ECONOMICS OF ALTERNATIVE BEEF DISTRIBUTION SYSTEMS

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ABSTRACT

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To estimate the least cost marketing, five alternative beef distribution systems were budgeted for ten regions in the State of Texas, and analyzed by a multi-dimension linear programming model. Boxed beef was clearly the leading system, accounting for 75 percent of volume; but due to varying wage rates, all five systems were in least cost solutions, including centrally packaged retail cuts. Cost differences were small, therefore, other considerations can dominate the choice of systems.

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The boxed beef innovation improved marketing efficiency by moving some of the processing labor out of the back room of the retail store towards the fabrication center and the slaughter plant. The next major innovation may come when the cutting and packaging of retail cuts is moved back to the fabrication center or packer level. This offers the possibility of further increasing most of the advantages already claimed by boxed beef, but there are still some technical and management problems. Boxed beef adoption has been slowest were retail wages are significantly lower than packer and fabricator wages. Central packaging of beef retail cuts is being done on a limited basis in the United States, Europe and Japan. Much depends on the extent of the economic incentives from the stand point of costs and from the stand point of sales. This study is an attempt to measure that incentive on the cost side.

Much of the U.S. poultry industry changed in the last few years from a case of whole chicken packed in ice delivered to retail stores, to retail packaging at the plant level. This is accomplished by holding the retail packages at 28°F until placed in the retail counter. The same concept cannot easily be transferred to beef, although it is being done by a few firms. The practice of using boxed beef and/or carcass quarters at the store level continues because it appears to be easier for some operators to maintain quality, freshness and neater appearing packages and display cases. Some with carcass supplies nearby claim that since the store must stay open long hours, it helps utilize labor more efficiently to break carcasses at the store level. These firms

generally use some boxed beef, also. Breaking carcass quarters at the retail store is clearly on the decline in the U.S., however.

Developments in technology, management and merchandizing practices may allow retailers in the future to have beef and other fresh red meat items delivered already packaged for retail sale, weighed, priced and the UPC code attached. The greatest incentive for this innovation is where retail wages are high relative to wholesale and packing plant wages. Many retailers already handle some fresh red meat items prepackaged at the packing plant such as fresh pork loin, beef liver, ground beef, corned beef and packer style beef brisket.

There are a variety of cost, price, quality, transportation and fabrication trade-offs for alternative beef marketing systems. The objective of this study was to estimate the relative cost of the alternative beef marketing systems. It is presumed that with a better understanding of the cost comparisons of different alternatives, operators can better evaluate the best system for their business. The working hypothesis is that marketing costs decline as more of the intensive labor operations of fabrication and processing are moved closer to the slaughter plant. Duewer and Crawford showed this to be the case in 1977, where wage rates were the same at all levels in the system. Where wage rates vary within the marketing channel and among geographic locations, the cost advantages become less clear. That is one of the reasons a variety of systems exist in practice.

This study estimated the cost advantages of five different systems under the conditions of the highly variable labor cost of the Texas beef industry. It then analyzed the impact of changes in productivity and costs on the competitive advantage of alternative systems. In addition,

estimates of the value of extra fabrication capacity at various locations were derived.

Method of Analysis

The approach to estimating costs of alternative systems was to develop a beef fabrication and distribution model using five different beef transformation and distribution channels representing the cost differences for using each of the alternative ways of processing and marketing beef. The State of Texas was divided into ten regions for beef supplies, and wholesale and retail markets. Wholesale supplies could also be obtained from outside the State. The format is a multi-dimension (space and form) transhipment linear programming model. The objective of the model was to minimize the costs of processing and distribution to meet the estimated demand for beef at retail stores in each region in Texas; subject to regional plant capacities and beef cattle supplies (Diaz). The input data are compiled by an interactive mode through the use of a FORTRAN computer program, to facilitate the analysis of different scenarios.

A more comprehensive meat study was in process at the same time in Canada with some what different objectives, but the basic model format and approach was essentially the same as this study (Deloitte, Haskins and Sells, Associates - Agricultural Consultants). In addition, a recent study "Cost of Retail Beef-Handling Systems: A Modeling Approach" by L.A. Duewer, ERS, USDA, compares budgets for ten alternative systems and concludes that centrally packaged retail cuts are the lowest cost system, however, it concludes the most profitable systems for retailers are boxed beef and tray-ready packed subprimals.

Framework of Analysis

Five systems of fresh beef distribution from packer to the retail store were included in this study:

System I. Packer sending carcasses directly to retail stores.

System II. Packer breaking carcasses down to primals and delivering directly to retail stores.

System III. Packer breaking carcasses down to retail cuts and delivering directly to retail stores.

System IV. Packer sending carcasses to fabrication centers where they are broken down to primals and then delivered to retail stores.

System V. Packer breaking carcasses down to primals sending them to fabrication centers where they are further processed into retail cuts and sent to retail stores.

In the first three systems, the distribution of beef in the different product forms could be accomplished by delivering directly from the packer to the stores, or through local warehouses where no beef processing takes place. The last two systems refer to shipments of carcass or primals that change form at an intermediate point before arriving at their final destination.

Budgets

Following a field survey, budgets of differences in plant, equipment, labor materials, etc., by system were estimated. A prototype plant able to slaughter between 25-50 head of cattle per hour was chosen as a model from which to derive the amount of man hours involved in the handling and fabrication carcasses into primals and retail cuts. This

size of plant is most common in the state except for the larger plants in the Panhandle, and the technology used in beef processing varies little among these medium-size packing plants. Recognizing that differences in plant size and efficiency exists, a 20 percent increase in labor productivity was assumed in one scenario.

Preparing retail cuts is more than three times as labor intensive. For example, in processing carcasses into primals, one man hour produces about 416 pounds of retail equivalent; whereas, processing primals into retail cuts yields about 125 pounds per man hour. It is important to keep in mind throughout this study that the results depend on the difference in the cost estimates among systems.

Dallas had the highest average wage at retail at $7.91 per hour and at fabrication centers at $8.31 in 1980. Houston had the highest average packer wage at $8.77 and the next highest wage at fabrication centers and at retail. The Lower Valley (Harlingen) had the lowest average wages in all three stages at less than $5 per hour. This approach was designed to present the general wage picture for each region, but does not represent the individual firms with the highest and the lowest wages. Different wage scenarios are used to address this problem.

An example of the difference among systems when the product is delivered to stores in the Dallas area is presented in Table 1. In this example, boxed beef (System II) is the lowest feasible cost system at 29.63 cents per retail pound equivalent. This is for those costs expected to differ by system for a packer engaged in boxing primals in a plant in Amarillo and sending the product to retail stores in Dallas. System III (retail cuts from Amarillo packer to store) is calculated to

Table 1: Detail Cost Differences of Five Beef Distribution Systems Between Packers in Amarillo (Region 2), Fabrication Centers in Abilene (Region 1) (where applicable) and Stores in Dallas (Region 3[a]), 1980

Costs Considered	System I Carcass to Store	System II Primals to Store	System III Retail Cuts to Store	System IV C to Warehouse PR to Store	System V PR to Warehouse RC to Store
	---------- cents per retail pound equivalent ----------				
Packer					
Labor	0.0865	2.6330[b]	7.7774	0.0865	2.6330[b]
Support	1.1331	3.2474	6.0857	1.1331	3.2474
Prefabrication Center					
Labor	-	-	-	1.7055	5.0364
Support	-	-	-	2.1574	4.8519[a]
Store					
Labor	11.3350	9.8021	0.2535	9.8021	0.2535
Support	2.8697	2.6996	1.4950	2.6996	1.4950
Labor Coverage	-	-	0.9300	-	0.9300
Other					
Shrinkage	6.2700	1.5952	1.3526	3.1372	1.8876
Fat and Bone Revenue	(0.5560)	(1.0000)	(1.4440)	(1.000)	(1.4440)
Merch. Slow Mov. Cuts	3.1480	1.8888	0.6296	1.8888	0.6296
Energy	1.0530	1.0020	1.0000	1.0620	1.1070
Materials	1.0000	2.9084	1.0000	2.9084	2.9084
Transportation					
Packer to Warehouse	-	-	-	2.0700	1.6500
Packer to Store	2.3200	1.8500	1.5800	-	-
Warehouse to Store	-	-	-	1.8400	1.5700
Intracity[c] Transportation	3.0000	3.0000	6.0000	3.0000	6.0000
Total Cost	31.6794	29.6266	26.6598[d]	31.4907	32.7558

[a] Wages differ according to the region. This table includes only cost differences by systems.

[b] Includes 0.37 cents for wrapping

[c] Calculated at 3 cents/.1b. System III and V requires twice as many deliveries.

[d] No[illegible]easible due to distance.

be lower at 26.66, however, this system is judged to not be feasible due to distance. In the model, retail cuts were restricted to being shipped no farther than the adjacent region.

Results

Following the example in Table 1, Dallas obtained boxed beef from Amarillo for 81 percent of its volume at the $29.62 cost shown in the budget example. It obtained another five percent of its volume in boxed beef from Omaha at 30.26. The remaining 14 percent was centrally packaged retail cuts from packers in Dallas at $27.51 and packers in two of the three adjacent regions for $25.02 and $25.27 respectively.

In the least cost solutions of a variety of scenarios, boxed beef produced by packers and delivered directly to retail stores, or through their warehouses, accounted for about 75 percent of the volume shipped (System II). Practically all of the rest was from centrally packaged retail cuts (System III) and boxed beef produced at chain or wholesale grocer fabrication centers (System IV). Carcass quarters delivered to retail stores (System I) had only 1 percent of the volume when packer wages were increased by 20 percent (Model III). Retail cuts centrally packaged at fabrication centers from boxed beef (System V) accounted for about one percent of the volume for most scenarios (Table 2).

Costs for the systems were close except for System V. The opportunity cost for using carcasses delivered to stores rather than other alternatives was often less than one cent per retail pound equivalent.

In various scenarios retail cuts centrally packaged at the packing plant accounted for 10 to 16 percent of the volume. Due to the necessity of making more frequent deliveries and to the experience reported by those few firms actually using this system, the source of

Table 2: Fresh Beef Distribution System--Participation by Model.

Model	Base 1980 I	All Texas Supplies II	Increase Packer Wages III	Increase Retail Wages IV	Productivity Packer Increased 20% V	Productivity Retail Increased 20% VI	Unltd. Fabricator Capacity VII	Texas Transport Deregulated VIII
System				(percent)				
I Packer Carcass to Store	-	-	1.0	-	-	-	-	-
II Packer Primal to Store	77.5	81.0	64.0	72.5	74.6	64.7	28.7	80.5
III Packer Retail Cuts to Store	12.8	13.5	10.0	16.5	16.4	12.7	44.7	12.9
IV Prefab. Center Primal to Store	8.7	4.5	24.0	8.7	8.4	21.6	26.6	5.6
V Prefab. Center Retail Cuts From Primals	1.0	1.0	1.0	2.3	0.6	1.0	-	1.0

supply could be no farther than an adjacent region. When it was assumed that fabricator capacity was not a limiting factor, the volume of centrally packaged retail cuts increased to 44 percent and packer boxed beef dropped to 28.7 percent (Table 2).

Since the practice of centrally packaged retail cuts was not actually in use in Texas, these results show only that costs favor its use particularly where retail wages are higher relative to fabricator or packer wages as indicated by Model IV. When retailer wages were increased by 20 percent, centrally packaged retail cuts increased in volume from 12.8 (Model I) to 16.5 (Model IV) (Table 2). This shows that the economic incentive to adopt this system grows with increases in retailer wages relative to fabricators or packers. The Dallas region, with the highest costs, received boxed beef from both Amarillo and Omaha, and a much smaller volume of retail cuts prepared by local packers. Local fabrication centers were not used to produce primals from carcasses in the Dallas Region due to high wage rates. The lowest opportunity cost for this alternative was $1.36 per cwt. retail equivalent.

Cost of Different Scenarios

To evaluate the impact of alternative scenarios on the cost of distributing beef in the total market system, the average cost difference of the optimum solutions are compared in Table 3. The average costs considered were $27.44 per cwt. for the base model I. When the system was forced to use existing fabrication center capacity and no centrally packaged retail cuts were allowed (Model Ia), the cost increased by $1 per cwt. to $28.44. Then, central packaging of retail cuts was allowed in Model Ib and it accounted for 12.5 percent of the

Table 3: Comparison of Total Cost by Beef Distribution Models.

Model	Scenario	Total Cost[a]	Average Cost Difference	Costs as a Percent of Model I
		(dollars per hundredweight)		(percent)
Model I (Base)	At least 20% of Texas Supply shipped out-of-state	175,536,389	27.44	100.-
Model Ia	Prefabrication Centers forced Blocking of retail cuts	181,931,997	28.44	103.6
Model Ib	Prefabrication Centers forced Central Cutting allowed	179,989,294	28.13	102.5
Model II	All Texas Supplies available to Texas	173,214,690	27.07	98.6
Model III	Increase packer wage 20%	182,298,395	28.49	103.8
Model IV	Increase retailer wages 20%	187,016,057	29.23	106.5
Model V	Packer productivity increased 20%	171,115,526	26.75	97.5
Model VI	Fabricator productivity increased 20%	125,246,888	27.38	99.8
Model VII	Unlimited fabricator capacity	164,506,984	25.71	93.7
Model VIII	Transportation deregulated	176,947,299	27.66	100.8

[a]Considered are only the costs expected to vary by processing and distribution system.

volume. The cost to the entire system dropped to $28.13 for a saving of $0.31 cents per cwt. or almost $2 million to the Texas market. The direct savings of centrally packaged retail cuts for those operators actually using the system averaged $2.48/cwt. This is likely a sufficient incentive to encourage adoption for some operators if there were no concern for a drop in sales due to less attractive packages or other management problems. Increasing packer wages 20 percent increases the average cost to $28.49/cwt (Model III) ($1.05/cwt over the base model). Increasing retail meat department wages 20 percent increases the average cost to $29.23/cwt (Model IV) or $1.79 above the base model (Table 3). The increase in packer wages reduces packer produced boxed beef from 77.5 percent to 64 percent and increases fabrication center volume from 8.7 to 24 percent (Table 2).

The greatest "cost reduction" was when it was assumed any region had unlimited fabricator central retail packaging capacity (Model VII). Cost dropped to $25.71/cwt., but that does not include the added cost of the capacity. The purpose of this scenario was to see the extent of central retail packaging, and its location, if the capacity was already in place--as is the case for packer boxed beef facilities. Under this assumption, central retail packaging (System III) increased to 44.7 percent of the volume, about 29 percent of the boxed beef was prepared by packers and 27 percent prepared by fabrication centers (Table 2). The increase in retail cuts was widespread with all the large metropolitan areas being served by capacity within their own region, or from adjacent regions under this scenario.

Imputed Values

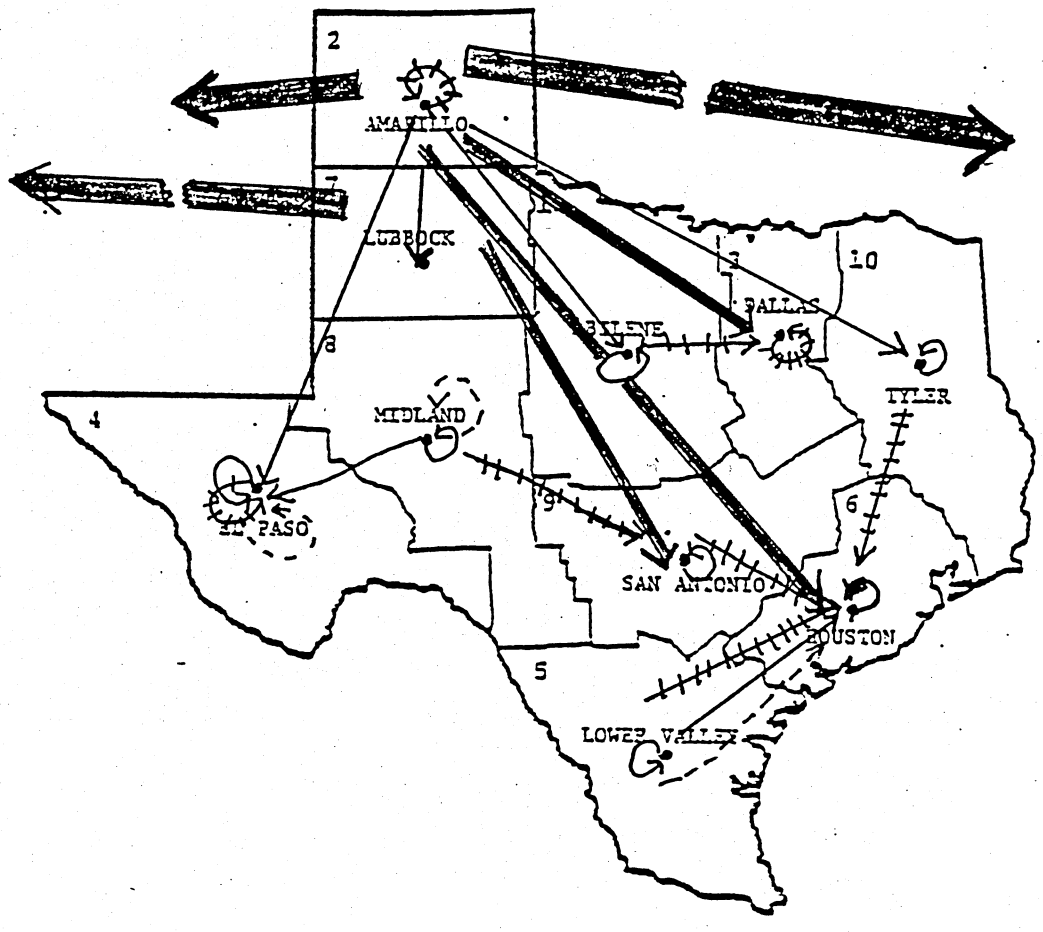
In the other scenarios (i.e. except for Model VII), capacity for

System III (central retail packaging) was limiting, particularly in Abilene, El Paso, Harlingen (Lower Valley), Midland, San Antonio and Tyler. This is illustrated by the imputed values for additional fabrication capacity ranging from $2.52 to $5.56 per cwt. retail weight equivalent. The least cost system utilized lower wage rates in these areas to produce retail packages for themselves and the higher wage adjacent regions. This is shown in Figure 1 where the lower wage regions of El Paso, Midland and the Lower Valley all produced retail cuts at the packer level and boxed beef at the packer and warehouse level.

Conclusions

Four conclusions can be reached from this analysis. (1) Boxed beef is the optimum system for a wide range of cost conditions. (2) Centrally packaged retail cuts can reduce costs where retail wages are relatively higher than fabrication wages. (3) The cost of all five systems are close, therefore, other consideration such as freshness, flexibility and managerial preferences can dominate the choice of systems without influencing costs significantly. Only System V, shipping primals from the packer, then centrally packaging retail cuts, appeared to have a significant cost disadvantage. (4) Although costs appear to be lower, we failed to prove that removing all of the processing and fabrication from the back room of the retail store would significantly improve economic efficiency in beef distribution. Boxed beef removes part of that back room labor and it has the storage life and flexibility to serve a wide variety of operations.

Deuwer (1985) suggests that tray ready cuts centrally vacuum packaged and the retail package prepared in the store may be preferable



Boxed beef from packer (System II) - 81%

Retail cuts from packer (System III) - 13.5%

Carcass to whse, primals to store (System IV) - 4.5%

Figure 1: Least Cost System and Routing in Supplying Fresh Beef to Retail Store Counters in Texas (Model II), 1980.

to centrally packaged retail cuts. This removes the fabrication from the back room of the store and has the advantage of longer storage life and reduces the problem of "purge" (blood and water collecting in the retail package). Finally, smaller packers and fabricators may want to explore retail packaging or tray-ready cuts where they have a wage advantage compared to retail stores.

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