
	Primals (1)	Sub-primals (2)	Fresh cuts (3)	Frozen cuts (4)	Primals (5)	(²) (6)	(²) (7)
<i>Cents per retail pound</i>							
Warehouse:							
Investment	0.72	0.79	1.39	1.76	0.32	0.00	0.00
Labor	1.34	2.65	7.14	7.14	0.15	0.00	0.00
Support ³	0.47	0.70	0.81	3.15	0.10	0.00	0.00
Total, warehouse	2.53	4.14	9.34	12.05	0.57	0.00	0.00
Store:							
Investment	3.35	3.32	1.91	1.91	3.35	3.44	3.35
Labor	9.67	8.56	1.08	1.08	9.67	10.61	9.67
Support ³	1.92	1.68	0.20	0.26	1.92	2.10	1.92
Labor coverage ⁴	0.23	0.52	2.13	2.13	0.23	0.00	0.23
Total, store	15.17	14.08	5.32	5.38	15.17	16.15	15.17
Other:							
Purchase premium ⁵	0.00	0.00	0.00	0.00	3.20	0.49	3.73
Shrinkage ⁶	3.10	3.10	2.05	2.05	0.60	2.05	0.60
Salvage income ⁷	(0.97)	(1.24)	(1.40)	(1.40)	(0.26)	(0.53)	(0.26)
Warehouse to store transportation	0.94	0.94	1.07	1.12	0.94	0.00	0.00
Merchandising slow-moving cuts ⁸	1.94	1.29	0.65	0.00	1.94	4.31	1.94
Control of product ⁹	0.12	0.09	0.00	0.00	0.12	0.31	0.12
Accounting control ¹⁰	0.00	0.00	0.00	0.00	0.00	0.07	0.07
Total, other	5.13	4.18	2.37	1.77	6.54	6.70	6.20
Transportation increase to 1,000 miles ¹¹	5.04	5.04	5.04	5.04	5.04	5.04	5.04
Total, costs considered	27.87	27.44	22.07	24.24	27.32	27.89	26.41

Note: Numbers in parentheses in boxheads refer to systems. In field they denote negative amounts.

¹ Costs that do not vary by type of handling system are not included in most cases; see text for details. ² Delivered direct to store, does not go through warehouse. ³ Includes maintenance, sanitation, carbon dioxide, electricity and so on. ⁴ Minimum labor required at store by union and for customer service. ⁵ Primal over carcass price difference and transportation relative to a carcass delivered to the retail warehouse. ⁶ Shrinkage explained in table 3. ⁷ Gain in value from fat and bone trim. ⁸ Includes the need to modify cut prices to move cuts in proportion purchased and display case pullbacks because of cut deterioration. ⁹ Costs incurred when consistent product trim is not maintained. ¹⁰ The additional accounting costs with direct delivery to stores. ¹¹ The additional transportation cost per retail pound incurred by retail firms with warehouses located 1,000 miles from the packer compared with retailers with warehouses located only 125 miles from the packer.

cuts might reduce retailer merchandising flexibility as the packer standardizes cuts.

Centralization of the retail cutting process by retailers appears to have considerable cost advantages. Larger stores have economies of scale in handling meat over small stores, regardless of system used. When there were a greater number of stores per chain, significant economies did not occur.

Transition to a central system will not occur smoothly unless management and labor satisfactorily work out procedures to handle the labor displaced and to retire the existing capital facilities. Traditional carcass delivery

to the store will probably not disappear from the scene, given its moderate cost ranking, particularly in areas near packing plants. However, in more distant areas, it is probable that a variety of systems will compete with each other, as the third through seventh ranked systems are fairly close together in costs.

Although very small stores and independents served by voluntary or cooperative wholesalers were not specifically considered, these retailers would not have the volume needed to operate a centralized cutting facility. However, affiliation with a wholesaler might give these stores the same advantage as a chain if services are per-

Table 6.—Cost sensitivity of moving from 59 to 29 percent ground beef (retail pounds), chain of 50 small stores 1,000 miles from packer¹

Cost item	Leaves packer as—						
	Carcass	Carcass	Carcass	Carcass	Primals	Carcass	Primals
	Leaves retail warehouse as—						
	Primals (1)	Sub-primals (2)	Fresh cuts (3)	Frozen cuts (4)	Primals (5)	(²) (6)	(²) (7)
<i>Change in costs, cents per retail pound</i>							
Warehouse grinding equipment	(³)	(³)	(³)	(³)	(²)	(²)	(²)
Warehouse cutting equipment	(³)	(³)	(³)	(³)	(²)	(²)	(²)
Product purchase premium ⁴	0(base)	0(base)	0(base)	0(base)	+2.3	0(base)	+2.3
Product salvage	0.4	0.5	0.6	0.6	0.1	0.2	0.1
Warehouse labor	0.4	0.8	2.0	2.0	0	(²)	(²)
Store labor	1.5	1.1	0	0	1.5	1.9	1.5
Merchandising slow-moving cuts	0	0	0	0	0	0.4	0
Labor coverage	0.1	0.2	0.5	0.5	0.1	0(base)	0.1
Control of product	0.1	(³)	0	0	0.1	0.2	0.1
Total change (increase in cost)	2.5	2.6	3.1	3.1	4.1	2.7	4.1

¹ Only those costs affected are listed. ² Delivered direct to store, or not applicable. ³ Less than 0.005. ⁴ Would vary relative to difference used between carcass price and primal price.

formed by the wholesaler for them. For larger firms a centralized cutting plant (systems 3 and 4) seems to be less expensive than buying boxed beef (systems 5 and 7).

We did not, as mentioned, examine packer costs, but rather used the price differential between carcasses and packer-cut primals. A range of costs for different price differentials was provided in table 4 to show the sensitivity of the packer systems to others as price differentials vary. Only a few firms currently cut a carcass into retail cuts (systems 3 and 4). A fairly large number break a carcass to primals and subprimals before distributing to their stores. One reason there are few such retail centralized cutting operations is the large investment required and the sunk cost of existing facilities.

While we did not specifically address labor implications, we do include the amount and location of labor needed for each system. Systems 1 through 4 shift varying amounts of labor from the local store to the retailers' warehouse. The need to stock shelves and to provide customer service means all stores require some meat department personnel, but job descriptions and wage levels might differ if less cutting is done at retail. Many of the meatcutters not needed in local stores could be shifted to the retailers' warehouse where additional labor would be required. Since the warehouse might be across town, getting to work could be considerably more difficult unless the employee moves. Warehouse wage rates would probably be similar to store rates.

Systems 5 and 7, using boxed beef, shift a portion of the labor from the store or warehouse to the packing

plant. This would probably mean a shift to another geographic area for the employee. The cutting functions shifted from the retailer to the packer are done by another firm in the boxed beef systems, making transfer of meatcutters more difficult than it would be in the same firm. Packers are normally located in production areas and these areas commonly have lower wage rates. Individual meatcutters may be unwilling to move and seek the lower paying jobs.

Moving a portion of the meatcutting to central warehouses or to packing plants allows for the use of disassembly lines and specialization of tasks. This efficiency is partially lost because some people must remain at local stores to stock and serve customers when the store is open. Thus, the number of people employed, while dropping slightly, is not as serious a problem as the relocation aspects. Centralization of meat cutting requires better forecasting of individual stores' demand for meat cuts. Forecasting can also help schedule labor more efficiently and possibly reduce the amount required.

Ultimately, specific characteristics of the firm and its management's judgment regarding intangibles will determine to a large extent the beef-handling system adopted. A firm viewing its competitive situation as favorable, and its pool of managerial resources as limited, may well opt for a particular system even though it may be slightly more costly. As retailers continue to sell beef in cut proportions different than those found in the animal, boxed beef offers advantages over systems requiring sale of the total carcass. Given consumer pressures for lower beef

GLOSSARY

- Boxed beef*—Beef cut to primals, subprimals, or both, vacuum-wrapped, and placed in cartons by the packer.
- Capital budgeting*—Series of decisions by individuals and firms concerning how much and where resources will be obtained and expended, setting standards for project acceptability, evaluating individual projects, and determining the source of capital to be used.
- Carcass proportion*—Amounts of each cut found in a beef carcass. When looking at retail cuts to obtain an accurate composite price, the user must weight all cuts as they are found in the carcass.
- Central breaking*—Carcasses broken to primals, subprimals, or both at the retailer's central warehouse.
- Central cutting*—Meat cut completely to retail cuts and packaged before delivery to local stores. It could be done by packers, but it is usually done at retail chain warehouses.
- Chain warehouse*—Central plant used by the chain to assemble, store, and distribute the product to local stores. In several of the systems examined, this facility processes the beef.
- Composite price*—Price of each cut weighted by its respective weight in the carcass.
- Cost per retail pound*—Cost per pound of beef sold. The records of pounds entering the retail store differ by system. Putting them all on a retail pound basis facilitates comparisons among systems.
- Fabrication*—Breaking and cutting of beef from carcass to retail cuts, wherever done and whether done partly or entirely.
- Fed beef*—Beef from animals fed rations that were largely grain for a period before slaughter.
- Industrial engineering approach*—Application of engineering techniques for collecting data on the operation of a large plant.
- Labor coverage*—Minimum labor required at store for customer service, regardless of volume, and to meet union agreements for staffing.
- Merchandizing slow-moving cuts*—The modification of prices to move cuts in proportion to purchases and to loss from product deterioration.
- Nonfed beef*—Beef from animals mainly fed grass or roughage, with little or no grain.
- Physical coefficients*—Basic, physical input; for instance, minutes of labor to do a job, not the dollar cost for labor.
- Primals*—Major divisions of the carcass, such as rounds, loins, chucks.
- Retail cuts*—Cuts sold by retailers and purchased by consumers.
- Subprimals*—Division of primals into smaller cuts, but not all the way to retail cuts; for instance, rounds to top round, bottom round, and knuckle.
- Systems*—Methods or channels of product flow, and locations of meat cutting, selected for analysis.