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Economics of Central Retail Packaged Beef*

by

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Abstract

The general objective of this study was to evaluate the economics of alternative technologies, systems and methods of fabricating and marketing retail packaged beef. A national beef distribution model (VAL-ADD) was developed and used to compare the economics of various case-ready systems with the conventional system of fabricating beef in the back room of the retail store. The VAL-ADD model identifies beef price premiums and/or discounts by packaging system for each of 30 regional distribution routes within the contiguous United States. In addition it estimates the competitive advantage of regions in central packaging. The Central and Southern Plains areas have a competitive advantage in producing prepackaged retail beef and retailers with high labor costs have the greatest incentive to buy it.

Introduction

Despite general adoption of central case-ready packaging for fresh poultry and processed red meat, adoption of central packaged case-ready beef in the United States has been slow. Fresh red meat items are instead generally fabricated and packaged in the back room of individual retail stores. There are examples of fresh case-ready beef, pork and lamb packaging operations in the United States, but they account for a small volume of the fresh beef, pork and lamb sales. Adoption involves complex decisions about merchandising, economics, labor relations and management. Case-ready beef appears to have the best cost

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advantage where store meat department wages are the highest and where slow moving products and differentiated products (branded products) are involved. Some people suggest that appropriate packaging technology is still not available for widespread adoption. A new modified atmosphere package currently (1991) being tested for pork may be cost effective for beef in some markets.

This research compares the economics of five case-ready packaging/distribution systems with the conventional system of boxed beef delivered to retail stores where retail cuts are fabricated and packaged. The study presumed that if fabrication and marketing costs can be sufficiently reduced by central packaging, it would provide an opportunity to promote such products based on price. However, some case-ready products have an appearance problem and price discounts may be necessary to encourage consumers to try such products and learn of their merits. Among the five systems evaluated, only the fresh vacuum and frozen vacuum packaged lack the bright red fresh cut appearance. Tray-ready is different from the other case-ready systems in that it is centrally fabricated into retail cuts and vacuum packaged in the original subprimal cut. The retail cuts are removed from the vacuum package and re-packaged as retail cuts at the store.

Changes in the fresh meat industry have tended to be evolutionary rather than revolutionary. Large food chains introduced boxed beef in the 1950's and it was relatively easy to combine with their central meat warehouse operations. A more difficult problem was moving excess retail store labor to the meat warehouse to perform the fabrication.

Meat packers a decade later moved into boxed beef fabrication and met with resistance from retail labor unions. It was not until wage rates at retail increased relative to packer wages that boxed beef became generally adopted.

Technology is now available to move the retail packaging back to the processing plants, but the retail package that provides the longest shelf life is a vacuum package that does not have the attractive bright red color of the store cut package. It will apparently take the meat industry and consumers some time to adjust and fully adopt central retail packaging of fresh beef. In some areas there appears to be a clear economic incentive.

Objective

The primary objective of this research was to evaluate the cost of different fabricating and packaging systems and the competitive advantage of different production regions in supplying stores with case-ready beef.

Method of Analysis

The approach has been to design a national beef fabrication and distribution model (VAL-ADD) that consists of 30 production, fabrication/marketing and consumption regions. This is a linear programming transhipment model that allows four case-ready, a tray-ready, a conventional boxed beef, and an HRI system to compete simultaneously on a least cost basis for beef markets in all areas of the United States. It achieves a national equilibrium solution among seven fabrication and packaging activities among 30 regions. Budgets were developed to include all costs from the carcass leaving the packer cooler until retail packages are sold in food stores, or until HRI products are ready for cooking. The results provide estimates of premiums and discounts required for each system to compete. If the industry moves further with case-ready adoption, these estimates should be useful guides for retail firms in various regions concerning case-ready systems most likely to provide a competitive advantage in competing for beef markets.

Data

National surveys were conducted of major trucking firms to obtain data for developing regional transportation costs. The methodology for development of regional transportation costs are available in Ward, Farris and Dietrich. Beef industry processing and fabrication labor cost data were obtained directly from beef packers, fabricators and retailers for 1989-90. A minimum of three to five firms were contacted in each region for labor cost data. Budget data for the packaging/fabrication systems were obtained directly

through personal interviews with beef packers, fabricators, retailers and packaging companies who were merchandising case-ready products. Budgets assumed fabrication plants large enough to deliver in truckload lots to their relevant market area. Regional demand and supply estimates were developed for each of the 30 regions from secondary data. Details of the data sources and methodology for developing estimates are available in Dietrich, Farris and Ward. A detailed description of the packaging systems is in the Appendix.

Results

Budgets for each system show that the vacuum package system is the lowest cost system and can reduce the cost of retail beef by as much as ten cents per pound compared to the conventional boxed beef system. Tray-ready and central overwrap follow in that order in cost advantage. When start up merchandising costs are considered and no adjustments in retail store labor are made, these costs are very close to that of the conventional system on the average (Table 1). However, for case-ready beef supplied from the Plains and Western Corn Belt to the East and West coasts case-ready has a cost advantage (Figure 1). For example, the cost of Colorado beef retailed in Northern California was 5.28 cents per retail pound higher in the boxed beef system than the vacuum packaged system. On the other hand, Colorado shipped boxed beef to New Mexico and Arizona because the lower wage rate made boxed beef the lower cost system (Figure 1). These results are based on simultaneous consideration of optimal distribution with HRI beef (Figure 2). Demand for HRI beef for purposes of this study is limited to a constant 30 percent of the total beef supply. The competitive advantage for this activity goes to local fabricators and to those operators in the Plains that have lowest labor costs--as it is the most labor intensive of the systems.

Once case-ready adoption has progressed to the point of general acceptance by consumers and the trade; the average cost of all the case-ready systems were below that of boxed beef except for the gas-flush package which was about three cents per pound higher (Tables 2, 3 and 4). This assumes that general acceptance results in decreased merchandising costs compared to initial start-up costs and relatively fewer cutters in the meat department. Trade sources expect to see a lower cost gas-flush (modified atmosphere) package available in 1992 that is expected to be cost competitive with boxed beef. The vacuum package system has a cost advantage over boxed beef on the average of 8.85 cents, but for some routes it is over ten cents per pound.

The main source of cost advantage by central vacuum is its three week shelf life and reduced store shrink of about 2 percent. Boxed beef and central overwrap, on the other hand, are estimated to have an average store shrink of 7 percent or about 18 cents per pound of retail product (Table 4). This is followed by tray-ready at 15 cents per pound at 1988 prices and costs.

Fabrication of retail cuts is a labor intensive activity and this is a source of considerable cost variation among systems and among regions. The average labor cost for boxed beef was 28.42 per pound, whereas, tray-ready was seven cents lower at 21.28 cents per pound (Table 2).

Budgets for Individual Routes

Variation in labor costs can be better understood by comparing budgets of individual routes. For example, the highest average retail labor cost reported was in Northern California at $20.25 per hour including fringe benefits. The total labor cost for boxed beef shipped from Nebraska was 40.30 cents per retail pound and 37.56 of this was for retail labor (Table 5). The average Nebraska labor cost per hour was $8.36. All labor cost data is for 1988-1989 and includes fringe benefits.

One of the lowest boxed beef labor costs was in South Texas at $7.60 per hour for packers and $10.63 per hour for retail meat departments. Boxed beef labor cost per retail pound in South Texas was 22.21 cents, of which 19.72 cents was retail store labor. Vacuum packaged beef in South Texas (Region 11 to Region 11) cost only 19.26 cents for labor with only 10.19 cents of that being retail labor. Meanwhile, the labor cost reduction was the greatest from Grand Island to Northern California from vacuum package at 29.40--10.9 cents per pound below the boxed beef

Table 1. Beef and packaging/distribution cost, by system and cost categories, packers, retailers, and total costs, short-run adoption, 1988(a).

Item	Boxed Beef	Tray-Ready	Central Overwrap	Central Vacuum	Central Gas	Central Frozen	Central HRI
	dollars/cwt						
PACKERS:							
Carcass	165.48	165.48	165.48	165.48	165.48	165.48	165.48
Fixed	0.84	1.10	1.00	1.18	1.18	1.18	0.93
Labor	2.86	5.53	9.73	9.76	9.76	9.76	16.06
Package	2.24	2.60	5.21	10.10	18.43	10.10	10.10
Distribution	2.75	2.75	5.35	2.75	3.72	2.27	4.20
Other	2.86	10.03	10.34	10.34	11.34	16.04	11.78
Sub-Total	177.03	187.49	197.11	199.61	209.91	204.83	208.55
RETAILERS:							
Fixed	7.72	6.72	6.32	6.32	6.32	8.49	13.52
Labor	25.56	15.75	14.59	14.63	14.63	14.63	19.63
Package	5.20	5.20	0.00	0.00	0.00	0.00	0.00
Distribution	3.11	3.11	0.00	3.11	3.53	2.57	3.70
Other	24.89	26.39	28.64	19.99	21.04	19.99	11.29
Sub-Total	66.48	57.17	49.55	44.05	45.52	45.68	48.14
TOTAL COST:							
Carcass	165.48	165.48	165.48	165.48	165.48	165.48	165.48
Fixed	8.56	7.82	7.32	7.50	7.50	9.67	14.45
Labor	28.42	21.28	24.32	24.39	24.39	24.39	35.69
Package	7.44	7.80	5.21	10.10	18.43	10.10	10.10
Distribution	5.86	5.86	5.35	5.86	7.25	4.84	7.90
Other	27.75	36.42	38.98	30.33	32.38	36.03	23.07
Total System(a)	243.51	244.66	246.66	243.66	255.43	250.51	256.69

Source: Estimated from information provided mostly by trade sources.

(a) Assumes short-run merchandising and other costs of $9/cwt for the case ready systems. Long-run costs are shown in Table 4. Higher 1990 carcass costs would increase these total costs by about $15/cwt.

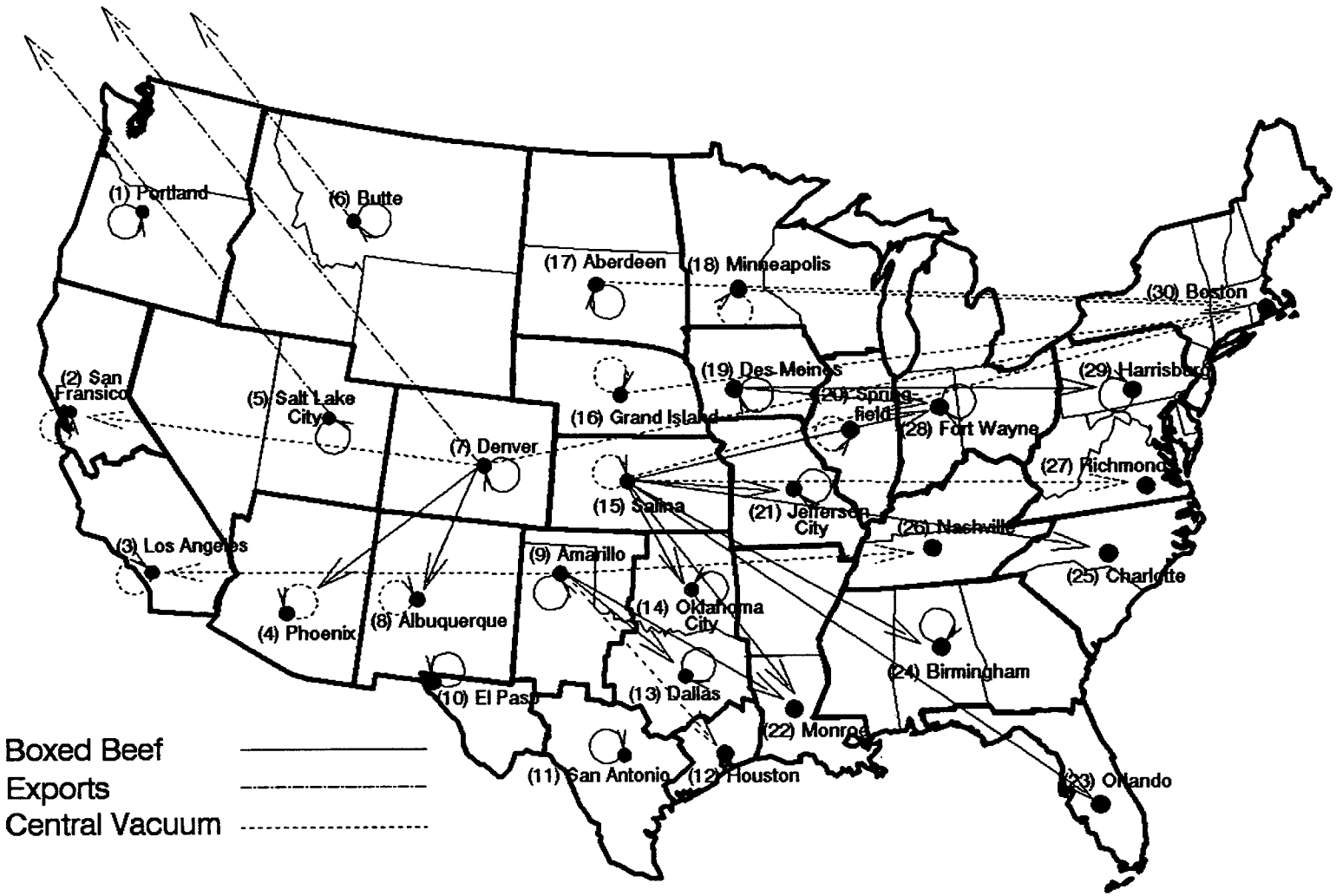

Figure 1. Optimal distribution of boxed beef and vacuum packaged beef with initial start-up merchandising costs

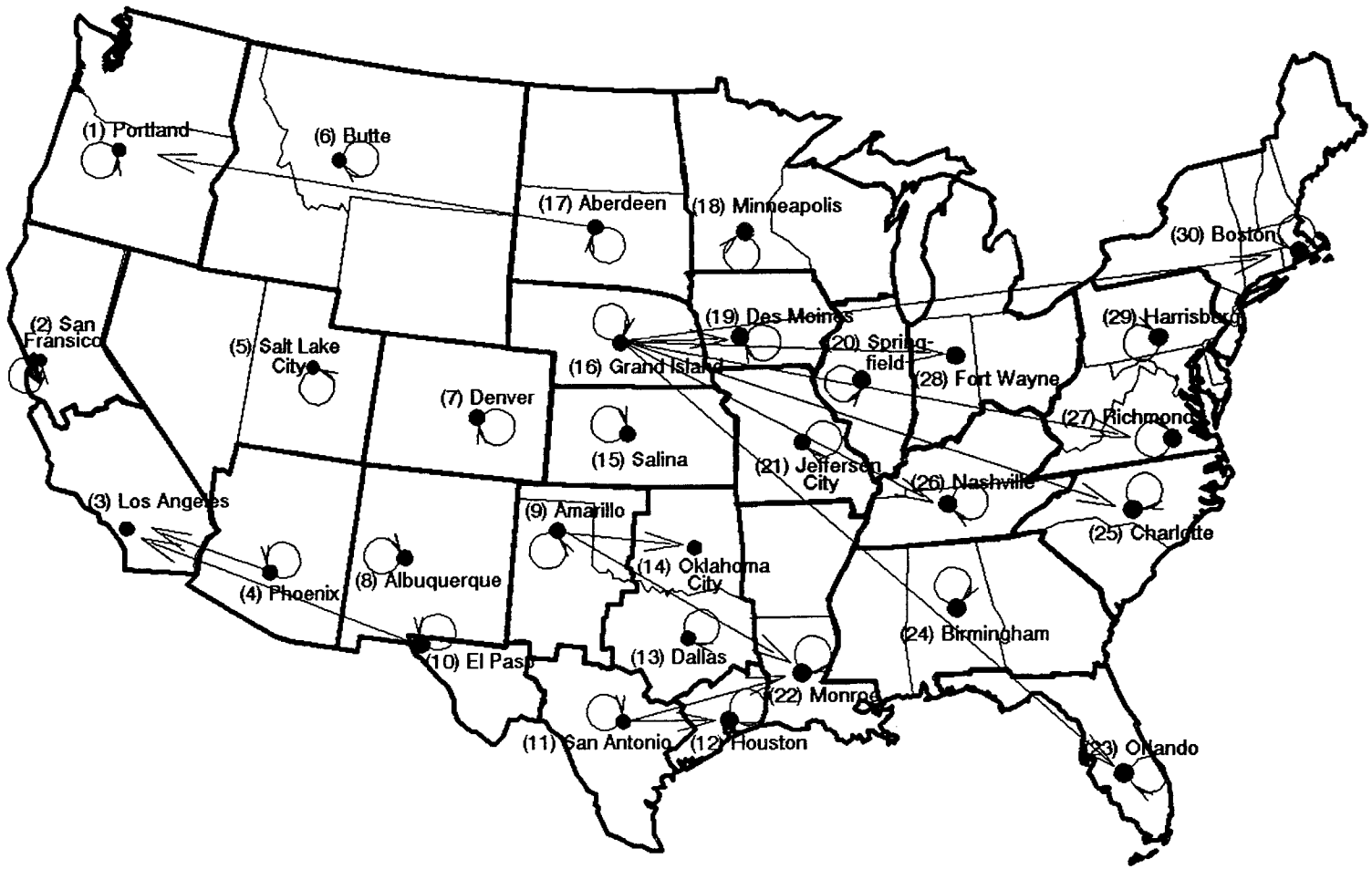

Figure 2. Optimal distribution of HRI beef with initial start-up merchandising costs

Table 2. Beef and packaging/distribution cost, by system and cost categories, packers, retailers, and total costs for long-run adoption, 1988(a).

	System						
Item	Boxed Beef	Tray-Ready	Central Overwrap	Central Vacuum	Central Gas	Central Frozen	Central HRI
	dollars/cwt						
PACKERS:							
Carcass	165.48	165.48	165.48	165.48	165.48	165.48	165.48
Fixed	0.84	1.10	1.00	1.18	1.18	1.18	0.93
Labor	2.86	5.53	9.73	9.76	9.76	9.76	16.06
Package	2.24	2.60	5.21	10.10	18.43	10.10	10.10
Distribution	2.75	2.75	5.35	2.75	3.72	2.27	4.20
Other	2.86	5.53	5.84	5.84	6.84	11.54	11.78
Sub-Total	177.03	182.99	192.61	195.11	205.41	200.33	208.55
RETAILERS:							
Fixed	7.72	6.72	6.32	6.32	6.32	8.49	13.52
Labor	25.56	15.75	14.59	14.63	14.63	14.63	19.63
Package	5.20	5.20	0.00	0.00	0.00	0.00	0.00
Distribution	3.11	3.11	0.00	3.11	3.53	2.57	3.70
Other	24.89	21.89	24.14	15.49	16.54	15.49	11.29
Sub-Total	66.48	52.67	45.05	39.55	41.02	41.18	48.14
TOTAL COST:							
Carcass	165.48	165.48	165.48	165.48	165.48	165.48	165.48
Fixed	8.56	7.82	7.32	7.50	7.50	9.67	14.45
Labor	28.42	21.28	24.32	24.39	24.39	24.39	35.69
Package	7.44	7.80	5.21	10.10	18.43	10.10	10.10
Distribution	5.86	5.86	5.35	5.86	7.25	4.84	7.90
Other	27.75	27.42	29.98	21.33	23.38	27.03	23.07
Total System	243.51	235.66	237.66	234.66	246.43	241.51	256.69

Source: Estimated from information provided mostly by trade sources.

(a) Average costs for 48 states in terms of 1988 prices. Higher carcass prices in 1990 would increases these total costs by about $15/cwt.

(b) Details are in Table 3.

(c) Details are in Table 4.

Table 3. Other operating costs, by system, packers, 1988(a).

Item	Boxed Beef	Tray-Ready	Central Overwrap	Central Vacuum	Central Gas	Central Frozen	Central HRI
	dollars/cwt						
Utilities	0.78	1.28	1.53	1.53	2.53	3.53	1.78
Supplies	0.34	0.40	0.46	0.46	0.46	0.46	0.50
Variable Interest	0.11	0.15	0.15	0.15	0.15	0.15	0.25
Sales & Advertising (b)	0.48	1.85	1.85	1.85	1.85	3.70	5.55
Earnings Before Taxes (c)	1.15	1.85	1.85	1.85	1.85	3.70	3.70
Total Other Cost	$2.86	$5.53	$5.84	$5.84	$6.84	$11.54	$11.78

Source: Estimated from personal interviews with beef fabricators and from industry financial reports in Meat Facts, AMI.

(a) Assumes an average sales price of $165/cwt for boxed beef (AMI Meat Facts, 1989).

(b) Tray-Ready, Central Overwrap, Central Vacuum, and Central Gas=1%, Central Frozen=2%, and Central HRI = 3% of the wholesale boxed beef price in retail terms ($185/cwt).

(c) Boxed Beef = 0.7% of $165/cwt. Tray-Ready, Central Overwrap, Central Vacuum, Central Gas, and Central Frozen=1%, and Central HRI=2% of the wholesale boxed beef price in retail terms, $185/cwt.

Table 4. Other operating costs, by system, retailers, 1988 (a).

	Boxed Beef	Tray-Ready	Central Overwrap	Central Vacuum	Central Gas	Central Frozen	Central HRI
	dollars/cwt						
Store "Shrink" (b)	17.80	15.30	17.80	7.60	10.20	7.60	5.10
Supplies	1.00	0.50	0.25	0.25	0.25	0.25	0.10
Sales & Advertising (c)	1.00	1.00	1.00	2.55	1.00	2.55	1.00
Income & Other (d)	5.09	5.09	5.09	5.09	5.09	5.09	5.09
Total Other Cost	$24.89	$21.89	$24.14	$15.49	$16.54	$15.49	$11.29

Source: estimated from personal interviews with retailers and from published sources such as Bishop and Duewer.

(a) Assumes a retail value of $255/cwt.

(b) 7% store cut "shrink", 2% on vacuum package (Bishop, 8%,3%).

(c) 1% of sales for central vacuum and central frozen.

(d) 2% of average retail beef price ($255/cwt).

Table 5. Comparison of budgets for boxed beef with budgets for tray-ready and vacuum package, 1988

Cost Item	Route: Amarillo to TX-OK Pan. (9 TO 9)			Amarillo to S. CA (9 TO 3)			Amarillo to E. TX (9 TO 13)			San Antonio to S. TX (11 TO 11)			Salina to VA-WVA-MD-DE (15 TO 27)			Salina to Kansas (15 TO 15)			Grand Island to N. CA (16 TO 2)			Grand Island to North East (16 TO 30)		
	B.B.(a)	T.R.(b)	C.V.P.(c)	B.B.	T.R.	C.V.P.	B.B.	T.R.	C.V.P.	B.B.	T.R.	C.V.P.	B.B.	T.R.	C.V.P.	B.B.	T.R.	C.V.P.	B.B.	T.R.	C.V.P.	B.B.	T.R.	C.V.P.
	$/cwt – retail weight																							
(1) Package cost	7.44	7.80	10.10	7.44	7.80	10.10	7.44	7.80	10.10	7.44	7.80	10.10	7.44	7.80	10.10	7.44	7.80	10.10	7.44	7.80	10.10	7.44	7.80	10.10
(2) Fixed costs	8.56	7.82	7.50	8.56	7.82	7.50	8.56	7.82	7.50	8.56	7.82	7.50	8.56	7.82	7.50	8.56	7.82	7.50	8.56	7.82	7.50	8.56	7.82	7.50
(3) Carcass cost	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77	163.77
(4) Other costs	27.75	27.42	21.20	27.75	27.42	21.20	27.75	27.42	21.20	27.75	27.42	21.20	27.75	27.42	21.20	27.75	27.42	21.20	27.75	27.42	21.20	27.75	27.42	21.20
(5) Warehouse cost	-----	-----	-----	2.00	2.00	2.00	2.00	2.00	2.00	-----	-----	-----	2.00	2.00	2.00	-----	-----	-----	2.00	2.00	2.00	2.00	2.00	2.00
(6) Labor costs–pkr	3.19	6.97	11.64	3.19	6.97	11.64	3.19	6.97	11.64	2.49	5.43	9.07	3.34	7.28	12.15	3.34	7.28	12.15	2.74	5.98	9.98	2.74	5.98	9.98
Labor costs–rtl	21.55	12.36	11.14	30.95	17.75	16.01	25.17	14.43	13.01	19.72	11.30	10.19	31.99	18.35	16.54	26.65	15.28	13.78	37.56	21.53	19.42	29.66	17.00	15.33
(7) Transportation	1.36	1.36	1.36	4.69	4.69	4.69	3.09	3.09	3.09	1.36	1.36	1.36	5.55	5.55	5.55	1.36	1.36	1.36	5.45	5.45	5.45	6.05	6.05	6.05
(8) Carcass cost adj	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.08	2.08	2.08	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total Cost	233.62	227.50	226.71	248.35	238.22	236.91	240.97	233.30	232.31	233.17	226.98	225.27	250.40	239.99	238.82	238.87	230.73	229.86	255.27	241.77	239.42	247.97	237.84	235.93
Retail price(d)	235.84	229.29	229.29	250.57	239.48	239.48	243.19	234.89	234.89	237.18	230.21	230.21	252.68	240.95	240.95	241.15	232.00	232.00	257.37	243.09	243.09	250.94	240.33	240.33

(a) Boxed beef

(b) Tray-ready

(c) Central vacuum package

(d) Retail prices are from the long-run adoption model.

system (Table 5). That is boxed beef packer labor (2.74) + retail labor (37.56) equals (40.30) cents per pound total labor cost, where as, vacuum package packer labor was (9.98) + retail labor (19.42) equals (29.40) cents. The total cost advantage for vacuum package from Grand Island, Nebraska to Northern California was 15.85 cents per pound (255.27 - 239.42 = 15.85).

The model not only calculates separate budgets for each route, it also provides estimated retail prices for each regional market. The price difference due to vacuum package beef compared to boxed beef for all of the markets ranged from a low of 5 cents for Arkansas-Louisiana and Montana-Idaho-Wyoming to a high of 14 cents in Northern California followed closely at a 13 cents advantage by Southern California and by Virginia-West Virginia-Maryland-Delaware at 12 cents (Table 6).

Comparison of Case-Ready

The dual solution of a linear programming model provides opportunity costs by system and route. In the long-run adoption scenario, vacuum packaging is in the optimal solution for all routes except Washington-Oregon where tray-ready comes into the optimal solution. For practical purposes it is a "coin-toss" between vacuum packaging and tray-ready in Washington-Oregon because the opportunity cost for vacuum packaging rounds to zero at two decimal places (Table 7).

Since the vacuum package is the least cost system for all routes (except for the tie in Region 1), the opportunity costs for the other systems reflect their cost disadvantage relative to vacuum packaged beef. Over 30 routes have opportunity costs for tray-ready that are less than one cent per pound (Table 7). With a cost that close for these routes, the choice of the system is not likely to be determined by cost. Since tray-ready is fabricated at the packer level and simply wrapped in the store avoiding the package appearance problem, you would expect it to have the advantage over these 30 plus routes.

The central overwrap packaging system uses essentially the same type of package used in the back room of retail stores. Consequently, its appearance is the same as store cut products. It is generally not feasible to ship beyond neighboring regions, however, because of a short shelf life (3-4 days)--the cost is higher than vacuum package. The opportunity costs show it is 2.65 cents per pound or more above vacuum package for all routes. The lowest two routes are Texas-Oklahoma Panhandle and Kansas. A validation of this result is that a central overwrap system has operated in Kansas for over a decade. The price advantage that central overwrap has relative to vacuum package is not clear, but it is likely to be at least five cents. If that is the case, the opportunity costs would suggest that central overwrap would have a competitive advantage in supplying part of its own regions retail beef. However, with that same kind of price premium, tray-ready would likely be the optimal system for all routes because as mentioned earlier there are over 30 regions that have a cost disadvantage relative to central vacuum of less than one cent per pound.

Conclusions

Case-ready beef has not lived up to the expectations of a few years ago when there was a great deal of interest in "branded beef" and when Excel and Kroger announced their plans for test marketing vacuum packaged beef.

Case-ready beef is being sold in a variety of ways, however, ranging from "chub" ground beef to vacuum packaged steaks and roasts to corned beef and marinated fajitas to 7/15# packer style brisket. There are also central overwrap and tray-ready operations.

It is reasonably clear that successful production and merchandising of case-ready and tray-ready beef is more complex than originally expected. There are still expectations of improved packaging that will provide the desired shelf-life and also maintain the bright red fresh cut appearance at a competitive price with boxed beef. The primary objective of this study was to provide a better understanding of the economics of alternative packaging and marketing systems. This should be useful in evaluating adoption of the appropriate packaging systems to fit into a variety of fabrication and merchandising conditions.

Table 6. Estimated retail price comparison by region and savings due to full adoption of vacuum packaged case-ready beef, 1988(a).

	Distribution System		
Region	Boxed Beef	Vacuum Package	Price Diff.
	(cents per retail pound or $/cwt)		
(1) WA-OR	247	238	9
(2) N. CA	257	243	14
(3) S. CA	251	239	12
(4) AZ	242	234	8
(5) UT-NV	240	233	7
(6) MT-ID-WY	235	230	5
(7) CO	238	230	8
(8) NM	242	234	8
(9) TX-OK PAN	236	229	7
(10) W. TX	239	231	8
(11) S. TX	237	230	7
(12) SE. TX	245	236	9
(13) E. TX	243	235	8
(14) E. OK	237	231	6
(15) KS	241	232	9
(16) NE	239	231	8
(17) ND-SD	238	230	8
(18) MN-WI	250	237	13
(19) IA	239	231	8
(20) IL	248	238	10
(21) MO	241	233	8
(22) AR-LA	236	231	5
(23) FL	243	235	8
(24) MS-AL-GA	238	232	6
(25) NC-SC	241	235	6
(26) KY-TN	246	236	10
(27) VA-W.VA-MD-DE	253	241	12
(28) MI-IN-OH	244	235	9
(29) PA	241	235	6
(30) NE	251	240	11

(a) Estimated average competitive retail regional price based on cost of alternative sources in the national model (VAL-ADD).

Table 7. Optimum shipments of tray-ready beef and opportunity shipping costs, with long-run adjustments in merchandising costs, by region, 1988.

Originating Region/Area	Destination Region* (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	Total Shipped
(1) WA-OR	377	4.03	4.44	5.04	6.41																										377
(2) N. CA	5.99	1.07	4.73	5.82	7.84																										
(3) S. CA	6.26	4.58	0.51	4.65	7.44																										
(4) AZ	7.41	6.14	5.03	1.69	8.05																										
(5) UT-NV	2.96	2.41	2.15	2.31	0.13																										
(6) MT-ID-WY	2.11	2.44	2.38	2.52	3.33	0.30	6.51	3.38	7.15	6.01	5.91	3.96	4.15	4.07	7.50	6.85	6.47	6.58	6.02	3.65	3.45	3.17	2.96	2.93	3.25	3.46	3.66	2.93	2.88	3.21	
(7) CO	1.95	1.47	1.10	0.73	2.23	3.51	0.72	0.99	4.32	3.70	3.42	1.50	1.59	1.43	4.75	4.25	5.17	4.97	3.98	1.48	1.21	0.92	1.10	0.91	1.02	1.38	1.67	1.13	0.93	1.34	
(8) NM	6.86	5.90	5.12	4.65	7.08	8.52	9.12	1.88	8.61	7.46	7.65	5.83	5.97	5.92	9.63	9.81	10.56	10.14	9.17	6.49	6.14	5.37	5.55	5.50	5.75	6.10	6.49	6.04	5.96	6.29	
(9) TX-OK PAN.	2.93	2.04	1.31	0.89	3.29	4.50	4.79	0.96	0.79	3.51	2.90	1.04	0.99	0.88	4.71	4.89	6.25	5.50	4.49	1.85	1.46	0.61	0.92	0.82	0.98	1.44	1.74	1.47	1.13	1.60	
(10) W. TX	4.47	3.27	2.36	1.80	4.82	6.18	6.87	2.49	6.22	1.37	4.60	2.92	3.18	3.47	7.14	7.48	8.14	7.56	6.60	4.00	3.58	2.60	2.82	2.77	3.04	3.45	3.84	3.48	3.27	3.77	
(11) S. TX	6.41	5.44	4.67	4.20	6.83	8.07	8.67	4.79	7.76	6.73	1.71	2.88	3.65	4.34	8.24	8.58	9.67	8.73	7.68	5.03	4.60	3.22	3.56	3.54	3.66	4.30	4.62	4.47	4.24	4.69	
(12) SE. TX	9.01	8.16	7.41	6.97	9.47	10.65	11.29	7.50	10.45	9.57	7.42	2.15	6.03	6.79	10.72	11.14	12.11	11.20	10.12	7.32	6.98	5.40	5.77	5.75	5.95	6.60	6.75	6.81	6.35	6.86	
(13) E. TX	6.97	6.15	5.43	5.00	7.44	8.59	9.12	5.38	8.12	7.56	5.90	3.75	0.90	4.34	8.40	8.94	9.98	9.10	7.98	5.32	4.85	3.51	4.13	3.96	4.02	4.67	4.95	4.90	4.49	5.01	
(14) E. OK	5.94	5.18	4.49	4.05	6.36	7.50	7.95	4.32	6.98	6.81	5.57	3.47	3.31	0.20	6.87	7.62	8.76	8.02	6.88	4.25	3.72	3.03	3.42	3.22	3.28	3.81	4.11	3.87	3.40	4.02	
(15) KS	2.96	2.34	1.64	1.28	3.33	4.49	4.85	1.58	4.36	4.04	3.03	0.96	0.93	0.43	0.87	4.33	5.57	4.86	3.68	1.13	0.66	0.45	0.72	0.47	0.51	0.91	1.17	0.80	0.59	1.04	
(16) NE	3.52	3.08	2.83	2.52	3.96	5.08	5.57	2.93	5.74	5.53	4.57	2.59	2.67	2.39	5.53	1.58	5.98	5.45	4.37	2.20	1.86	1.94	1.91	1.70	1.67	2.12	2.22	1.75	1.44	1.91	
(17) ND-SD	2.61	2.72	2.53	2.43	3.74	4.00	5.70	2.90	6.36	5.42	4.91	2.81	2.96	2.78	6.03	5.23	1.42	4.96	4.68	2.30	2.19	2.10	1.88	1.82	1.89	2.22	2.20	1.64	1.39	1.77	
(18) MN-WI	3.18	3.10	2.89	2.55	4.07	4.52	5.88	2.97	6.05	5.38	4.49	2.40	2.51	2.42	5.65	4.96	5.20	1.30	3.74	1.48	1.40	2.03	1.33	1.20	0.90	1.54	1.38	0.88	0.53	0.99	
(19) IA	3.32	2.92	2.63	2.27	3.85	4.71	5.58	2.69	5.71	5.11	4.09	1.97	2.04	1.93	5.10	4.53	5.75	4.47	0.58	1.08	0.90	1.24	1.14	0.91	0.74	1.23	1.21	0.71	0.39	0.90	
(20) IL	7.12	6.69	6.30	5.79	7.67	8.56	9.28	6.20	9.26	8.71	7.64	5.33	5.58	5.49	8.76	8.65	9.61	8.38	7.25	1.24	4.12	4.16	4.26	3.94	3.48	4.13	4.04	3.71	3.47	3.98	
(21) MO	6.58	6.16	5.60	5.20	7.13	8.10	8.75	5.58	8.58	8.01	6.90	4.71	4.79	4.64	7.98	8.03	9.27	8.06	6.83	3.88	0.73	3.95	3.83	3.50	3.31	3.88	4.00	3.74	3.26	3.90	
(22) AR-LA	9.96	9.22	8.55	8.09	10.50	11.62	12.26	8.54	11.44	10.73	9.12	6.70	7.07	7.70	11.63	12.02	13.06	12.42	10.90	7.65	7.68	2.90	6.39	6.09	6.57	6.86	7.14	7.20	6.86	7.38	
(23) FL																							5.27								
(24) MS-AL-GA																							4.02	0.78	3.29	4.39	4.42	4.98	4.08	4.72	
(25) NC-SC																							8.48	8.78	3.74	9.44	7.89	9.56	8.43	8.54	
(26) KY-TN																							4.93	4.12	3.67	1.79	4.62	4.96	4.34	4.95	
(27) VA-WVA-MD-DE																							11.18	11.54	9.73	12.06	6.44	11.81	9.34	10.18	
(28) MI-IN-OH																							4.16	3.92	3.18	4.18	3.57	0.52	2.76	3.39	
(29) PA																							6.21	6.47	5.62	7.04	4.70	6.41	0.60	4.55	
(30) North East																														1.64	
Total	377																														377

*Underscored figures are shipments (in million pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

The key implications of this study are the following:

(1) Food retailers with the highest labor costs are likely to have the greatest cost incentive to adopt case-ready beef. These are generally located on the West Coast, upper Mid-West and the Northeast.

(2) Savings for vacuum package could be as much as ten cents per pound of retail beef for the vacuum package and as much as eight cents per pound for tray-ready per pound and five cents per pound for central overwrap. These latter two systems have the same package appearance as beef cut and packaged in the back room of the store, but with the same short shelf-life problem of 3 to 4 days.

(3) Packers and fabricators that have a competitive advantage in supplying case-ready beef include a wide range of plant sizes because the economies of size at this stage of development do not appear substantial unless they involve brand advertising or transportation. Long distance delivery of less than truck load lots can be more costly. Lowest cost supplies originate in the Central and Southern Plains. However, most areas with below average labor costs can compete at the firm level by purchasing boxed beef supplies to fabricate into case-ready packages.

(4) Retailers who have stores with higher than average shrink due to slow or erratic product movement may have an incentive to adopt vacuum package because of its longer shelf life. This might include the neighborhood stores entire beef counter or superstores that desire to offer both Select and Choice grades where one of the grades has a substantially lower volume. A modified atmosphere package (gas-flush) might also serve this role. The gas-flush system evaluated in this study was more expensive than the store cut method, however, there is likely to be a lower cost alternative on the market in 1992.

(5) Central packaging lends itself to branded differentiated products, whether it is a few items or a full line of beef products. However, delivering small lots increases the cost.

(6) Case-ready beef is likely to be more satisfactory for supermarkets or superstores when a service meat case is available which provides flexibility and a wider range of cuts and sizes.

(7) In the early stages of adoption, finding a supplier or alternative suppliers may be a problem for retailers. There are fabricators serving HRI who might be able to add a case-ready line. Small packers or processors may also find this a useful value-added activity for them.

Appendix:
Fabrication/Packaging Systems Employed

Seven fabrication/packaging beef systems are specified in this study to provide information and guidelines to packer/processors, wholesalers and retailers relative to the economics of specific case-ready beef systems. The fabrication, packaging and distribution systems designed for this study are as follows:

Conventional Boxed-Beef: Packers and wholesalers under this system fabricate carcasses and ship wholesale primal and subprimal products (boxed-beef) to stores for on-site fabrication into retail products that are packaged in foam trays with a film overwrap. The conventional system is designed to depict the most common (1988) packaging/distribution system used by the beef industry. The conventional system will be used as a base for comparing other alternative systems specified below.

Tray-ready: Packers or wholesalers fabricate carcasses and ship precut retail products to stores in a boxed vacuum bag for on-site packaging in foam trays with an oxygen permeable film overwrap.

Central Overwrap: Packers or wholesalers centrally fabricate carcasses and ship retail products packaged in foam trays with an oxygen permeable film overwrap to stores ready for the meat case. This system limits distribution within a radius of 200 miles.

Central Vacuum: Packers or wholesalers centrally fabricate carcasses and ship retail prod-

ucts vacuum packaged in an oxygen barrier film to stores ready for the meat case.

Central Gas: Packers or wholesalers centrally fabricate carcasses into case-ready retail products packaged in foam trays with an oxygen permeable film overwrap which are packed in bulk gas flushed boxes with a barrier film for shipment to retail stores.

Central Frozen: Packers or wholesalers centrally fabricate carcasses and ship retail products (vacuum packaged in an oxygen barrier film and frozen) to stores ready for the meat case.

Central HRI: Packers or wholesalers centrally fabricate carcasses and ship retail products vacuum packaged in an oxygen barrier film to the hotel and restaurant industry ready for storage.

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