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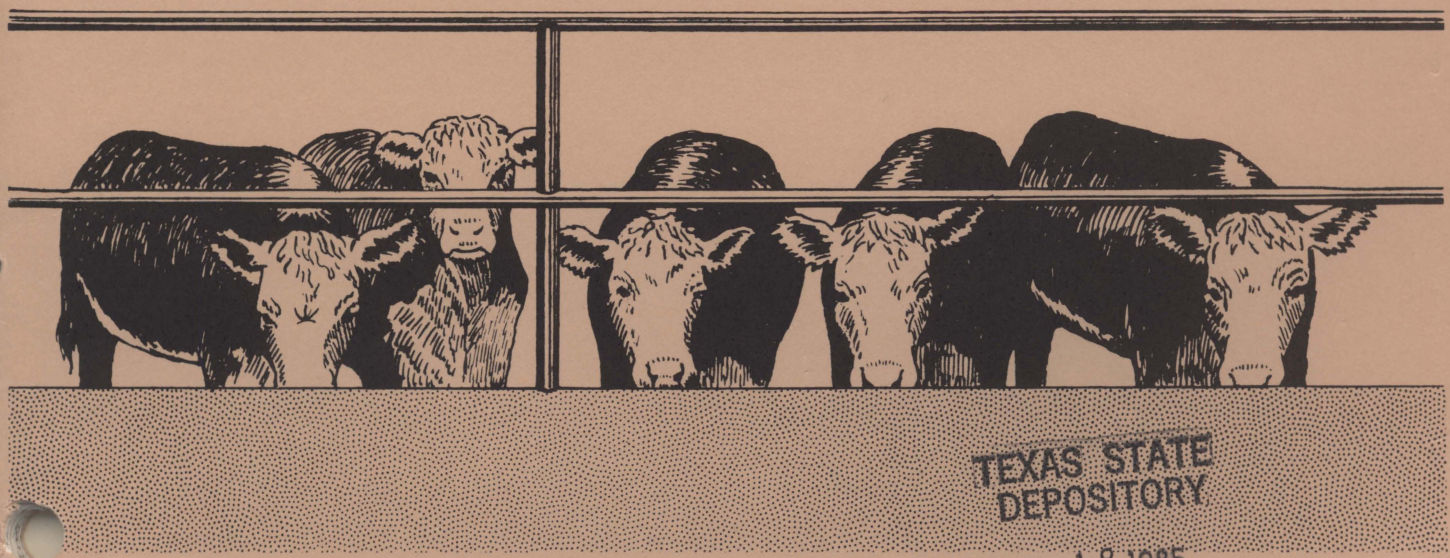
with emphasis on the Southern Plains



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INTERREGIONAL COMPETITION IN THE U.S. CATTLE FEEDING FED-BEEF ECONOMY

with emphasis on the Southern Plains

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FOREWORD

The U.S. cattle feeding–fed-beef economy faces a rapidly changing economic environment. Factors generating change include energy and labor costs, population increases, interregional migrations, regional variations in per capita disposable income, inflation, and fluctuating livestock and feed grain prices.

This study uses a multiproduct transshipment model of the U.S. cattle and beef economy, based on industry conditions in 1980, to examine interregional economic relationships. In addition, six alternative models show how changes in feed grain and feeder cattle supplies and in slaughter and transportation costs affect optimum feedlot and slaughter plant location and production levels.

Results suggest that cattle feeding and slaughtering firms in the Southern and Central Plains, especially West Texas–West Oklahoma, Kansas, and Nebraska, enjoy considerable locational advantages due to proximity to feed grain and feeder cattle supplies, access to major fed-beef markets, and economies of size associated with the feeding and slaughter industries. Additional analyses incorporating the impact of declining water tables in Southern and Central Plains states, including increases in regional slaughter and transportation costs, reveal that the natural competitive advantages of the Southern and Central Plains states are stable and should continue for some time in the future.

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with emphasis on the Southern Plains

INTRODUCTION

During the last 10 years, the cattle feeding–fed-beef economy in the United States has been characterized by wide-spread structural and technological change under a rapidly changing economic environment. Modifications in the livestock economy have been generated by increasing energy and labor costs, overall inflation, highly fluctuating livestock and feed grain prices, and the actions of concerned consumer groups. These modifications stimulate adjustments in location and size of operations, in marketing strategies, and in patterns of distribution.

Cattle feeding is big business in the United States. In 1980, approximately 113,000 feedlots sold 23.2 million head of cattle for approximately $17 billion (USDA, *Cattle on Feed*, 1980–81). Nearly 72 percent of the U.S. commercial beef production in 1980 came from cattle finished in feedlots. The 26 billion pounds of fed beef produced in 1980 nearly tripled the 1950 total U.S. commercial beef production.

Cattle feeding has undergone major changes in the United States, and especially in Texas, since the early 1960s. Since 1970, major shifts in the cattle feeding industry have been toward the Central[1] and Southern[2] Plains and away from the traditional Corn Belt[3] and Western[4] feeding area (Table 1). Nearly 60 percent of all fed cattle were marketed from Southern and Central Plains feedlots in 1980. The rate of growth in some regional fed-cattle marketings has differed significantly from the rate for the United States as a whole (Table 2). For example, numbers of fed cattle marketed decreased approximately 7 percent in the United States from 1970 to 1980, while they increased 26 percent in the Southern Plains and 19 percent in the Central Plains. In contrast, fed-cattle marketings decreased about 41 percent in the Corn Belt and nearly 30 percent in the West.

[1]Colorado, Kansas, Nebraska.
[2]Texas, Oklahoma, New Mexico.
[3]Iowa, Missouri, Illinois, Indiana, Ohio.
[4]Arizona, California, Washington.

TABLE 1. Fed cattle marketed as a percentage of the 23-state total and selected feeding areas, 1970–80

Areas	1970	1975	1980
		%	
Southern Plains	16.4	18.8	22.1
Texas	12.6	15.0	17.9
Oklahoma	2.2	2.5	2.8
New Mexico	1.6	1.3	1.4
Central Plains	29.6	33.6	37.7
Colorado	7.7	9.0	8.3
Kansas	7.6	11.0	13.0
Nebraska	14.3	13.6	16.4
Corn Belt	29.6	21.9	18.8
Iowa	18.4	12.9	11.6
Missouri	2.7	1.6	0.8
Illinois	4.7	3.9	3.8
Indiana	2.1	1.7	1.5
Ohio	1.7	1.8	1.1
Western Region	12.8	13.1	9.5
Arizona	3.5	3.6	2.4
California	7.9	8.0	5.4
Washington	1.4	1.5	1.7
Other States*	11.6	12.6	11.9
23-state Total	100.0	100.0	100.0

Source: U.S. Department of Agriculture, *Cattle on Feed*.
*Idaho, Montana, Oregon, North Dakota, South Dakota, Michigan, Minnesota, Pennsylvania, and Wisconsin.

TABLE 2. Number of fed cattle marketed by selected areas, 23 major cattle feeding states, and percentage changes, 1970–80

Areas	1970	1980	Change 1970–80
	1,000 Head	1,000 Head	%
Southern Plains	4,073	5,142	26.2
Central Plains	7,368	8,765	19.0
Corn Belt	7,375	4,343	−41.1
Western Region	3,174	2,207	−30.5
Other States	2,890	2,726	− 5.7
23-state Total	24,880	23,183	− 6.8

Source: U.S. Department of Agriculture, *Cattle on Feed*.

TABLE 3. Cattle feedlots and fed cattle marketed as a percentage of the 23-state total, by size group of feedlot capacity, 1970 and 1980

Feedlot Capacity* (head)	1970		1980	
	Lots	Cattle Marketed	Lots	Cattle Marketed
	%			
Under 1,000	98.8	45.4	98.1	27.6
1,000- 1,999	0.5	4.8	0.9	5.8
2,000- 3,999	0.3	5.5	0.4	6.2
4,000- 7,999	0.2	7.8	0.2	7.1
8,000-15,999	0.1	12.6	0.2	12.8
16,000-31,999	0.1	12.9	0.1	19.7
32,000-over	†	11.3	0.1	20.7
Total over 1,000	1.2	55.0	1.9	72.4
23-state Total	100.0	100.0	100.0	100.0

Source: U.S. Department of Agriculture, *Cattle on Feed*.

*Number of feedlots with 1,000-head-or-more capacity is number of lots operating any time during the year. Number under 1,000-head capacity and 23-state total is number at end of year.

†Less than 0.05 percent.

Major changes are also evident in the structure and size of feedlot operations (Table 3). Feedlots with less than 1,000 head capacity represented approximately 98 percent of the total feedlots in the 23 major cattle feeding states in 1980. Such feedlots accounted for slightly less than 28 percent of the total fed cattle marketed in 1980, compared to 45 percent in 1970. Feedlots with a capacity greater than 1,000 head increased their share of U.S. fed-cattle marketings from 55 percent in 1970 to over 72 percent in 1980.

The cattle slaughtering industry, especially fed-cattle slaughtering, is characterized by large and highly specialized cattle slaughter plants with national systems of distribution. Nearly 85 percent of the cattle slaughtered in federally inspected plants in 1980 were slaughtered by firms annually killing more than 50,000 head of cattle per plant (USDA, *Livestock Slaughter*, 1980). Commercial cattle slaughter has increased primarily in those states realizing large increases in cattle feeding, especially Texas and Kansas (Table 4). Cattle slaughtering firms have found it more economical to locate slaughter plants near concentrated sources of fed cattle, a practice which results in increased competition for fed slaughter cattle in concentrated feeding areas.

The Southern Plains and southeastern states are major producers of feeder cattle in the United States (Table 5). Texas accounted for about 12 percent of the U.S. calf crop in 1980. Almost 45 percent of the U.S. beef cows were held on farms and ranches in the Southern Plains and southeastern states[5] on January 1, 1980 (USDA, *Cattle*, 1980–81). Beef cows accounted for over 78 percent of the total U.S. cow numbers in 1980, up from 57 percent in 1960.

The Problem

Cattle feeding and slaughtering firms must continually reexamine decisions relative to optimum size and location, optimum sources of supply, and optimum distributional systems in this era of rapidly changing costs, especially for energy, labor, and other inputs. The feeding sector is concerned with regional differences in feeding costs, feed supplies, feeder cattle supplies, economies of size in feedlot operations, feeding practices, etc. The slaughtering sector is concerned with regional price differences in fed slaughter cattle sources and supplies, slaughter and fabrication costs, economies of size in slaughter operations, demand for fed and nonfed beef, packaging and distribution costs, etc.

Dietrich (1971) showed that the Texas–Oklahoma

TABLE 4. Commercial cattle slaughter as a percentage of U.S. slaughter, 10 major slaughtering states, 1969 and 1979, and percentage change 1969–79

State	Commercial Cattle Slaughter		
	1969	1979	Change 1969–79*
	%		
Nebraska	12.1	15.5	27.0
Texas	7.5	15.2	103.3
Iowa	11.9	9.8	– 18.5
Kansas	4.7	8.4	75.9
Colorado	5.0	6.7	33.0
California	8.4	6.2	– 26.4
Illinois	4.0	3.9	– 4.0
Wisconsin	3.9	3.4	– 14.2
Minnesota	5.5	3.2	– 42.6
Pennsylvania	2.3	2.4	2.9
10-state Total	65.3	74.7	– 0.5†
U.S. Total	100.0	100.0	

Source: U.S. Department of Agriculture, *Livestock Slaugher*.

*Percentage change based on total liveweight slaughtered.

†Percentage change in U.S. commercial cattle slaughter, 1969–79.

TABLE 5. Calf crop: U.S. production and percentage distribution by geographic regions, 1970–80

	1970	1975	1980
	1,000 Head		
U.S. Production	45,845	50,106	45,279
Distribution by Regions	%		
Southern Plains	17.7	18.0	18.2
Texas	11.7	12.0	12.1
Oklahoma	4.6	4.9	4.8
New Mexico	1.4	1.1	1.3
Central Plains*	11.0	10.2	10.5
Corn Belt†	15.2	16.2	15.8
Southeastern‡	19.6	20.8	18.8
Western§	16.2	14.0	15.1
Other States	20.3	20.8	21.6
48-state Total	100.0	100.0	100.0

Source: U.S. Department of Agriculture, *Livestock and Meat Statistics*.

*Colorado, Kansas, Nebraska

†Iowa, Missouri, Illinois, Indiana, Ohio, Michigan

‡Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, N. Carolina, S. Carolina, Kentucky, Tennessee

§Montana, Idaho, Wyoming, Arizona, Utah, Nevada, Washington, Oregon, California

[5]See Table 5 footnotes for states included in region.

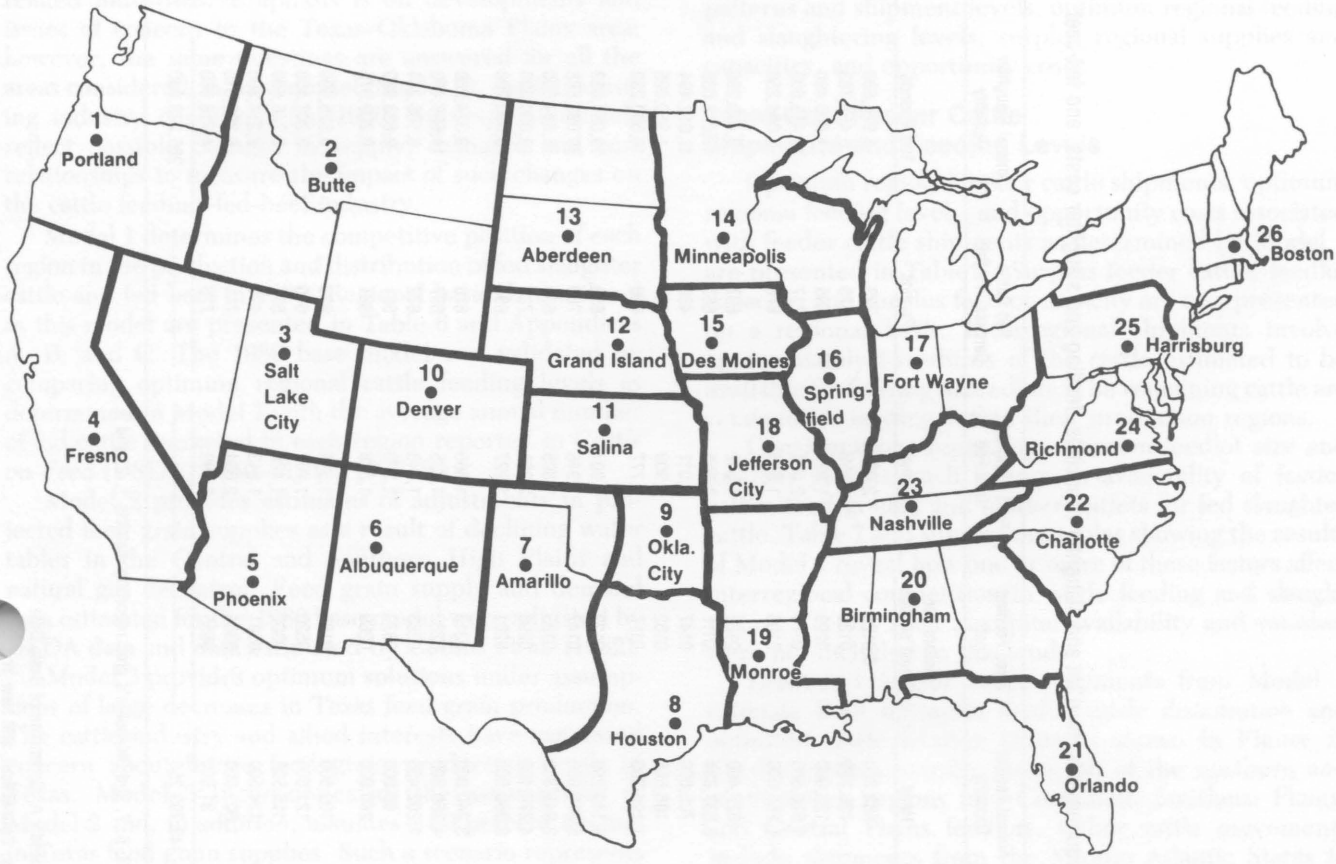

Figure 1. Regional demarcation and regional shipping and receiving points.

Panhandle had a competitive advantage in cattle feeding and beef packing during the early 1970s. Timely analysis is required to determine whether this advantage still exists. The purpose of this study was to determine optimal location and size of cattle feeding and slaughter operations and optimal distribution of feeder cattle, feed grains, fed slaughter cattle, and fed beef in the United States. Primary attention is focused on Texas and the western region of Oklahoma. In addition, the economic implications of regional changes in supplies of feed grain and feeder cattle and in transportation and slaughter costs on the cattle feeding–fed-beef economy are examined.

Specific objectives:

(1) Develop a multiproduct, transshipment model of the cattle and beef economy in the United States based 1980 economic and industry conditions.

(2) Estimate least-cost locations and optimum levels of cattle feeding, fed-cattle slaughter, and fed-beef distribution among designated regions as determined by specific input factors, production and distribution practices, economies of size, and demand.

(3) Determine least-cost shipment routes and modes of transportation for feeder cattle, feed grains, fed slaughter cattle, and dressed fed beef to meet demand requirements in the various sectors of the cattle and beef economy.

(4) Estimate the impact of changes in specified costs, supplies, tariff structures, governmental policies, and demand on optimum locations and levels of cattle feeding, fed-cattle slaughter, and fed-beef distribution among designated regions.

Methods and Models

The 48 contiguous states were divided into 26 regions as detailed in Figure 1. A point within each specified region was selected to represent the geographic concentration of cattle feeding, cattle slaughter,

TABLE 6. Estimated feeder cattle and feed grain supplies, feed grain requirements, feed lot and slaughter capacities, feeding and slaughter costs, and fed-beef consumption, by region, 1980

Region	Feeder Cattle Supplies	Feed Grain Supplies	Feed Grain for Other Livestock	Annual Feedlot Capacity	Fixed Feeding Costs	Feed Grain per Head Fed	Fed Cattle Carcass Weights	Annual Slaughter Capacity	Slaughter Costs	Fed-beef Consumption
	Head	10,000 Pounds	10,000 Pounds	Head	Dollars per Pound of Gain	Pounds	Pounds	100 Pounds	Dollars per 100 Pounds	100 Pounds
(1) WA-OR	697,000	226,300	493,300	582,300	$.0128	2,024	723	5,974,680	$4.89	4,923,760
(2) MT-ID-WY	2,277,000	542,800	308,900	726,200	.0133	1,859	675	6,453,783	4.50	1,466,780
(3) UT-NV	428,000	66,500	161,200	126,000	.0209	1,927	695	1,860,490	4.38	1,413,310
(4) CA	245,000	402,000	1,031,200	1,876,600	.0114	2,001	717	17,415,500	4.92	18,729,330
(5) AZ	133,000	58,300	81,200	1,166,000	.0105	1,865	676	3,004,250	4.49	1,700,230
(6) NM	512,000	103,300	67,900	627,400	.0126	1,542	637	3,470,280	4.76	763,550
(7) W.TX-W.OK	1,473,054	1,406,812	554,120	5,537,834	.0111	1,785	653	42,872,038	3.81	2,073,320
(8) E.TX	2,203,000	573,800	824,200	705,000	.0147	1,011	486	11,012,494	5.13	7,812,090
(9) E.OK	1,378,946	45,188	356,880	108,566	.0182	1,909	527	1,350,095	3.88	1,726,860
(10) CO	302,000	609,100	239.800	1,196,300	.0117	1,777	650	16,590,280	4.68	2,077,160
(11) KS	1,148,000	2,257,400	788,200	3,149,250	.0123	1,904	688	19,084,883	4.86	1,772,590
(12) NB	1,075,000	5,381,500	954,100	5,210,650	.0147	1,946	700	36,082,588	4.78	1,073,080
(13) ND-SD	2,345,000	1,432,900	623,900	2,045,800	.0185	1,805	659	6,684,000	5.09	808,870
(14) MN-WI	634,000	6,091,500	3,029,800	4,274,100	.0296	2,061	734	19,080,800	4.46	6,209,160
(15) IA	1,277,000	8,558,200	3,102,200	8,360,500	.0201	1,927	695	28,590,700	4.83	2,069,600
(16) IL	55,000	6,246,300	1,813,700	3,240,000	.0313	1,865	676	9,324,260	4.85	9,103,950
(17) MI-IN-OH	567,000	6,099,300	2,320,700	4,360,800	.0282	1,935	697	14,606,450	4.72	18,598,620
(18) MO	2,003,000	768,000	1,349,000	1,202,450	.0283	1,848	672	6,168,244	4.99	3,301,720
(19) AR-LA	1,201,000	106,100	1,584,600	60,000	.0373	1,320	561	2,633,980	4.45	3,756,280
(20) MS-AL-GA	1,637,000	621,400	2,980,800	240,000	.0269	1,378	581	8,209,975	3.23	6,611,390
(21) FL	557,000	82,200	375,200	109,500	.0195	1,516	628	3,525,800	3.03	6,208,010
(22) NC-SC	451,000	800,400	1,716,200	121,500	.0520	1,462	610	2,207,590	3.09	5,071,540
(23) KY-TN	1,544,000	873,700	1,001,300	115,500	.0302	1,425	597	6,746,600	3.89	4,774,810
(24) VA-WV-MD-DE	853,000	641,400	1,506,600	124,500	.0541	1,843	670	2,214,300	4.10	8,440,490
(25) PA	§	689,300	888,400	1,501,000	.0384	2,084	741	6,390,010	3.72	8,257,220
(26) NE (7 states)‖	§	689,300	1,109,600	31,500	.0555	2,199	775	4,718,960	3.56	28,102,950
48-state Total	24,996,000	45,957,400	29,263,000	46,799,250	----------	----------	----------	286,273,030	----------	156,846,660

*West Texas-West Oklahoma includes Texas' crop reporting districts 1-N, 1-S, 2-N, 2-S, 3, 6, 7, and Oklahoma's crop reporting districts 1, 2, and 3.

†East Texas includes crop reporting districts 4, 5-N, 5-S, 8-N, 8-S, 9, 10-N, and 10-S.

‡East Oklahoma includes crop reporting districts 4–9.

§Feeder cattle supplies were estimated to be 0 in regions 25 and 26 during 1980. See Appendix A, Generation of Basic Data.

‖No[illegible]region includes Maine, Vermont, New Hampshire, Rhode Island, Massachusetts, Connecticut, and New Yo[illegible]

and fed-beef consumption. Population centers close to the center of each region were generally selected as shipping and receiving points. The Mathematical Programming System (MPS/360) was employed to distribute live cattle, feed grains, and fed beef under the assumptions of the various models.[6]

Six models provide insights and guidelines for decision making in cattle feeding, cattle slaughtering, and related industries. Emphasis is on developments and issues of concern to the Texas–Oklahoma Plains area; however, the same questions are answered for all the areas considered. A base model (Model 1), depicts existing industry conditions for 1980. Subsequent models reflect possible changes in supply, demand, and cost relationships to measure the impact of such changes on the cattle feeding–fed-beef industry.

Model 1 determines the competitive position of each region in the production and distribution of fed slaughter cattle and fed beef in 1980. Regional basic data utilized in this model are presented in Table 6 and Appendices A, B, and C. The 1980 base model was validated by comparing optimum regional cattle feeding levels as determined in Model 1 with the average annual number of fed cattle marketed in each region reported in *Cattle on Feed* (USDA, 1980–81) for 1977–80.

Model 2 provides estimates of adjustments in projected feed grain supplies as a result of declining water tables in the Central and Southern High Plains and natural gas decontrol. Feed grain supply and demand data estimated for the 1980 base model were adjusted by USDA data and data estimated by Collins et al. (1982).

Model 3 provides optimum solutions under assumptions of large decreases in Texas feed grain production. The cattle industry and allied interests have expressed concern about future feed grain production levels in Texas. Model 3 incorporates all the assumptions of Model 2 and, in addition, assumes a 50 percent decline in Texas feed grain supplies. Such a scenario represents one of the more drastic decreases which could be anticipated concerning future Texas feed grain production.

Model 4 provides optimum solutions under decreased feeder cattle supplies. It combines the 1990 feed grain supply–demand estimates of Model 2 with a 30 percent decrease in feeder cattle supplies from the southern states (Regions 19–24). This scenario assumes that future feeder cattle input costs could increase, resulting in decreased returns to feeder cattle production and possible diversion of land from cow–calf enterprises to cash crop production by some southern farmers and ranchers.

Model 5 combines the assumptions of Model 2 with a 50 percent increase in regional variable slaughter costs to measure the impact of such increased costs on the optimum location of cattle feeding and cattle slaughter in the United States.

Model 6 combines the assumptions of Model 5 with a 50 percent increase in regional transportation costs to determine the impact of increasing transportation costs on the cattle feeding–fed-beef economy.

[6]See Appendix B for a detailed description of the model employed.

INTERREGIONAL ECONOMIC RELATIONSHIPS IN THE CATTLE FEEDING–FED-BEEF ECONOMY—1980

Model 1 depicts interregional economic relationships in the cattle feeding–fed-beef economy in 1980 under conditions where total industry costs are minimized. All models in this study reflect optimum commodity flow patterns and shipment levels, optimum regional feeding and slaughtering levels, surplus regional supplies and capacities, and opportunity costs.

Least-Cost Feeder Cattle Shipments and Feeding Levels

Optimum regional feeder cattle shipments, optimum regional feeding levels, and opportunity costs associated with feeder cattle shipments as determined by Model 1 are presented in Table 7. Surplus feeder cattle, feedlot capacity, and surplus feedlot capacity are also presented on a regional basis. Interregional shipments involve approximately two-thirds of the cattle estimated to be available for feeding in feedlots. The remaining cattle are retained for feeding within their production regions.

Considerations regarding optimum feedlot size and location include such factors as availability of feeder cattle, feed grains, and market outlets for fed slaughter cattle. Table 7 and subsequent tables showing the results of Model 1 reveal how one or more of these factors affect interregional competition in cattle feeding and slaughtering. Factors such as capital availability and weather were not included in this study.

Least-cost feeder cattle shipments from Model 1 estimate both optimum feeder cattle distribution and optimum cattle feeding locations shown in Figure 2. Feeder cattle generally move out of the northern and southeastern regions into Corn Belt, Southern Plains, and Central Plains feedlots. Other cattle movements include shipments from the Middle Atlantic States to Pennsylvania.

Some regions, such as Arkansas–Louisiana, serve as transshipment points in the Model 1 interregional movement of feeder cattle (Figure 2). Even though cattle are fed in such regions, the model specifies that feeder cattle should pass through these points to feedlots in deficit feeder cattle production regions in order to minimize costs.

Six major cattle feeding areas account for nearly 79 percent of the total cattle fed in the United States. West Texas–West Oklahoma is the foremost cattle feeding region followed by Nebraska, Kansas, Colorado, Iowa, and Michigan–Indiana–Ohio. West Texas–West Oklahoma accounts for nearly 24 percent of all cattle fed in the United States in 1980 when costs are minimized under Model 1 (Table 7). All six of the major cattle feeding regions possess locational advantages with respect to feeder cattle and/or feed grain availabilities. West Texas–West Oklahoma has the additional advantage of relatively lower fixed feeding costs generally attributed to economies of size present in Southern Plains cattle feedlots (Dietrich, 1971).

Approximately half of the U.S. feedlot capacity is

unused when cattle feeding is allowed to occur on a least-cost basis in the cattle feeding–fed-beef economy. Excess feedlot capacity exists predominantly in California, North Dakota–South Dakota, Minnesota–Wisconsin, Iowa, Illinois, Michigan–Indiana–Ohio, and Missouri. Feedlots in these regions generally require inshipments of feeder cattle or feed grain or both, placing them at a locational disadvantage relative to feedlots in other regions. Nearly 82 percent of the estimated available feedlot capacity in the northern Midwest and Corn Belt (Regions 13–18) is unused. Dietrich (1971) estimated most of the excess U.S. feedlot capacity to be in the West and Northwest in 1968; the shift in location is primarily due to sharply decreased feedlot capacities in the West and Northwest since his study, the inability of small Midwestern and Northern farmer-feeder feedlots to realize cost advantages associated with economies of size, and the increased costs associated with importing feeder cattle and feed grains from surplus production regions. The model does not penalize for excess capac-

TABLE 7. Model 1: Feeder cattle supplies, optimum feeding levels, opportunity costs, surplus feeder cattle, feedlot capacity, and surplus feedlot capacity

Shipping Region	Feeder Cattle Supply	Feeder Cattle Destinations and Optimum Regional Feeding Levels*												
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
	Head													
(1) WA-OR	697,000	582,300	9.73	11.00	114,700	11.17	15.14	21.63	39.81	30.40	14.28	23.99	20.29	19
(2) MT-ID-WY	2,277,000	5.86	468,933	126,000	2.82	2.42	2.74	6.94	24.44	14.33	615,855	7.83	3.74	2
(3) UT-NV	428,000	13.81	6.61	4.40	3.25	311,416	.21	6.91	23.76	15.09	116,584	9.63	6.33	11
(4) CA	245,000	21.26	28.82	21.71	245,000	7.24	15.44	22.51	39.41	31.92	23.39	31.09	31.64	36
(5) AZ	133,000	31.60	28.09	18.80	7.84	133,000	5.91	12.37	26.50	21.36	14.49	20.38	21.87	29
(6) NM	512,000	32.45	25.72	16.55	12.76	3.48	512,000	2.92	19.14	11.80	6.11	10.79	12.43	20
(7) W.TX-W.OK	1,473,054	34.37	26.30	19.53	15.57	6.58	115,400	1,357,654	12.59	4.54	4.27	4.77	6.33	14
(8) E.TX	2,203,000	31.98	26.12	19.59	14.03	5.60	2.34	1,498,000	705,000	1.91	6.79	3.02	5.00	11
(9) E.OK	1,378,946	30.34	23.42	18.26	13.67	6.69	1.78	1,378,946	7.42	.57	4.44	.14	2.14	8
(10) CO	302,000	26.99	18.55	12.18	15.14	7.39	1.90	3.08	19.69	10.38	302,000	4.94	3.58	10
(11) KS	1,148,000	37.39	27.12	21.67	23.70	13.93	6.63	3.40	15.13	4.26	4.82	130,741	1,017,258	8
(12) NB	1,075,000	35.25	23.90	19.31	25.54	16.59	9.25	5.90	19.05	8.00	4.06	.54	1,075,000	5
(13) ND-SD	2,345,000	27.48	16.00	17.90	22.54	17.44	11.49	8.64	20.96	10.79	5.98	3.83	2,345,000	0
(14) MN-WI	634,000	36.88	23.40	25.48	33.01	24.31	16.29	12.51	22.92	12.65	10.46	5.31	1.92	
(15) IA	1,277,000	39.27	26.42	23.52	29.47	20.09	12.65	8.88	18.56	9.00	8.37	3.05	.44	6
(16) IL	55,000	39.77	28.09	24.67	27.67	18.18	11.05	7.49	14.24	6.72	8.56	2.12	2.36	8
(17) MI-IN-OH	567,000	44.13	31.48	29.20	34.34	24.35	16.79	12.57	18.53	11.36	14.01	7.26	6.03	10
(18) MO	2,003,000	38.46	27.96	23.53	24.88	15.44	8.47	5.09	12.81	4.39	7.27	2,003,000	1.73	9
(19) AR-LA	1,201,000	33.98	26.83	21.00	16.00	7.50	3.21	1,201,000	1.23	1.17	7.08	2.28	4.40	10
(20) MS-AL-GA	1,637,000	33.86	24.98	20.74	17.39	8.67	3.65	102,234	.87	0.00	5.88	1,015,508	1.48	7
(21) FL	557,000	48.83	36.68	34.03	30.16	19.77	14.33	10.27	7.98	10.73	18.01	11.19	13.03	10
(22) NC-SC	451,000	41.30	30.98	27.45	26.17	17.18	11.15	6.92	8.02	6.70	11.92	5.29	6.77	11
(23) KY-TN	1,544,000	36.08	26.48	22.68	21.15	12.83	6.76	2.89	6.13	2.64	7.51	1.08	2.49	
(24) VA-WV-MD-DE	853,000	46.87	35.06	32.71	34.34	24.94	18.01	13.81	15.37	12.80	17.08	10.11	10.66	14
(25) PA	0	55.27	41.28	38.98	44.39	33.28	24.88	19.81	24.01	18.21	22.24	14.02	14.18	18
(26) NE (7 states)	0	66.20	51.26	48.96	56.82	44.88	35.79	30.11	34.18	28.26	32.34	34.02	22.77	26
Total	24,996,000	582,300	468,933	126,000	359,700	444,416	627,400	5,537,834	705,000	0	1,034,439	3,149,250	4,437,258	0
Feedlot Capacity		582,300	726,200	126,000	1,876,600	1,166,000	627,400	5,537,834	705,000	108,566	1,196,300	3,149,250	5,210,650	2,045
Surplus Feedlot Capacity		0	257,267	0	1,516,900	721,584	0	0	0	108,566	161,861	0	773,39	45

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

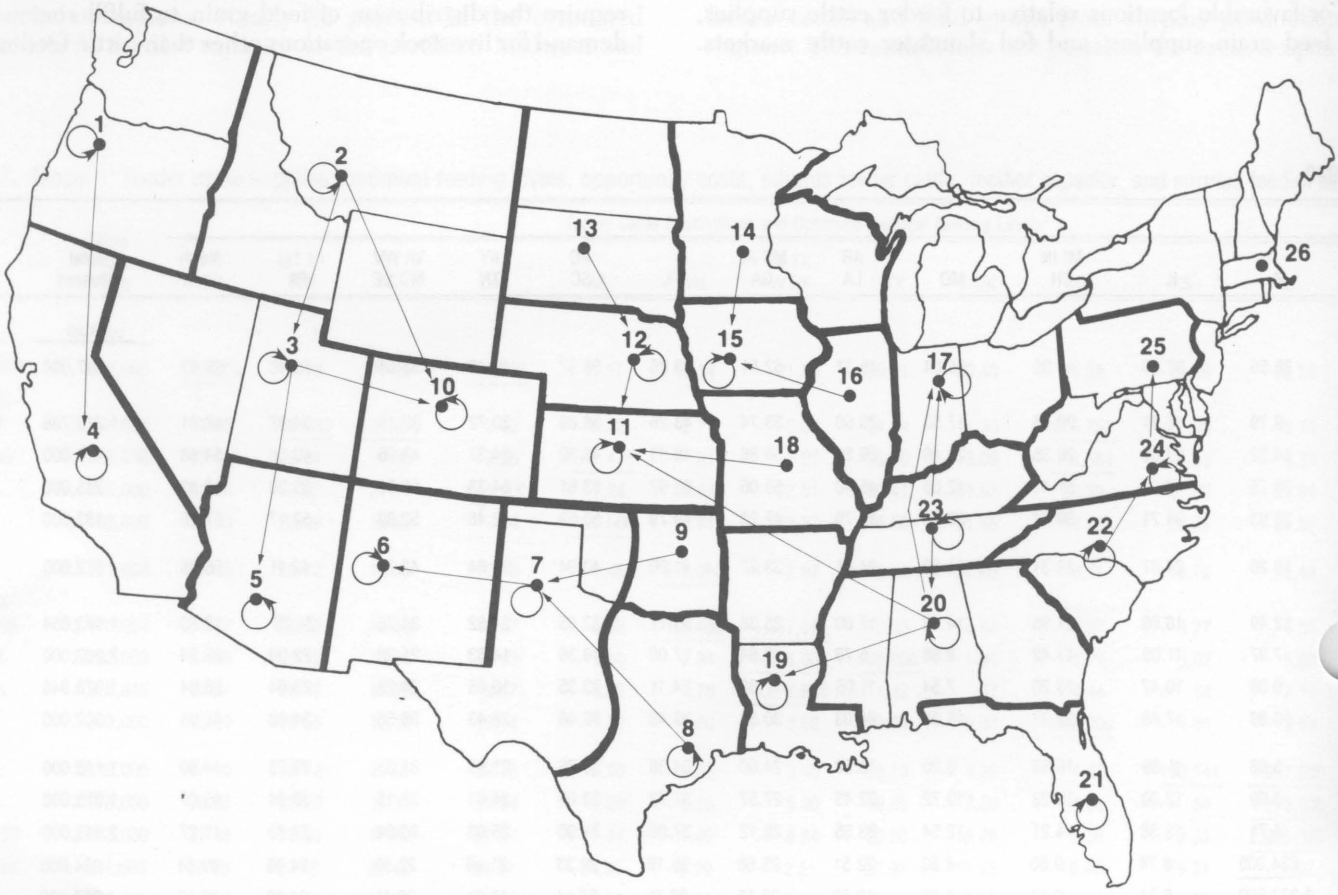

Figure 2. Optimum interregional flows of feeder cattle (Model 1).

(Table 8). As a result, total costs are minimized when Missouri and Illinois ship nearly all their feed grain production to deficit feed grain regions. Therefore, in Model 1, little feed grain is available for cattle feeding in these regions.

Least-Cost Feed Grain Shipments

Total feed grain production for a given period is normally utilized as feed for feedlot cattle or other kinds of livestock, as inputs into various industries, or as exports. The models developed for this study do not include feed grain for export markets in total available feed grain supplies. Also, regional feed grain demand for other livestock is satisfied on a least-cost basis before supplying feed grain to the cattle feeding industry. Feed grain available for cattle is distributed on a least-cost basis in relation to a region's ability to compete in the cattle feeding–fed-beef economy.

Figure 3 shows the optimum distribution of feed grain for uses other than feeding cattle in feedlots. Shipments are generally from the Corn Belt to the Southeast and Northeast, from the Central Plains to the West and Southwest, and from the Northern Plains to the West.

Feed grain quantities shipped, opportunity costs, and feed grain quantities available for cattle feeding are shown in Table 9. Nearly 36 percent of the total feed grain shipped for use other than feeding cattle in feedlots is involved in interregional shipments. Approximately 71 percent of all feed grain available for cattle feeding is supplied by the Central Plains and Corn Belt regions, including over 33 percent supplied by Kansas and Nebraska.

The optimum flow of feed grains available for cattle feeding and the optimum cattle feeding locations are shown in Figure 4. Interregional shipments of feed grain

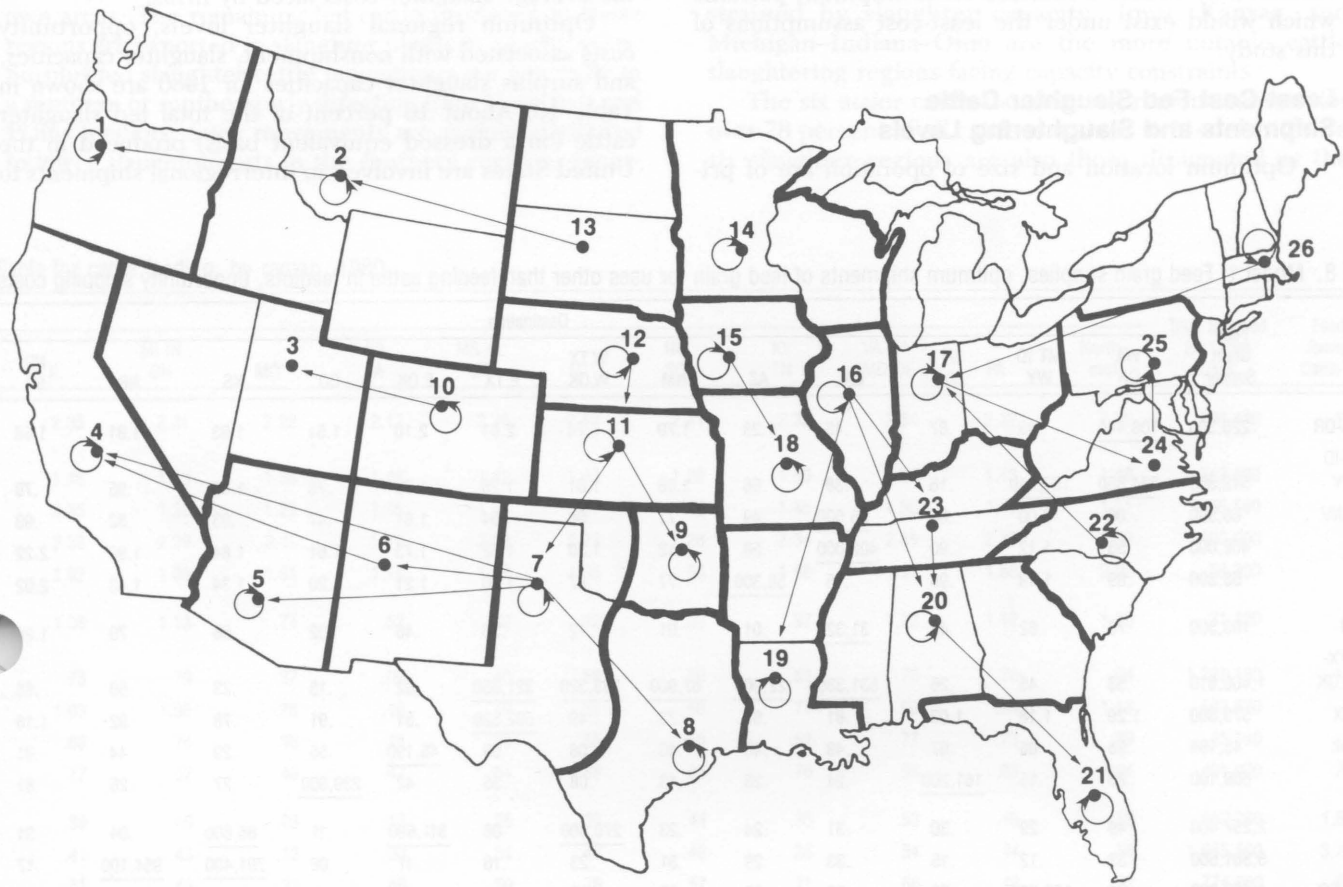

Figure 3. Optimum interregional flows of feed grain for uses other than feeding cattle in feedlots (Model 1).

for cattle feeding are generally from Illinois to the Southeast, and from the Central and Southern Plains to the Southwest and the West.

Quantities of feed grains shipped for cattle feeding, opportunity costs associatd with nonshipments, and surplus feed grain supplies are shown in Table 9. Surplus feed grain supplies result mostly in Nebraska, Minnesota–Wisconsin, and Iowa. Even though cattle feeding occurs in West Texas–West Oklahoma, Mississippi–Alabama–Georgia, and New Mexico in Model 1, this model does not indicate intraregional shipments of feed grain for cattle feeding in these regions. Under the least-cost distribution system, total costs are minimized when feed grain produced in these regions is shipped to feedlots in competing regions. Such shipment patterns can generally be attributed to relative distances between designated base trading points and estimated transportation costs. Washington–Oregon, East Texas, and North Carolina–South Carolina have a competitive disadvantage in cattle feeding relative to feed grain supplies. However, these regions import sufficient feed grain from surplus regions to allow 100 percent utilization of regional feedlot capacities. Such shipments are justified by competitive advantages in terms of feeder cattle supplies, feeding and slaughter costs, and fed slaughter cattle markets.

Opportunity costs associated with nonshipment of feed grain for cattle feeding (Table 9) suggest that the best potential feed grain markets for West Texas–West Oklahoma, in addition to regions that receive feed grain for cattle feeding, are California and East Texas. Other potential markets in order of lowest opportunity costs include East Oklahoma with $.02 and Arkansas–Louisiana with $.09. (An opportunity cost of $.02 suggests that efficiencies in grain handling, transportation, feeding, etc., would have to increase at least $.02 per

hundredweight for shipments to occur, for example, from West Texas–West Oklahoma to East Oklahoma, given the assumptions and data associated with Model 1.) Available data indicate that during 1980 shipments actually did occur between West Texas–West Oklahoma and East Oklahoma and Arkansas–Louisiana (Hill, Leath, and Fuller, 1981). However, optimum flows determined by Model 1 indicate other shipment patterns which would exist under the least-cost assumptions of this study.

Least-Cost Fed Slaughter Cattle Shipments and Slaughtering Levels

Optimum location and size of operation are of primary concern in the cattle slaughtering industry. The determination of optimum slaughter plant location and size draws attention to such factors as fed slaughter cattle supplies, slaughter costs, and proximity to fed-beef markets. Beef slaughter and fabricating operations represent a substantial investment in fixed facilties. In addition, negotiated labor contracts have a significant impact on the average slaughter costs faced by firms.

Optimum regional slaughter levels, opportunity costs associated with nonshipment, slaughter capacities, and surplus slaughter capacities for 1980 are shown in Table 10. About 16 percent of the total fed slaughter cattle (on a dressed equivalent basis) produced in the United States are involved in interregional shipments to

TABLE 8. Model 1: Feed grain supplies, optimum shipments of feed grain for uses other than feeding cattle in feedlots, opportunity shipping costs, and f

Shipping Region	Feed Grain Supply	Destination													
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD	MN WI
(1) WA-OR	226,300	108,440	.65	.87	.46	1.23	1.79	1.74	2.01	2.10	1.51	1.93	1.81	1.68	1.
(2) MT-ID WY	542,800	384,860	157,940	.16	.38	.88	1.06	1.01	1.25	1.36	.78	1.08	.95	.79	1.
(3) UT-NV	66,500	.06	0.00	.06	66,500	.49	.71	.66	.94	1.01	.47	.93	.82	.93	1.
(4) CA	402,000	.55	1.12	.90	402,000	.58	1.18	1.30	1.62	1.73	1.61	1.84	1.90	2.22	2.
(5) AZ	58,300	.89	1.19	.96	.15	58,300	.77	.87	1.00	1.21	1.20	1.34	1.43	2.02	1.
(6) NM	103,300	.70	.62	.43	31,320	.01	.01	.12	.36	.46	.32	.58	.70	1.2	1.
(7) W.TX-W.OK	1,406,810	.53	.45	.26	531,380	22,900	67,900	283,320	321,680	.02	.15	.23	.50	.86	
(8) E.TX	573,800	1.29	1.18	1.03	.81	.62	.73	.49	502,520	.51	.91	.78	.92	1.16	1.
(9) E.OK	45,188	.95	.86	.67	.49	.40	.40	.08	.08	45,190	.55	.29	.44	.91	
(10) CO	609,100	.23	.15	161,200	.24	.26	.13	.08	.35	.42	239,800	.27	.26	.81	
(11) KS	2,257,400	.49	.29	.30	.31	.24	.23	270,800	.06	311,690	.11	86,800	.04	.31	
(12) NB	5,381,500	.33	.12	.15	.33	.29	.31	.23	.16	.11	.06	701,400	954,100	.17	
(13) ND-SD	1,432,900	.24	150,960	.30	.69	.92	.93	.63	.44	.62	.65	.30	.21	623,900	
(14) MN-WI	6,091,500	.43	.20	.49	.67	.65	.64	.42	.39	.37	.40	.30	.21	.04	3,029,
(15) IA	8,558,200	.55	.29	.37	.52	.45	.44	.22	.19	.17	.27	.12	.08	.13	
(16) IL	6,246,300	.74	.50	.55	.62	.55	.54	.33	.14	.23	.44	.22	.28	.34	
(17) MI-IN-OH	6,099,300	.83	.60	.72	.82	.74	.74	.52	.30	.43	.62	.42	.43	.44	
(18) MO	768,000	.92	.73	.74	.72	.65	.53	.28	.20	.21	.44	.17	.30	.45	
(19) AR-LA	106,100	1.24	1.25	.98	.81	.62	.73	.42	.02	.42	.87	.68	.80	1.02	
(20) MS-AL-GA	621,400	1.30	1.11	1.12	1.04	.85	.95	.65	.25	.58	.96	.73	.86	.98	
(21) FL	82,200	2.07	1.84	1.85	1.70	1.55	1.57	1.35	.79	1.26	1.72	1.39	1.51	1.76	
(22) NC-SC	800,400	1.74	1.27	1.56	1.52	1.33	1.44	1.13	.73	1.06	1.44	1.21	1.29	1.35	1.
(23) KY-TN	873,700	1.25	1.05	1.16	1.15	.90	.96	.64	.33	.57	.94	.69	.76	.85	
(24) VA-WV-MD-DE	641,400	1.80	1.53	1.63	1.76	1.51	1.57	1.25	.88	1.18	1.50	1.23	1.28	1.36	1.
(25) PA	689,300	1.69	1.45	1.29	1.67	1.59	1.58	1.34	1.08	1.27	1.48	1.26	1.29	1.29	1.
(26) NE (7 states)	373,700	1.83	1.60	1.79	1.90	1.83	1.82	1.62	1.37	1.51	1.69	1.50	1.51	1.43	1.
Total	45,057,400	493,300	308,900	161,200	1,031,200	81,200	67,900	554,120	824,200	356,880	239,800	788,200	954,100	623,9	029,

*Underscored figures are shipments (in 10,000 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

slaughter plants. Interregional shipments occur mainly because particular regions have competitive advantages with respect to slaughter costs and because slaughter levels in some areas are limited by capacity constraints.

Optimum flows of fed slaughter cattle to slaughtering sites as derived from Table 10 are illustrated in Figure 5. The six major cattle feeding areas named earlier slaughter 85 percent of the fed cattle produced within their own areas. The remaining fed cattle produced in these regions are exported to slaughter plants in nearby areas. Surplus fed slaughter cattle movements are generally in a southern or southeasterly direction from Corn Belt and Plains feedlots. Such movements are mainly attributed to lower slaughter costs in the southern regions, generally resulting from relatively lower wage rates and excess slaughter capacity.

As estimated in Model 1, slightly more than 57 percent of the U.S. cattle slaughter capacity is utilized under the least-cost system. Regions with significant surplus slaughter capacity include Minnesota–Wisconsin, Nebraska, California, East Texas, Colorado, and Illinois. Cattle slaughter in several regions is constrained by slaughter capacity. Iowa, Kansas, and Michigan–Indiana–Ohio are the more notable cattle slaughtering regions facing capacity constraints.

The six major cattle slaughtering regions account for over 78 percent of all cattle slaughter in Model 1. These six slaughter regions are also those designated as the

ain available for cattle feeding, by region, 1980

IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped for Other Uses	Feed Grain Available for Cattle Feeding
2.10	2.35	2.31	2.22	2.12	2.26	2.52	2.41	2.35	2.54	2.32	2.36	108,440	117,860
1.19	1.46	1.43	1.38	1.48	1.42	1.63	1.29	1.50	1.62	1.43	1.48	542,800	0
1.11	1.35	1.39	1.23	1.05	1.27	1.47	1.42	1.45	1.56	1.11	1.51	66,500	0
2.16	2.32	2.39	2.11	1.78	2.08	2.23	2.28	2.34	2.59	2.39	2.52	402,000	0
1.66	1.82	1.88	1.61	1.16	1.47	1.65	1.66	1.66	1.91	1.88	2.02	58,300	0
.9	1.06	1.13	.74	.52	.82	.92	1.02	.97	1.22	1.12	1.26	31,320	71,980
.56	.73	.79	.37	.09	.40	.58	.59	.53	.78	.76	.94	1,227,180	179,630
1.02	1.03	1.06	.78	.18	.49	.51	.68	.71	.90	.99	1.18	502,520	71,280
.57	.69	.76	.36	.15	.39	.55	.58	.52	.77	.75	.89	45,190	0
.54	.77	.82	.46	.47	.64	.88	.83	.76	.96	.83	.94	401,000	208,100
.23	.39	.46	.03	.12	.25	.39	.44	.35	.53	.45	.59	669,290	1,588,110
.15	.41	.43	.12	.20	.34	.47	.48	.38	.54	.44	.56	1,655,500	3,726,000
.24	.51	.48	.31	.46	.50	.76	.57	.71	.66	.48	.52	774,860	658,040
.13	.34	.27	.19	.33	.35	.50	.39	.34	.41	.28	.32	3,029,800	3,061,700
102,200	.21	.22	581,000	.18	.20	.35	.29	.21	.34	.23	.35	3,683,200	4,875,000
.15	1,813,700	.07	.26	1,478,500	1,795,300	.15	.09	1,001,300	.14	.06	.20	6,088,800	157,500
.29	.20	2,320,700	.14	.15	.05	.15	933,560	.06	1,261,390	.14	735,900	5,251,550	847,750
.25	.57	.32	768,000	.13	.15	.30	.27	.18	.37	.30	.45	768,000	0
.85	.73	.75	.55	106,100	.16	.25	.35	.38	.58	.66	.85	106,100	0
.79	.65	.57	.49	.08	311,800	293,000	.03	.14	.27	.34	.53	341,100	280,300
1.46	1.32	1.19	1.16	.69	.52	82,200	.37	.80	.56	.72	.88	82,200	0
1.17	1.03	.81	.90	.56	.32	.14	782,640	.55	.11	.24	.40	782,640	17,760
.66	.51	.44	.38	.16	873,700	.14	.12	.11	.26	.34	.51	873,700	0
1.15	1.01	.74	.93	.72	.49	.26	.04	.62	245,210	199,100	.16	444,310	197,090
1.15	1.04	.99	.97	.91	.67	.53	.28	.81	.11	689,300	.12	689,300	0
1.37	1.28	.95	1.22	1.20	.96	.79	.54	1.08	.37	.22	373,300	373,700	0
102,	1,813,800	2,320,700	1,349,000	1,584,600	2,980,800	375,200	1,716,200	1,001,300	1,506,600	888,400	1,109,600	28,999,300	16,058,100

major cattle feeding areas. This documents the advantages of locating cattle slaughter facilities near major cattle feeding areas.

Least-Cost Fed-Beef Shipments

Optimum distribution patterns of dressed fed beef are determined to a great degree by regional production levels, location and consumption levels of population centers, and regional differentials in production costs, transportation costs, and prices of finished products. Fed-beef production is characterized by concentrated slaughter in regions possessing significant competitive advantages relative to fed slaughter cattle supplies, slaughter plant capacity, and slaughter costs. Production and shipment levels shown in Table 11 reveal that approximately 90 percent of the U.S. fed-beef production is involved in interregional shipments when costs are minimized in the cattle feeding–fed-beef economy.

The two most populated regions, California and the Northeast, are large deficit fed-beef producing areas, accounting for nearly 30 percent of the total U.S. fed-beef consumption. Other areas requiring inshipments of fed beef to meet demand include the North Central States, the Southeast and South, the Middle Atlantic States, and Pennsylvania. Surplus fed-beef production, as determined by Model 1, is concentrated in West Texas–West Oklahoma, Colorado, Kansas, Nebraska, and Iowa.

Optimum flows of fed beef from slaughter to consumption regions are shown in Figure 6. Fed beef is generally distributed to the west, especially to California from Colorado, Montana–Idaho–Wyoming, and southwestern feedlots. West Texas–West Oklahoma is the only region with considerable movement of fed beef both west and east. The Northwest is relatively self-sufficient in terms of fed-beef production. However, Washington–Oregon imports fed beef from Montana–Idaho–Wyoming.

West Texas–West Oklahoma has significant locational and cost advantages in supplying fed beef to deficit markets in the East and West. Slaughter plants in West Texas–West Oklahoma supply nearly 70 percent of the fed beef consumed in Florida and over 30 percent of California's fed-beef consumption. This same area indirectly supplies nearly all of the fed beef consumed in the Southwest, Southeast, and most Middle Atlantic States when transshipment patterns are considered. Potential markets for West Texas–West Oklahoma fed beef, as indicated by smaller opportunity costs, are Arizona, North Carolina–South Carolina, Kansas, and Virginia–West Virginia–Maryland–Delaware.

Iowa and Nebraska enjoy a locational advantage in supplying fed-beef to the large deficit Northeast region.

TABLE 9. Model 1: Optimum shipments of available feed grain for cattle feeding, opportunity costs, and surplus feed grain, by region, 1980

Shipping Region	Destination*												
	WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) Washington-Oregon	117,860	.65	.87	.46	1.23	1.79	1.74	2.01	2.10	1.51	1.93	1.81	1.6
(6) New Mexico	.70	.62	.43	71,980	.01	.01	.12	.36	.46	.32	.58	.70	1.2
(7) West Texas-West Oklahoma	.53	.45	.26	0.00	82,880	96,750	0.00	0.00	.02	.15	.23	.50	.8
(8) East Texas	1.29	1.18	1.03	.81	.62	.73	.49	71,280	.51	.91	.78	.92	1.1
(10) Colorado	.23	.15	24,280	.24	.26	.13	.08	.35	.42	183,820	.27	.26	.8
(11) Kansas	.49	.29	.30	.21	.24	.23	988,500	.06	0.00	.11	599,620	.04	.3
(12) Nebraska	.33	.12	.15	.33	.29	.31	.23	.16	.11	.06	0.00	863,490	.1
(13) North Dakota-South Dakota	.24	8,717	.30	.69	.92	.93	.63	.44	.62	.65	.30	.21	0.0
(14) Minnesota-Wisconsin	.43	.20	.49	.67	.65	.64	.42	.39	.37	.40	.30	.21	.0
(15) Iowa	.55	.29	.37	.52	.45	.44	.22	.19	.17	.27	.12	.08	.1
(16) Illinois	.74	.50	.55	.62	.55	.54	.33	.14	.23	.44	.22	.28	.2
(17) Michigan-Indiana-Ohio	.83	.60	.72	.82	.74	.74	.52	.30	.43	.62	.42	.43	.4
(20) Mississippi-Alabama-Georgia	1.30	1.11	1.12	1.04	.85	.95	.65	.25	.58	.96	.73	.86	.9
(22) North Carolina-South Carolina	1.74	1.27	1.56	1.52	1.33	1.44	1.13	.73	1.06	1.44	1.21	1.29	1.3
(24) Virginia-West Virginia-Maryland-Delaware	1.80	1.53	1.63	1.76	1.51	1.57	1.25	.88	1.18	1.50	1.23	1.28	1.3
Total	117,860	87,170	24,280	71,980	82,880	96,750	988,500	71,280	0	183,820	599,620	863,49	0

*Underscored figures are shipments (in 10,000 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

Kansas has a distinct advantage in shipping fed beef to Illinois and Missouri, but must compete with the South and Southern Plains to supply markets in Kentucky–Tennessee and Virginia–West Virginia–Maryland–Delaware.

The various competitive relationships between West Texas–West Oklahoma, Colorado, and Kansas indicated by Model 1 raise important questions regarding current industry trends. Recently constructed large capacity slaughter plants have initiated operations in southwestern Kansas. Since these plants are located relatively close to the Texas and Oklahoma Panhandle Plains slaughtering area, it is likely that they can compete effectively for fed-beef markets especially in southern regions. Estimates of respective opportunity costs associated with potential shipments of fed-beef from Kansas to Arkansas–Louisiana, Mississippi–Alabama–Georgia, and Florida are only $0.57, $0.23, and $0.38 per hundredweight on a carcass basis.

Large slaughtering operations with national systems of distribution located in the concentrated cattle feeding regions generally produce a relatively homogeneous product. Regions such as West Texas–West Oklahoma and Colorado, which compete for the California fed-beef market, tend to produce carcasses of similar size and quality. Such production practices suggest an increasing reliance on price competition in these markets. Those firms with the more efficient production and marketing practices will have increased chances of survival in the competitive cattle feeding–fed-beef economy.

EFFECTS OF CHANGES IN INPUT COSTS ON REGIONAL COMPETITIVE RELATIONSHIPS

Making decisions concerning optimum plant size and location, sources of supply, and distribution systems in the cattle feeding–fed-beef economy is difficult in a volatile economic environment. Constantly changing economic relationships involve such factors as feeder cattle, feed grain, fed slaughter cattle prices and supplies, fed-beef prices and demand, and feeding and slaughtering costs. In addition, changing energy costs have economic implications for available supplies of irrigation water, feed grains, feeder cattle, and optimum distribution patterns.

Transshipment models can be used to study the effects of changes in economic conditions and resources on optimum production levels, commodity flows, opportunity costs, and changes in regional competitive alignments as resource situations undergo change.

Effects of Changes in Energy Costs on Irrigation Potential and Feed Grain Supplies by 1990

Model 2 provides optimum solutions given estimated feed grain supplies and demands for 1990. The 1990

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Surplus Feed Grain
2.25	2.10	2.40	2.31	2.46	2.12	2.26	2.52	2.41	2.35	2.54	2.32	2.66	117,860	0
1.37	.90	1.11	1.13	.98	.52	.82	.92	1.02	.97	1.22	1.12	1.56	71,980	0
1.03	.56	.78	.79	.61	.09	.40	.58	.59	.53	.78	.76	1.24	179,630	0
1.49	1.02	1.08	1.06	1.02	.18	.49	.51	.68	.71	.90	.99	1.48	71,280	0
.94	.54	.83	.82	.70	.47	.64	.88	.83	.76	.96	.83	1.24	208,090	0
.68	.23	.44	.46	.27	.12	.25	.39	.44	.35	.53	.45	.89	1,588,120	0
.54	.15	.46	.43	.36	.20	.34	.47	.48	.38	.54	.44	.86	863,490	28,630
.42	.24	.56	.48	.55	.46	.50	.76	.57	.51	.66	.48	.82	87,170	5,710
.35	.13	.39	.27	.43	.33	.35	.50	.39	.34	.41	.28	.62	0	30,620
.40	378,850	.26	.22	.24	.18	.20	.35	.29	.21	.34	.23	.65	78,450	44,960
.55	.15	.05	.07	.50	7,920	33,070	.15	.09	16,460	.14	.06	.50	57,450	1,000
.61	.29	.25	428,560	.38	.15	.05	.15	0.00	.06	0.00	.14	.30	428,560	4,190
1.21	.79	.70	.57	.73	.08	0.00	16,600	.03	.14	.27	.34	.83	16,600	0
1.54	1.17	1.08	.81	1.14	.56	.32	.14	17,760	.55	.11	.24	.70	17,760	0
1.49	1.15	1.06	.74	1.17	.72	.49	.26	.04	.62	22,950	174,140	.46	197,090	0
0	378,850	0	428,560	0	7,920	33,070	16,600	17,760	16,460	22,950	174,140	0	4,283,920	115,100

regional feed grain production levels reflect the projected effects of declining availability of irrigation water and deregulation of natural gas prices on irrigation practices, especially in the Central and Southern Plains.[7] Results of Model 2 were compared with those of Model 1 to examine potential cattle feeding–fed-beef industry adjustments. Total costs in the cattle feeding–fed-beef economy, as represented in Model 2, are more than $4.5 billion, an increase of nearly 13 percent over the 1980 base model. Such total industry cost estimates should be used only for purposes of comparison between the models estimated in this study.

The U.S. feed grain supplies are estimated to be more than 7 percent higher in 1990 than in 1980 (Tables D–1 and D–8 in Appendix D). Supplies in New Mexico and Nebraska increase more than 75 percent. Washington–Oregon and Arizona are the only other regions posting increased supplies. Feed grain supplies in all other regions are estimated to decrease by as much as 11 percent from 1980 to 1990.

Adjustments in regional feed grain supplies affect regional competitive advantages, causing shifts in regional cattle feeding levels or feed grain distribution patterns or both (Table D–2). However, cattle feeding levels in West Texas–West Oklahoma are not altered by these projected changes; this region continues to utilize 100 percent of its feedlot capacity, as does Kansas. These results show that regions such as West Texas–West Oklahoma enjoy competitive advantages in cattle feeding and that costs to the economy are minimized when

[7]Regional estimates were based on data concerning potential water availabilities (High Plains Associates, 1982) and deregulation of natural gas prices (Collins et al., 1982).

TABLE 10. Model 1: Optimum shipments of fed slaughter cattle (dressed weight equivalent) for slaughter, opportunity shipping costs, slaughter capacity,

Shipping Region	Destination* WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) WA-OR	4,210,029	2.74	2.99	1.62	5.09	6.25	6.98	9.99	8.36	6.07	7.94	7.09	6.
(2) MT-ID-WY	.90	2,180,511	984,790	2.07	2.93	3.25	3.57	6.75	4.73	2.54	4.17	3.16	2.
(3) UT-NV	1.68	.53	875,700	.96	1.15	1.48	2.33	5.22	3.65	1.41	3.38	2.59	3.
(4) CA	3.14	5.42	3.78	2,579,049	2.58	4.74	5.61	8.38	7.16	6.53	7.98	8.08	8.
(5) AZ	5.00	4.68	2.37	1.00	3,004,250	1.74	2.61	4.94	4.16	3.85	4.98	5.35	6.
(6) NM	5.07	3.91	1.61	2.05	.63	3,470,580	526,258	2.89	1.55	1.52	2.37	2.80	4.
(7) W.TX-W.OK	6.56	4.99	3.22	3.68	2.26	.76	36,162,060	2.14	.51	1.83	1.63	2.05	3.
(8) E.TX	10.08	8.63	6.53	6.91	4.98	4.01	2.37	.62	1.98	5.32	3.63	4.38	5.
(10) CO	3.94	2.25	.59	2.89	1.79	.57	.12	3.24	1.31	6,723,853	.97	.62	1.
(11) KS	6.33	4.40	3.08	4.86	3.44	1.94	.44	2.11	1,350,095	1.49	19,084,880	1,171,121	1.
(12) NB	5.61	3.53	2.42	5.09	3.94	2.50	.99	2.96	.85	1.27	.13	16,133,800	.
(15) IA	7.59	5.10	4.40	7.12	5.78	5.28	2.66	3.83	2.04	3.25	1.67	1.05	1.
(17) MI-IN-OH	10.63	8.21	7.65	10.11	8.70	7.20	5.46	5.72	4.55	6.51	4.61	4.32	4.
(19) AR-LA	11.90	10.13	8.34	8.84	7.03	5.81	3.96	2.72	3.36	6.90	4.97	5.71	7.
(20) MS-AL-GA	13.73	11.58	10.36	11.25	9.55	8.22	6.31	5.05	5.41	8.75	6.60	7.09	8.
(21) FL	16.73	14.64	13.45	13.91	12.17	11.00	9.19	7.33	8.59	11.90	9.80	10.27	11.
(22) NC-SC	15.29	13.03	12.10	13.35	11.85	10.44	8.52	7.44	7.68	10.58	8.41	8.84	9.
(23) KY-TN	13.04	10.81	9.76	11.09	9.61	8.06	6.16	5.65	5.24	8.17	5.95	6.40	7.
(24) VA-WV-MD-DE	14.98	12.56	11.97	13.78	12.37	7.87	9.05	8.23	8.11	10.58	8.50	8.63	9.
(25) PA	14.62	12.20	11.66	13.82	12.41	10.91	9.12	9.03	8.23	10.37	8.33	8.33	8.
Total	4,210,029	2,180,511	1,860,490	2,579,050	3,004,250	3,470,280	36,688,318	0	1,350,095	6,723,853	19,084,883	17,304,930	0
Slaughter Capacity	5,974,680	6,453,783	1,860,490	17,415,500	3,004,250	3,470,280	42,872,038	11,012,494	1,350,095	16,590,280	19,084,883	36,082,588	6,684
Surplus Slaughter Capacity	1,764,651	4,273,272	0	14,836,451	0	0	6,183,724	11,012,494	0	9,866,427	0	18,777,65	84

*Underscored figures are shipments (100 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

feed grain is shipped into such a region. Cattle feeding increases about 3 percent in Nebraska and nearly 85 percent in Iowa. Adjustments in the western United States cause cattle feeding levels to increase substantially in Montana–Idaho–Wyoming and also in Colorado. Increased feeder cattle demand in Montana–Idaho–Wyoming is supplied by intraregional production, while additional feeder cattle requirements in Colorado are met by increased shipments from Montana–Idaho–Wyoming and Utah–Nevada. The largest decreases in cattle feeding are in Michigan–Indiana–Ohio and in Pennsylvania.

Reapportionment of cattle feeding activities causes changes in many of the least-cost feeder cattle movements between surplus and deficit production regions. Additional feeders are shipped from Kansas to Nebraska to substantiate increased feeding levels in Nebraska. Iowa's increased cattle feeding creates increased demand for feeder cattle shipments from Michigan–Indiana–Ohio, Mississippi–Alabama–Georgia, and Kentucky–Tennessee. Decreased feeding activity in Michigan–Indiana–Ohio eliminates the need for feeder cattle imports from Mississippi–Alabama–Georgia and Kentucky–Tennessee.

The total quantity of feed grain demanded for uses other than cattle feeding increases an estimated 23 percent in the United States from Model 1 to Model 2 (Tables D–1, D–8). These increases result in a 14 percent decline in the quantity of feed grain available to the U.S. cattle feeding industry. Regions with significant increases in feed grains available for cattle feeding include West Texas–West Oklahoma, Colorado, Nebraska, and Michigan–Indiana–Ohio (Table D–3). Total feed grain supplies available for cattle feeding in West Texas–

urplus slaughter capacity, by region, 1980

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped
6.85	8.02	8.52	8.74	8.58	9.07	8.54	10.17	9.34	8.52	9.97	9.56	9.90	4,210,029
2.65	3.69	4.32	4.48	4.64	5.52	4.61	6.24	5.24	4.51	5.71	6.30	5.63	3,165,301
3.58	3.52	4.01	4.45	4.08	4.31	3.95	5.58	4.84	4.02	5.65	5.29	5.64	875,700
	9.00	8.93	9.71	8.60	7.58	7.60	8.86	8.89	8.09	10.27	10.25	10.88	2,579,049
6.57	5.14	5.94	6.72	5.61	4.26	4.39	5.54	5.80	5.11	7.28	7.26	7.88	3,004,250
4.01	3.53	3.33	4.11	3.00	1.98	2.00	3.26	3.28	2.50	4.67	4.65	5.27	3,996,538
3.24	2.67	2.45	3.13	2.16	1.01	1.02	2.21	2.13	1.52	3.61	3.62	4.21	36,162,060
4.89	4.19	3.29	3.80	3.24	0.00	3,426,300	.72	1.45	1.24	3.19	3.95	4.59	3,426,300
1.81	1.55	1.72	2.47	1.71	2.10	1.58	3.21	2.48	1.66	3.43	3.16	3.66	6,723,853
.93	.49	.31	1.07	.07	.72	60,741	1.63	.83	.02	1.87	1.64	2.26	21,666,840
.29	14,927,000	.49	.93	.63	1.57	.60	2.23	1.39	.57	2.13	1.77	2.11	31,060,809
.03	13,663,700	0.00	.30	.48	1.62	.30	1.92	.91	.19	1.54	1.14	1.49	13,663,700
2.55	2.64	1.00	14,606,450	2.50	2.96	.34	1.66	632,290	.11	.40	198,120	.41	15,436,860
5.38	4.68	3.34	3.69	3.43	.84	336,600	1.20	1.47	1.12	3.20	3.97	4.61	336,600
6.27	5.72	3.70	3.39	4.29	2.34	1,394,400	.67	.44	.65	2.18	2.94	3.58	1,394,400
9.34	8.91	6.83	6.31	7.63	5.09	2.28	687,660	1.87	3.72	3.49	4.58	4.98	687,660
7.40	7.31	5.19	4.06	6.23	4.80	1.47	1.28	741,150	2.24	.95	1.96	2.43	741,150
5.39	4.93	2.82	2.49	3.73	2.81	689,535	1.48	.55	.46	0.00	.16	.57	689,535
6.90	6.99	5.04	3.51	6.32	5.55	2.23	1.95	834,150	2.62	.10	.25	.65	834,150
6.54	6.65	4.83	3.17	6.19	6.36	3.04	3.11	1.07	3.34	.31	6,191,890	0.00	6,191,890
0	28,590,700	0	14,606,450	0	0	5,907,576	687,660	2,207,590	0	0	6,390,010	0	156,846,675
19,080,800	28,590,700	9,324,260	14,606,450	6,168,244	2,633,980	8,209,975	3,525,800	2,207,590	6,746,600	2,214,300	6,390,010	4,718,960	286,273,030
19,0	0	9,324,260	0	6,168,244	2,633,980	2,302,399	2,838,140	0	6,746,600	2,214,300	0	4,718,960	129,426,355

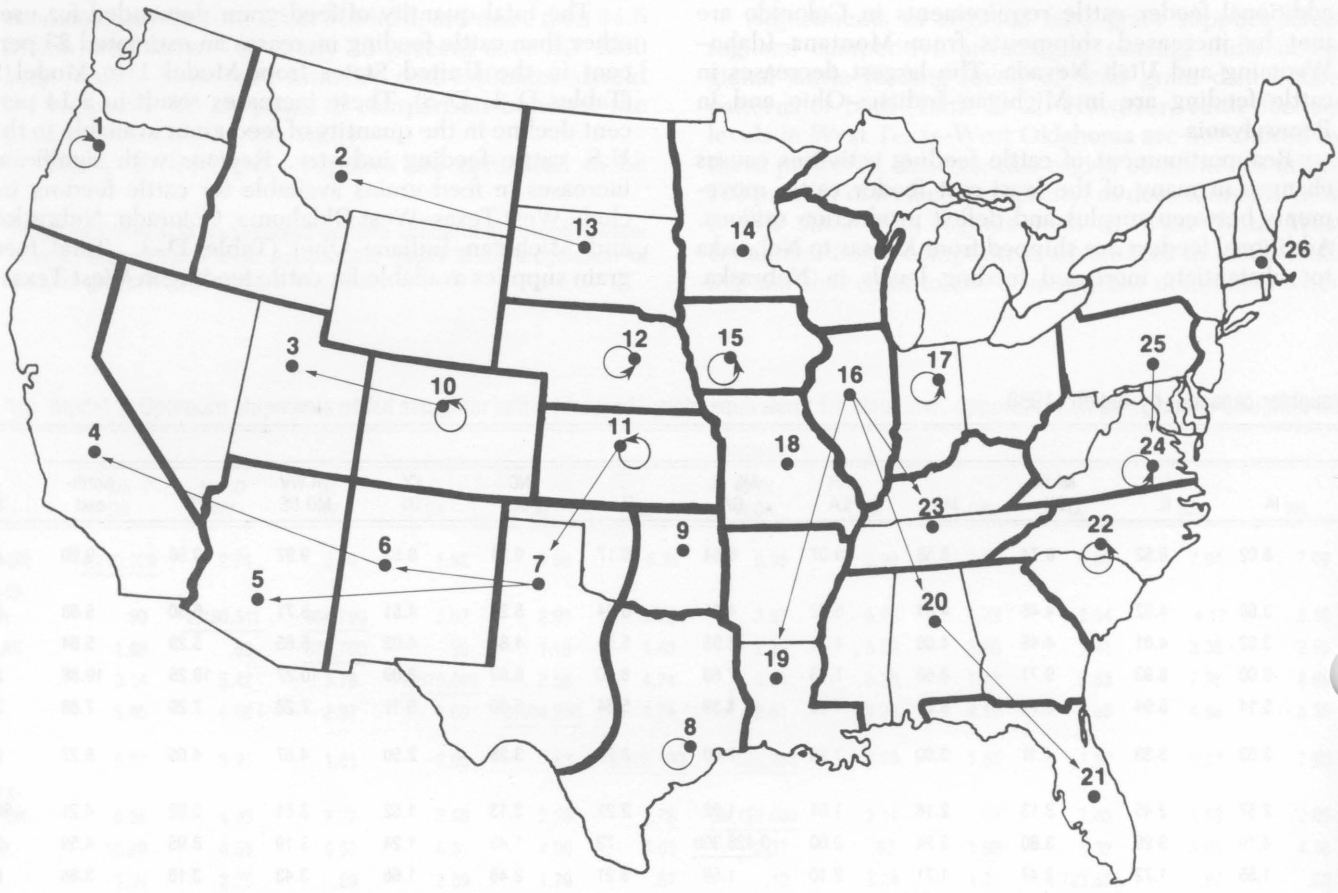

Figure 4. Optimum interregional flows of feed grain for cattle feeding (Model 1).

West Oklahoma increase more than 6 percent in Model 2. These increased supplies, partially a result of decreased shipments to Arizona, allow East Texas feedlots to receive feed grain shipments from West Texas–West Oklahoma.

Only a few changes occur in fed cattle slaughter levels as a result of adjustments to 1990 estimated feed grain supply–demand conditions specified in Model 2. Slaughtering levels increase in Nebraska, Colorado, and Montana–Idaho–Wyoming but decrease in Mississippi–Alabama–Georgia (Table D–4).

The optimum distribution patterns of fed beef also change very little from the 1980 base model to Model 2, since no significant changes occur in the slaughtering sector (Table D–5). California imports fed beef from Montana–Idaho–Wyoming to compensate for decreased imports from West Texas–West Oklahoma. Kansas plays an integral role in the transshipment of beef from the Southwest to Middle Atlantic and Northeast consumption regions. Other adjustments in optimum fed-beef flows include the termination of exports from Kansas to Kentucky–Tennessee and from Michigan–Indiana–Ohio to the Northeast, although the respective opportunity costs of continuing to serve these markets are only $.11 and $.15 per hundredweight.

Effects of a 50 Percent Decrease in West Texas–West Oklahoma Feed Grain Supplies by 1990

Some projections regarding future feed grain supplies in West Texas–West Oklahoma show dramatic decreases over the next decade. Declining water supplies and increased energy costs generally are cited as reasons for the decreases. Model 3 assesses the impact of a dramatic decrease in the feed grain supply in West Texas–West Oklahoma on the cattle feeding–fed-beef economy. The 1990 projected feed grain supply-demand assumptions of Model 2 are incorporated in Model 3 except that West Texas–West Oklahoma feed grain sup-

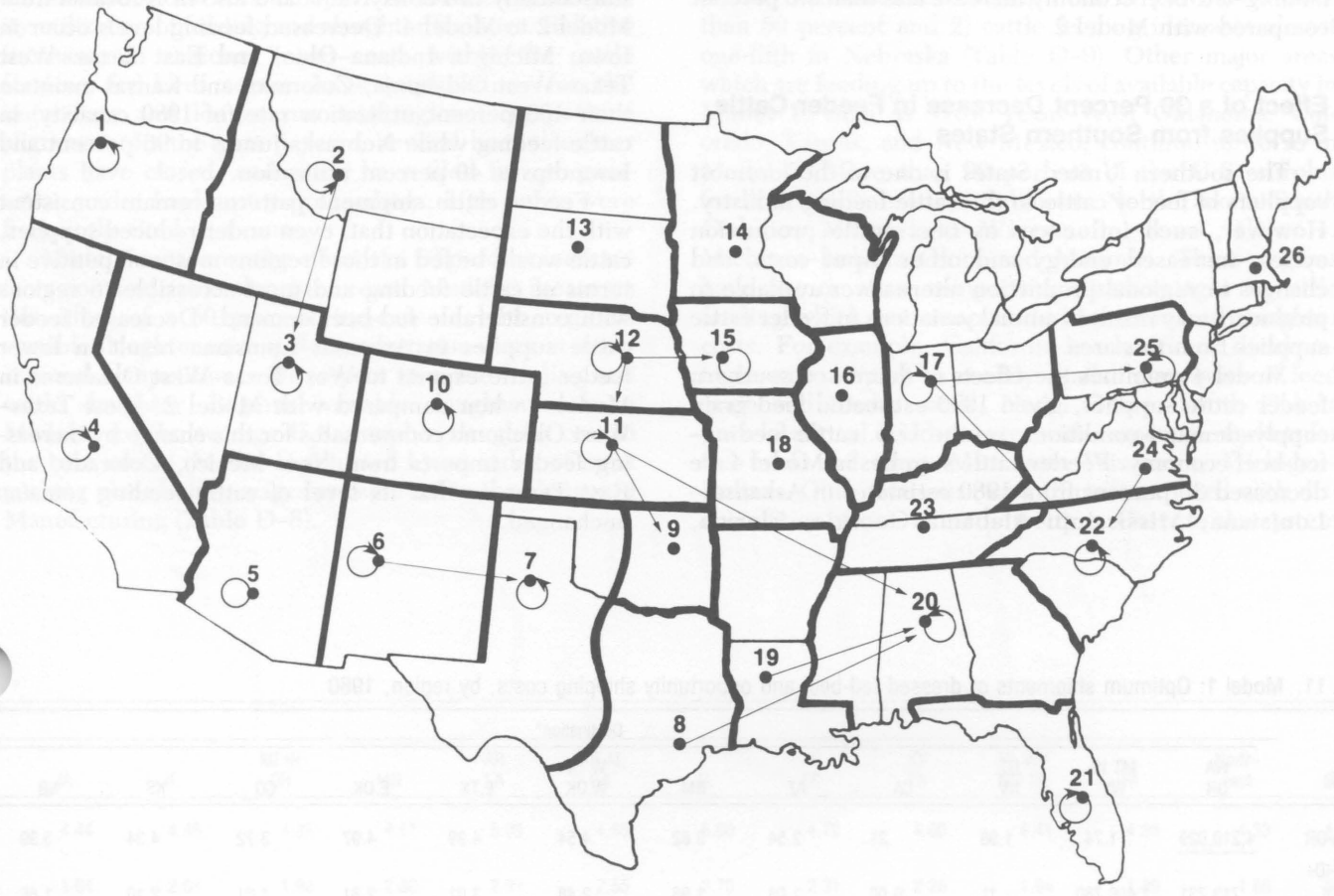

Figure 5. Optimum interregional flows of fed slaughter cattle (Model 1).

plies are decreased 50 percent from the 1980 level. Results of Model 3 are compared with those of Model 2 to show how drastic reductions in West Texas–West Oklahoma feed grain supplies may alter competitive relationships.

Results show that a 50 percent reduction in West Texas–West Oklahoma feed grain supplies would have a minimal impact on the U.S. cattle feeding industry (Table D–6). Cattle feeding levels in West Texas–West Oklahoma are unchanged from Model 2, even with the drastically reduced feed grain supplies of Model 3. Comparative advantages in terms of feeding and slaughter costs and feeder cattle availability overshadow the increased costs of importing feed grain for cattle feeding. Feed grain price patterns generally range from a low in the Dakotas to the highest price at Gulf, East, and West Coast ports. Consequently, the price of grain to feedlots in the Southern Plains is not significantly altered by local changes in grain production. Other regions are affected more severely by changes in feed grain shipment patterns, as cattle feeding declines 32 percent in California and 22 percent in Michigan–Indiana–Ohio. Pennsylvania feeds 31 percent more cattle under Model 3. West Texas–West Oklahoma, Colorado, and Kansas continue feeding at 100 percent of 1980 feedlot capacity, compared with 45 percent for Iowa, while Michigan–Indiana–Ohio decreases to 9 percent, and Nebraska remains at 88 percent.

Optimum feed grain flows in Model 3 indicate that costs to the system are minimized when West Texas–West Oklahoma ships feed grain supplies equal to its total production to California and Arizona for uses other than cattle feeding. Such shipments, in turn, result in significant imports of feed grain from Kansas into West Texas–West Oklahoma.

A 32 percent decrease in California slaughter activity results in increased fed-beef shipments from West Texas–West Oklahoma to California. In addition, under

the assumptions of Model 3, Arizona becomes a market for fed beef from New Mexico.

Decreased feed grain supplies of 50 percent in West Texas–West Oklahoma create few cost inefficiencies even though they have an impact on optimum feed grain flows in the United States. Total costs in the U.S. cattle feeding–fed-beef economy increase less than 0.5 percent compared with Model 2.

Effect of a 30 Percent Decrease in Feeder Cattle Supplies from Southern States

The southern United States is one of the foremost suppliers of feeder cattle to the cattle feeding industry. However, such influences as beef cattle production cycles, increased energy and other input costs, and changes in regional production alternatives available to producers may result in annual variations in feeder cattle supplies from this area.

Model 4 examines the effects of decreased southern feeder cattle supplies, given 1990 estimated feed grain supply–demand conditions, on the U.S. cattle feeding–fed-beef economy. Feeder cattle supplies in Model 4 are decreased 30 percent from 1980 estimates in Arkansas–Louisiana, Mississippi–Alabama–Georgia, Florida, North Carolina–South Carolina, Kentucky–Tennessee, and Virginia–West Virginia–Maryland–Delaware.

Feedlots affected by decreased feeder cattle supplies are primarily in those regions located relatively long distances from southern feeder cattle production areas (Table D–7). For example, cattle feeding levels increase substantially in Pennsylvania and also in Nebraska from Model 2 to Model 4. Decreased feeding levels occur in Iowa, Michigan–Indiana–Ohio, and East Texas. West Texas–West Oklahoma, Colorado, and Kansas maintain their 100 percent utilization rate (of 1980 capacity) in cattle feeding while Nebraska jumps to 96 percent and Iowa dips to 40 percent utilization.

Feeder cattle shipment patterns remain consistent with the expectation that, even under reduced supplies, cattle would be fed in those regions most competitive in terms of cattle feeding and most accessible to regions with considerable fed-beef demand. Decreased feeder cattle supplies in Arkansas–Louisiana result in fewer feeder cattle exports to West Texas–West Oklahoma in Model 4 when compared with Model 2. West Texas–West Oklahoma compensates for this change by increasing feeder imports from New Mexico, Colorado, and East Texas so that its level of cattle feeding remains unchanged.

TABLE 11. Model 1: Optimum shipments of dressed fed-beef and opportunity shipping costs, by region, 1980

Shipping Region	Destination*												
	WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) WA-OR	4,210,029	1.74	1.96	.21	2.54	3.82	4.54	4.99	4.97	3.72	4.34	3.99	3.3
(2) MT-ID-WY	713,731	1,466,780	.11	0.00	1.08	1.96	2.48	3.01	2.81	1.61	2.10	1.68	.8
(3) UT-NV	.90	.79	.64	1,860,490	.76	1.64	2.42	2.81	2.82	1.60	2.26	1.94	1.9
(4) CA	2.06	3.59	2.91	2,579,049	1.91	3.66	4.44	4.78	4.96	4.51	4.92	5.03	5.0
(5) AZ	2.48	2.76	1.76	3,004,250	.20	1.75	2.53	2.66	3.05	2.75	3.01	3.25	3.6
(6) NM	2.01	1.89	.89	1,770,050	1,700,230	.41	.78	1.17	1.29	1.13	1.26	1.52	1.9
(7) W.TX-W.OK	1.95	1.63	.89	6,282,108	0.00	763,550	2,073,320	7,812,090	1,726,860	.50	.12	.39	.8
(9) E.OK	3.04	2.62	1.95	1.18	1.18	1.17	.66	.07	1.47	2.89	1.82	2.22	2.6
(10) CO	1.06	.69	1,413,310	3,233,383	.15	.28	.43	.94	.78	2,077,160	.18	.08	.3
(11) KS	2.50	2.00	1.48	1.23	1.23	1.23	.87	.69	.44	1.00	.01	.07	.4
(12) NB	2.08	1.51	1.09	1.27	1.40	1.42	1.07	1.02	.77	.83	1,772,590	1,073,080	808,8
(15) IA	3.32	2.56	2.33	2.50	2.56	2.56	2.16	1.73	1.63	2.06	1.03	.79	
(17) MI-IN-OH	5.31	4.58	4.42	4.49	4.49	4.49	4.03	3.18	3.36	4.16	2.96	2.88	2.7
(20) MS-AL-GA	6.00	5.44	4.97	4.27	4.16	4.27	3.62	2.17	3.09	4.51	3.22	3.51	3.7
(21) FL	7.87	7.31	6.84	5.96	5.80	5.96	5.46	3.58	4.94	6.38	5.09	5.38	5.6
(22) NC-SC	7.24	7.59	6.25	5.74	5.70	5.74	5.19	3.70	4.56	5.80	4.48	4.75	4.7
(25) PA	7.41	6.68	6.53	6.46	6.46	6.46	5.97	4.94	5.32	6.19	4.93	4.99	4.8
Total	4,923,760	1,477,780	1,413,310	18,729,330	1,700,230	763,550	2,073,320	7,812,090	1,726,860	2,077,160	1,772,590	1,073,080	3,8

*Underscored figures are shipments (100 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

EFFECTS OF CHANGES IN VARIABLE SLAUGHTER COSTS AND TRANSPORTATION COSTS

Some of the major concerns in the cattle feeding–fed-beef sector are the effects of increases in slaughter costs and transportation costs on optimum location and capacity utilization of feeding and slaughter facilities. Relative increases in regional input costs within the cattle feeding–fed-beef sector have implications for the immediate and longer run interregional competitive alignment. In the past 5 years, several beef slaughter plants have closed, and some have filed for reorganization under bankruptcy proceedings; high wages were frequently cited as a cause.

Model 5 measures the effect of a 50 percent increase in regional variable slaughter costs. Model 6 measures the effect of a 50 percent increase in both regional variable slaughter costs and transportation costs on interregional competition with respect to cattle feeding and cattle slaughter. Regional variable slaughter costs in Model 5 are the average U.S. variable slaughter cost in the base model (Model 1) adjusted by an index of meat packing plant hourly wages as reported in the Census of Manufacturing (Table D–8).

Effects of a 50 Percent Increase In Variable Slaughter Costs

Major changes in the regional levels of cattle feeding as regional slaughter costs increase 50 percent from Model 1 to Model 5 are 1) numbers of cattle fed in California, Iowa, and Montana–Idaho–Wyoming decrease, with declines ranging from 21 percent to more than 50 percent and 2) cattle feeding increases almost one-fifth in Nebraska (Table D–9). Other major areas which are feeding up to the levels of available capacity in Model 1, such as West Texas–West Oklahoma, Colorado, Kansas, and New Mexico, continue to do so in Model 5. More than 90 percent of the U.S. surplus feedlot capacity exists in California, North Dakota–South Dakota, Minnesota–Wisconsin, Iowa, Illinois, Michigan–Indiana–Ohio, and Missouri. These regions have one or more competitive disadvantages in cattle feeding which are compounded by increased slaughter costs. For example, California has locational disadvantages with respect to readily available supplies of feed grain and feeder cattle; North Dakota–South Dakota have locational disadvantages with respect to markets for fed beef; and Iowa, Minnesota–Wisconsin, Michigan–Indiana–Ohio, Missouri, and Illinois are faced with diseconomies of size in cattle feeding. Costs to the system

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped
3.74	4.44	4.46	4.35	4.61	5.09	4.85	5.00	4.70	4.60	4.41	4.36	4.33	4,210,029
1.30	1.94	2.03	1.88	2.30	2.97	2.55	2.70	2.31	2.26	1.94	1.89	1.86	2,180,511
2.28	2.39	2.41	2.40	2.56	2.92	2.76	2.91	2.65	2.55	2.44	2.42	2.39	1,860,490
5.37	5.47	5.22	5.38	5.19	4.95	4.97	4.94	5.05	4.97	5.11	5.26	5.36	2,579,049
3.69	3.62	3.31	3.47	3.27	2.88	2.95	2.87	3.10	3.06	3.20	3.35	3.45	3,004,250
1.97	1.87	1.56	1.72	1.52	1.28	1.31	1.28	1.39	1.30	1.45	1.60	1.70	3,470,280
.82	.69	.37	.48	.35	3,756,280	6,611,390	4,684,314	.06	2,978,402	.17	.33	.41	36,688,314
2.31	2.14	1.49	1.51	.36	.16	.01	.14	.09	1,350,095	.15	.34	.44	1,350,095
.51	.52	.39	.54	.50	.94	.70	.85	.60	.50	.46	.48	.53	6,723,853
.37	.31	9,103,950	.16	3,301,720	.57	.23	.38	.10	446,313	6,232,900	.04	.14	19,084,883
209,160	2,069,600	.02	.01	.20	.91	.45	.60	.30	.20	.05	.03	5,371,630	17,304,930
.16	.29	.07	18,595,620	.42	1.22	.60	.74	.36	.30	.06	.02	9,992,080	28,590,700
1.90	2.08	1.08	.38	1.92	2.39	1.14	1.15	.45	.79	.04	8,257,220	6,349,230	14,606,450
2.98	2.87	1.70	1.33	2.15	1.43	.33	836,036	5,071,540	.40	.21	.73	.82	5,907,576
4.80	4.73	3.52	3.06	4.02	3.07	1.72	687,660	.99	2.17	1.16	1.85	1.84	687,660
3.92	4.02	2.79	2.03	3.40	2.97	1.39	.66	.15	1.51	2,207,590	.64	.67	2,207,590
4.00	4.19	3.10	2.09	3.87	4.21	2.63	2.03	1.15	2.53	.19	.20	6,390,010	6,390,010
20	2,069,600	9,103,950	18,595,620	3,301,720	3,756,280	6,611,390	6,208,010	5,071,540	4,774,810	8,440,490	8,257,220	28,102,950	156,846,670

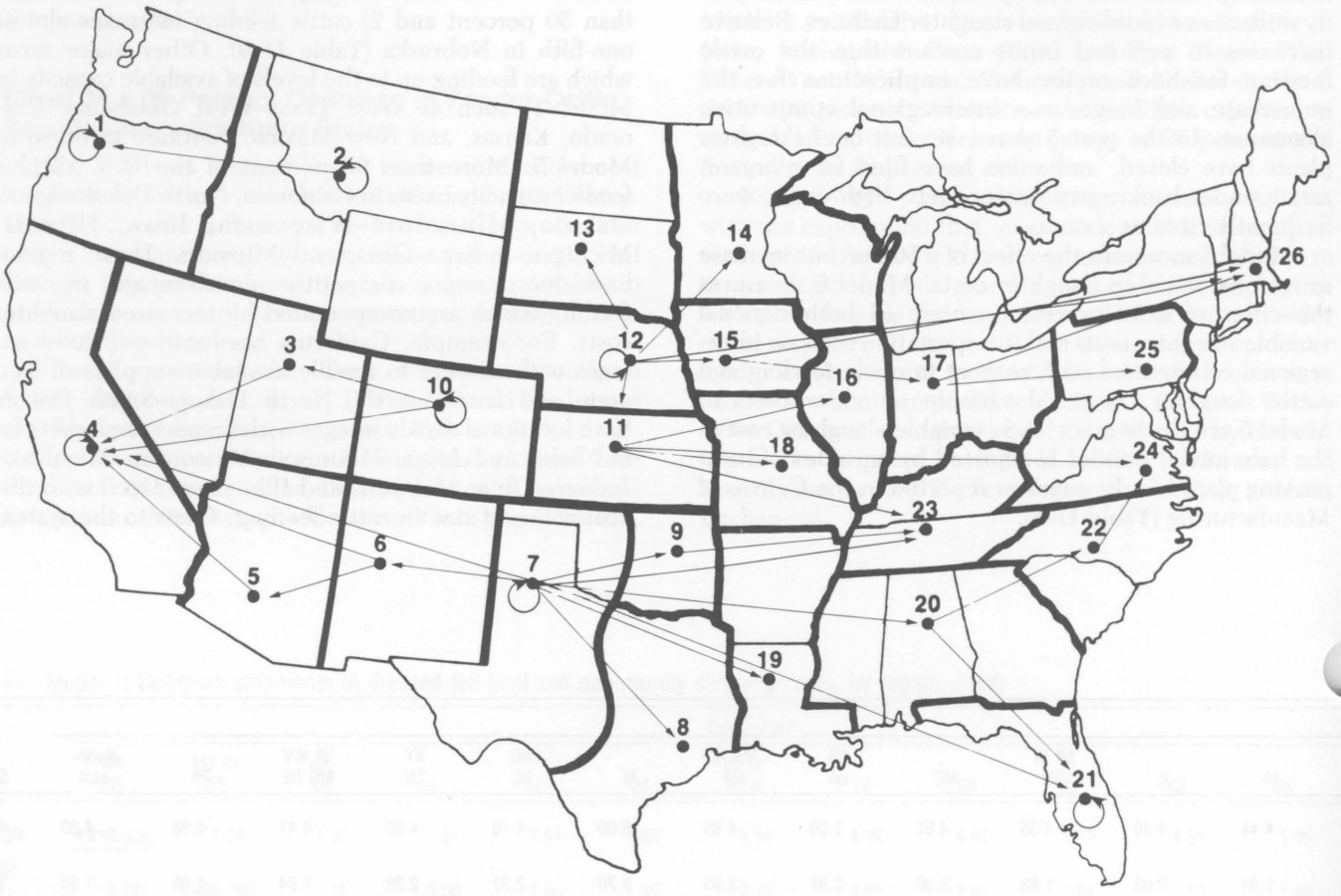

Figure 6. Optimum interregional flows of fed beef (Model 1).

are minimized when Missouri and Illinois ship feed grain supplies to the South for uses other than cattle feeding.

If regional slaughter wages are increased 50 percent, in the absence of offsetting cost factors or services, major realignments in the location of fed-beef slaughter could result in regions with relatively high slaughter wage costs (Table D–10). Major changes from Model 1 to Model 5 are 1) slaughter in Iowa is eliminated, 2) California slaughter is decreased one-third, 3) Kansas and Nebraska slaughter is increased almost 40 percent, 4) Missouri slaughters up to its capacity, and 5) some southern regions either increase or initiate slaughter. Other major fed cattle slaughter areas, such as West Texas–West Oklahoma and Colorado, do not undergo any changes in slaughter levels from Model 1 to Model 5.

Although multi-product transshipment models occasionally overstate changes, they are valuable tools for determining directions of potential changes in an industry. For example, it is unlikely that fed cattle slaughter will be eliminated in Iowa in the foreseeable future. However, the models suggest that if slaughter and other associated costs remain at relatively higher levels in one region, compared with competing regions, the higher cost region will find it increasingly difficult to compete in interstate commerce. The longer run implications are that industries will relocate to lower cost regions, other things being equal or in the absence of offsetting considerations.

Effects of a 50 Percent Increase in Variable Slaughter and Transportation Costs

Model 6 reveals that when transportation costs, in addition to slaughter costs, are increased 50 percent, large surplus feed grain producing areas, such as Iowa and Illinois, become more competitive with respect to feeding cattle (Table D–11). However, both of these regions utilize only 33 percent or less of their available

feedlot capacity because of diseconomies of size in feeding and relatively high slaughter costs. Other major changes from Model 5 to Model 6 include a 34 percent decrease in feeding in Nebraska as a result of increased feeding in Iowa and Illinois. Pennsylvania feeds up to its capacity in Model 6 while West Texas–West Oklahoma and Kansas maintain feeding levels.

When transportation cost are increased, 1) slaughter declines in Arkansas–Louisiana and Mississippi–Alabama–Georgia; 2) Illinois initiates fed-cattle slaughter up to available capacities, and Kansas increases cattle slaughter up to its available capacity; 3) Kentucky–Tennessee realizes competitive advantages from relatively low slaughter costs and proximity to fed-cattle slaughter supplies and initiates fed-cattle slaughter; 4) slaughter in West Texas–West Oklahoma declines less than 2 percent while increasing substantially in East Texas; 5) fed-cattle slaughter decreases more than 10 percent in Colorado and about 25 percent in Nebraska; and 6) even though transportation costs are increased 50 percent, Iowa does not initiate fed cattle slaughter because of relatively high slaughter costs (Table D–12).

The implications of Model 6, where regional slaughter and transportation costs are increased 50 percent in each region, are that interregional competitive feeding and slaughter advantages tend to accrue to regions with surplus feed grains and fed slaughter cattle. Regions like West Texas–West Oklahoma, which have the ability to compete favorably with other cattle feeding regions under the current cattle feeding input and transportation cost structure, would not be adversely affected if current variable slaughter and transportation costs were increased 50 percent above current levels. However, additional research has shown that Corn Belt states such as Iowa and Illinois, which are large surplus producers of feed grains, would enjoy the greatest increase in competitive advantages in both cattle feeding and cattle slaughter if transportation costs were to increase sharply (75-100 percent) relative to other input costs (Clary, Dietrich, and Farris, 1984). Under such a scenario, competitive advantages due to economies of size, currently enjoyed by such regions as West Texas–West Oklahoma, would be partially offset by the increased costs of importing bulky feed items from surplus feed grain regions.

IMPLICATIONS OF INTERREGIONAL ECONOMIC RELATIONSHIPS AND REGIONAL PRICE DIFFERENTIALS

Regional price structures for feeder cattle, fed slaughter cattle, feed grains, and fed beef are primarily a function of regional surplus and deficit production situations, regional ability to compete for feeder cattle, feed grain, and slaughter cattle, and proximity to markets. These price patterns are affected by changes in optimum regional cattle feeding and slaughter plant location and production levels.

TABLE 12. Feeder cattle price differentials, in dollars per hundredweight, by model and region

Region	Model					
	1	2	3	4	5	6
(1) Washington-Oregon	$-1.48	$-1.92	$-1.95	$-1.88	$-1.45	$-2.55
(2) Montana-Idaho-Wyoming	-2.24	-2.50	-2.50	-2.74	-1.76	-3.02
(3) Utah-Nevada	-1.12	-1.37	-1.37	-1.57	-1.94	-1.80
(4) California	0	- .44	- .76	- .40	- .25	- .93
(5) Arizona	- .35	.09	.09	- .13	.43	.22
(6) New Mexico	.06	- .17	- .17	- .39	.28	0
(7) West Texas-West Oklahoma	0	0	0	0	0	0
(8) East Texas	- .98	- .98	- .98	- .98	-1.07	-1.60
(9) East Oklahoma	- .48	- .48	- .48	- .48	- .35	- .52
(10) Colorado	- .54	- .82	- .82	-1.04	- .10	- .60
(11) Kansas	- .50	- .39	- .39	- .42	- .02	0
(12) Nebraska	- .51	- .41	- .41	- .44	- .03	-1.19
(13) North Dakota-South Dakota	- .96	- .84	- .84	- .88	- .49	- .70
(14) Minnesota-Wisconsin	- .99	- .89	- .89	- .94	- .56	- .73
(15) Iowa	- .73	- .62	- .62	- .66	- .27	- .28
(16) Illinois	-1.07	- .96	- .96	-1.01	- .74	- .98
(17) Michigan-Indiana-Ohio	-1.12	-1.44	-1.44	-1.49	- .74	-1.02
(18) Missouri	- .92	.90	- .90	- .90	- .52	- .75
(19) Arkansas-Louisiana	-1.23	-1.23	-1.23	-1.23	-1.19	-1.78
(20) Mississippi-Alabama-Georgia	-2.25	-2.22	-2.22	-2.22	-2.14	-3.11
(21) Florida	-1.88	-2.15	-2.15	-3.15	-1.88	-3.26
(22) North Carolina-South Carolina	-2.21	-2.49	-2.49	-2.72	-1.96	-2.91
(23) Kentucky-Tennessee	-1.76	-1.84	-1.84	-1.89	-1.54	-2.22
(24) Virginia-West Virginia-Maryland-Delaware	-1.85	-2.21	-2.21	-2.16	-1.67	-1.71
(25) Pennsylvania	-1.55	-1.86	-1.86	-1.73	-1.16	-1.06
(26) Northeast (seven states)	-1.57	-1.78	-1.78	-1.32	- .73	-2.04

Table 12 shows feeder cattle prices generally lowest in the Southeast, Northwest, Intermountain states, and Middle Atlantic states. These regions produce surplus feeder cattle which they ship considerable distances to major cattle feeding regions. Highest feeder cattle prices are found in deficit feeder cattle production areas such as the Southwest and the Central Plains. These areas can be characterized as large concentrated cattle feeding regions that import substantial numbers of feeder cattle from distant surplus production areas.

The West Texas–West Oklahoma cattle feeding industry has operated primarily under a deficit feeder cattle production situation as a result of the advent of large commercial feeding operations in the region. Favorable weather and costs of operation are important factors accounting for that region's expanded cattle feeding industry and its role as net importer of feeder cattle, as reflected by price differentials in Table 12. In contrast, such surplus feeder cattle regions as East Texas, East Oklahoma, Arkansas–Louisiana, and Mississippi–Alabama–Georgia and Florida export substantial volumes of feeder cattle, as demonstrated by relatively low regional price differentials.

Price differentials in Table 12 demonstrate the sensitivity of regional feeder cattle prices to increased and decreased demand for feeders stimulated by various changes in supply–demand–cost relationships. For example, Iowa feeder cattle prices increase 11 cents per hundredweight as cattle feeding in Iowa increases nearly 85 percent from Model 1 to Model 2. In contrast, feeder cattle prices in Michigan–Indiana–Ohio decline 32 cents per hundredweight as cattle feeding in Michigan–Indiana–Ohio decreases nearly 76 percent from Model 1 to Model 2.

Feed grain price differentials are highest in such deficit feed grain areas as the West, the South, and the Northeast (Table 13). These regions are characterized by excess demand for feed grains, primarily for use other than cattle feeding. Feed grain prices are generally highest in California, followed by Washington–Oregon, Arizona, and Florida. The lowest feed grain prices are estimated for surplus feed grain regions, such as Central and Northern Plains, the Corn Belt, and the Lake states.

Table 14 shows regional fed slaughter cattle price differences generally highest in the South, the Middle Atlantic states, and the Northeast. Higher fed slaughter cattle prices in these regions can be attributed primarily to excess fed-beef demand, relative to production, resulting from locational and cost disadvantages in cattle feeding and slaughtering. Lower fed slaughter cattle prices in the Northwest and Central Plains are generally accounted for by slaughter capacity limitations which prompt shipments of fed slaughter cattle to other areas for slaughter. Such relationships encourage slaughtering firms to locate new plants in concentrated cattle feeding areas in order to minimize fed slaughter cattle acquisition cost.

Regional price differentials for fed beef show that

TABLE 13. Feed grain price differentials, in dollars per hundredweight, by model and region

Region	Model					
	1	2	3	4	5	6
(1) Washington-Oregon	$ .68	$ .76	$ .63	$ .76	$ .68	$ 1.02
(2) Montana-Idaho-Wyoming	.31	.39	.26	.39	.31	.47
(3) Utah-Nevada	.25	.27	.25	.27	.25	.38
(4) California	.71	.71	.71	.71	.71	1.07
(5) Arizona	.53	.53	.61	.53	.53	.79
(6) New Mexico	.16	.16	.16	.16	.16	.24
(7) West Texas-West Oklahoma	0	0	0	0	0	0
(8) East Texas	.34	.34	.21	.34	.34	.51
(9) East Oklahoma	.20	.15	.02	.15	.20	.30
(10) Colorado	.05	– .05	– .18	– .05	.02	– .05
(11) Kansas	– .01	– .06	– .19	– .06	– .01	– .02
(12) Nebraska	– .04	– .20	– .33	– .10	– .04	– .06
(13) North Dakota-South Dakota	– .04	– .20	– .33	– .10	– .04	– .06
(14) Minnesota-Wisconsin	– .04	– .20	– .33	– .10	– .04	– .06
(15) Iowa	– .04	– .20	– .33	– .10	– .04	– .06
(16) Illinois	– .04	0	– .13	0	– .04	.02
(17) Michigan-Indiana-Ohio	– .04	.02	– .15	.02	– .04	– .06
(18) Missouri	.07	– .04	– .17	– .04	.07	.10
(19) Arkansas-Louisiana	.25	.27	.14	.27	.25	.45
(20) Mississippi-Alabama-Georgia	.21	.25	.12	.25	.21	.39
(21) Florida	.46	.50	.37	.50	.46	.76
(22) North Carolina-South Carolina	.37	.43	.30	.43	.37	.56
(23) Kentucky-Tennessee	.21	.25	.12	.25	.21	.39
(24) Virginia-West Virginia-Maryland-Delaware	.32	.38	.25	.38	.32	.48
(25) Pennsylvania	.40	.46	.33	.46	.40	.6
(26) Northeast (seven states)	.41	.47	.34	.47	.41	.62

TABLE 14. Fed slaughter cattle price differentials, in dollars per hundredweight, by model and region

Region	Model 1	2	3	4	5	6
(1) Washington-Oregon	$ .21	$ .21	$ .21	$ .21	$ −.42	$ .42
(2) Montana-Idaho-Wyoming	−1.01	−1.01	−1.01	−1.01	−1.41	−1.37
(3) Utah-Nevada	− .80	− .80	− .80	− .80	−1.20	−1.05
(4) California	.87	.87	.87	.87	.03	.91
(5) Arizona	.28	.49	.80	.33	− .13	.07
(6) New Mexico	− .28	− .28	− .28	− .28	− .64	− .93
(7) West Texas-West Oklahoma	0	0	0	0	0	0
(8) East Texas	.52	.52	.52	.58	1.01	1.46
(9) East Oklahoma	.30	.39	.35	1.58	.46	.64
(10) Colorado	− .82	− .82	− .82	− .82	−1.30	−1.38
(11) Kansas	− .42	− .30	− .26	− .26	− .56	− .39
(12) Nebraska	− .46	− .34	− .38	− .38	− .73	− .45
(13) North Dakota-South Dakota	.06	.52	.11	.14	−1.44	.42
(14) Minnesota-Wisconsin	1.44	.61	1.50	1.41	− .88	− .76
(15) Iowa	.21	.33	.29	.29	− .23	− .06
(16) Illinois	1.36	1.36	1.36	1.39	1.01	1.21
(17) Michigan-Indiana-Ohio	1.28	1.58	1.54	1.53	.90	.96
(18) Missouri	1.01	1.01	1.01	1.76	.87	1.46
(19) Arkansas-Louisiana	1.91	1.91	1.91	1.97	1.77	2.33
(20) Mississippi-Alabama-Georgia	2.66	2.66	2.66	2.72	2.52	3.46
(21) Florida	3.48	3.48	3.48	3.48	3.31	4.49
(22) North Carolina-South Carolina	3.35	3.65	3.61	3.60	2.97	4.07
(23) Kentucky-Tennessee	2.68	2.82	2.78	2.77	2.61	3.48
(24) Virginia-West Virginia-Maryland-Delaware	2.82	3.12	3.08	3.07	2.65	3.53
(25) Pennsylvania	2.97	3.27	3.23	3.22	2.59	3.44
(26) Northeast (seven states)	3.59	3.89	3.85	3.84	5.76	4.37

TABLE 15. Dressed fed-beef price differentials, in dollars per hundredweight, by model and region

Region	Model 1	2	3	4	5	6
(1) Washington-Oregon	$ 2.15	$ 1.29	$ 1.29	$ 1.29	$ 1.29	$ 2.24
(2) Montana-Idaho-Wyoming	.64	.28	.28	.28	.28	.73
(3) Utah-Nevada	1.36	.91	.91	.91	.91	1.37
(4) California	3.25	2.17	2.17	2.17	2.17	3.25
(5) Arizona	2.11	1.41	1.41	1.41	1.41	2.11
(6) New Mexico	.96	.64	.64	.64	.64	.96
(7) West Texas-West Oklahoma	0	0	0	0	0	0
(8) East Texas	1.44	1.65	1.03	1.03	.98	1.44
(9) East Oklahoma	.85	.58	.58	.58	.59	.87
(10) Colorado	.27	− .02	− .02	− .20	− .02	− .03
(11) Kansas	.34	.46	.57	.53	.64	.92
(12) Nebraska	.18	.37	.49	.45	.67	.99
(13) North Dakota-South Dakota	.75	.75	.87	.83	1.05	1.57
(14) Minnesota-Wisconsin	1.05	.98	1.10	1.03	1.25	1.87
(15) Iowa	1.10	.98	1.10	1.06	2.09	1.92
(16) Illinois	1.92	1.50	1.62	1.58	1.72	2.56
(17) Michigan-Indiana-Ohio	2.66	2.05	2.26	2.22	2.32	3.48
(18) Missouri	1.38	1.15	1.34	1.30	1.31	1.93
(19) Arkansas-Louisiana	2.05	1.45	1.45	1.45	1.40	2.07
(20) Mississippi-Alabama-Georgia	2.70	2.05	2.05	2.05	2.00	2.97
(21) Florida	3.70	2.72	2.72	2.72	2.67	3.97
(22) North Carolina-South Carolina	3.72	2.71	2.82	2.78	2.87	4.27
(23) Kentucky-Tennessee	2.59	2.01	2.01	2.01	1.96	2.62
(24) Virginia-West Virginia-Maryland-Delaware	3.94	2.91	2.97	2.93	3.02	4.49
(25) Pennsylvania	4.16	3.02	3.15	3.11	3.32	4.97
(26) Northeast (seven states)	4.16	3.46	3.76	3.72	3.62	5.42

fed-beef prices are generally highest in such deficit fed-beef regions as the Northeast, the South, California, and the Middle Atlantic states (Table 15). Lowest fed-beef prices are generally seen in the Southern and Central Plains and Montana–Idaho–Wyoming. These regions encounter relatively low fed-beef prices primarily because of surplus fed-beef production and because exports must be shipped long distances to reach major consumption centers.

The comparative value of a specific regional fed-beef price differential indicates the relative amount of excess fed-beef demand in addition to the relative distances between major production and consumption areas. The highest fed-beef price was in the Northeast for all models estimated. Fed-beef prices in the Northeast decrease when their principle suppliers increase fed-beef production. For example, fed-beef prices in the Northeast decrease when Nebraska increases fed cattle slaughter.

SUMMARY

The cattle feeding–fed-beef economy faces a rapidly changing economic environment over the next decade. As a consequence, firms hoping to succeed in this highly competitive industry must continually analyze their decision-making processes. Economic, technological, and social considerations will likely encourage changes in the optimum location, size, and management of cattle feeding and slaughter firms. The objective of this study was to help the industry anticipate the impact of some of these changes; specifically, those that relate to changes in feed grain production in the Southern Plains, increased transportation and slaughter costs, reduced feeder cattle supplies, and projected regional changes in population in 1990.

This study used a multiproduct transshipment model based on 1980 industry conditions to examine interregional economic relationships in the cattle feeding and fed beef economy among 26 regions in the contiguous 48 states. The 1980 base model revealed that cattle feeding and slaughter firms in the Southern and Central Plains and the Corn Belt enjoy considerable competitive advantages over other regions—advantages very similar to those described by Dietrich (1971) over a decade ago. These regions, especially West Texas–West Oklahoma, Kansas, and Nebraska have considerable locational advantages due to proximity to feed grain and feeder cattle supplies, access to growing fed-beef markets in the South and Southwest, and economies of size associated with the feeding and slaughter industries.

The 1980 base model also indicated that slaughter would generally remain production oriented as slaughter firms locate near large concentrated sources of fed slaughter cattle, namely feedlots, to ensure consistent supplies of fed cattle and to minimize fed slaughter cattle acquisition costs. Approximately half of the U.S. estimated feedlot capacity was unused when cattle feeding was allowed to occur on a least-cost basis in the cattle feeding–fed-beef economy in 1980. Most of the excess feedlot capacity existed in California, North Dakota–South Dakota, Minnesota–Wisconsin, Iowa, Illinois, Michigan–Indiana–Ohio and Missouri.

Fed-beef was generally distributed to the West from slaughter plants in the Southern Plains and Colorado in

all models analyzed. Fed beef was distributed to the East from slaughter plants in the Central Plains and the Corn Belt. West Texas–West Oklahoma enjoyed locational advantages over other slaughter regions for deficit fed-beef markets in the Southeast. West Texas–West Oklahoma, competing with Colorado for the large deficit fed-beef market in California, shipped almost twice as much fed beef to California as did Colorado.

Iowa and Nebraska enjoyed a locational advantage in supplying fed beef to the large deficit Northeast market. Kansas had a competitive advantage in shipping fed beef to Illinois and Missouri. Kansas had to compete with the Southern Plains for deficit fed-beef markets in Kentucky–Tennessee and the Atlantic Coast.

Regional feed grain supplies for 1990 were estimated to reflect changing irrigation practices, a result of declining water tables in the Central and Southern Plains, and deregulation of natural gas prices in the United States. Results showed that West Texas–West Oklahoma and Kansas possess strong competitive advantages in feeding and slaughter, as indicated by 100 percent utilization of available feedlot and slaughter plant capacities in these regions. Further, estimated changes in regional feed grain supplies tended to shift cattle feeding and slaughter activities from the eastern Corn Belt to the western Corn Belt and the Central Plains. These regions, especially Iowa and Nebraska, not only had significant locational and cost advantages over regions to the east, but also had excess feedlot and slaughter capacity available to accommodate additional feeding.

The demand for feed grain for uses other than cattle feeding was estimated to increase nearly 23 percent from 1980 to 1990, resulting in a 14 percent decline in the quantity of feed grain available to the U.S. cattle feeding industry. Such decreased supplies imply generally higher feed grain prices to feedlots in 1990. Regional feed grain price differentials revealed that higher prices would occur in surplus as well as deficit feed grain production regions. However, the relatively wide variation in feed grain price differentials suggests that considerable competitive advantages would accrue to regions with surplus feed grain supplies.

The study also showed that West Texas–West Oklahoma cattle feeding and slaughter levels would not be substantially affected even if grain supplies in that region were decreased 50 percent below the 1980 estimated level. If feed grain supplies were to decrease in the Southern Plains—given 1980 regional feeding-slaughter demand conditions—total costs in the cattle feeding–fed-beef economy would be minimized by feed grain being shipped from surplus production areas into the Southern Plains. Price increases above the surplus Corn Belt areas are estimated at $0.20 to $0.30 per hundredweight under the above scenario.

Changes may occur in major feeder cattle supply areas, such as the southern United States, as a result of beef cattle production cycles, increased energy costs, and regional production alternatives. Results of a model designed to examine the effects of decreased southern regional feeder cattle supplies showed that regions more dependent on feeder cattle from southern suppliers, such as the Corn Belt, would be impacted most adversely. West Texas–West Oklahoma, Colorado, Kansas, and Nebraska feedlots would maintain feeding levels at or near 100 percent utilization rates of 1980 capacity under such a scenario. Feeder cattle shipment patterns revealed that cattle would continue to be fed primarily in the Central and Southern Plains, as these regions had the greatest competitive advantages in terms of cattle feeding and slaughter, as well as shipments of fed beef to deficit fed-beef regions.

The study indicated that regions with relatively higher regional slaughter costs—such as the Western Corn Belt, the Lake states, and the West Coast—would be adversely impacted if such regional cost differences were to persist. However, when regional transportation costs were assumed to increase 50 percent or more, results showed that cattle feeding and slaughter would tend to become more production oriented. That is, under this scenario and in the absence of advances in transportation technology, increasing numbers of cattle would likely be fed in the primary areas of feed grain production. A potential alternative for cattle feeders in deficit feed grain regions under conditions of highly escalating transportation costs may be to place cattle on feed at heavier placement weights. Although current fed cattle slaughter is becoming predominantly production oriented, relative increases in transportation costs, compared with other costs, would tend to accelerate this trend to production oriented slaughter.

In summary: The Southern Plains has a locational advantage in cattle feeding, in cattle slaughter, and in shipping fed beef both to the East and West. However, increased competition is likely, especially from feedlots in the Central Plains and slaughter plants in the Central Plains and the western Corn Belt. If the Southern Plains is to remain the foremost cattle feeding and slaughter region, it must maintain a level of efficiency at least equal to such competitors as Kansas, Nebraska, Colorado, and Iowa.

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APPENDICES

A GENERATION OF BASIC DATA

Analysis of interregional competition in the cattle feeding–fed-beef economy required the development of national and regional data relative to feeder cattle and feed grain supplies, feed grain and fed-beef demand, and transportation costs. In addition, estimates were developed relative to regional feeding and slaughter capacities and regional feeding and slaughter costs.

Regional Feeder Cattle Supplies

Data for this study required regional estimates of feeder cattle available for shipment to cattle feeding operations. Regional feeder cattle and calf supplies were estimated from data published by the USDA in *Meat Animals* (1979–80), *Cattle* (1980–81), and *Livestock Slaughter* (1970–80). The 1980 regional feeder cattle supplies were derived as follows:

Regional feeder cattle = calf crop − commercial and farm calf slaughter-deaths − milk and beef cow replacements − bull replacements

where:

Farm calf slaughter = total cattle and calf farm slaughter − total cattle farm slaughter

Total cattle farm slaughter = total cattle and calf farm slaughter × net inventory of total cattle ÷ net inventory of total cattle and calves

Net inventory of total cattle = ending inventory of cattle and calves − ending inventory of calves.

Ending inventory of calves was defined as steers, heifers, and bulls under 500 pounds on hand the end of the calendar year. Dairy cow replacements were defined as heifers 500 pounds and over kept for milk cow replacement as reported in *Cattle* (USDA, 1980–81). Regional beef cow and bull replacements were estimated using the following equation:

Replacements = net inventory + deaths − beginning inventory where:

Net inventory = ending inventory + commercial slaughter.

Regional Feed Grain Supplies

Regional estimates of feed grain availabilities were derived from USDA reported stocks, production, and disposition. Corn, grain sorghum, barley, and oats data were aggregated on a corn equivalent basis to represent total feed grains.

U.S. feed grain supplies were postulated as beginning stocks plus production minus exports as reported in *World Agriculture Supply and Demand Estimates* (WASDE) (USDA, 1981). Feed grain production and stocks data necessary for deriving such supplies on a state basis were reported by the USDA in *Grain Stocks* (1980–81), *Small Grains* (1980–81), and *Field Crops* (1980–81).

Regional Feed Grain Demand

Feed grain demand was divided into two forms: 1) demand for feeding livestock other than cattle in addition to other domestic uses and 2) demand for feeding cattle. Data concerning total U.S. feed grain demand were reported as total domestic use in the WASDE for 1980. Total domestic use was subdivided into feed and residual use, and food, seed, and industrial use. Regional estimates of grain-consuming animal units were used to estimate regional feed and residual use (Allen, Hodges, and Devers, 1974). The number of establishments and employees for selected industries reported in *Census of Manufacturers* (U.S. Department of Commerce, 1980) was used to estimate regional feed, seed, and industrial use.

Estimated per head feed grain requirements for feeding cattle were based on regional feeder cattle placement weights, fed slaughter cattle marketing weights, and length of time on feed (Table A–1). Fed slaughter cattle marketing weights were estimated from available slaughter data and weights of cattle on feed as reported by the USDA in *Livestock Slaughter* (1970–80) and *Cattle on Feed* (1980–81) for 1980. Regional feeding periods and total gain per head were based on fat cattle marketing weights as follows (Dietrich, 1971):

Fat Cattle Marketing Weights	Days on Feed	Total Gain per Head
(pounds)	(days)	(pounds)
1,050 and over	165	450
800 to 1,049	145	400
799 and under	125	325

Regional placement weights were defined as the difference between fat cattle marketing weights and total gain per head. Total regional feed grain consumption per head was set at 1.5 percent of body weight for the first 30 days and 2.0 percent thereafter.

TABLE A-1. Estimated feeder cattle placement and fed cattle marketing weights, days on feed, and feed grain requirements, by region

Region	Feeder Cattle Placement Weights	Fed Cattle Marketing Weights	Days on Feed	Per Head Feed Grain Requirements
	Pounds	Pounds	Days	Pounds
(1) Washington-Oregon	736	1,186	165	2,024
(2) Montana-Idaho-Wyoming	656	1,106	165	1,859
(3) Utah-Nevada	689	1,139	165	1,927
(4) California	725	1,175	165	2,001
(5) Arizona	659	1,109	165	1,865
(6) New Mexico	645	1,045	145	1,542
(7) West Texas-West Oklahoma	620	1,070	165	1,785
(8) East Texas	492	817	125	1,011
(9) East Oklahoma	487	887	145	1,909
(10) Colorado	616	1,066	165	1,777
(11) Kansas	678	1,128	165	1,904
(12) Nebraska	698	1,148	165	1,946
(13) North Dakota-South Dakota	630	1,080	165	1,805
(14) Minnesota-Wisconsin	754	1,204	165	2,061
(15) Iowa	689	1,139	165	1,927
(16) Illinois	659	1,109	165	1,865
(17) Michigan-Indiana-Ohio	693	1,143	165	1,935
(18) Missouri	651	1,101	165	1,848
(19) Arkansas-Louisiana	520	920	145	1,320
(20) Mississippi-Alabama-Georgia	553	953	145	1,378
(21) Florida	630	1,030	145	1,516
(22) North Carolina-South Carolina	600	1,000	145	1,462
(23) Kentucky-Tennessee	579	979	145	1,425
(24) Virginia-West Virginia-Maryland-Delaware	648	1,098	165	1,843
(25) Pennsylvania	765	1,215	165	2,084
(26) Northeast (seven states)	821	1,271	165	2,199

Regional Fed-Beef Demand

U.S. per capita fed-beef demand was assumed to be influenced predominantly by per capita disposable consumer income. Therefore, the following fed-beef consumption function was used to estimate regional fed-beef consumption.[1]

$$Y = -12.43292 + 0.029156X$$
$$(8.24)^{**}$$

$$R^2 = .7471 \qquad F = 67.94^{**}$$

where:

Y = per capita fed-beef consumption in pounds,

X = deflated per capita disposable consumer income in dollars.

Regional per capita fed-beef consumption estimates were multiplied by regional population estimates as reported by the U.S. Department of Commerce to estimate regional fed-beef demand.

Regional Feeding and Slaughtering Capacities

Total one-time regional feedlot capacities for feedlots with 1,000 head or more capacity were estimated by multiplying the number of reported feedlots within each size category by the lower one-quarter range and summing over all size categories (Dietrich, 1971). The one-time feeding capacities of these large lots were adjusted by annual turnover ratios which reflected the average days on feed with some adjustments for harsh weather conditions and regional feeding practices.[2] One-time regional feeding capacities for feedlots with less than 1,000 head one-time capacity were taken to be 250 head, or the lower one-quarter range of the category.

Regional slaughter plant capacity was defined as the largest annual commercial cattle slaughter as reported in *Livestock Slaughter* (USDA, 1970–80) for 1976–80.

Regional Fixed Feeding Costs

Estimated regional feeding costs were calculated using the fixed feeding cost–feedlot size function developed in a study of Texas–Oklahoma cattle feedlot operations (Dietrich, 1969). The function used to estimate fixed costs per pound of gain in this study was as follows:

$$\text{Log } Y = -0.932490 - 0.231240 \text{ (Log X)}$$

where:

Y = fixed costs per pound of gain

X = estimated average regional feedlot size.

[1]The *t*-value of the estimated coefficient is shown in parenthesis below the coefficient. **denotes statistical significance at the 1% probability level.

[2]Assumed turnover of 2.0 in regions 4–9, 19–23; turnover of 1.5 in regions 1, 11, 12, 18; turnover of 1.0 in regions 2, 3, 10, 13–17, 24–26. See Table 6 for key to region numbers.

Average regional feedlot size for feedlots with 1,000 head or more feeding capacity was based on a weighting procedure as represented by 1980 fed cattle marketings among the various feedlot size groups as reported in *Cattle on Feed* (USDA 1980–81). The average capacity within each size category was defined as the lower one-quarter range. The lower one-quarter range was weighted by the proportion of fed slaughter cattle marketings from lots with 1,000 head or more capacity and aggregated over the various feedlot sizes.

Current data on average regional feedlot sizes for feedlots with less than 1,000-head capacity were not available, so those obtained by Dietrich (1971) were utilized in this study. The estimated regional feedlot sizes for feedlots with 1,000 head or more capacity and those with less than 1,000 head capacity were weighted by the proportion of fed cattle marketings represented by each size group to obtain the regional average feedlot size.

To insure that regional fixed-cost coefficients approximated existing regional cost situations, estimated regional fixed feeding costs were increased to reflect regional differences in fixed investments per head of capacity and considerations concerning climatic conditions in the various regions.[3]

Regional Slaughtering Costs

The total cost associated with the transformation of live fed slaughter cattle into fed-beef carcasses was divided into fixed and variable costs. Fixed costs were estimated from Cothern, Peard, and Weeks (1978) for a slaughter plant with a 60 head-per-hour killing capacity. Dubov (1972) provided the basis for regional adjustments of fixed slaughtering costs. Fixed costs used in this study were assumed to include all building and equipment fixed costs.

Variable costs were also estimated from Cothern, Peard, and Weeks (1978) and were adjusted to reflect 1980 wage rates. Labor and fringe benefits comprised nearly 64 percent of total variable costs of slaughtering. Regional adjustments in variable costs were based on wage rates for meatpacking plants reported on a regional basis by the U.S. Department of Labor (1980).

Transportation Costs

Four equations based on the length of haul were used in developing truck and rail transportation rate functions for live cattle, feed grains, and fed beef. These equations were postulated as follows:

1. $Y = a + b_1X$
2. $Y = a + b_1X + b_2(X)^2$
3. $Y = a + b_1X + b_2(X)^2 + b_3(X)^3$
4. $Y = a + b_1X + b_2\sqrt{X}$

where:

Y = shipping cost in dollars per hundredweight for the specific commodity.

X = miles shipped.

Truck and rail transportation cost data for live cattle, feed grains, and beef were obtained from state and regional tariff bureaus and from private shipping firms. Highway and rail mileages corresponding to rates were estimated from various publications and maps (Rand McNally, 1973). Transportation cost data were not adjusted for back-hauls. Intraregional mileage was assumed to be equal to one-half of the farthest possible shipment from the specified central point within each region (Dietrich, 1971).

Rail shipments of feeder cattle, fed slaughter cattle, and fed-beef as carcasses were assumed physically and economically impractical. Therefore, only truck transportation of these commodities was considered. Feed grains commonly move by both truck and rail, so transportation functions were estimated for both modes. Feed grain transportation costs used in this study were taken to be the lesser cost of the two modes considered.

Truck and rail transportation functions appearing to conform most closely to observed shipping rates were adopted for this study. These functions were as follows:[4]

Cattle:

$$Y_{ct} = 44.681176 + 0.288781X$$
$$(15.26)^{**}$$
$$R^2 = 0.5588 \qquad F = 233.01^{**}$$

Feed grain:

$$Y_{fgt} = 7.194031 + 0.283464X$$
$$(6.90)^{**}$$
$$R^2 = 0.5697 \qquad F = 47.65^{**}$$

$$Y_{fgr} = 38.465877 + 0.075488X$$
$$(82.58)^{**}$$
$$R^2 = 0.9650 \qquad F = 6819.12^{**}$$

Fed-beef carcasses:

$$Y_{bt} = 123.391166 + 0.226720X$$
$$(82.12)^{**}$$
$$R^2 = 0.7318 \qquad F = 6744.40^{**}$$

where:

Y_{ct} = feeder cattle shipping costs in cents per hundredweight by truck.

X = number of miles shipped.

Y_{fgt} = feed grain shipping cost in cents per hundredweight by truck.

Y_{fgr} = feed grain shipping cost in cents per hundredweight by single-car rail.

Y_{bt} = fed-beef carcass shipping cost in cents per hundredweight by truck.

[3]Fixed feeding costs were raised 100 percent in regions 2, 3, 10, 13–17, 24–26; 50 percent in regions 1, 9, 11, 12, 18; 33 percent in regions 8, 19–23. See Table 6 for key to region numbers.

[4]The *t*-value of the estimated coefficients is directly below the coefficient in all estimated equations. (**) denotes statistical significance at the 1.0 percent probability level.

B PROGRAMMING TABLEAU

A two-region example of the programming tableau developed for this study is illustrated in Table B–1. Row designations in this tableau are as follows:

TABLE B-1. Example of the tableau employed for optimizing cattle feeding, fed cattle slaughter, and fed-beef distribution

Row Name	01FDR 01	01FDR 02	02FDR 01	02FDR 02	01OTG 01	01OTG 02	02OTG 01	02OTG 02	01FDG 01	01FDG 02	02FDG 01	02FDG 02	01FDL T	02FDL T	01FSLC 01	01FSLC 02	02FSLC 01
N COST2	8.10	17.59	15.68	9.58	.56	.93	.93	.65	.56	.93	.93	.65	8.66	8.96	6.69	8.81	8.42
L 01FDRSUP	1.0	1.0															
L 02FDRSUP			1.0	1.0													
L 01OTGR					.01	.01											
L 02OTGR							.01	.01									
L 01FEEDGR					.01		.01		.01		.01						
L 02FEEDGR						.01		.01		.01		.01					
L 01LOTFD									−1.0	−1.0			20.24				
L 02LOTFD											−1.0	−1.0		18.59			
L 01LOTCAT	−1.0		−1.0										1.0				
L 02LOTCAT		−1.0		−1.0										1.0			
L 01LOTCAP													1.0				
L 02LOTCAP														1.0			
L 01FCSLC													−7.23		1.0		1.0
L 02FCSLC														−6.75		1.0	
L 01SLACAP															1.0	1.0	
L 02SLACAP																	1.0
L 01FBSUC															−1.0	−1.0	
L 02FBSUC																	−1.0
L 01FDBF																	
L 02FDBF																	
L 01FBD																	
L 02FBD																	

Row Name	02FSLC 01	02FSLC 02
N COST2	8.42	
L 01FDRSUP		
L 02FDRSUP		
L 01OTGR		
L 02OTGR		
L 01FEEDGR		
L 02FEEDGR		
L 01LOTFD		
L 02LOTFD		
L 01LOTCAT		
L 02LOTCAT		
L 01LOTCAP		
L 02LOTCAP		
L 01FCSLC		
L 02FCSLC		
L 01SLACAP		
L 02SLACAP	1.0	
L 01FBSUC		
L 02FBSUC		−1.0
L 01FDBF		
L 02FDBF		
L 01FBD		
L 02FBD		

This tableau represents only a small portion of the tableau actually employed. This example illustrates the various situations included in the basic model.

COST2 — regional transportation costs for shipping feeder cattle (FDR), feed grain for other livestock and uses (OTGR), feed grain for cattle feeding (FDGR), fed slaughter cattle (FSLC), and fed-beef (FBDC). Also includes fixed feeding costs (FDLT) and the addition of slaughter costs to transportation charges for moving fed slaughter cattle (FSLC).

01FDRSUP — feeder cattle supply in region 1.

01OTGR — feed grain requirements for feeding livestock and poultry (except cattle in feedlots) and food, seed, and industrial use in region 1.

01FEEDGR — feed grain supply in region 1.

01LOTFD — feed grain requirements per head and shipment of available grain for cattle feeding in region 1.

01LOTCAT — summation of feeder cattle shipped to region 1.

01LOTCAP — annual feedlot capacity in region 1.

01FCSLC — fed slaughter cattle shipments to slaughter from region 1 on a carcass weight basis.

01SLACAP — annual slaughter capacity in region 1.

01FBSUC — summation of fed slaughter cattle shipments to slaughter in region 1.

01FDBF — fed-beef supply in region 1.

01FBD — fed-beef demand in region 1.

Column designations in the tableau are as follows:

01FDR01 — permits shipment of feeder cattle (head) from region 1 to feedlots in region 1.

01OTGR01 — permits shipments of feed grain (hundredweight) from region 1 to feed livestock other than cattle in region 1.

01FDGR01 — permits shipment of feed grain (hundredweight) from region 1 to feedlots in region 1.

01FDLT — the level of cattle feeding (head) in region 1,

01FSLC01 — permits shipments of fed cattle (hundredweight-carcass weight basis) from region 1 to slaughter in region 1.

01FBSUP — the level of slaughter (hundredweight-carcass weight basis) in region 1.

01FBDC01 — permits shipments of beef (hundredweight-carcass weight basis) from region 1 to consumption in region 1.

			0	0	0	0	
	0	0	1	1	2	2	
	1	2	F	F	F	F	
	F	F	B	B	B	B	
	B	B	D	D	D	D	
	S	S	C	C	C	C	
	U	U	0	0	0	0	
	P	P	1	2	1	2	RHS
.90	.00	.00	1.75	2.76	2.76	2.03	
							697,000
							2,277,000
							493,300
							308,900
							226,300
							542,800
							0
							0
							0
							0
							582,300
							726,200
							0
.0							0
							5,974,680
.0							6,453,783
	1.0						0
.0		1.0					0
	−1.0		1.0	1.0			0
		−1.0			1.0	1.0	0
			1.0		1.0		4,923,760
				1.0		1.0	1,466,780

Estimated regional price differentials were calculated using available transportation cost data and opportunity costs generated by estimation of the linear programming model. Opportunity costs resulted from shipments not occurring within or between regions and reflected the increase in f.o.b. delivered price or the reduction in transportation costs necessary before shipments would occur. Opportunity costs may also be interpreted as the additional costs to the system of employing non-optimum shipment routes. Estimates of regional price differentials were postulated as follows:

$$W_{ij} = V_j + C^0_{ij} - C_{ij}$$

where:

W_{ij} = estimated price differential between region i and the base region j.

V_j = intraregional transportation cost as the price in the base region j.

C^0_{ij} = opportunity cost of shipment from region i to the base region j.

C_{ij} = transportation cost of shipment from region i to the base region j.

Variable costs of cattle feeding in this study were represented primarily by the regional price differentials for feeder cattle and feed grains. Feeder cattle and feed grain costs generally comprised more than 90 percent of the total variable costs in cattle feeding. Variable costs of cattle slaughter were included and generally reflect regional differences in relative wage rates.

TABLE C-1. Feed grain transportation rates, in dollars per hundredweight, by region

	Portland	Butte	Salt Lake	Fresno	Phoenix	Albuquerque	Amarillo	Houston	Oklahoma City	Denver	Salina	[illegible]
(1) Portland	0.56	0.93	1.05	1.08	1.60	1.78	1.77	2.19	1.99	1.42	1.74	1.61
(2) Butte	0.94	0.65	0.71	1.67	1.62	1.42	1.41	1.80	1.62	1.06	1.26	1.12
(3) Salt Lake	1.05	0.72	0.67	1.05	1.29	1.13	1.12	1.55	1.33	0.82	1.17	1.05
(4) Fresno	1.08	1.37	1.05	0.59	0.92	1.14	1.30	1.77	1.59	1.49	1.62	1.67
(5) Phoenix	1.60	1.62	1.29	0.92	0.52	0.90	1.05	1.33	1.25	1.26	1.30	1.38
(6) Albuquerque	1.78	1.42	1.13	1.14	0.90	0.52	0.67	1.06	0.87	0.75	0.91	1.02
(7) Amarillo	1.77	1.41	1.12	1.30	1.05	0.67	0.71	0.86	0.59	0.74	0.72	0.98
(8) Houston	2.19	1.80	1.55	1.77	1.33	1.06	0.86	0.52	0.74	1.16	0.93	1.06
(9) Oklahoma City	1.99	1.62	1.33	1.59	1.25	0.87	0.59	0.74	0.37	0.94	0.58	0.72
(10) Denver	1.42	1.06	0.81	1.49	1.26	0.75	0.74	1.16	0.94	0.54	0.71	0.69
(11) Salina	1.74	1.26	1.17	1.62	1.30	0.91	0.72	0.93	0.58	0.71	0.50	0.53
(12) Grand Island	1.61	1.12	1.05	1.67	1.38	1.02	0.98	1.06	0.72	0.69	0.53	0.53
(13) Aberdeen	1.52	1.00	1.20	2.03	2.01	1.64	1.38	1.34	1.23	1.28	0.83	0.73
(14) Minneapolis	1.71	1.20	1.39	2.01	1.74	1.35	1.17	1.29	0.98	1.03	0.83	0.73
(15) Des Moines	1.83	1.29	1.27	1.86	1.54	1.15	0.97	1.09	0.78	0.90	0.65	0.60
(16) Springfield	2.02	1.50	1.45	1.96	1.64	1.25	1.08	1.04	0.84	1.07	0.75	0.80
(17) Fort Wayne	2.11	1.60	1.62	2.16	1.83	1.45	1.27	1.20	1.04	1.25	0.95	0.95
(18) Jefferson City	2.09	1.62	1.53	1.95	1.63	1.13	0.92	0.99	0.71	0.96	0.59	0.71
(19) Monroe	2.23	1.96	1.59	1.86	1.42	1.15	0.88	0.63	0.74	1.21	0.92	1.03
(20) Birmingham	2.33	1.86	1.77	2.13	1.69	1.41	1.15	0.90	0.94	1.34	1.01	1.13
(21) Orlando	2.86	2.34	2.25	2.54	2.14	1.78	1.60	1.19	1.37	1.85	1.42	1.53
(22) Charlotte	2.61	1.86	2.05	2.45	2.01	1.74	1.47	1.22	1.26	1.66	1.33	1.40
(23) Nashville	2.28	1.80	1.81	2.24	1.74	1.42	1.14	0.98	0.93	1.32	0.97	1.03
(24) Richmond	2.72	2.17	2.17	2.74	2.24	1.92	1.64	1.42	1.43	1.77	1.40	1.44
(25) Harrisburg	2.53	2.01	1.75	2.57	2.24	1.85	1.65	1.54	1.44	1.67	1.35	1.37
(26) Boston	2.66	2.15	2.24	2.79	2.47	2.08	1.92	1.82	1.67	1.87	1.58	1.58

Truck and single-car rail transportation functions estimated by linear regression techniques as $Y_{fgt} = 7.194031 + 0.283464X$ and $Y_{fgr} = 38.465877 + 0.075488X$, where Y_{fgt} = feed grain shipping co[illegible]nts

TABLE C-2. Cattle transportation rates, in dollars per hundredweight, by region

	Portland	Butte	Salt Lake	Fresno	Phoenix	Albuquerque	Amarillo	Houston	Oklahoma City	Denver	Salina	Grand Island
(1) Portland	1.10	2.39	2.74	2.61	4.11	4.49	5.23	6.89	5.88	4.13	5.34	4.93
(2) Butte	2.39	1.46	1.66	3.62	3.54	3.41	3.89	5.65	4.41	2.72	3.79	3.27
(3) Salt Lake	2.74	1.66	1.53	2.82	2.33	2.19	3.01	4.59	3.62	1.90	3.18	2.80
(4) Fresno	2.61	3.62	2.82	1.21	2.19	3.16	3.99	5.50	4.74	4.01	4.96	5.13
(5) Phoenix	4.11	3.54	2.33	2.19	0.98	1.70	2.52	3.76	3.28	2.73	3.50	3.83
(6) Albuquerque	4.49	3.41	2.19	3.16	1.70	0.98	1.27	2.86	2.03	1.65	2.25	2.61
(7) Amarillo	5.23	3.39	3.01	3.99	2.52	1.27	1.10	2.17	1.19	1.67	1.62	1.98
(8) Houston	6.89	5.65	4.59	5.50	3.76	2.86	2.17	0.96	1.75	3.40	2.47	3.01
(9) Oklahoma City	5.88	4.41	3.62	4.74	3.28	2.03	1.19	1.75	0.75	2.21	1.16	1.71
(10) Denver	4.13	2.72	1.90	4.01	2.73	1.65	1.67	3.40	2.21	1.05	1.72	1.61
(11) Salina	5.34	3.79	3.18	4.96	3.50	2.25	1.62	2.47	1.16	1.72	0.89	0.99
(12) Grand Island	4.93	3.27	2.80	5.13	3.83	2.61	1.98	3.01	1.71	1.61	0.99	1.01
(13) Aberdeen	4.56	2.70	3.21	5.54	4.71	3.58	2.96	3.97	2.67	2.42	1.95	1.45
(14) Minneapolis	5.33	3.51	3.96	6.29	5.12	3.90	3.26	3.85	2.75	2.89	2.10	1.74
(15) Des Moines	5.73	3.83	3.60	5.92	4.54	3.29	2.59	3.13	2.03	2.41	1.52	1.24
(16) Springfield	6.48	4.67	4.35	6.33	4.87	3.61	2.91	3.03	2.19	2.96	1.86	2.00
(17) Fort Wayne	6.94	5.08	4.94	7.13	5.67	4.41	3.65	3.65	2.90	3.75	2.66	2.58
(18) Jefferson City	6.18	4.53	4.05	5.80	4.33	3.08	2.40	2.67	1.68	2.62	1.38	1.75
(19) Monroe	7.14	5.72	4.85	5.82	4.16	3.11	2.29	1.38	1.75	3.51	2.43	2.97
(20) Birmingham	7.78	6.13	5.60	6.81	5.21	4.09	3.24	2.32	2.52	4.17	2.96	3.35
(21) Orlando	9.31	7.66	7.13	8.11	6.44	5.39	4.58	3.57	4.02	5.69	4.48	4.88
(22) Charlotte	8.52	6.76	6.39	7.85	6.33	5.13	4.25	3.44	3.55	4.96	3.72	4.08
(23) Nashville	7.36	5.66	5.23	6.70	5.24	3.99	3.14	2.67	2.41	3.81	2.56	2.92
(24) Richmond	8.65	6.79	6.63	8.43	6.96	5.71	4.90	4.22	4.13	5.29	4.09	4.28
(25) Harrisburg	8.34	6.48	6.35	8.37	6.90	5.65	4.85	4.62	4.12	5.07	3.89	4.00
(26) Boston	9.26	7.41	7.29	9.47	8.00	6.75	5.93	5.70	5.22	6.10	5.00	[illegible]3

Truck transportation function estimated by linear regression techniques as $Y_{ct} = 44.681176 + 0.288781X$, where Y_{ct} = cattle shipping cost in cents per hundredweight and X = number of miles shipped.

REGIONAL TRANSPORTATION RATES

	Minneapolis	Des Moines	Springfield	Fort Wayne	Jefferson City	Monroe	Birmingham	Orlando	Charlotte	Nashville	Richmond	Harrisburg	Boston
.52	1.71	1.83	2.02	2.11	2.09	2.23	2.33	2.86	2.61	2.28	2.72	2.53	2.66
.00	1.20	1.29	1.50	1.60	1.62	1.96	1.86	2.34	1.86	1.80	2.17	2.01	2.15
.20	1.39	1.27	1.45	1.62	1.53	1.59	1.77	2.24	2.05	1.81	2.17	1.75	2.24
2.03	2.01	1.86	1.96	2.16	1.95	1.86	2.13	2.54	2.45	2.24	2.74	2.57	2.79
2.01	1.74	1.54	1.64	1.83	1.63	1.42	1.69	2.14	2.01	1.74	2.24	2.24	2.47
.64	1.35	1.15	1.25	1.45	1.13	1.15	1.41	1.78	1.74	1.42	1.92	1.85	2.08
.38	1.17	0.97	1.08	1.27	0.92	0.88	1.15	1.60	1.47	1.14	1.64	1.65	1.92
.34	1.29	1.09	1.04	1.20	0.99	0.63	0.90	1.19	1.22	0.98	1.42	1.54	1.82
.23	0.98	0.78	0.84	1.04	0.71	0.74	0.94	1.37	1.26	0.93	1.43	1.44	1.67
.28	1.03	0.90	1.07	1.25	0.96	1.21	1.34	1.85	1.66	1.32	1.77	1.67	1.87
0.83	0.83	0.65	0.75	0.95	0.59	0.92	1.01	1.42	1.33	0.97	1.40	1.35	1.58
0.73	0.73	0.60	0.80	0.95	0.71	1.03	1.13	1.53	1.40	1.03	1.44	1.37	1.58
0.56	0.60	0.69	0.90	1.00	0.90	1.29	1.29	1.82	1.49	1.16	1.56	1.41	1.54
0.60	0.53	0.58	0.73	0.79	0.78	1.16	1.14	1.56	1.31	0.99	1.31	1.21	1.34
0.69	0.58	0.45	0.60	0.74	0.59	1.01	0.99	1.41	1.21	0.86	1.24	1.16	1.37
0.90	0.73	0.60	0.39	0.59	0.85	0.83	0.79	1.21	1.01	0.65	1.04	0.99	1.22
1.00	0.79	0.74	0.59	0.52	0.73	0.98	0.84	1.21	0.92	0.71	0.90	1.07	1.02
0.90	0.78	0.59	0.85	0.73	0.48	0.85	0.83	1.25	1.08	0.72	1.16	1.12	1.36
1.29	1.16	1.01	0.83	0.98	0.85	0.54	0.66	1.02	0.98	0.74	1.19	1.30	1.58
1.29	1.14	0.99	0.79	0.84	0.83	0.66	0.54	0.81	0.70	0.54	0.92	1.02	1.30
1.82	1.56	1.41	1.21	1.21	1.25	1.02	0.81	0.56	0.79	0.95	0.96	1.15	1.40
1.49	1.31	1.21	1.01	0.92	1.08	0.98	0.70	0.79	0.51	0.79	0.60	0.76	1.01
1.16	0.99	0.86	0.65	0.71	0.72	0.74	0.54	0.95	0.79	0.51	0.91	1.02	1.28
1.56	1.31	1.24	1.04	0.90	1.16	1.19	0.92	0.96	0.60	0.91	0.54	0.57	0.82
1.41	1.21	1.16	0.99	1.07	1.12	1.30	1.02	1.15	0.76	1.02	0.57	0.49	0.70
1.54	1.34	1.37	1.22	1.02	1.36	1.58	1.30	1.40	1.01	1.28	0.82	0.70	0.57

dweight by truck, Y_{fgr} = feed grain shiping cost in cents per hundredweight by rail (single-car rate), and X = number of miles shipped.

erdeen	Minneapolis	Des Moines	Springfield	Fort Wayne	Jefferson City	Monroe	Birmingham	Orlando	Charlotte	Nashville	Richmond	Harrisburg	Boston
4.56	5.33	5.73	6.48	6.94	6.18	7.14	7.78	9.31	8.52	7.36	8.65	8.34	9.26
2.70	3.51	3.83	4.67	5.08	4.53	5.72	6.13	7.66	6.76	5.66	6.79	6.48	7.41
3.21	3.96	3.60	4.35	4.94	4.05	4.85	5.60	7.13	6.39	5.23	6.63	6.35	7.29
5.54	6.29	5.92	6.33	7.13	5.80	5.82	6.81	8.11	7.85	6.70	8.43	8.37	9.47
4.71	5.12	4.54	4.87	5.67	4.33	4.16	5.21	6.44	6.33	5.24	6.96	6.90	8.00
3.58	3.90	3.29	3.61	4.41	3.08	3.11	4.09	5.39	5.13	3.99	5.71	5.65	6.75
2.96	3.26	2.59	2.91	3.65	2.40	2.29	3.24	4.58	4.25	3.14	4.90	4.85	5.93
3.97	3.85	3.13	3.03	3.65	2.67	1.38	2.32	3.27	3.44	2.67	4.22	4.62	5.70
2.67	2.75	2.03	2.19	2.90	1.68	1.75	2.52	4.02	3.55	2.41	4.13	4.12	5.22
2.42	2.89	2.41	2.96	3.75	2.62	3.51	4.17	5.69	4.96	3.81	5.29	5.07	6.10
1.95	2.10	1.52	1.86	2.66	1.38	2.43	2.96	4.48	3.72	2.56	4.09	3.89	5.00
2.45	1.74	1.24	2.00	2.58	1.75	2.97	3.35	4.88	4.08	2.92	4.28	4.00	4.93
3.12	1.26	1.82	2.62	2.87	2.56	3.80	4.13	5.63	4.57	3.63	4.58	4.27	5.19
3.26	1.00	1.17	1.85	2.06	1.92	3.31	3.40	4.86	3.75	2.86	3.77	3.46	4.38
2.82	1.17	0.83	1.28	1.80	1.24	2.59	2.76	4.28	3.38	2.28	3.51	3.21	4.14
2.62	1.85	1.28	0.77	1.25	1.02	2.23	2.00	3.46	2.54	1.46	2.77	2.55	3.61
2.87	2.06	1.80	1.25	0.95	1.82	2.75	2.13	3.47	2.17	1.58	2.16	1.86	2.83
3.56	1.92	1.24	1.02	1.82	0.86	1.96	2.08	3.61	2.84	1.68	3.22	3.04	4.14
4.80	3.31	2.59	2.23	2.75	1.96	1.05	1.50	2.73	2.62	1.77	3.40	3.80	4.88
4.13	3.40	2.76	2.00	2.13	2.08	1.50	1.05	1.97	1.56	1.04	2.34	2.75	3.83
4.63	4.86	4.28	3.46	3.47	3.61	2.73	1.97	1.11	1.97	2.44	2.70	3.32	4.28
3.57	3.75	3.38	2.54	2.17	2.84	2.62	1.56	1.97	0.91	1.61	1.23	1.79	2.80
4.63	2.86	2.28	1.46	1.58	1.68	1.77	1.04	2.44	1.61	0.91	2.17	2.52	3.60
4.58	3.77	3.51	2.77	2.16	3.22	3.40	2.34	2.70	1.23	2.17	1.04	1.08	2.02
4.27	3.46	3.21	2.55	1.86	3.04	3.80	2.75	3.32	1.79	2.52	1.08	0.83	1.55
5.27	4.38	4.14	3.61	2.83	4.14	4.88	3.83	4.28	2.80	3.60	2.02	1.55	1.17

TABLE C-3. Fed slaughter cattle transportation rates, on a dressed equivalent weight basis, in dollars per hundredweight, by region

	Portland	Butte	Salt Lake	Fresno	Phoenix	Albuquerque	Amarillo	Houston	Oklahoma City	Denver	Salina	Grand Island
(1) Portland	1.80	3.92	4.49	4.27	6.74	7.36	8.57	11.29	9.64	6.77	8.76	8.08
(2) Butte	3.92	2.40	2.72	5.94	5.80	5.58	6.38	9.27	7.23	4.46	6.21	5.37
(3) Salt Lake	4.49	2.72	2.51	4.62	3.81	3.60	4.93	7.53	5.94	3.12	5.21	4.59
(4) Fresno	4.28	5.94	4.62	1.80	3.58	5.19	6.54	9.02	7.78	6.57	8.14	8.41
(5) Phoenix	6.74	5.80	3.81	3.58	1.59	2.78	4.13	6.17	5.37	4.48	5.73	6.27
(6) Albuquerque	7.36	5.58	3.60	5.19	2.78	1.60	2.08	4.68	3.32	2.71	3.68	4.28
(7) Amarillo	8.57	6.38	4.93	6.54	4.13	2.08	1.80	3.56	1.95	2.74	2.66	3.25
(8) Houston	11.57	9.50	7.72	9.25	6.33	4.81	3.56	1.61	2.95	5.71	4.14	5.06
(9) Oklahoma City	9.64	7.24	5.94	7.78	5.37	3.32	1.95	2.88	1.22	3.62	1.91	2.80
(10) Denver	6.77	4.46	3.12	6.57	4.48	2.74	2.74	5.57	3.62	1.73	2.82	2.64
(11) Salina	8.76	6.21	5.21	8.14	5.73	3.68	2.66	4.04	1.91	2.82	1.45	4.62
(12) Grand Island	8.08	5.37	4.59	8.41	6.27	4.28	3.25	4.93	4.80	2.64	1.62	1.66
(13) Aberdeen	7.40	4.42	5.27	9.09	7.72	5.86	4.85	6.51	4.38	3.97	3.20	2.37
(14) Minneapolis	8.74	5.76	6.48	10.30	8.39	6.39	5.34	6.31	4.51	4.73	3.45	2.85
(15) Des Moines	9.39	6.28	5.90	9.71	7.44	5.39	4.25	5.13	3.32	3.95	2.49	2.04
(16) Springfield	10.60	7.65	7.13	10.38	7.98	5.93	4.77	4.96	3.58	4.86	3.05	3.27
(17) Fort Wayne	11.37	8.33	8.09	11.69	9.29	7.24	5.98	5.95	4.76	6.14	4.36	4.24
(18) Jefferson City	10.14	7.42	6.65	9.50	7.10	5.05	3.93	4.38	2.75	4.30	2.26	2.86
(19) Monroe	12.00	9.61	8.14	9.79	6.99	5.22	3.75	2.32	2.94	5.90	4.09	5.00
(20) Birmingham	13.08	10.31	9.41	11.45	8.76	6.88	5.31	3.90	4.24	7.00	4.97	5.63
(21) Orlando	15.26	12.55	11.68	12.90	10.56	8.84	7.51	5.36	6.60	9.33	7.35	7.99
(22) Charlotte	13.96	11.08	10.47	12.86	10.37	8.41	6.97	5.63	5.82	8.14	6.19	6.69
(23) Nashville	12.37	9.52	8.79	11.27	8.80	6.70	5.15	4.48	4.05	6.40	4.30	4.92
(24) Richmond	14.18	11.14	10.87	13.82	11.42	9.37	8.03	6.92	6.78	8.67	6.71	7.01
(25) Harrisburg	13.67	10.63	10.41	13.71	11.31	9.26	7.95	7.57	6.75	8.31	6.39	6.56
(26) Boston	15.19	12.15	11.94	15.52	13.11	11.06	9.72	9.35	8.55	9.99	8.19	8.08

Truck transportation function estimated by linear regression techniques as $Y_{ct} = 44.681176 + 0.288781X$, where Y_{ct} = cattle shipping costs in cents per hundredweight and X = number of miles shipped

TABLE C-4. Fresh fed-beef carcass transportation rates, in dollars per hundredweight, by region

	Portland	Butte	Salt Lake	Fresno	Phoenix	Albuquerque	Amarillo	Houston	Oklahoma City	Denver	Salina	Grand Island
(1) Portland	1.75	2.76	3.03	2.93	4.11	4.41	4.99	6.29	5.50	4.12	5.08	4.75
(2) Butte	2.76	2.03	2.19	3.73	3.66	3.56	3.94	5.32	4.35	3.02	3.85	3.45
(3) Salt Lake	3.03	2.19	2.09	3.10	2.71	2.61	3.25	4.49	3.73	2.38	3.38	3.08
(4) Fresno	2.93	3.73	3.10	1.84	2.60	3.37	4.01	5.20	4.61	4.03	4.78	4.91
(5) Phoenix	4.11	3.66	2.71	2.60	1.65	2.22	2.86	3.84	3.46	3.03	3.63	3.89
(6) Albuquerque	4.41	3.56	2.61	3.37	2.22	1.65	1.88	3.12	2.47	2.18	2.65	2.93
(7) Amarillo	4.99	3.94	3.25	4.01	2.86	1.88	1.74	2.59	1.82	2.19	2.15	2.44
(8) Houston	6.29	5.32	4.49	5.20	3.84	3.12	2.59	1.63	2.26	3.55	2.82	3.24
(9) Oklahoma City	5.50	4.35	3.73	4.61	3.46	2.47	1.82	2.26	1.47	2.62	1.80	2.22
(10) Denver	4.12	3.02	2.38	4.03	3.03	2.18	2.19	3.55	2.62	1.71	2.23	2.15
(11) Salina	5.08	3.85	3.38	4.78	3.63	2.65	2.15	2.82	1.80	2.23	1.58	1.66
(12) Grand Island	4.75	3.45	3.08	4.91	3.89	2.93	2.44	3.24	2.22	2.15	1.66	1.68
(13) Aberdeen	4.43	3.00	3.41	5.24	4.58	3.69	3.20	4.00	2.98	2.78	2.42	2.02
(14) Minneapolis	5.07	3.64	3.99	5.82	4.90	3.95	3.44	3.90	3.04	3.15	2.53	2.25
(15) Des Moines	5.38	3.89	3.71	5.53	4.44	3.46	2.92	3.34	2.47	2.77	2.08	1.86
(16) Springfield	5.97	4.55	4.30	5.85	4.70	3.72	3.17	3.26	2.60	3.21	2.34	2.41
(17) Fort Wayne	6.33	4.87	4.76	6.48	5.33	4.35	3.75	3.75	3.16	3.83	2.97	2.91
(18) Jefferson City	5.74	4.44	4.07	5.44	4.28	3.30	2.77	2.98	2.20	2.94	1.96	2.25
(19) Monroe	6.48	5.37	4.69	5.46	4.15	3.32	2.68	1.97	2.26	3.64	2.79	3.22
(20) Birmingham	6.99	5.70	5.28	6.23	4.97	4.10	3.43	2.71	2.86	4.15	3.20	3.51
(21) Orlando	8.19	6.90	6.48	7.25	5.94	5.12	4.48	3.45	4.04	5.35	4.40	4.71
(22) Charlotte	7.57	6.19	5.90	7.04	5.85	4.91	4.22	3.58	3.67	4.78	3.80	4.09
(23) Nashville	6.66	5.33	4.99	6.15	5.00	4.01	3.35	2.98	2.77	3.87	2.89	3.18
(24) Richmond	7.68	6.22	6.09	7.50	6.35	5.37	4.73	4.19	4.13	5.04	4.10	4.24
(25) Harrisburg	7.43	5.97	5.87	7.45	6.30	5.32	4.69	4.51	4.12	4.86	3.94	4.02
(26) Boston	8.16	6.70	6.60	8.31	7.16	6.18	5.53	5.36	4.98	5.67	4.80	4.75

Truck transportation function estimated by linear regression techniques as $Y_{bt} = 123.391166 + 0.226720X$, where Y_{bt} = fed-beef carcass shipping cost in cents per hundredweight and X = number of mile

erdeen	Minneapolis	Des Moines	Springfield	Fort Wayne	Jefferson City	Monroe	Birmingham	Orlando	Charlotte	Nashville	Richmond	Harrisburg	Boston
	8.74	9.39	10.63	11.37	10.14	11.70	12.76	15.26	13.96	12.07	14.18	13.67	15.19
4.42	5.76	6.28	7.65	8.33	7.42	9.37	10.05	12.55	11.08	9.28	11.14	10.63	12.14
5.27	6.48	5.90	7.13	8.09	6.65	7.95	9.18	11.68	10.47	8.58	10.87	10.41	11.94
9.09	10.30	9.71	10.38	11.69	9.50	9.55	11.16	13.29	12.86	10.98	13.82	13.71	15.52
7.72	8.39	7.44	7.98	9.29	7.10	6.82	8.54	10.56	10.36	8.59	11.42	11.31	13.11
5.86	6.39	5.39	5.93	7.24	5.05	5.10	6.71	8.84	8.40	6.54	9.37	9.26	11.06
4.85	5.34	4.25	4.77	5.98	3.93	3.75	5.31	7.51	6.97	5.15	8.03	7.95	9.72
6.68	6.47	5.25	5.09	6.13	4.49	2.32	3.91	5.50	5.77	4.48	7.09	7.76	9.58
4.37	4.51	3.32	3.58	4.76	2.75	2.87	4.13	6.60	5.82	3.95	6.78	6.75	8.55
3.97	4.73	3.95	4.86	6.14	4.30	5.76	6.83	9.33	8.14	6.24	8.67	8.31	9.99
3.20	3.45	2.49	3.05	4.33	2.26	3.98	4.85	7.35	6.09	4.20	6.71	6.39	8.19
2.37	2.85	2.04	3.27	4.24	2.86	4.87	5.49	7.99	6.69	4.79	7.01	6.56	8.08
1.84	2.07	2.98	4.29	4.70	4.20	6.23	6.77	9.23	7.49	5.96	7.51	7.00	8.52
2.07	1.64	1.92	3.04	3.37	3.14	5.43	5.57	7.96	6.15	4.69	6.18	5.67	7.18
2.98	1.92	1.37	2.11	2.94	2.04	4.25	4.52	7.01	5.54	3.74	5.75	5.26	6.79
4.29	3.04	2.11	1.26	2.04	1.68	3.66	3.28	5.67	4.16	2.40	4.54	4.18	5.93
4.70	3.37	2.94	2.04	1.57	2.99	4.52	3.49	5.68	3.56	2.59	3.54	3.05	4.64
4.20	3.14	2.04	4.38	2.99	1.41	3.21	3.42	5.92	4.65	2.75	3.27	4.77	6.79
6.39	5.57	4.35	3.75	4.63	3.29	1.77	2.52	4.59	4.40	2.97	5.71	6.39	8.21
6.94	5.74	4.64	3.36	3.58	3.50	2.52	1.77	3.31	2.62	1.75	3.94	4.61	6.43
9.23	7.96	7.01	5.67	5.68	5.92	4.45	3.23	1.82	3.23	4.00	4.43	5.44	7.01
7.49	6.15	5.54	4.16	3.56	4.65	4.29	2.55	3.23	1.49	2.65	2.02	2.94	4.59
6.11	4.81	3.83	2.46	2.66	2.82	2.97	1.75	4.10	2.71	1.54	1.74	1.81	3.40
7.51	6.18	5.75	4.54	3.54	5.27	5.57	3.84	4.43	2.02	3.56	1.70	1.76	3.34
7.00	5.67	5.26	4.18	3.05	4.99	6.23	4.50	5.44	2.94	4.13	1.76	1.36	2.54
8.52	7.18	6.79	5.93	4.64	6.79	8.00	6.28	7.01	4.59	5.91	3.31	2.54	1.92

erdeen	Minneapolis	Des Moines	Springfield	Fort Wayne	Jefferson City	Monroe	Birmingham	Orlando	Charlotte	Nashville	Richmond	Harrisburg	Boston
4.43	5.07	5.38	5.97	6.33	5.74	6.48	6.99	8.19	7.57	6.66	7.68	7.43	8.16
3.00	3.64	3.89	4.55	4.87	4.44	5.37	5.70	6.90	6.19	5.33	6.22	5.97	6.70
3.41	3.99	3.71	4.30	4.76	4.07	4.69	5.28	6.48	5.90	4.99	6.09	5.87	6.60
5.24	5.82	5.53	5.85	6.48	5.44	5.46	6.23	7.25	7.04	6.15	7.50	7.45	8.31
4.58	4.90	4.44	4.70	5.33	4.28	4.15	4.97	5.94	5.85	5.00	6.35	6.30	7.16
3.69	3.95	3.46	3.72	4.35	3.30	3.32	4.10	5.12	4.91	4.01	5.37	5.32	6.18
3.20	3.44	2.92	3.17	3.75	2.77	2.63	3.43	4.48	4.22	3.35	4.73	4.69	5.53
4.00	3.90	3.34	3.26	3.75	2.98	1.97	2.71	3.45	3.58	2.98	4.19	4.51	5.36
2.98	3.04	2.47	2.60	3.16	2.20	2.26	2.86	4.04	3.67	2.77	4.13	4.12	4.98
2.78	3.15	2.77	3.21	3.83	2.94	3.64	4.15	5.35	4.78	3.87	5.04	4.86	5.67
2.42	2.53	2.08	2.34	2.97	1.96	2.79	3.20	4.40	3.80	2.89	4.10	3.94	4.80
2.02	2.25	1.86	2.45	2.91	2.25	3.22	3.51	4.71	4.09	3.18	4.24	4.02	4.75
1.76	1.87	2.31	2.94	3.14	2.90	3.87	4.13	5.30	4.47	3.74	4.48	4.24	4.96
1.87	1.67	1.80	2.34	2.50	2.39	3.48	3.55	4.70	3.83	3.13	3.84	3.60	4.32
2.31	1.80	1.54	1.89	2.29	1.86	2.92	3.05	4.24	3.54	2.67	3.64	3.40	4.14
2.94	2.34	1.89	1.49	1.86	1.69	2.64	2.45	3.60	2.88	2.03	3.06	2.88	3.72
3.14	2.50	2.29	1.86	1.63	2.32	3.05	2.55	3.61	2.59	2.12	2.58	2.34	3.10
2.90	2.39	1.86	1.69	2.32	1.56	2.42	2.52	3.72	3.11	2.20	3.41	3.27	4.14
3.87	3.48	2.92	2.64	3.05	2.42	1.71	2.06	3.03	2.94	2.27	3.55	3.87	4.72
4.13	3.55	3.05	2.45	2.55	2.52	2.06	1.71	2.43	2.11	1.70	2.72	3.04	3.89
5.30	4.70	4.24	3.60	3.61	3.72	3.03	2.43	1.76	2.43	2.80	3.00	3.49	4.24
4.47	3.83	3.54	2.88	2.59	3.11	2.94	2.11	2.43	1.60	2.15	1.85	2.29	3.08
3.74	3.13	2.67	2.03	2.12	2.20	2.27	1.70	2.80	2.15	1.60	3.59	2.86	3.71
4.48	3.84	3.64	3.06	2.58	3.41	3.55	2.72	3.00	1.85	3.59	1.70	1.73	2.47
4.24	3.60	3.40	2.88	2.34	3.27	3.87	3.04	3.49	2.29	2.86	1.73	1.54	2.10
4	4.32	4.14	3.72	3.10	4.14	4.72	3.89	4.24	3.08	3.71	2.47	2.10	1.80

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TABLE D-1. Model 2: Feed grain supplies, optimum shipments of feed grain for uses other than feeding cattle in feedlots, opportunity shipping costs, and feed

Shipping Region	Feed Grain Supply	Destination													
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD	MN WI
(1) WA-OR	227,800	130,300	.89	1.05	.54	1.31	1.87	1.87	2.09	2.23	1.69	2.17	2.05	1.92	2.14
(2) MT-ID WY	535,400	535,400	.24	.34	.46	.96	1.14	1.14	1.33	1.49	.96	1.32	1.19	1.03	1.26
(3) UT-NV	65,600	65,600	.18	.18	.02	.51	.73	.73	.96	1.08	.59	1.11	1.01	1.11	1.33
(4) CA	398,100	.47	1.28	1.00	398,100	.58	1.18	1.35	1.62	1.78	1.71	2.00	2.06	2.38	2.39
(5) AZ	59,700	.81	1.35	1.06	.15	0.00	.77	.92	1.00	1.26	1.30	1.50	1.59	2.18	1.94
(6) NM	182,700	.62	.78	.53	110,724	.01	.01	.17	.36	.51	.42	.74	.86	1.44	.18
(7) W.TX-W.OK	1,323,112	.45	.61	.36	739,376	83,900	69,400	.05	239,232	.07	.25	.39	.66	1.02	.84
(8) E.TX	559,800	1.21	1.34	1.13	.81	.62	.73	.54	559,800	.56	1.01	.94	1.08	1.32	1.30
(9) E.OK	42,500	.82	.97	.72	.44	.35	.35	.08	.03	42,500	.60	.40	.55	1.02	.80
(10) CO	567,000	.05	.21	216,500	.14	.16	.03	.03	.25	.37	113,637	.33	.32	.87	.65
(11) KS	2,160,600	.36	.40	.35	.26	.19	.18	718,920	.01	453,177	.16	.11	.15	.42	.44
(12) NB	9,587,400	.09	.12	.09	.17	.13	.15	.12	168,868	110,703	183,263	1,166,400	1,179,600	.17	.19
(13) ND-SD	1,409,200	0.00	355,500	.24	.53	.76	.77	.52	.28	.51	.59	.30	.21	683,000	.07
(14) MN-WI	6,008,600	.19	.20	.43	.51	.49	.48	.31	.23	.26	.34	.30	.21	.04	3,552,600
(15) IA	8,341,500	.31	.29	.31	.36	.29	.28	.11	.03	.06	.21	.12	.08	.13	.05
(16) IL	6,088,200	.70	.70	.69	.66	.59	.58	.42	.18	.32	.58	.42	.48	.54	.40
(17) MI-IN-OH	5,950,800	.81	.82	.88	.88	.80	.80	.63	.36	.54	.78	.64	.65	.66	.48
(18) MO	748,500	.73	.78	.73	.61	.54	.42	.22	.09	.15	.43	.22	.35	.50	.41
(19) AR-LA	94,500	1.18	1.43	1.10	.83	.64	.75	.49	.04	.49	.99	.86	.98	1.20	1.10
(20) MS-AL-GA	595,300	1.26	1.31	1.26	1.08	.89	.99	.74	.29	.67	1.10	.93	1.06	1.18	1.06
(21) FL	78,700	2.03	2.04	1.99	1.74	1.59	1.61	1.44	.83	1.35	1.86	1.59	1.71	1.96	1.72
(22) NC-SC	771,500	1.72	1.49	1.72	1.58	1.39	1.50	1.24	.79	1.17	1.60	1.43	1.51	1.57	1.41
(23) KY-TN	846,500	1.21	1.25	1.30	1.19	.94	1.00	.73	.37	.66	1.08	.89	.96	1.05	.91
(24) VA-WV-MD-DE	621,400	1.78	1.75	1.79	1.82	1.57	1.63	1.36	.94	1.29	1.66	1.45	1.50	1.58	1.36
(25) PA	672,500	1.67	1.67	1.45	1.73	1.65	1.64	1.45	1.14	1.38	1.64	1.48	1.51	1.51	1.34
(26) NE (7 states)	364,600	1.81	1.82	1.95	1.96	1.89	1.88	1.73	1.43	1.62	1.85	1.72	1.73	1.65	1.48
Total	48,301,512	731,300	355,500	216,500	1,248,200	83,900	69,400	718,920	967,900	606,380	296,900	1,166,400	1,179,600	683,000	600

*Underscored figures are shipments (in 10,000 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

D SUPPLEMENTARY TABLES FOR MODELS 2–6

ain available for cattle feeding, by region

IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Feed Grain Available for Feeding
2.34	2.39	2.33	2.46	2.18	2.30	2.56	2.43	2.39	2.56	2.34	2.38	130,300	97,500
1.43	1.50	1.45	1.62	1.54	1.46	1.67	1.31	1.54	1.64	1.45	1.50	535,400	0
1.29	1.33	1.35	1.41	1.05	1.25	1.45	1.38	1.43	1.52	1.07	1.47	65,500	0
2.32	2.28	2.33	2.27	1.76	2.04	2.19	2.22	2.03	2.53	2.33	2.46	398,100	0
1.82	1.78	1.82	1.77	1.14	1.43	1.61	1.60	1.62	1.85	1.82	1.96	0	59,700
	1.02	1.07	.90	.50	.78	.88	.96	.93	1.16	1.06	1.20	110,724	71,976
.72	.69	.73	.53	.07	.36	.54	.53	.49	.72	.70	.88	1,131,909	191,203
1.18	.99	1.00	.94	.16	.45	.47	.62	.67	.84	.93	1.12	559,800	0
.68	.60	.65	.47	.08	.30	.46	.47	.43	.66	.64	.78	42,500	0
.60	.63	.66	.52	.35	.50	.74	.67	.62	.80	.67	.78	330,137	236,863
.34	.30	.35	.14	.05	.16	.30	.33	.26	.42	.34	.48	1,172,097	988,503
.15	.21	.21	.12	.02	.14	.27	.26	.18	.32	.22	.34	2,808,834	6,778,566
.24	.31	.26	.31	.28	.30	.56	.35	.31	.44	.26	.30	1,038,500	370,700
.13	.14	.05	.19	.15	.15	.30	.17	.14	.19	.06	.10	3,552,600	2,456,000
306,100	.01	952,629	1,745,300	842,600	0.00	.15	.07	.01	.12	.01	.13	7,346,629	994,871
.35	2,394,200	.05	.46	.02	2,157,600	.15	.07	1,309,900	.12	.04	.18	6,061,700	26,500
.51	.22	2,047,271	.36	.19	.07	.17	1,184,000	.08	1,568,365	.14	1,133,400	5,933,037	17,763
.30	.42	.15	.05	748,500	0.00	.15	.10	.03	.20	.13	.28	748,500	0
1.03	.71	.71	.73	94,500	.14	.23	.31	.36	.54	.62	.81	94,500	0
.99	.65	.55	.69	.10	230,600	348,100	.01	.14	.25	.32	.51	578,700	16,600
1.66	1.32	1.17	1.36	.71	.52	78,700	.35	.80	.54	.70	.86	78,700	0
1.39	1.05	.81	1.12	.60	.34	.16	771,500	.57	.11	.24	.40	771,500	0
.86	.51	.42	.58	.18	846,500	.14	.10	.11	.24	.32	.49	846,500	0
1.37	1.03	.73	1.15	.76	.51	.28	.04	.64	63,335	535,120	.16	598,455	22,945
1.37	1.06	.99	1.19	.95	.69	.55	.28	.83	.11	598,580	.12	598,580	73,920
1.59	1.30	.95	1.44	1.24	.98	.81	.52	1.10	.37	.22	364,600	364,600	0
	2,594,200	2,999,900	1,745,300	1,685,600	3,234,700	426,000	1,955,500	1,309,900	1,631,700	1,133,700	1,498,000	34,486,373	13,815,139

TABLE D-2. Model 2: Feeder cattle supplies, optimum feeding levels, opportunity shipping costs, surplus feeder cattle, feedlot capacity, and surplus feedlot

Shipping Region	Feeder Cattle Supply	Feeder Cattle Destination and Optimum Regional Feeding Levels*												
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
	Head													
(1) WA-OR	697,000	582,300	8.20	9.47	114,700	9.64	13.40	18.37	36.55	27.00	12.75	20.59	16.29	16.04
(2) MT-ID-WY	2,277,000	7.39	726,200	126,000	4.35	2.42	2.53	5.21	22.72	12.46	893,116	5.96	1.26	0.00
(3) UT-NV	428,000	15.34	6.61	4.40	4.78	311,416	115,400	5.18	22.03	13.22	1,184	7.76	3.85	9.16
(4) CA	245,000	21.26	27.28	20.17	245,000	5.71	13.69	19.25	36.15	28.52	21.85	27.69	27.63	33.08
(5) AZ	133,000	33.13	28.09	18.80	9.37	133,000	5.70	10.65	24.78	19.49	14.49	18.51	19.39	27.67
(6) NM	512,000	34.19	25.93	16.76	14.50	3.69	512,000	1.41	17.62	10.14	6.32	9.13	10.16	18.90
(7) W.TX-W.OK	1,473,054	37.62	28.02	21.25	18.82	8.30	1.50	1,473,054	12.59	4.40	5.99	4.63	5.58	.12
(8) E.TX	2,203,000	35.23	27.84	21.31	17.29	7.32	3.85	1,498,000	705,000	1.77	8.51	2.88	4.25	.44
(9) E.OK	1,378,946	33.59	25.14	19.98	16.92	8.41	3.29	1,365,780	7.42	.43	6.16	13,166	1.39	8.53
(10) CO	302,000	28.52	18.55	12.18	16.67	7.39	1.69	1.35	17.96	8.52	302,000	3.07	1.10	8.57
(11) KS	1,148,000	41.39	29.59	24.14	27.70	16.40	8.89	4.15	15.87	4.86	7.29	.60	1,148,000	8.98
(12) NB	1,075,000	39.25	26.37	21.78	29.54	19.06	11.51	6.65	19.79	8.61	6.53	1.14	1,075,000	5.54
(13) ND-SD	2,345,000	31.48	18.47	20.37	26.54	19.91	13.75	9.38	21.70	11.39	8.45	4.43	2,345,000	.39
(14) MN-WI	634,000	40.86	25.85	27.93	36.99	26.76	18.53	13.24	23.65	13.24	12.91	5.90	1.90	.75
(15) IA	1,277,000	43.25	28.87	25.97	33.45	22.54	14.89	9.61	19.29	9.59	10.82	3.64	.42	6.89
(16) IL	55,000	43.75	30.54	27.12	31.66	20.63	13.29	8.22	14.97	7.31	11.01	2.71	2.34	8.90
(17) MI-IN-OH	567,000	45.11	30.93	28.65	35.32	23.80	16.03	10.30	16.26	8.95	13.46	4.85	3.01	7.49
(18) MO	2,003,000	41.85	29.82	25.39	28.27	17.30	10.12	5.23	12.95	4.39	9.13	2,003,000	1.12	8.87
(19) AR-LA	1,201,000	37.23	28.55	22.72	19.25	9.22	4.72	1,201,000	1.23	1.03	8.80	2.14	3.65	10.44
(20) MS-AL-GA	1,637,000	37.25	26.84	22.60	20.78	10.53	5.30	.14	1.01	0.00	7.74	1,133,084	.87	7.65
(21) FL	557,000	50.36	38.69	34.03	31.69	19.77	14.12	8.54	6.25	8.86	18.01	9.32	10.55	17.76
(22) NC-SC	451,000	32.83	30.98	27.45	27.70	17.18	10.94	5.19	6.29	4.83	11.92	3.42	4.29	9.71
(23) KY-TN	1,544,000	38.90	27.77	23.97	23.98	14.12	7.84	2.46	5.70	2.07	8.80	.51	1.31	7.5
(24) VA-WV-MD-DE	853,000	47.76	34.42	32.07	35.23	24.30	17.16	11.44	13.00	10.29	16.44	7.60	7.54	11.97
(25) PA	0	56.16	40.64	38.34	45.28	32.64	24.03	17.44	21.64	15.70	21.60	11.51	11.06	15.61
(26) NE (7 states)	0	67.73	51.26	48.96	58.35	44.88	35.58	28.38	32.45	26.39	32.24	22.15	20.29	24.90
Total	24,996,000	582,300	726,200	126,000	359,700	444,415	627,400	5,537,834	705,000	0	1,196,300	3,149,250	4,568,000	0
Feedlot Capacity		582,300	726,200	126,000	1,876,600	1,166,000	627,400	5,537,834	705,000	108,566	1,196,300	3,149,250	5,210,650	2,045,800
Surplus Feedlot Capacity		0	0	0	1,516,900	721,584	0	0	0	108,566	0	0	642,650	,800

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

acity, by region

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Surplus Feeder Cattle
													Head	Head
22.91	24.57	34.84	39.37	31.64	41.91	49.11	61.72	57.44	46.08	57.11	54.57	68.34	697,000	0
6.52	7.34	17.59	21.42	15.69	26.69	31.87	43.26	38.89	28.85	37.80	35.51	48.61	1,745,316	531,684
15.52	11.76	21.68	26.89	18.62	27.34	34.99	46.89	43.32	32.50	43.69	41.50	54.98	428,000	0
39.72	35.76	43.48	50.42	38.65	42.00	51.66	62.44	62.08	50.93	65.00	64.30	79.28	245,000	0
31.57	26.47	33.39	30.81	28.84	30.92	40.33	49.79	50.59	40.59	53.47	52.81	67.06	133,000	0
22.17	16.95	23.76	30.06	19.36	22.75	31.56	41.30	41.15	30.98	43.61	42.96	57.06	512,000	0
	11.76	18.49	24.22	14.34	16.86	25.24	34.89	34.37	24.68	37.12	36.55	50.25	1,473,054	0
	7.24	11.50	15.69	8.74	5.59	12.70	18.72	21.08	14.49	23.64	25.35	37.66	2,203,000	0
10.13	5.35	10.88	15.47	7.40	10.94	17.18	25.83	25.07	17.71	26.61	26.30	38.66	1,378,946	0
12.66	8.44	16.56	22.57	13.48	22.16	28.72	39.43	36.46	26.56	37.22	35.60	48.95	302,000	0
11.20	5.99	13.04	19.60	8.80	19.12	35.30	36.85	33.23	22.55	34.46	32.84	47.37	1,148,000	0
8.77	4.00	14.05	19.24	11.32	23.03	28.17	40.20	36.15	25.23	36.26	34.05	47.54	1,075,000	0
2.47	4.72	14.51	17.22	13.14	24.15	28.72	39.52	34.37	25.63	33.15	30.94	43.74	2,345,000	0
0.00	634,000	9.88	12.60	9.42	23.10	26.27	38.61	31.78	22.25	30.65	28.05	41.99	634,000	0
3.62	1,277,000	7.85	12.57	6.58	19.09	22.75	34.56	29.89	19.50	29.50	27.18	40.58	1,277,000	0
5.03	55,000	1.38	5.69	2.04	13.22	14.19	25.15	20.62	10.69	20.85	19.14	33.13	55,000	0
3.09	35,519	.94	531,481	3.90	13.55	11.74	22.37	14.89	7.99	13.54	11.20	24.92	567,000	0
5.91	.20	3.52	9.87	1.49	11.85	15.12	26.42	22.94	12.58	24.13	22.70	36.86	2,003,000	0
9.10	4.08	6.96	10.80	4.56	3.03	7.86	15.60	16.55	9.32	19.33	21.15	33.77	1,201,000	0
4.82	88,416	.55	2.41	0.00	60,000	240,000	6.42	5.69	115,500	8.72	10.73	23.70	1,637,000	0
14.11	9.17	8.76	9.96	8.71	6.37	4.07	109,500	6.95	7.09	10.27	13.92	26.96	109,500	447,500
5.99	2.49	2.20	1.12	3.01	4.89	1.02	4.83	121,500	1.38	.64	3.74	16.80	121,500	329,500
4.64	1,544,000	0.00	1.84	.29	4.01	2.27	11.72	8.44	1.58	10.40	12.17	25.42	1,544,000	0
7.92	4.95	4.91	2.10	6.84	11.20	6.82	10.51	2.51	5.78	124,500	354,702	13.09	479,202	373,798
10.61	7.42	7.12	2.98	9.88	18.89	13.35	19.06	8.88	11.65	2.17	0.00	12.51	0	0
19.45	16.20	16.60	11.33	19.96	29.23	23.10	28.15	17.53	21.28	9.84	5.73	9.61	0	0
0	3,633,935	0	531,481	0	60,000	240,000	109,500	121,500	115,500	124,500	354,702	0	23,313,518	1,682,482
74,100	8,260,500	3,240,000	4,360,800	1,202,450	60,000	240,000	109,500	121,500	115,500	124,500	1,501,000	31,500	46,799,250	
	4,726,565	3,240,000	3,829,319	1,202,450	0	0	0	0	0	0	1,146,298	31,500	23,485,732	

TABLE D-3. Model 2: Optimum shipments of available feed grain for cattle feeding, opportunity shipping costs, and surplus feed grain, by region

Shipping Region	Destination* WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) Washington-Oregon	97,500	.89	1.05	.54	1.31	1.87	1.87	2.09	2.42	1.69	2.17	2.05	1.92
(5) Arizona	.81	1.35	1.06	.15	59,700	.77	.92	1.00	1.44	1.30	1.50	1.59	2.18
(6) New Mexico	.62	.78	.53	71,976	.01	.01	.17	.36	.70	.42	.74	.86	1.44
(7) West Texas-West Oklahoma	.45	.61	.36	.00	23,184	96,745	.05	71,275	.26	.25	.39	.66	1.02
(10) Colorado	.05	.21	24,280	.14	.16	.03	.03	.25	.55	212,582	.33	.32	.87
(11) Kansas	.36	.40	.35	.26	.19	.18	988,503	.01	.18	.16	.11	.15	.42
(12) Nebraska	.09	.12	.09	.17	.13	.15	.12	.00	.19	.00	599,617	888,933	.17
(13) North Dakota-South Dakota	20,358	135,001	.24	.53	.76	.77	.52	.28	.70	.59	.30	.21	.00
(14) Minnesota-Wisconsin	.19	.20	.43	.51	.49	.48	.31	.23	.44	.34	.30	.21	.04
(15) Iowa	.31	.29	.31	.36	.29	.28	.11	.03	.24	.21	.12	.08	.13
(16) Illinois	.70	.70	.69	.66	.59	.58	.42	.18	.50	.58	.42	.48	.54
(17) Michigan-Indiana-Ohio	.81	.82	.88	.88	.80	.80	.63	.36	.72	.78	.64	.65	.66
(20) Mississippi-Alabama-Georgia	1.26	1.31	1.26	1.08	.89	.99	.74	.29	.85	1.10	.93	1.06	1.18
(24) Virginia-West Virginia-Maryland-Delaware	1.78	1.75	1.79	1.82	1.57	1.63	1.36	.94	1.47	1.66	1.45	1.50	1.58
(25) Pennsylvania	1.67	1.67	1.45	1.73	1.65	1.64	1.45	1.14	1.56	1.64	1.48	1.51	1.51
Total	117,858	135,001	24,280	71,976	82,884	96,745	988,503	71,275	0	212,582	599,617	888,933	

*Underscored figures are shipments (in 10,000 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Surplus Feed Grain
.14	2.34	2.39	2.33	2.71	2.18	2.30	2.56	2.43	2.39	2.56	2.34	2.71	97,500	0
94	1.82	1.78	1.82	2.02	1.14	1.43	1.61	1.60	1.62	1.85	1.82	2.29	59,700	0
18	1.06	1.02	1.07	1.15	.50	.78	.88	.96	.93	1.16	1.06	1.53	71,976	0
84	.72	.69	.73	.78	.07	.36	.54	.53	.49	.72	.70	1.21	191,204	0
65	.60	.63	.66	.77	.35	.50	.74	.67	.62	.80	.67	1.11	236,862	0
44	.34	.30	.35	.39	.05	.16	.30	.33	.26	.42	.34	.81	988,503	0
19	.15	.21	.21	.37	.02	.14	.27	.26	.18	.32	.22	.67	1,488,550	5,290,016
07	.24	.31	.26	.56	.28	.30	.56	.35	.31	.44	.26	.63	155,359	215,342
00	.13	.14	.05	.44	.15	.15	.30	.17	.14	.19	.06	.43	0	2,456,000
05	700,259	.01	102,842	.25	7,920	23,031	.15	.07	.01	.12	.01	.46	834,052	160,820
40	.35	.00	.05	.71	.02	10,041	.15	.07	16,459	.12	.04	.51	26,500	0
48	.51	.22	.00	.61	.19	.07	.17	17,763	.08	.00	.14	.33	17,763	0
06	.99	.65	.55	.94	.10	.00	16,600	.01	.14	.25	.32	.84	16,600	0
36	1.37	1.03	.74	1.40	.76	.51	.28	.04	.64	22,945	.00	.49	22,945	0
34	1.37	1.06	.99	1.44	.95	.69	.55	.28	.83	.11	73,920	.45	73,920	0
	700,259	0	102,842	0	7,920	33,072	16,600	17,763	16,459	22,945	73,920	0	4,281,434	8,122,178

TABLE D-4. Model 2: Optimum shipments of fed slaughter cattle (dressed weight equivalent) for slaughter, opportunity shipping costs, slaughter capacity, and

Shipping Region	Destination* WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) WA-OR	4,210,029	2.74	2.99	1.62	4.87	6.25	6.98	9.37	8.24	6.07	7.82	6.97	6.22
(2) MT-ID-WY	.90	3,917,060	984,790	2.07	2.71	3.25	3.57	6.13	4.61	2.54	4.05	3.04	2.02
(3) UT-NV	1.68	.53	875,700	.96	.93	1.48	2.33	4.60	3.53	1.41	3.26	2.47	3.08
(4) CA	3.14	5.42	3.78	2,579,049	2.37	4.74	5.61	7.76	7.04	6.53	7.86	7.96	3.57
(5) AZ	5.21	4.89	2.58	1.20	3,004,250	1.94	2.81	4.52	4.24	4.05	5.06	5.43	6.81
(6) NM	5.07	3.91	1.61	2.05	.42	3,470,280	526,258	2.27	1.43	1.52	2.25	2.68	4.19
(7) W.TX-W.OK	6.56	4.99	3.22	2.68	2.05	.76	36,162,056	1.52	.39	1.83	1.51	1.93	3.46
(8) E.TX	10.08	8.63	6.53	6.91	4.77	4.01	2.37	.00	1.86	5.32	3.51	4.26	5.81
(10) CO	3.94	2.25	.59	2.89	1.58	.57	.12	2.62	1.19	7,775,950	.85	.50	1.76
(11) KS	6.45	4.52	3.20	4.98	3.35	2.06	.56	1.61	1,350,095	1.61	19,084,883	1,231,862	1.51
(12) NB	5.73	3.64	2.54	5.21	3.85	2.62	1.11	2.46	.85	1.39	.13	28,641,148	.64
(15) IA	7.71	5.22	4.52	7.24	5.69	5.40	2.78	3.33	2.04	3.37	1.67	1.05	1.92
(17) MI-IN-OH	10.93	8.51	7.95	10.40	8.79	7.49	5.75	5.39	4.72	6.80	4.78	4.49	4.88
(19) AR-LA	11.90	10.13	8.34	8.84	6.82	5.81	3.96	2.10	3.24	6.90	4.85	5.59	6.91
(20) MS-AL-GA	13.73	11.58	10.36	11.25	9.34	8.22	6.31	4.43	5.29	8.75	6.48	6.97	8.21
(21) FL	16.73	14.64	13.45	13.91	11.96	11.00	9.19	6.71	8.47	11.90	9.68	10.15	11.32
(22) NC-SC	15.59	13.33	12.41	13.64	11.94	10.73	8.81	7.11	7.85	10.87	8.58	9.01	9.74
(23) KY-TN	13.17	10.94	9.89	11.22	9.54	8.19	6.29	5.16	5.25	8.30	5.96	6.41	7.53
(24) VA-WV-MD-DE	15.28	12.86	12.27	14.07	12.46	8.16	9.34	7.90	8.28	10.87	8.67	8.80	9.23
(25) PA	14.92	12.50	11.96	14.11	12.50	11.20	9.41	8.70	8.40	10.66	8.50	8.50	8.87
Total	4,210,029	3,917,060	1,860,490	2,579,049	3,004,250	3,470,280	36,688,314	0	1,350,095	7,775,950	19,084,883	29,873,010	0
Slaughter Capacity	5,974,680	6,453,783	1,860,490	17,415,500	3,004,250	3,470,280	42,872,037	11,012,494	1,350,095	16,590,280	19,084,883	36,082,588	6,684,000
Surplus Slaughter Capacity	1,764,651	2,536,723	0	14,836,451	0	0	6,183,724	11,012,494	0	8,814,330	0	6,209,578	4,000

*Underscored figures are shipments (100 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimal solution.

rplus slaughter capacity, by region

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped
6.70	7.90	8.46	8.43	8.39	9.07	8.54	10.17	9.03	8.52	9.83	9.25	9.59	4,210,029
2.50	3.57	4.26	4.17	4.45	5.52	4.61	6.24	4.93	4.51	5.57	5.99	5.32	4,901,850
[illegible]	3.40	3.95	4.14	3.89	4.31	3.95	5.58	4.53	4.02	5.51	4.98	5.33	875,700
	8.88	8.87	9.41	8.41	7.58	7.60	8.86	8.59	8.09	10.13	9.95	10.58	2,579,049
6.62	6.22	6.08	6.62	5.62	4.46	4.59	5.74	5.70	5.31	7.34	7.16	7.78	3,004,250
3.86	3.41	3.27	3.81	2.81	1.98	2.00	3.26	2.98	2.50	4.53	4.35	4.97	3,996,538
3.09	2.55	2.39	2.83	1.97	1.01	1.02	2.21	1.83	1.52	3.47	3.32	3.91	36,162,056
4.74	4.07	3.23	3.50	3.05	.00	3,426,300	.72	1.15	1.24	3.05	3.65	4.29	3,426,300
1.66	1.43	1.66	2.17	1.52	2.10	1.58	3.21	2.18	1.66	3.29	2.86	3.36	7,778,950
.90	.49	.37	.88	.00	.84	.12	1.75	.65	.14	1.85	1.46	2.08	21,666,840
.26	3,334,852	.55	.75	.56	1.69	.72	2.35	1.21	.69	2.11	1.59	1.93	31,976,000
.00	25,255,848	.06	.12	.41	1.74	.42	2.04	.73	.31	1.52	.96	1.31	25,255,848
2.69	2.81	1.23	.00	2.60	3.25	.63	1.95	632,290	.40	.56	3,072,133	.41	3,704,423
5.23	4.56	3.28	3.39	3.24	.84	336,600	1.20	1.17	1.12	3.06	3.67	4.31	336,600
6.12	5.60	3.64	3.09	4.20	2.34	1,394,400	.67	.14	.65	2.04	2.64	3.28	1,394,400
9.19	8.79	6.77	6.01	7.44	5.09	2.28	687,660	1.57	3.72	3.35	4.28	4.68	687,660
7.54	7.48	5.42	4.06	6.33	5.09	1.76	1.57	741,150	2.53	1.11	1.96	2.43	741,150
5.37	4.94	2.89	2.33	3.67	2.94	.13	1.61	.39	.59	.00	689,535	.41	689,535
7.04	7.16	5.27	3.51	6.42	5.84	2.52	2.24	834,150	2.91	.26	.25	.65	834,150
6.68	6.82	5.06	3.17	6.29	6.65	3.33	3.40	1.07	3.63	.47	2,628,342	.00	2,628,342
0	28,590,700	0	0	0	0	5,157,300	687,660	2,207,590	0	0	6,390,010	0	156,846,670
080,800	28,590,700	9,324,260	14,606,450	6,168,244	2,633,980	8,209,975	3,525,800	2,207,590	6,746,600	2,214,300	6,390,010	4,718,960	286,273,030
[illegible]	0	9,324,260	14,606,450	6,168,244	2,633,980	3,052,675	2,838,140	0	6,746,600	2,214,300	0	4,718,960	129,426,360

TABLE D-5. Model 2: Optimum shipments of dressed fed-beef carcasses and opportunity shipping costs, by region

Shipping Region	Destination* WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) WA-OR	4,210,029	1.74	1.96	.21	2.54	3.82	4.54	4.99	4.97	3.72	4.22	3.91	3.21
(2) MT-ID-WY	713,731	1,466,780	.11	1,736,549	1.08	1.96	2.48	3.01	2.81	1.61	1.98	1.60	.77
(3) UT-NV	.90	.79	.64	1,860,490	.76	1.64	2.42	2.81	2.82	1.60	2.14	1.86	1.81
(4) CA	2.06	3.59	2.91	2,579,049	1.91	3.66	4.44	4.78	4.96	4.51	4.80	4.95	4.90
(5) AZ	2.48	2.76	1.76	3,004,250	.20	1.75	2.53	2.66	3.05	2.75	2.89	3.17	3.48
(6) NM	2.01	1.89	.89	1,770,050	1,700,230	.41	.78	1.17	1.29	1.13	1.14	1.44	1.82
(7) W.TX-W.OK	1.95	1.63	.89	4,566,542	.00	763,550	2,073,320	7,812,090	1,726,860	.50	518,977	.31	.69
(9) E.OK	3.04	2.62	1.95	1.18	1.18	1.17	.66	.25	.23	1.51	.23	.67	1.05
(10) CO	1.06	.69	1,413,310	3,212,400	.15	.28	.43	.94	.78	2,077,160	.06	1,073,080	.25
(11) KS	2.61	2.11	1.59	1.34	1.34	1.34	.98	.80	.55	1.11	446,313	.10	.48
(12) NB	2.20	1.63	1.21	1.39	1.52	1.54	1.19	1.14	.89	.95	807,300	.04	808,870
(15) IA	3.44	2.68	2.45	2.62	2.68	2.68	2.28	1.85	1.75	2.18	1.03	.83	.90
(20) MS-AL-GA	6.00	5.44	4.97	4.27	4.16	4.27	3.62	2.17	3.09	4.51	3.10	3.43	3.67
(21) FL	7.87	7.31	6.84	5.96	5.80	5.96	5.46	3.58	4.94	6.38	4.97	5.30	5.51
(22) NC-SC	7.35	6.70	6.36	5.85	5.81	5.85	5.30	3.81	4.67	5.91	4.47	4.78	4.78
(25) PA	7.53	6.80	6.65	6.58	6.58	6.58	6.09	5.06	5.44	6.31	4.93	5.03	4.87
Total	4,923,760	1,466,780	1,413,310	18,729,330	1,700,230	763,550	2,073,320	7,812,090	1,726,860	2,077,160	1,772,590	1,073,080	870

*Underscored figures are shipments (100 pounds). Other figures are opportunity costs (in dollars per hundredweight) which result from not having an activity in the optimum solution.

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped
3.62	4.32	4.35	4.23	4.50	5.09	4.85	5.00	4.70	4.60	4.30	4.22	4.21	4,210,029
1.18	1.82	1.92	1.76	2.19	2.97	2.55	2.70	2.31	2.26	1.83	1.75	1.74	3,917,060
2.16	2.27	2.30	2.28	2.45	2.92	2.76	2.91	2.65	2.55	2.33	2.28	2.27	1,860,490
5.25	5.35	5.11	5.26	5.08	4.95	4.97	4.94	5.05	4.97	5.00	5.12	5.24	2,579,049
3.57	3.50	3.20	3.35	3.16	2.88	2.95	2.87	3.10	3.06	3.09	3.21	3.33	3,004,250
1.85	1.75	1.45	1.60	1.41	1.28	1.31	1.28	1.39	1.30	1.34	1.46	1.58	3,470,280
.70	.57	.26	.36	.24	3,756,280	6,611,390	5,434,590	.06	3,424,715	.06	.19	.29	36,688,314
.88	.70	.27	.35	.25	.16	.01	.14	.09	1,350,095	.04	.20	.32	1,350,095
.39	.40	.28	.42	.39	.94	.70	.85	.60	.50	.35	.34	.41	7,775,950
.36	.30	9,103,950	.15	3,301,720	.68	.34	.49	.21	.11	6,232,900	.01	.13	19,084,883
209,160	2,069,600	.03	.01	.21	1.03	.57	.72	.42	.32	.06	.01	19,978,080	29,873,010
.16	.29	.08	18,598,620	.43	1.34	.72	.86	.48	.42	.07	8,257,220	1,734,860	28,590,700
2.86	2.75	1.59	1.21	2.04	1.43	.33	857,760	5,071,540	.40	.10	.59	.70	5,157,300
4.68	4.61	3.41	2.94	3.91	3.07	1.72	687,660	.99	2.17	1.05	1.71	1.72	687,660
3.91	4.01	2.79	2.02	3.40	3.08	1.50	.77	.26	1.62	2,207,590	.61	.66	2,207,590
4.00	4.19	3.11	2.09	3.88	4.33	2.75	2.15	1.27	2.65	.20	.18	6,390,010	6,390,010
2	2,069,600	9,103,950	18,598,620	3,301,720	3,756,280	6,611,390	6,208,010	5,071,540	4,774,810	8,440,490	8,257,220	28,102,950	156,846,670

TABLE D-6. Model 3: Feeder cattle supplies, optimum feeding levels, surplus feeder cattle, feedlot capacity, and surplus feedlot capacity, by region

Shipping Region	Feeder Cattle Supply	Feeder Cattle Destinations and Optimum Regional Feeding Levels												
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
	Head													
(1) WA-OR	697,000	582,300												
(2) MT-ID-WY	2,277,000		726,200	126,000							893,116			
(3) UT-NV	428,000					311,416	115,400				1,184			
(4) CA	245,000				245,000									
(5) AZ	133,000					133,000								
(6) NM	512,000						512,000							
(7) W.TX-W.OK	1,473,054							1,473,054						
(8) E.TX	2,203,000							1,498,000	705,000					
(9) E.OK	1,378,946							1,365,780				13,166		
(10) CO	302,000										302,000			
(11) KS	1,148,000												1,148,000	
(12) NB	1,075,000												1,075,000	
(13) ND-SD	2,345,000												2,345,000	
(14) MN-WI	634,000													
(15) IA	1,277,000													
(16) IL	55,000													
(17) MI-IN-OH	567,000													
(18) MO	2,003,000											2,003,000		
(19) AR-LA	1,201,000							1,201,000						
(20) MS-AL-GA	1,637,000											1,133,084		
(21) FL	557,000													
(22) NC-SC	451,000													
(23) KY-TN	1,544,000													
(24) VA-WV-MD-DE	853,000													
Total	24,996,000	582,300	726,200	126,000	245,000	444,416	627,400	5,537,834	705,000	0	1,196,300	3,149,250	4,568,000	0
Feedlot Capacity		582,300	726,200	126,000	1,876,600	1,166,000	627,400	5,537,834	705,000	108,566	1,196,300	3,149,250	5,210,650	,800
Surplus Feedlot Capacity		0	0	0	1,631,600	721,584	0	0	0	108,566	0	0	642,650	2,045,800

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Surplus Feeder Cattle
													Head	Head
													582,300	114,700
													1,745,316	531,684
													428,000	0
													245,000	0
													133,000	0
													512,000	0
													1,473,054	0
													2,203,000	0
													1,378,946	0
													302,000	0
													1,148,000	0
													1,075,000	0
													2,345,000	0
	634,000												634,000	0
	1,277,000												1,277,000	0
	55,000												55,000	0
	153,850		413,150										567,000	0
													2,003,000	0
													1,201,000	0
	88,416				60,000	240,000			115,500				1,637,000	0
							109,500						109,500	447,500
								121,500					121,500	329,500
	1,544,000												1,544,000	0
										124,500	466,006		590,506	262,494
0	3,752,266	0	413,150	0	60,000	240,000	109,500	121,500	115,500	124,500	466,006	0	23,310,122	1,685,878
7	8,360,500	3,240,000	4,360,800	1,202,450	60,000	240,000	109,500	121,500	115,500	124,500	1,501,000	31,500	46,799,250	
74,100	4,608,234	3,240,000	3,947,650	1,202,450	0	0	0	0	0	0	1,034,994	31,500	23,489,128	

TABLE D-7. Model 4: Feeder cattle supplies, optimum feeding levels, surplus feeder cattle, feedlot capacity, and surplus feedlot capacity, by region

Shipping Region	Feeder Cattle Supply	Feeder Cattle Destinations and Optimum Regional Feeding Levels												
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
	Head													
(1) WA-OR	697,000	582,300			114,700									
(2) MT-ID-WY	2,277,000		726,200	126,000							1,196,300		228,500	
(3) UT-NV	428,000					311,416	116,584							
(4) CA	245,000				245,000									
(5) AZ	133,000					133,000								
(6) NM	512,000						510,816	1,184						
(7) W.TX-W.OK	1,473,054							1,473,054						
(8) E.TX	2,203,000							1,873,967	329,033					
(9) E.OK	1,378,946							1,272,796				106,150		
(10) CO	302,000							75,132					226,868	
(11) KS	1,148,000												1,148,000	
(12) NB	1,075,000												1,075,000	
(13) ND-SD	2,345,000												2,345,000	
(14) MN-WI	634,000													
(15) IA	1,277,000													
(16) IL	55,000													
(17) MI-IN-OH	567,000													
(18) MO	2,003,000											2,003,000		
(19) AR-LA	1,201,000							841,700						
(20) MS-AL-GA	1,637,000											1,040,100		
(21) FL	557,000								140,400					
(22) NC-SC	451,000													
(23) KY-TN	1,544,000													
(24) VA-WV-MD-DE	853,000													
Total	24,996,000	582,300	726,200	126,000	359,700	444,416	627,400	5,537,834	469,433	0	1,196,300	3,149,250	5,023,368	0
Feedlot Capacity		582,300	726,200	126,000	1,876,600	1,166,000	627,400	5,537,834	705,000	108,566	1,196,300	3,149,250	5,210,650	[illegible],800
Surplus Feedlot Capacity		0	0	0	1,516,900	721,584	0	0	235,567	108,566	0	0	187,282	2,045,800

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Surplus Feeder Cattle
													Head	Head
													697,000	0
													2,277,000	0
													428,000	0
													245,000	0
													133,000	0
													512,000	0
													1,473,054	0
													2,203,000	0
													1,378,946	0
													302,000	0
													1,148,000	0
													1,075,000	0
													2,345,000	0
	634,000												634,000	0
	1,277,000												1,277,000	0
	55,000												55,000	0
	293,219		273,781										567,000	0
													2,003,000	0
													841,700	0
					60,000				45,800				1,145,900	0
						240,000	109,500						489,900	0
								121,500	69,700	124,500			315,700	0
	1,080,800												1,080,800	0
											597,000		597,000	0
0	3,340,019	0	273,781	0	60,000	240,000	109,500	121,500	115,500	124,500	597,000	0	23,224,001	0
'4	8,360,500	3,240,000	4,360,800	1,202,450	60,000	240,000	109,500	121,500	115,500	124,500	1,501,000	31,500	46,799,250	
'4,100	5,020,481	3,240,000	4,087,019	1,202,450	0	0	0	0	0	0	904,000	31,500	23,575,249	

TABLE D-8. Index of meat packing plant hourly wages and slaughter costs in dollars per hundredweight, by region, 1980

Region	Index of Meat Packing Plant Hourly Wages*	Adjusted Variable Slaughter Cost†	Fixed Slaughter Cost‡	Total Adjusted Slaughter Costs§	Region	Index of Meat Packing Plant Hourly Wages*	Adjusted Variable Slaughter Cost†	Fixed Slaughter Cost‡	Total Adjusted Slaughter Costs§
(1) WA-OR	1.08	$4.19	$.43	$4.62	(14) MN-WI	1.26	4.89	.43	5.32
(2) MT-ID-WY	.97	3.76	.45	4.21	(15) IA	1.27	4.93	.46	5.39
(3) UT-NV	.76	2.95	.44	3.39	(16) IL	1.09	4.23	.47	4.70
(4) CA	1.12	4.35	.43	4.78	(17) MI-IN-OH	.97	3.76	.47	4.23
(5) AZ	1.03	4.00	.45	4.45	(18) MO	1.01	3.92	.47	4.39
(6) NM	.92	3.57	.47	4.04	(19) AR-LA	.74	2.87	.55	3.42
(7) W.TX-W.OK	.82	3.18	.45	3.63	(20) MS-AL-GA	.68	2.64	.49	3.13
(8) E.TX	.78	3.03	.62	3.65	(21) FL	.66	2.56	.50	3.06
(9) E.OK	.78	3.03	.46	3.49	(22) NC-SC	.70	2.72	.48	3.20
(10) CO	1.01	3.92	.47	4.39	(23) KY-TN	.84	3.26	.51	3.77
(11) KS	.94	3.65	.45	4.10	(24) VA-WV-MD-DE	.82	3.19	.45	3.64
(12) NB	1.05	4.07	.44	4.51	(25) PA	.88	3.41	.43	3.84
(13) ND-SD	1.23	4.77	.48	5.25	(26) NE (7 states)	.92	3.57	.41	3.98

*1977 Census of Manufacturers, Volume II, Industry Statistics, U.S. Department of Commerce, Bureau of Census.

†Average U.S. variable slaughter cost ($3.88/cwt from Table 8). Multiplied by the regional Index of Meat Packing Plant Hourly Wages.

‡Derived from Table 8.

§Adjusted variable slaughter cost plus fixed slaughter cost.

TABLE D-9. Model 5: Feeder cattle supplies, optimum feeding levels, and surplus feeder cattle, assuming a 50 percent increase in slaughter wages

Shipping Region	Feeder Cattle Supply	Feeder Cattle Destinations and Optimum Regional Feeding Levels												
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
	Head													
(1) WA-OR	697,000	582,300												
(2) MT-ID-WY	2,277,000		584,513	126,000							623,496			
(3) UT-NV	428,000					311,416	7,642				108,942			
(4) CA	245,000				245,000									
(5) AZ	133,000					133,000								
(6) NM	512,000						512,000							
(7) W.TX-W.OK	1,473,054						107,758	1,365,296						
(8) E.TX	2,203,000							1,498,000	705,000					
(9) E.OK	1,378,946							1,378,946						
(10) CO	302,000										302,000			
(11) KS	1,148,000											431,942	716,058	
(12) NB	1,075,000												1,075,000	
(13) ND-SD	2,345,000												2,345,000	
(14) MN-WI	634,000													
(15) IA	1,277,000												1,074,592	
(16) IL	55,000													
(17) MI-IN-OH	567,000													
(18) MO	2,003,000											2,003,000		
(19) AR-LA	1,201,000							1,201,000						
(20) MS-AL-GA	1,637,000							94,592		108,566		714,308		
(21) FL	557,000													
(22) NC-SC	451,000													
(23) KY-TN	1,544,000													
(24) VA-WV-MD-DE	853,000													
Total	24,996,000	582,300	584,513	126,000	245,000	444,416	627,400	5,537,834	705,000	108,566	1,034,438	3,149,250	5,210,650	0
Feedlot Capacity		582,300	726,200	126,000	1,876,600	1,166,000	627,400	5,537,834	705,000	108,566	1,196,300	3,149,250	5,210,650	2,345,800
Surplus Feedlot Capacity		0	141,687	0	1,631,600	721,584	0	0	0	0	161,862	0	0	2,345,800

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Surplus Feeder Cattle
													Head	Head
													582,300	114,700
													1,334,003	942,991
													428,000	0
													245,000	0
													133,000	0
													512,000	0
													1,473,054	0
													2,203,000	0
													1,378,946	0
													302,000	0
													1,148,000	0
													1,075,000	0
													2,345,000	0
	634,000												634,000	0
	202,408												1,277,000	0
	55,000												55,000	0
			567,000										567,000	0
													2,003,000	0
													1,201,000	0
			304,034		60,000	240,000			115,500				1,637,000	0
							109,500						109,500	447,500
								121,500		124,500			246,000	205,000
			1,544,000										1,544,000	0
											853,000		853,000	0
0	891,408	0	2,415,034	0	60,000	240,000	109,500	121,500	115,500	124,500	853,000	0	23,285,809	1,710,191
74	8,360,500	3,240,000	4,360,800	1,202,450	60,000	240,000	109,500	121,500	115,500	124,500	1,501,000	31,500	46,799,250	
74,1	7,469,092	3,240,000	1,945,766	1,202,450	0	0	0	0	0	0	648,000	31,500	23,513,441	

TABLE D-10. Model 5: Optimum shipments of fed slaughter cattle (dressed weight equivalent) for slaughter, slaughter capacity, and surplus slaughter

Shipping Region	Regional Destinations												
	WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) WA-OR	4,210,029												
(2) MT-ID-WY		2,960,674	984,790										
(3) UT-NV			875,700										
(4) CA				1,756,650									
(5) AZ					3,004,250								
(6) NM						3,470,280	526,258						
(7) W.TX-W.OK							36,162,060						
(8) E.TX								1,364,463					
(9) E.OK													
(10) CO										6,723,853			
(11) KS									1,350,095		13,864,810		
(12) NB											1,681,810	34,792,230	
(15) IA													
(17) MI-IN-OH													
(19) AR-LA													
(20) MS-AL-GA													
(21) FL													
(22) NC-SC													
(23) KY-TN													
(24) VA-WV-MD-DE													
(25) PA													
Total	4,210,029	2,960,674	1,860,490	1,756,650	3,004,250	3,470,280	36,688,318	1,364,463	1,350,095	6,723,853	15,546,620	34,792,730	0
Slaughter Capacity	5,974,680	6,453,783	1,860,490	17,415,500	3,004,250	3,470,280	42,873,038	11,012,494	1,350,095	16,590,280	19,084,883	36,082,588	6,684,000
Surplus Slaughter Capacity	1,764,651	3,493,109	0	15,658,850	0	0	6,183,720	9,648,031	0	9,866,427	3,538,263	1,289,858	6,684,000

pacity, assuming a 50 percent increase in slaughter wages, 1980

MN W	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped
													4,210,029
													3,945,464
													875,700
													1,756,650
													3,004,250
													3,996,538
													36,162,060
					2,061,837								3,426,300
					572,143								572,143
													6,723,853
				6,168,244		283,688							21,666,837
													36,474,540
						6,195,287							6,195,287
			14,606,450					1,466,440			759,895		16,832,785
						336,600							336,600
						1,394,400							1,394,400
							687,600						687,660
								741,150					741,150
										689,535			689,535
										834,150			834,150
										690,615	5,620,115		6,320,730
0	0	0	14,606,450	6,168,244	2,633,980	8,209,975	687,660	2,207,590	0	2,214,300	6,390,010	0	156,846,661
080,800	28,590,700	9,324,260	14,606,450	6,168,244	2,633,980	8,209,075	3,525,800	2,207,590	6,746,600	2,214,300	6,390,010	4,718,960	286,273,030
080,800	28,590,700	9,324,260	0	0	0	0	2,838,140	0	6,746,600	0	0	4,718,960	129,426,369

TABLE D-11. Model 6: Feeder cattle supplies, optimum feeding levels, and surplus feeder cattle, assuming a 50 percent increase in slaughter wages and

Shipping Region	Feeder Cattle Supply	Feeder Cattle Destinations and Optimum Regional Feeding Levels												
		WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
	Head													
(1) WA-OR	697,000	582,300												
(2) MT-ID-WY	2,277,000		468,933	126,000							518,257			
(3) UT-NV	428,000					311,416	32,785				83,799			
(4) CA	245,000				245,000									
(5) AZ	133,000					133,000								
(6) NM	512,000						512,000							
(7) W.TX-W.OK	1,473,054							1,473,054						
(8) E.TX	2,203,000							1,498,000	705,000					
(9) E.OK	1,378,946							1,365,780				13,166		
(10) CO	302,000										302,000			
(11) KS	1,148,000											1,133,084	14,016	
(12) NB	1,075,000												1,075,000	
(13) ND-SD	2,345,000												2,345,000	
(14) MN-WI	634,000													
(15) IA	1,277,000													
(16) IL	55,000													
(17) MI-IN-OH	567,000													
(18) MO	2,003,000											2,003,000		
(19) AR-LA	1,201,000							1,201,000						
(20) MS-AL-GA	1,637,000													
(21) FL	557,000													
(22) NC-SC	451,000													
(23) KY-TN	1,544,000													
(24) VA-WV-MD-DE	853,000													
Total	24,966,000	582,300	468,933	126,000	245,000	444,416	544,785	5,537,834	705,000	0	904,056	3,149,250	3,434,916	0
Feedlot Capacity		582,300	726,200	126,000	1,876,600	1,166,000	627,400	5,537,834	705,000	108,566	1,196,300	3,149,250	5,210,650	2,045,000
Surplus Feedlot Capacity		0	257,267	0	1,631,600	721,584	82,615	0	0	108,566	292,244	0	1,775,734	5,000

*Increases in transportation costs apply to feed grains, feeder cattle, fed cattle, and fed beef.

nsportation costs*

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped	Surplus Feeder Cattle
													Head	Head
													582,300	114,700
													1,113,190	1,163,810
													428,000	0
													245,000	0
													133,000	0
													512,000	0
													1,473,054	0
													2,203,000	0
													1,378,946	0
													302,000	0
													1,148,000	0
													1,075,000	0
													2,345,000	0
	634,000												634,000	0
	1,277,000												1,277,000	0
		55,000											55,000	0
			567,000										567,000	0
													2,003,000	0
													1,201,000	0
		1,026,490	195,010		60,000	240,000			115,500				1,637,000	0
							109,500						109,500	447,500
								121,500		124,500	205,000		451,000	0
			1,544,000										1,544,000	0
											853,000		853,000	0
0	1,911,000	1,081,490	2,306,010	0	60,000	240,000	109,500	121,500	115,500	124,000	1,058,000	0	23,269,990	1,726,010
74,100	8,360,500	3,240,000	4,360,000	1,202,450	60,000	240,000	109,000	121,500	115,500	124,000	1,501,000	31,500	46,799,250	
74	6,449,500	2,158,510	2,054,790	1,202,450	0	0	0	0	0	0	443,000	31,500	23,529,260	

TABLE D-12. Model 6: Optimum shipment of fed slaughter cattle (dressed weight equivalent) for slaughter, slaughter capacity, and surplus slaughter capacity,

Shipping Region	Regional Destinations												
	WA OR	MT ID WY	UT NV	CA	AZ	NM	W.TX W.OK	E.TX	E.OK	CO	KS	NB	ND SD
(1) WA-OR	4,210,029												
(2) MT-ID-WY		2,180,511	984,790										
(3) UT-NV			875,700										
(4) CA				1,756,650									
(5) AZ					3,004,250								
(6) NM						3,470,280							
(7) W.TX-W.OK							36,162,060						
(8) E.TX								3,426,300					
(10) CO										5,876,365			
(11) KS									1,350,095		19,084,880	782,811	
(12) NB												24,044,410	
(15) IA													
(16) IL													
(17) MI-IN-OH													
(19) AR-LA													
(20) MS-AL-GA													
(21) FL													
(22) NC-SC													
(23) KY-TN													
(24) VA-WV-MD-DE													
(25) PA													
Total	4,210,029	2,180,511	1,860,490	1,756,650	3,004,250	3,470,280	36,162,060	3,426,095	1,350,095	5,876,365	19,084,880	24,827,221	0
Slaughter Capacity	5,074,680	6,543,783	1,860,490	17,415,500	3,004,250	3,470,280	42,872,038	11,012,494	1,350,095	16,590,280	19,084,883	36,082,588	6,684,000
Surplus Slaughter Capacity	1,764,651	4,273,272	0	15,658,850	0	0	6,709,978	7,586,194	0	10,713,015	3	11,255,367	4,000

*Increases in transportation costs apply to feed grains, feeder cattle, fed cattle, and fed beef. Beef shipments are in hundredweights.

uming a combined 50 percent increase in slaughter wages and transportation costs, 1980*

MN WI	IA	IL	MI IN OH	MO	AR LA	MS AL GA	FL	NC SC	KY TN	VA WV MD DE	PA	North-east	Total Shipped
													4,210,029
													3,165,301
													875,700
													1,756,650
													3,004,250
													3,470,280
													36,162,060
													3,426,300
													5,876,365
				449,051									21,666,837
													24,044,410
		7,562,257		5,719,193									13,281,450
		1,762,003							5,548,869				7,310,872
			14,606,450					1,466,440					16,072,890
						336,600							336,600
						1,394,400							1,394,400
							687,660						687,660
								741,150					741,150
						689,535							689,535
										834,150			834,150
										1,380,150	6,390,010	69,620	7,839,780
0	0	9,324,260	14,606,450	6,168,244	0	2,420,535	687,660	2,207,590	5,548,869	2,214,300	6,390,010	69,620	156,846,669
30,800	28,590,700	9,324,260	14,606,450	6,168,244	2,633,980	8,209,975	3,525,800	2,207,590	6,746,600	2,214,300	6,390,010	4,718,960	286,273,030
30	28,590,700	0	0	0	2,633,980	5,789,440	2,838,140	0	1,197,731	0	0	4,640,340	129,426,361

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