THE EFFECT OF INCREASING TRANSPORTATION COSTS ON FLORIDA'S CATTLE FEEDING INDUSTRY: AN EXTENSION APPLICATION

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Rapid fuel price increases in 1979 and early 1980, along with concern about further rises, have led to speculation that Florida, a net calf exporter but net importer of finished cattle and beef, will be increasingly competitive in finishing cattle to slaughter weight. This hypothesis is strengthened by recognition of significant structural changes in the Florida cattle feeding industry since the late 1960s, as large-scale feedlots were developed and smaller-scale feeders declined in importance (Simpson and Baker). Furthermore, yield improvements and new techniques, such as the use of bagasse for silage and feeding of high-moisture corn, have been adopted in the production of Florida feedstuffs. There is no crucial evidence showing differences in investment or operating costs between Florida and the major cattle feeding areas because of the relatively large size feedlots in Florida that allow them to take advantage of substantial economies of size (Simpson, et al.). This paper evaluates the potential effect that increased transportation costs, as a result of higher fuel prices, might have on Florida's competitive cattle feeding position.

AN EXTENSION APPLICATION

Economists have traditionally considered spatial equilibrium models to be the most appropriate tool for evaluating interregional competition problems. As a form of linear programming, the approach determines optimal values and quantities transshipped as an extension of transportation models. Transportation models fix both supply and demand factors, whereas spatial equilibrium models vary one factor at a time. A number of models appropriate for analysis of the Florida problem have been constructed, but all of them would have to be reconstructed to simulate the present Florida situation (Aylor and Juillerat; Browser and Goodwin; Carmon; Dietrich; Goodwin and Crom; Heady and Srivastava; King and Schrader; Liu and West; Mallett; Malphrus, et al. Williams and Dietrich). Even with the existing models, the vast data requirements mean that estimation of the effect of the fuel price increases would be a lengthy process. Furthermore, not all data are readily available, thus exacerbating an already expensive process.

An alternative method for considering the probable impact of higher fuel costs on the transport of cattle is presented here. The method is not designed to replace spatial equilibrium techniques developed for use with computers; rather, it is intended to complement such approaches. This method is analogous to the use of partial budgeting, rather than complete enterprise budgeting to solve investment questions. It is an outgrowth of recognition of the increasing need for cost-effective techniques that have an "acceptable" degree of validity, and that can be used quickly by extension personnel and others to answer questions about the impact of escalating energy costs on industry structure.

Transportation theory states that the higher a commodity's value relative to its weight, the greater the distance it can be shipped and remain competitive with locally produced commodities. There is no incentive to move cattle long distances if cattle prices are low and transportation cost, as a value of the animal, is relatively large. If the percentage remains small over time, transportation expense cannot be considered a significant factor in encouraging shifts in feedlot location from one geographic area to another. Transportation costs would be overshadowed by factors such as the competition in the packing industry or access to ration inputs at relatively low cost.

FEEDER CATTLE ANALYSIS

Calculations to determine the percentage that fuel comprises of the value of Florida feeder calves are given in Table 1. The analysis is by quarters beginning with the first quarter of 1977, a period of relatively low fuel and cattle prices. At that time, the average price of 380-pound Florida steer calves was $31.17 per cwt., while the transportation rate for pot trailers hauling similar calves from Florida to Texas was about $0.90 per loaded mile. Assuming a 1,000-mile haul from central Florida to a central Texas feedlot, the transportation cost attributed to one ani-

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Thanks are due to three anonymous *SJAE* reviewers and the editors for their helpful comments on earlier drafts of this article.

mal was about $9.00, i.e., about 7.6 percent of the value of the animal in early 1977. Diesel fuel was valued at $0.40 per gallon. Cost of fuel used on the trip was 9.22 percent of the transportation cost, or 0.70 percent of the value of the animal. In effect, the fuel cost was relatively small in comparison to other production and marketing costs because fuel was only seven-tenths of 1 percent of the value of a 380-pound feeder calf. The relatively small dollar expenditure for transportation also helps to explain why Florida cattlemen occasionally purchased cattle in Texas for feeding in Florida when, at the same time, similar types of cattle were purchased in Florida for feeding in Texas.

Beginning in 1978, cattle prices increased dramatically. But, even with increasing diesel fuel prices, fuel as a percent of the value of a 380-pound calf reached a low of 0.34 percent in the second quarter of 1979. Despite the stabilizing of cattle prices in the first half of 1980 and a dramatic increase in fuel prices, the fuel/animal value ratio was only 0.87 during the second quarter of that year, a ratio not significantly higher than in 1977. During this same period, 1977–80, *total transport costs* for feeder calves actually decreased from 7.58 percent of the value of the animal to 4.60 percent.

FED CATTLE ANALYSIS

Data used in analyzing the 1,000-mile backhaul from Texas to Florida as a percent of the value of a 1,050-pound fed animal are given in Table 2. The fuel/animal value ratio of 0.60 percent in the first quarter of 1977 declined to 0.51 percent in the second quarter of 1978, and gradually increased to 1.09 percent in the second quarter of 1980. Although the percentage doubled from that of two years earlier, fuel cost remained a relatively small percentage of the animal's value. Total transportation cost declined from 4.36 percent of a fed animal's value in the first quarter of 1977, to 3.09 percent in the second quarter of 1980. The net result is that the transportation analysis on fed cattle yields results similar to feeder cattle, i.e., that total transport costs on a ratio basis to cattle actually declined. The analysis also shows that transport cost/cattle price ratio fluctuations are a normal event in the industry.

FEED ANALYSIS

Corn, on a dry matter basis, accounts for about 65 percent of all Florida feedlot ingredients (Simpson and Baker). Given that about 8 pounds of feed on a dry matter basis are required per pound of gain, then about 5 pounds of corn are used for every pound of gain. Assuming that 350 pounds of gain will be put on the animal in confinement feeding (apart from stocker or backgrounding operations) 1,750 pounds of corn are required. In Florida, about 75 percent of all corn (on a dry matter basis) is imported from Georgia or other states (Simpson and Baker), which means that about 1,313 pounds of imported corn are required per animal fed. Transportation costs of Georgia corn accounted for 0.73 percent of the value of a 1,050-pound fed animal in early 1980. Total value of the Georgia corn accounted for 9.75 percent of the value of the fed animal (Table 3). However, if the corn was imported from the Midwest, transportation amounted to 1.77 percent of the value of the animal, and the value of corn represented 9.6 percent of the value of the fed animal.

Approximately 60 percent of the corn imported into Florida is from Georgia, and the remaining 40 percent is from other states, primarily the Corn Belt (Simpson and Baker). Thus, approximately 1.15 percent [0.73(.6) + 1.77(.4)] of the value of the fed animal is attributed to the transportation cost of importing corn to Florida feedlots (Table 3). The utilization rate of five pounds of corn per pound of gain is low for some feedlots, so that the actual corn transportation per animal value percentage would be higher for these lots.

FUTURE IMPACTS

The historical data presented provide valuable insights into interregional cattle feeding economics, and methods for evaluating them; but the more important question relates to the future. What effect could continued fuel price increases have on the competitive structure of cattle feeding? While no definitive answers can be provided, some guidelines can be anticipated by simulating alternative situations. The year 1985 was chosen for one such evaluation, as the middle of the decade is common for projections. Of course, there is considerable speculation concerning future cattle prices and the phase of the cattle cycle in 1985 (Simpson). The projections used in this analysis should be evaluated as a simulation approach and not as predictions.

An unlimited range of cattle prices and transport costs could have been selected. However, a projected average price for 380-pound Florida calves ranging between $125.00 and $150.00 per cwt. by the spring of 1985 (8.5 percent and 10.8 percent compounded annual increase in prices from the first quarter 1980 to first quarter 1985) was chosen. The projected fed cattle price range chosen is between $95.00 and $120.00 per cwt. (7.2 percent and 12.2 percent annual rate of increase from first quarter of 1980 to first quarter of 1985). The inflation rate is likely to be between 7.2 and 12.2 percent. In effect, it is assumed that

TABLE 1. Estimations of Fuel and Transport as a Percent of the Value of Florida Feeder Calves, 1977–80 With Projections to 1985

Item	Units	Year and quarter: 1977 I	1977 II	1977 III	1977 IV	1978 I	1978 II	1978 III	1978 IV	1979 I	1979 II	1979 III	1979 IV	1980 I	1980 II	II, 1985 H_CH_F	II, 1985 L_CL_F	II, 1985 H_CL_F	II, 1985 L_CH_Fe
Avg. price Fla. calves[a]	$/cwt.	31.17	34.60	32.50	31.90	45.40	59.17	64.70	68.40	91.83	107.30	96.80	85.73	91.90	76.90	150	135	150	135
Transport rate/ truck[b]	$/mi.	0.8974	0.8974	0.8974	0.9353	0.9353	0.9824	0.9824	1.0807	1.0807	1.0806	1.2896	1.2896	1.3455	1.3455	----------3.50----------			
Transport cost/ head/mile (100 head, 380 lb. avg.)	$/hd/mi.	0.008974	0.008974	0.008974	0.00953	0.009353	0.009824	0.00984	0.010897	0.010807	0.010807	0.012896	0.012896	0.013455	0.013455	----------0.035----------			
Transport cost (1,00 mi.)	$/head	8.974	8.974	8.974	9.353	9.353	9.824	9.824	10.807	10.807	10.807	12.896	12.896	13.455	13.455	----------35----------			
Value/head (380 lb.)	$/head	118.45	131.48	123.50	121.22	172.52	224.86	245.86	259.92	348.954	407.74	367.84	325.774	349.22	292.22	570	513	570	513
Transport as % value of animal	%	7.58	6.38	7.27	7.72	5.42	4.37	4.00	4.16	3.10	2.65	3.51	3.96	3.85	4.60	6.14	6.82	6.14	6.82
Fuel usage (loaded) (19T)[c]	gal/T-mile	0.01089	0.01089	0.01089	0.01089	0.01130	0.01130	0.01130	0.01130	0.01110	0.01110	0.0110	0.01110	0.01120	0.01120	----------0.0113----------			
Diesel fuel cost[d]	$/gal.	0.40	0.42	0.43	0.44	0.45	0.47	0.50	0.55	0.60	0.65	0.75	0.85	1.00	1.20	4.00	3.00	3.00	4.00
Fuel cost/ load/trip	$/load	82.764	86.9022	88.9713	91.0404	96.615	100.909	107.35	118.085	126.54	137.085	158.175	179.265	212.8	255.36	858.8	644.1	644.1	358.8
Fuel cost/ animal	$/head	0.83	0.87	0.89	0.91	0.97	1.01	0.07	1.18	1.2654	1.3709	1.5818	1.7927	2.128	2.5536	8.588	6.441	6.441	8.588
Fuel as % value of animal	%	0.70	0.66	0.72	0.75	0.56	0.45	0.44	0.45	0.36	0.34	0.43	0.55	0.61	0.87	15.1	1.26	1.13	1.67
Fuel as % transport cost	%	9.22	9.68	9.01	9.73	10.33	10.27	10.93	10.93	11.71	12.69	12.27	13.90	15.82	18.98	24.54	18.40	18.40	24.54

[a] Florida Crop and Livestock Reporting Service
[b] Composite average of rates quoted by three Florida livestock trucking firms, and USDA, *Operations of For-Hire Livestock Trucking Firms*
[c] USDA, *Transportation Fuel Requirements in the Food and Fiber System*
[d] Department of Transportation data files and USDA, *Cost of Operating Trucks for Livestock Transportation*
[e] High cattle-high fuel; low cattle-low fuel, etc.

TABLE 2. Estimations of Fuel and All Transportation Costs as a Percent of the Value of Fed (Slaughter Weight) Cattle, 1977–80 With Projections to 1985

Item	Units	Year and quarter														Year and quarter			
		1977				1978				1979				1980		II, 1985			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	H_CH_F	L_CL_F	H_CL_F	L_CH_F[e]
Avg. price Omaha Ch. fed cattle [a]	$/cwt.	37.88	40.77	40.47	42.42	45.77	55.06	53.75	54.76	65.42	72.51	65.88	66.86	66.85	64.65	120	95	120	95
Transport frt. rate (back-haul) [b]	$/cwt.	1.65	1.65	1.65	1.70	1.70	1.70	1.70	1.80	1.80	1.80	1.90	1.90	1.90	2.00	----------5.00----------			
Transport cost/ hd/mi. (40 hd. 42,000 lb., 1,000 mi.)	$/hd/mi.	0.017325	0.017325	0.017325	0.01785	0.01785	0.01785	0.01785	0.0189	0.0189	0.0189	0.01995	0.01995	0.01995	0.021	----------0.0525----------			
Transport cost/ one way (1,000 mi.)	$/head	17.325	17.325	17.325	17.85	17.85	17.85	17.85	18.90	18.9	18.9	19.95	19.95	19.95	21.00	----------52.50----------			
Value/hd. (1,050 lb.)	$/head	397.74	428.085	424.935	445.41	480.585	578.13	564.375	574.98	686.91	761.355	691.74	720.03	701.925	678.825	1260	997.5	1260	997.5
Transport as % value of animal	%	4.36	4.04	4.08	4.01	3.71	3.09	3.16	3.29	2.75	2.48	2.88	2.84	2.84	3.09	4.17	5.26	4.17	5.26
Fuel usage (loaded)[c]	gal/T-mi.	0.01089	0.01089	0.01089	0.01089	0.01130	0.01130	0.01130	0.01130	0.01110	0.01110	0.01110	0.01110	0.01120	0.01120	----------.01130----------			
Diesel fuel cost[d]	$/gal.	0.40	0.42	0.43	0.44	0.45	0.47	0.50	0.55	0.60	0.65	0.75	0.85	1.00	1.20	4.00	3.00	3.00	4.00
Fuel cost/trip	$/load	95.832	100.6236	103.0194	105.4152	111.87	116.842	124.3	136.73	146.52	158.73	183.15	207.57	246.4	295.68	994.4	745.8	745.8	994.4
Fuel cost/animal	$/head	2.3958	2.51559	2.575485	2.63538	2.79675	2.92105	3.1075	3.41825	3.663	3.96835	4.57875	5.18925	6.16	7.392	24.86	18.65	18.65	24.86
Fuel as % value of animal	%	0.60	0.59	0.61	0.59	0.58	0.51	0.55	0.59	0.53	0.52	0.66	0.75	0.88	1.09	1.97	1.87	1.48	2.49
Fuel as % transport. cost	%	13.83	14.52	14.87	14.76	15.67	16.36	17.41	18.09	19.38	21.00	22.95	26.01	30.88	35.2	47.35	35.51	35.51	47.35
Total fuel cost calf west & fed cattle east	$/head	3.22	3.38	3.47	3.55	3.76	3.93	4.18	4.60	4.93	5.34	6.16	6.98	8.29	8.94	33.45	25.09	25.09	33.45
% value of animal	%	0.81	0.79	0.82	0.80	0.78	0.68	0.74	0.80	0.72	0.70	0.89	0.99	1.18	1.32	2.65	2.51	1.99	3.35

[a] USDA, *Livestock and Meat Situation,* various issues
[b] Composite average of rates quoted by three Florida livestock trucking firms, and USDA, *Operations of For-Hire Livestock Trucking Firms*
[c] USDA, *Transportation Fuel Requirements in the Food and Fiber System*
[d] Department of Transportation data files and USDA, *Cost of Operating Trucks for Livestock Transportation*
[e] High cattle-high fuel; low cattle-low fuel, etc.

TABLE 3. Estimations of Fuel and All Transportation Costs as a Percent of the Value of Imported Corn to Florida Feedlots, 1977–80 With Projections to 1985

		Year and quarter														Year and quarter			
		1977				1978				1979				1980		II, 1985			
Corn	Units	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	H_CH_F	L_CL_F	H_CL_F	L_CH_F[b]
FOB price (Midwest)[a]	$/bu.	2.34	2.33	1.70	1.84	2.06	2.27	2.05	2.03	2.17	2.37	2.55	2.35	2.35	2.55	5.00	4.00	5.00	4.00
Transport cost from M.W.[a]	$/bu.	0.35	0.35	0.38	0.39	0.40	0.41	0.42	0.43	0.47	0.48	0.50	0.51	0.53	0.55	1.35	1.00	1.00	1.35
Total corn cost from M.W.	$/bu.	2.69	2.60	2.08	2.23	2.46	2.68	2.47	2.46	2.64	2.85	3.05	2.86	2.88	3.10	6.35	5.00	6.00	5.35
FOB price (Georgia)[a]	$/bu.	2.60	2.45	2.00	2.10	2.20	2.60	2.25	2.30	2.35	3.00	2.80	2.80	2.70	2.90	6.00	5.00	6.00	5.00
Transport cost from GA[a]	$/bu.	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.17	0.17	0.18	0.19	0.22	0.24	0.60	0.45	0.45	0.60
Total corn cost from GA	$/bu.	2.73	2.58	2.14	2.24	2.34	2.75	2.40	2.45	2.52	3.17	2.98	2.99	2.92	3.14	6.60	5.45	6.45	5.60
Georgia corn transport as % of corn value	%	0.05	0.05	0.07	0.06	0.06	0.05	0.06	0.05	0.07	0.05	0.06	0.06	0.08	0.08				
Georgia corn as % of animal value	%	16.09	14.13	11.80	11.79	11.41	11.15	9.97	9.99	8.60	9.76	10.10	9.98	9.75					
Corn transport as % of animal value	%	0.77	0.71	0.77	0.74	0.68	0.61	0.62	0.61	0.58	0.52	0.61	0.63	0.73					
Midwest corn transport as % of corn value	%	0.13	0.14	0.18	0.17	0.16	0.17	0.17	0.17	0.18	0.17	0.16	0.18	0.19	0.18				
Midwest corn as % of animal value	%	15.85	14.23	11.47	11.73	12.00	10.87	10.26	10.03	9.01	8.77	10.33	9.55	9.62					
Corn transport as % of animal value	%	2.06	2.03	2.10	2.05	1.95	1.66	1.74	1.75	1.60	1.48	1.69	1.70	1.77					

[a] Gold Kist, Live Oak, Florida
[b] High corn-high fuel; low corn-low fuel, etc.

prices would increase at about the rate of inflation.[1] Diesel fuel prices were assumed to range from $3.00 per gallon to $4.00 per gallon in 1985. Therefore, diesel fuel costs were assumed to increase between 200 and 300 percent, respectively, over the five-year projection, while calf prices were assumed to increase between 80 and 100 percent and fed cattle prices between 45 and 85 percent. Figure 1 provides a graphic representation of the situation when transportation costs increase more rapidly than cattle prices.

Using these assumed cattle and fuel price projections for 1985, fuel as a percent of the value of Florida feeder calves would range from 1.14 percent to 1.67 percent, approximately double the percentage in 1980. Fuel costs attributed to transporting fed cattle would increase from about 0.88 percent of the value of the animal, to between 1.48 percent and 2.49 percent of the value of the animal, an increase of 100 to 200 percent over 1980 figures, but still a low figure in comparison to the value of the animal, feedlot relocation costs, etc.

Corn prices were fairly steady during the 1977–80 period and the long-range outlook indicates relatively moderate price increases (approximately 50 percent for corn) compared to the per bushel transportation cost increases for corn (at least 100 percent). Estimates for 1985 indicate that the costs of shipping Georgia corn to Florida could range from 10 to 20 percent of the value of corn, while the transportation costs of corn imported from other states would be slightly higher, ranging from 17 to 25 percent. The net result is that these estimates reflect little change from the current transportation charge as a percent of the value of corn imported from the Midwest, but a 200-percent increase in the transportation cost of importing Georgia corn as a percent of its value. The transportation cost for shipping corn is projected to be about 0.20 percent of the fed cattle value, a slight increase above 1980 ratios.

Total transportation costs (including fuel) were increased at a compounded rate of 20 percent annually. These costs (reflected in the projections in Tables 1 and 2) indicate that all transport

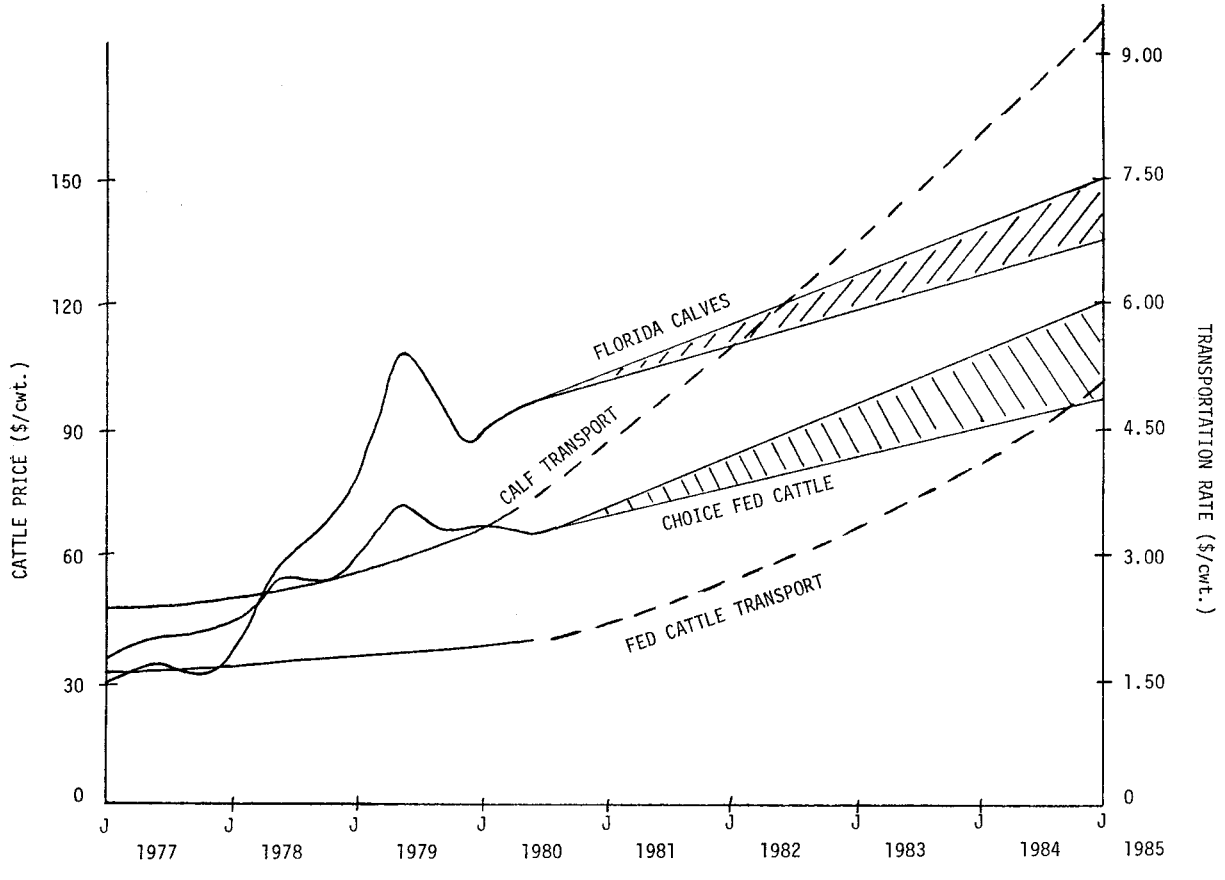

FIGURE 1. Transportation Rate Florida–Texas–Florida, and Cattle Prices, 1977–80, With Projection to 1985.

[1] Price projections, like fuel cost increases, are largely arbitrary. The key point is that the analysis is based on fuel price increases, which are two to three times as much as the cattle price increases, i.e., a worst case situation. The objective is to provide a useful framework and data to enable individuals to evaluate their own assumptions.

costs would fluctuate between 4.17 and 5.26 percent of the value of fed cattle, and between 6.14 and 6.82 percent of the value of feeder calves.

A summary of the cost differential between transporting cattle and transporting corn is given in Table 4. Total transportation costs were $33.40 per head, round trip, Florida–Texas–Florida, in the first quarter of 1980. They are projected at $87.50 for 1985. Imported corn transportation costs, on a per-head basis, are projected to increase from $10.85 to $24.53. The net result is that, even though the total differential increases from $22.55 to $62.97, this differential, as a percent of the round trip transportation cost, is about the same as in 1980.

TABLE 4. Cost Differential Between Transporting Cattle and Transporting Corn, Florida 1977–1980 and 1985

Item	First quarter costs				
	1977	1978	1979	1980	1985
	----------Dollars per head----------				
Calves[a]	8.97	9.35	10.81	13.45	35.00
Fed cattle[b]	17.33	17.85	18.90	19.95	52.50
Round trip	26.30	27.20	29.71	33.40	87.50
Imported corn[c]	6.82	7.63	9.06	10.85	24.53
Differential	9.48	19.57	20.65	22.55	62.97
	----------Percent----------				
Difference as % of round trip	74	72	70	68	72

[a] Source: Table 1
[b] Source: Table 2
[c] Source: Derived from Table 3. For example, assuming cattle gain 350 pounds on corn, and 5 pounds of imported corn are required per pound of gain per head, then 1,750 pounds of imported corn are required, or 31.25 bushels (1,750 pounds ÷ 56 pounds/bushel). Given that 40 percent of imported corn is from the Corn Belt, that means 12.5 bushels/head are from that area. With a 1977 first quarter freight charge of $0.35/bushel (Table 3), the transportation cost of Midwest corn was $4.38/head. With 60 percent of corn coming from Georgia at $0.13/bushel, the transportation cost of Georgia corn was $2.44/head. Thus, the total transportation charge is $6.82 ($4.38 + $2.44). See [Simpson and Baker] for the 40 and 60 percent.

SUMMARY

The economics profession has developed substantial capability in analyzing interregional competition problems by using spatial equilibrium models. A drawback is that the tools are often cumbersome, time consuming, and consequently expensive. These tools provide valuable insights into problems such as the one posed in this study, but are of limited use to extension agricultural economists, who are often called upon to provide judgments about interregional competition problems in a severely limited time frame, and with heavy constraints on resources. This study's analysis is an effort to demonstrate one method that can be used to fit this need. It is basically a screening process, which should be followed by spatial equilibrium analysis, if the preliminary analysis indicates a shift could occur.

The method presented is based on traditional economic theory that states that the economic rationale for shipping products depends on its value/transport cost relationship. The analysis indicates that even with fuel prices and total transport costs increasing 2-3 times as fast as cattle prices, transport costs, as a percent of all feeder calves' value, will increase only from about 4.60 percent, to between 6.14 and 6.82 percent from 1980 to 1985. To place this in historical perspective, the percentage was more than 7 percent in 1977. The situation is similar for fed cattle, where transportation costs are projected to range between 4.7 and 5.26 percent of the value of fed cattle in 1985, compared with 3.09 in early 1980 and 4.36 in early 1977. In the final analysis, the cost differential between transporting feeder cattle from Florida and fed cattle back to Florida, and transporting the corn required to make up feeding deficits is expected to remain about the same as in the late 1970s.

The analysis indicates that projected increases in transportation costs associated with hauling Florida calves out of state, and backhauling fed cattle into Florida, do not appear to be of sufficient magnitude to offset, for or against, any decision to expand cattle feeding in Florida. The question of how much change in the ratios would be required to make a difference is largely subjective; however, the method presented in this article does provide a basis for making a judgment relatively quickly. The technique is not intended as a tool for determining overall projections of interregional competition, rather, it is aimed at providing answers to one specific question—the impact of fuel price increases. The results of the projections, although derived by apparently naive methods compared to spatial equilibrium computer models, support and complement the findings associated with regional specialization and the comparative advantage of resource utilization. The analysis is especially designed to provide a cost-effective screening approach to spatial equilibrium models.

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